PN-ART-658 72023

isnar inform
Information for Agricultural Research Managers

Methods and Procedures for the Development of INFORM

Govert Gijsbers

12 Guidelines

The International Service for National Agricultural Research (ISNAR) began operating at its headquarters in The Hague, the Netherlands, on September 1, 1980. It was established by the Consultative Group on International Agricultural Research (CGIAR), on the basis of recommendations from an international task force, for the purpose of assisting governments of developing countries to strengthen their agricultural research. It is a nonprofit autonomous agency, international in character, and nonpolitical in management, staffing, and operations.

Of the 13 centers in the CGIAR network, ISNAR is the only one that focuses primarily on national agricultural research issues. It provides advice to governments, upon request, on research policy, organization, and management issues, thus complementing the activities of other assistance agencies.

ISNAR has active advisory service, research, and training programs.

ISNAR is supported by a number of the members of CGIAR, an informal group of donors that includes countries, development banks, international organizations, and foundations.

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International Service for National Agricultural Service
with the support of the Asian Development Bank

2 Guidelines March 1991

Citation:

Gijsbers, G. 1991. Methods and Procedures for the Development of INFORM. INFORM Guidelines, Part 2. The Hague: ISNAR.

AGROVOC Descriptors

information systems; management; research; research projects; scientists

CABI Descriptors

information systems; agricultural research; management; research projects

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Preface

Lack of good information can be a major impediment to effective management of research. Managers need to know exactly what experiments their scientists are doing, with which facilities and at what cost. Without this information, managers cannot perform, or improve, essential functions such as planning, programming, monitoring and evaluation.

- Effective agricultural research policy cannot be set without good information on which to base decisions.

- Sound agricultural research management is impossible without good information on which to base programs.

To help national agricultural research systems (NARS) address their needs for better information and to improve information use for planning and policy setting, ISNAR has developed a management information system called INFORM - *INFO*rmation for agricultural *R*esearch *M*anagers.

INFORM is described in a series of guidelines, which are supported by a set of training manuals. This volume, Part 1 of the guidelines, provides an introduction to INFORM. It is followed by a volume on INFORM methodology (Part 2) and two reference guidelines - Part 3, revenue and cost codes, and Part 4, a minithesaurus of keywords.

Training materials include a brief guide to the computer software (Reflex) used to develop INFORM and several practical exercises for developing skills with INFORM.

This volume shows how INFORM can help improve decision making through better use of information that is usually readily available within NARS.

Examples given in Part 1 are based on actual data from ISNAR research. Many of the figures and tables relate to the program budgeting component of INFORM but examples are also provided to show how INFORM can be used for management of personnel and research facilities and for priority setting.

Acknowledgements

ISNAR acknowledges the support of the Asian Development Bank for funding this study through a Technical Assistance Agreement (RETA 5341) for Strengthening Agricultural Research management in Asia with Special Emphasis on Inproving Information Systems.

Much of the field work associated with the collection of data from which the methodology was subsequently developed was carried out in Sri Lanka. This would not have been possible without the support of the Sri Lankan Council for Agricultural Research (CARP), particularly Dr. D. T. Wettasinghe, the Executive Secretary of CARP, and the directors of the research institutes associated with the Council. Much of the source data collection was carried out by Mr. J. A. P. T. Gunawardena of the Planning Cell of the Department of Agriculture, whose assistance was especially appreciated, as was that of Mrs. A. Basnayake of CARP, who helped field-test the methodology.

We also gratefully acknowledge the cooperation of India's National Academy for Agricultural Research Management (NAARM), the Southeast Asian Ministers of Education Organization Regional Center for Graduate Study and Research in Agriculture (SEARCA), and the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) in planning and running two workshops in the second half of 1990, at which earlier drafts of this document were extensively discussed. Feedback from workshop participants was obtained through a structured review process, focusing on substance, presentation, and applicability of the material. Revised drafts were produced after each of the workshops and the document in its present form has benefitted considerably from participants' comments and suggestions.

Many colleagues at ISNAR and from other national agricultural research organizations contributed ideas and suggestions throughout the development of this volume. The assistance at ISNAR of Byron Mook, Barry Nestel, and Howard Elliott is especially acknowledged.

1 Managing Agricultural Research

Agricultural research managers, administrators and planners at all levels of a national agricultural research system (NARS) need pertinent, reliable information on people, finance and facilities in order to effectively manage their research programs.

Although managers of small research units may be well informed about their entire research program, the directors of large institutes, or of multi-institute national systems usually have a problem in maintaining up-to-date information on resource use and program implementation. At large research institutes, there is also a more obvious need to develop a systematic information base to be used in planning and program formulation activities. As many NARS have grown rapidly during the last two decades, the problems of managing information have become more important.

INFORM (*INFO*rmation for agricultural *R*esearch *M*anagers), a management information and program budgeting system developed by ISNAR, is a practical tool that assists research managers in planning and programming research and in its monitoring and evaluation.

Examples of the sort of questions that a research institute director might ask INFORM to answer are listed below:

- How much money is planned for a particular commodity group, i.e., grain legumes. Within grain legumes, what percentage of the budget is planned for mungbean research? Is this allocation consistent with development priorities?

- How many multidisciplinary experiments are implemented, and how can the current program be restructured to give more emphasis to multidisciplinary work?

- In which experiments is a particular researcher involved?

- Is implementation of the agronomy experiments on schedule?

- The minister wants to know what is being done on tissue culture. How many experiments deal with tissue culture and what is their cost?

- Is the allocation of research resources to different rice soils in line with production problems in those soils and the number of farmers affected?

1.1 INFORM Characteristics

As noted in Part 1 of these guidelines, ISNAR designed INFORM as a tool for the benefit of research managers. This, in addition to a number of practical considerations involved in the development of INFORM, resulted in a system that meets the following requirements:

- The outputs are of value to different kinds of users, including policy-makers, national research managers, research institute directors, program leaders and individual researchers.

- Information-gathering requirements are limited. Most of the information required for INFORM is readily available at the level of the agricultural research institute, which facilitates the use of INFORM at the institute or station level.

- The focus of INFORM is on essential information for management and planning purposes, which keeps it small and practical. The system is not overburdened with information that is interesting but not essential.

- The system is suitable for a wide range of different agricultural systems, commodities and institutes of different sizes.

- Hardware requirements are limited. The necessary equipment includes no more than a standard microcomputer and a printer.

- The software is simple and easy to learn and use, and it is able to produce a variety of outputs such as tables and graphs.

ISNAR used these considerations to develop and test INFORM in several NARS. This part of the guidelines describes the methods and procedures used. Several features of the methodology are innovative for many NARS, including the following:

- **Integrating information on projects, personnel and finance.** Figure 1.1 illustrates how this information is linked and used for different purposes. Information on projects includes data on all research activities (current or proposed) at an institute. Information on personnel includes researcher biodata and information on research activities. Financial information is presented at the experiment level for a series of major cost codes.

As yet, INFORM does not include information on equipment and facilities used for research because much of that information relates to capital rather than recurrent expenditure. At its present stage of development, INFORM focuses on recurrent expenditure because it is of more importance in research management. Information on capital and facilities will be included later.

- **Including all revenues and recurrent costs of research in the analysis.** This is an important principle, generally accepted in the private sector but not always appreciated in public-sector research. Managers often take a narrow look at the cost of research and consider only operational costs such as travel and inputs (fertilizer, chemicals, seed). The most important element in research cost, that of the personnel involved, is often neglected. In addition, where a central department takes care of part of the administration and management of a research institute, the costs of that department are usually ignored in the tabulation of research costs.

- **Estimating costs at the research activity level.** A research activity is the smallest discrete unit of research: a project, an experiment or a study.

DECISIONS / INFORMATION	PLANNING AND PROGRAMMING	MONITORING AND EVALUATION
PROJECTS OR EXPERIMENTS	STRATEGY TACTICS	OUTPUT IMPACT
HUMAN RESOURCES	RECRUITMENT CAREERS TRAINING	PERFORMANCE
FINANCE	BUDGETING	ACCOUNTING AUDITING
EQUIPMENT SUPPLIES FACILITIES	UTILIZATION PROCUREMENT	STOCK CONTROL

Figure 1.1. The INFORM Matrix

INFORM develops a budget for each experiment. At large institutes this may involve collecting information on several hundred experiments. The alternative of conducting the analysis at the level of broad program categories is usually unsatisfactory, as it does not provide sufficient detail. It is not difficult to aggregate information from the research activity level into meaningful programs for analytical purposes, but the actual data collection needs to be at the level of research activity.

- **Allocating researchers' time and cost to activities and programs.** One of the research manager's most important tasks is to optimize the use of the institute's human resources, particularly its researchers, who constitute a substantial cost element. Because the cost of researchers represents a large part of the budget, INFORM ensures that researchers' time and cost commitments are properly allocated to research activities and programs.

  The way in which researchers are deployed changes from year to year as new experiments begin and old ones end. Indeed, planning often involves the reallocation of researchers to different activities and programs. Since researchers' time can be reassigned to alternative experiments, their cost is a variable cost at the experiment or program level (at the institute level it may be considered a quasi-fixed cost).

  This means that, because the INFORM analysis is undertaken at the experiment level, the cost of a researcher participating in an experiment has to be calculated at that level. This is done by estimating the percentage of time that researchers spend on each research activity that they are involved in and allocating a corresponding share of their total cost to that experiment. Data are collected through a researcher questionnaire on which each researcher indicates the time spent, or to be spent, on different activities. If researchers spend 10% of their time on a project, then 10% of their cost is charged to that project.

- **Grouping budget costs into categories meaningful for research management.** The budgets used in agricultural research are usually based on standard government accounting codes designed for financial control. In most cases budgets are presented in a form that shows who will expend the funds rather than indicating what is to be achieved by the expenditure. Part 3 of these guidelines suggests procedures for accommodating national cost codes into cost codes used by INFORM.

- **Using keywords to analyze research program content.** An adapted version of the FAO CARIS (Current Agricultural Research Information System) was used to develop a thesaurus and coding system for agricul-

tural research. A system of keywords allows users to find detailed information on very specific aspects of research (see Part 4 of these guidelines).

1.2 The INFORM Process

The flowchart in Figure 1.2 presents the INFORM process, showing the types of information collected at different stages, how this information is structured and entered into database files, and how outputs are generated. The top row of Figure 1.2 shows the four sources of secondary data: the payroll, a list of personnel, a list of experiments, and the budget. The researcher activity questionnaire provides information on who the researchers are (biodata) and what they do (time allocation). Time allocation information in combination with information on the researchers' salaries, benefits and allowances (SBA) allows the calculation of the costs of researchers' participation in experiments or projects. All information is entered in database files, one on personnel and one on experiments. Finally, outputs are generated from the databases, e.g., a budget by crop or discipline.

The finance, or program budgeting, component of INFORM consists of three steps (Fig. 1.3):

- **Disaggregation of institute budget information.** At this stage, a budget is developed for each research activity.

- **Entry of disaggregated data into two databases:** one for personnel and one for experiments or projects. This relates cost information to the qualitative information collected for each experiment, e.g., crop, discipline, etc.

- The **aggregation stage**. This consists of building up the budget in different ways to provide information to research managers. Aggregation can entail the use of any of the descriptors attached to the research activity. Figure 1.3 shows how the budgets of individual experiments can be aggregated in two ways: providing a budget by crop and providing a budget by discipline.

The structure of this document follows the stages outlined in Figure 1.2:

- Chapter 2 discusses the first stage of INFORM work. It describes what information is required, where it can be found and how it is checked for completeness and consistency. The four basic documents that are required as source material are discussed.

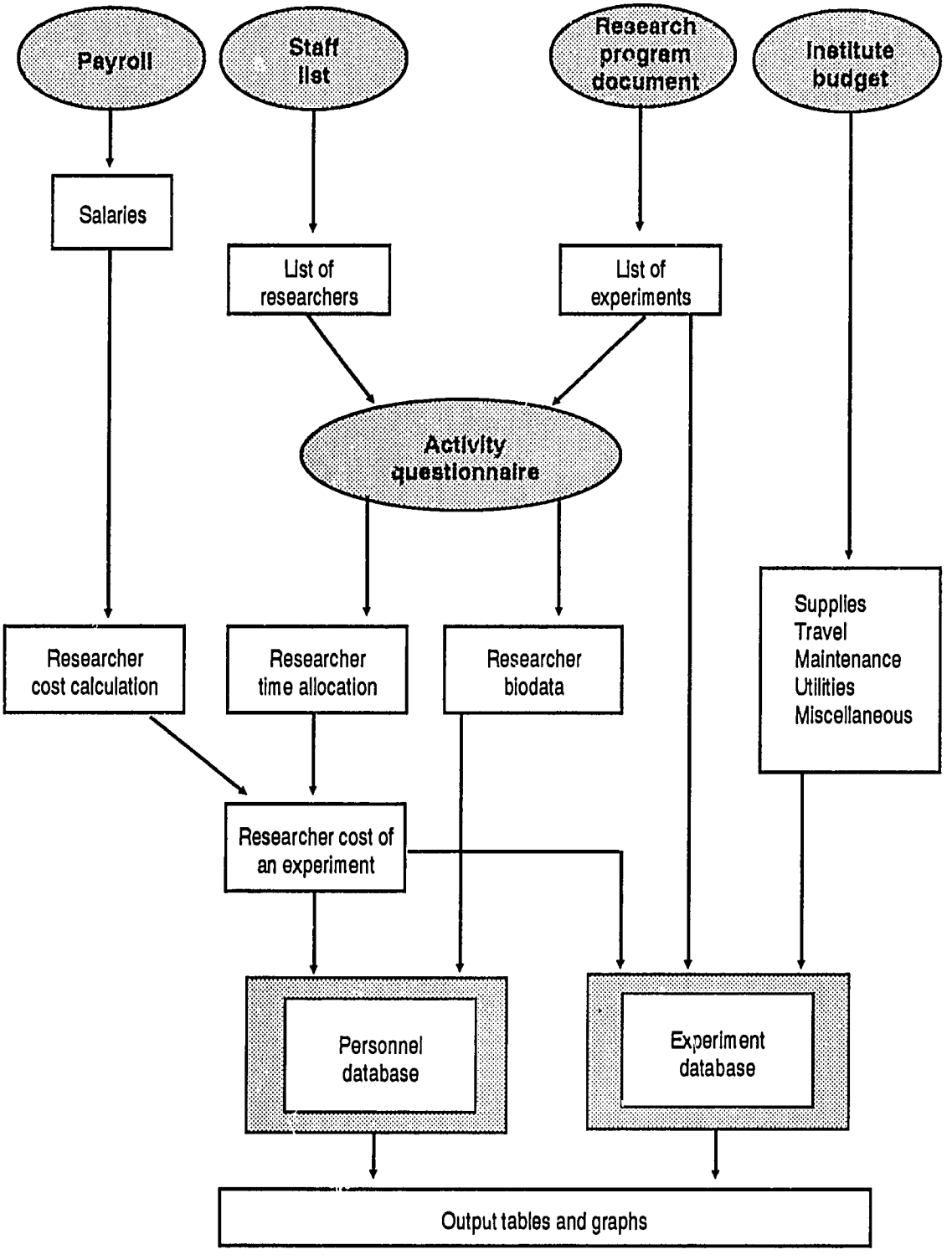

Figure 1.2. INFORM flowchart

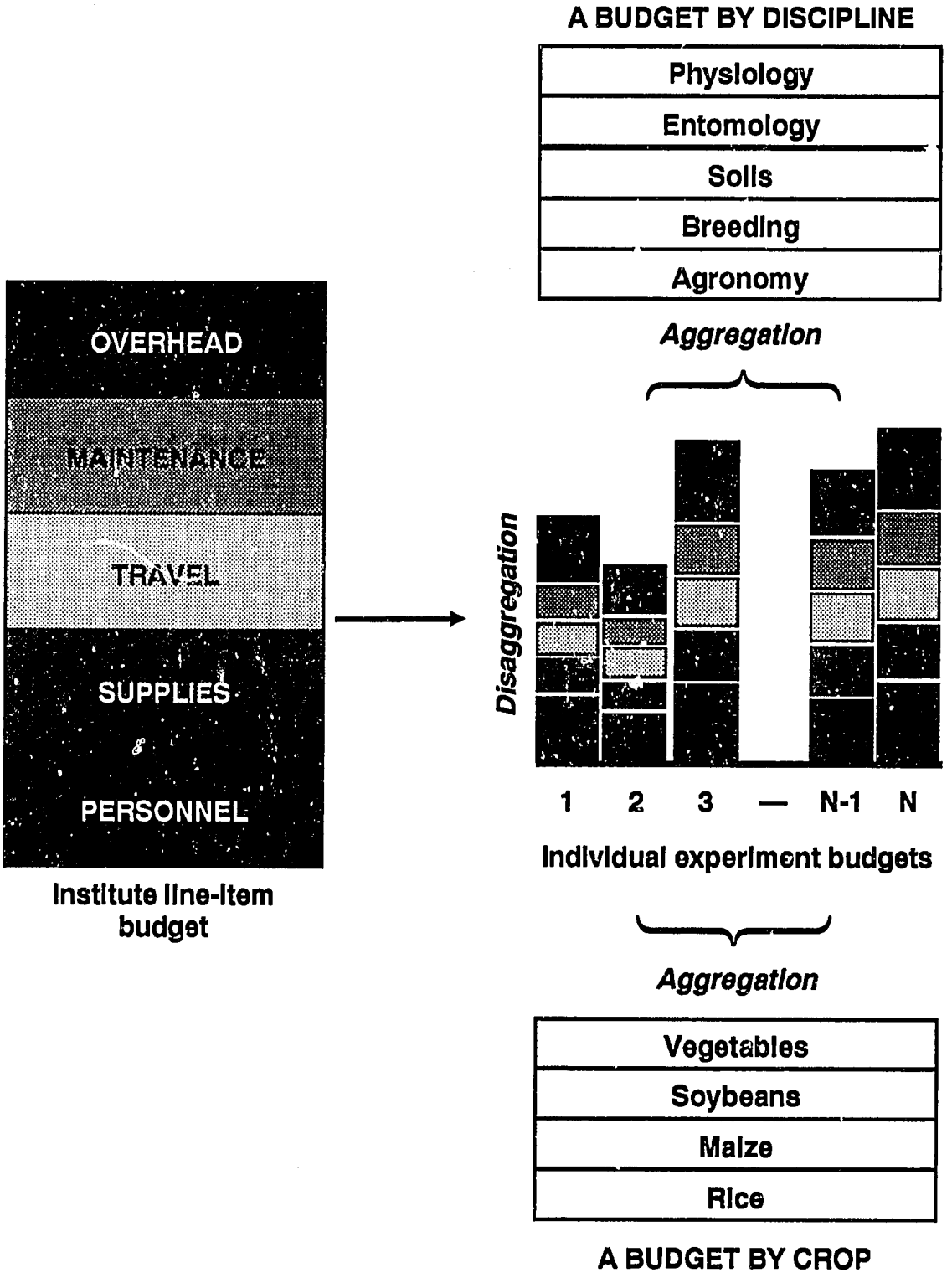

Figure 1.3 Disaggregation and aggregation of the budgets

- Chapter 3 focuses on the researchers and their activities. Characteristics of researchers are discussed in a section on biodata. The chapter argues why the use of scientists' time is important. It discusses the issue of time allocation and how this information is collected through a questionnaire. Chapter 3 concludes by illustrating how the process of collecting time allocation information may be linked to program formulation activities.

- Chapter 4 covers the analysis of research programs. It discusses descriptive information to be collected for each research activity. In combination with information on the costs of research activities, it allows an analysis of the budget in terms of crops, disciplines, research themes, keywords, locations, agroecological zones or any other information category describing the research activity.

- Chapter 5 discusses the costs of research, including personnel, operational, and overhead costs (often referred to as indirect costs). It shows how to rearrange the budget from a traditional accounting format to a format more useful for the financial analysis of agricultural research activities. The chapter also discusses the issues dealing with direct and indirect costs. Indirect costs cannot be traced to specific research activities, so each research activity is allocated a share of the total cost.

- Chapter 6 describes the database formats that are used to analyze all this information.

- Finally, Chapter 7 provides examples of how INFORM outputs may be used to answer research managers' questions.

2 Secondary Data Collection

The early stages of setting up INFORM deal with the collection of secondary data on researchers, experiments, salaries, and budgets that are available in research institute files and documents. Emphasis is put on checking the data for completeness and consistency. Data requirements are fairly limited and most of the information required will be readily available at the majority of agricultural research institutes.

Four sets of data be obtained:

- an accurate, up-to-date **list of researchers and support staff** at the institute (Section 2.1);
- **payroll** information to determine **salaries, benefits and allowances** paid to researchers, support staff and labor (Section 2.2);
- **a list of research activities (experiments or projects)** at the institute for the year under analysis (Section 2.3);
- **the recurrent budget** of the research institute and its components (Section 2.4).

The information contained in the source documents is often out of date and incomplete, and it is common to find inconsistencies between different sources. This requires extra effort to sort out inconsistencies and information gaps at the beginning of the exercise. Several rounds of consultation with the director, accountants, program leaders and individual researchers may be needed to arrive at clean lists of researchers and research activities.

The lists of researchers and research activities become inputs into the process of developing time allocations, which are discussed in Chapter 3. The seemingly simple task of obtaining complete, up-to-date lists of researchers and experiments is extremely important. It is often the most time-consuming and tedious task in the development of INFORM. If problems with data completeness and consistency are not sorted out early, the later stages of INFORM work will be extremely cumbersome and time consuming.

2.1 List of Researchers and Support Staff

A list containing the names and grades of all researchers should be updated (or created if none exists) at the beginning of the INFORM exercise. The institute director (or accountant) should be able to prepare a correct list of researchers and support staff. Any inconsistencies between this list, the payroll and the questionnaires returned by the researchers should be resolved.

> For example, at one agricultural research institute, inconsistent information on researcher names was obtained from the two information sources available: the payroll and the list of researchers who had returned completed questionnaires. There were 118 names on the payroll and 120 questionnaire returns. Four persons (*A*, *B*, *C* and *D*) had filled in a questionnaire but did not appear on the payroll. Two other persons (*X* and *Y*) appeared on the payroll but had not filled in the questionnaire. It turned out that the payroll document was out of date and *A*, *B* and *D* were new recruits who had joined after it was printed. *X* and *Y* had recently retired from the institute. *C* was an active researcher at the institute but his salary was paid from a special scheme, so he did not appear on the payroll. Thus, it turned out that the number of 120 researchers was correct.

There are three common sources of problems:

a. **Timing.** The available payroll document or print-out may be out of date. Recent recruitments and retirements at the institute may not be included.

b. **Purpose.** The payroll may not indicate precisely who is working at the institute. It may contain names of researchers on study leave or who are otherwise on the payroll but are not working at the institute (e.g., staff outposted to other institutes). It will, on the other hand, not contain the names of active researchers who are not on the institute payroll, such as those who are paid from a special fund or by an external donor.

c. **Spelling of names.** One of the first things to do is to go through all the names and sort out spelling mistakes, identical and almost identical names and double names. Several researchers may have the same or similar names. A person's name may be spelled in different ways (not uncommon if the name is transcribed from a non-roman script) or it may be presented in different ways (initials or full name). People may be known under different names: a woman may appear under her maiden name and her husband's name in different documents. These problems can be solved by giving identification (ID) numbers to researchers.

Some of these problems may seem trivial but they can be tedious to solve, especially if the INFORM analyst does not personally know the institute staff. A lot of unnecessary work in the preparation of time budgets can be avoided if adequate attention is given to the development of the list of researchers. Unless time allocation questionnaires (Chapt. 3) are sent to technical support staff, their names are not required. The total number of persons in each category of support staff (and their cost, from the payroll) is sufficient.

Five issues need to be considered with regard to the staff list.

2.1.1 Researcher or Support Staff?

Whether an individual should be classified as a researcher or a member of the support staff is usually obvious, but not always. For example:

- A degree is usually required for classification as a researcher. Situations do occur, however, where recently recruited graduates are considered support staff.

- On the other hand, senior officers without a degree sometimes conduct experiments and are regarded as researchers.

- Some senior support staff positions, such as librarian or publications officer, may be filled by a scientist. These are support rather than research functions and if the people concerned do not conduct any research, they are not classified as researchers.

2.1.2 Activity and Payroll Status

An individual may be an **active** or **non-active** researcher. Active researchers are those currently working at the institute. Non-active staff may be on long-term study leave for a higher degree or on other leave with pay (they may, for example, be outposted to work at another institute while they remain on their old institute's payroll) or on unpaid leave. Non-active researchers who are on the payroll are excluded from INFORM because they do not contribute to the implementation of any programs, even though they constitute a cost to the institute. Their costs (and time) are accounted for at the institute where they are active.

Most active researchers will be on the institute's payroll. But there are situations where some researchers are on another institute's payroll; they are "inposted staff," the opposite of outposted staff mentioned above. The same situation occurs when a researcher is paid from a special fund or by a donor.

Such researchers, who represent no cost to the institute, may be assigned the salary of an equivalent grade for purposes of financial analysis. In either case, time and costs are included in the INFORM analysis of the institute where the researcher is active.

In summary, researchers fall into one of four categories:

- Active and on the payroll: the majority of researchers will be in this group.
- Not active at the institute and on the payroll: these are researchers on study leave, outposted or otherwise on leave with pay.
- Active at the institute but not on the payroll: these are researchers "inposted" from another institute or paid from a different source.
- Not active and not on the payroll: these are researchers on leave without pay (disregarded in INFORM).

2.1.3 *Types of Support Staff*

In INFORM, support staff are separated into three categories (Fig. 2.1):

- technical support staff (such as laboratory technicians and experimental officers);
- administrative support staff (such as accountants, secretaries and clerks);
- general services staff (such as cleaners, watchmen and drivers).

For INFORM, the administrative and general services staff are usually treated as a single group. It is not possible to relate their cost to research activities, because they do not participate in the institute's research projects. Accountants, clerks, secretaries, watchmen, cleaners and drivers work for the institute as a whole and not on specific experiments.

There may sometimes be confusion as to whether someone belongs to the technical support staff. Consider the case of an electrician or a mechanic. They clearly have technical jobs; however, in INFORM they are treated as general service staff because they serve the institute as a whole and do not work directly in research.

The classification of staff has important implications for INFORM. As discussed earlier, program budgeting entails developing a budget for each

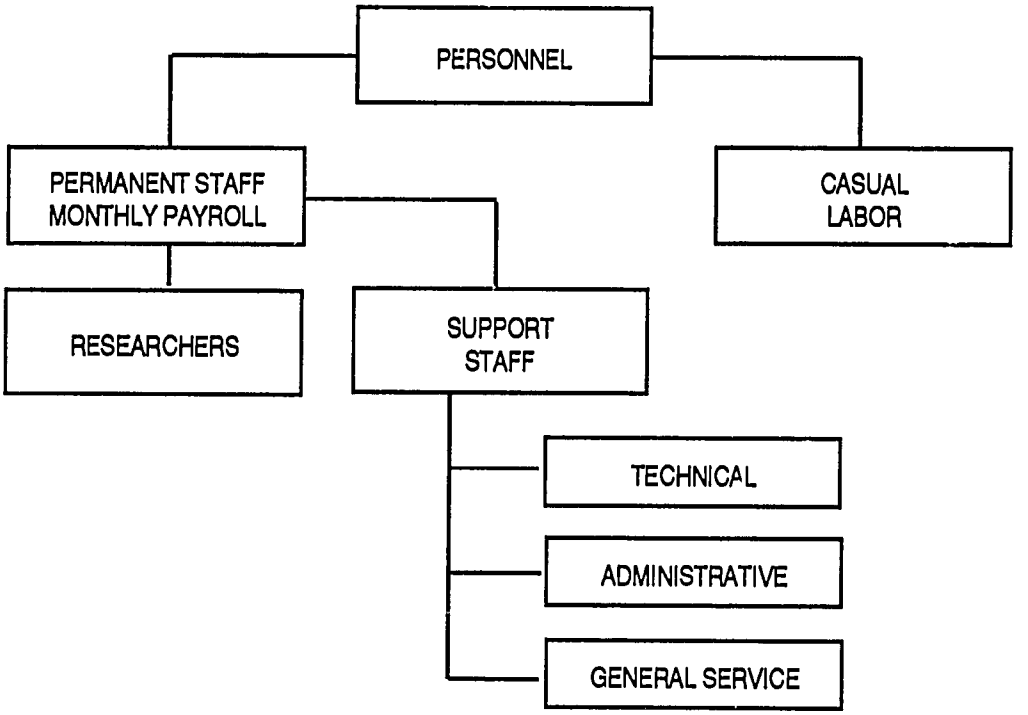

Figure 2.1. Types of staff

research activity and allocating all recurrent costs to these research activities. As there is no direct relationship between administrative support staff and research activities, an indirect method has been developed for charging administrative personnel to specific research activities. This is discussed in Chapter 5.

2.1.4 Labor

Laborers may be permanent staff on the monthly payroll or they may be casual day labor. Where they are employed on a full-time basis, many of them can be regarded as semi-skilled support staff, and some institutes do this. Where it is not done, laborers are usually listed on a different payroll (weekly rather than monthly), which is presented separately in the budget. If an institute distinguishes between support staff and labor, INFORM follows that distinction.

2.1.5 The Time Dimension

The list of researchers must correspond to the period of analysis, which may be a financial or an agricultural year. An INFORM analysis can be undertaken for a previous year (ex post), for the current year or for the following

year (ex ante). Developing a list of researchers for the previous or present year is straightforward as long as the staff list for the appropriate year is used. For ex ante analysis, it is necessary to estimate which researchers will be working at the institute in the following year. This can be done by first listing the researchers active at the institute in the present year. Next, the names of researchers due to retire before next year and those expected to go away on long-term study leave are deleted. Then, any new recruits and researchers returning to the institute from leave are added. Compiling such a list requires consultation with the institute director and the personnel department.

2.2 The Payroll

The payroll is used to calculate **the cost of researchers and support staff.** The payroll should contain a list of all people employed at an institute and their monthly or annual salaries. The payroll may also contain information on pension contributions and fringe benefits (education allowance, cost of living allowance, etc.). The payroll usually contains the salary scale, level or class of all persons listed.

Some problems may occur when using payroll information:

- All personnel costs may not be found in the payroll. One example is a situation where pension contributions for the entire civil service are handled centrally. In this case, the most practical solution is to use the pension contribution cost as a percentage of salary (often between 10% and 20%) and then increase payroll salary costs by that percentage to reflect full costs. In other cases, a pension fund may exist for the research institute, and actual costs for each individual may be available.

- Some indirect personnel costs may be found elsewhere in the institute budget: for example, costs related to staff housing (maintenance and electricity). In many cases, it is possible to reallocate those costs to personnel.

- Whereas researchers and permanent support staff are usually on the monthly payroll, casual labor is usually on a different (often a weekly) payroll.

2.3 List of Experiments

Most institutes have a document that describes research activities at the institute and its stations. The quality of this document varies widely. Some institutes publish a complete and up-to-date document that lists all experi-

ments and provides information on objectives, researchers involved, location, starting and completion dates, costs, etc. In other instances, there may be an outdated, incomplete list, giving inaccurate information on only part of the program, and sometimes the research program contains a long shopping list of "experiments" that never get done. In these latter cases, more preparatory work is required. Two points require particular attention:

2.3.1 *Definition of Research Activity*

For INFORM, a research activity is defined as the smallest discreet unit of research, usually an experiment.

Defining research activities seems straightforward but may turn out to be rather complicated. An institute's research work is often divided into departments, divisions or programs. Each ministry, and sometimes each institute, may have its own system of subdivision, which may include the use of the terms *program*, *subprogram*, *project*, *subproject*, *experiment* or *study*. The definition of these terms may differ between institutes. At some there is a hierarchical relationship between projects and experiments, whereby a number of similar experiments are referred to as a project. Some institutes restrict themselves to the term *experiment*. The term *project* is sometimes used specifically for foreign-funded research activities.

An experiment is the smallest unit of research for which a protocol is normally prepared. Replicates are considered part of an experiment. A research institute may have several hundred experiments, and a question often asked is whether time could be saved dealing with larger units, such as projects, subprograms or programs. The answer is: usually not! An experiment is normally homogeneous as far as discipline, research emphasis, location and other substantive aspects are concerned, whereas a program or subprogram may include different disciplines, themes and locations. Building a budget by discipline, research theme, etc., is only possible if the building blocks are homogeneous experiments.

2.3.2 *Time Parameters of Research Activities*

As with the staff list, it is important to consider the timeframe of the INFORM analysis. This may cover a previous financial or agricultural year (ex post), the current year or the following year (ex ante). The list of experiments compiled for the INFORM analysis **must** correspond to the appropriate year. In the case of ex post and current-year analysis, it is not difficult to find out which experiments were, or are, being implemented. Analyzing activities to be conducted in the following year is somewhat more complex. Research activities to be included in the list for next year comprise current activities that will be continued next year plus any new activities that will be initiated

next year. Preparing such a list amounts to the preparation of a work plan at the institute level. This is discussed in Section 3.3.

2.4 The Research Budget

A public-sector research institute's budget is normally presented in a form that is identical for all government departments and institutes. If different research institutes use different budget formats, any comparison between institutes and an aggregation of budget information across different institutes is complicated. Chapter 5 deals with the analysis of budgets and standardization of their formats for INFORM.

Where INFORM is used for ex ante analysis and where there is a poor fit between the agricultural year and the financial year, it may be necessary to do the INFORM analysis on a half-year basis. Alternatively, budget growth for the latter part of the cycle can be estimated.

Although the presentation of budget information may differ among institutes, a number of common elements can usually be found. The budget can generally be divided into capital budget and recurrent components. The capital budget covers investments in land, buildings, machinery and equipment. The useful life of such capital goods is often more than 10 years, which may constrain the use of resources for a long time. For example, capital investment in research stations for irrigated rice may reduce the level of funding for the implementation of an upland rice research program for many years. Fixed capital investments in land, buildings and equipment can be regarded as infrastructure over which the research manager has little control. INFORM therefore, concentrates on the recurrent budget, over which the research manager has greater control.

The recurrent budget is sometimes referred to as the operational budget. Some countries divide it into routine and development budgets. Whichever way the budget is presented, care has to be taken that **all research costs**, including those not obvious at first sight, are taken into account. Those include the following:

- **salary costs**, which are sometimes paid centrally and, therefore, do not appear in the institute budget;
- **pension costs** and other fringe benefits, such as staff housing, free medical care, cost-of-living allowances, education allowance, etc.;
- **operational costs funded from the government core budget**, including those for supplies, travel, maintenance, utilities, communication, etc.;

- **operational costs funded from nongovernment sources,** such as foreign donors, producers associations, etc.;

- an appropriate **share of the cost of any central government department** that provides the finance and administration functions for research institutes. Such a cost is considered to be a departmental support cost for the research undertaken at the institutes under it.

On the other hand, some costs are best excluded from INFORM. These include the following:

- capital costs, because many public-sector research institutes do not depreciate their capital assets. For those that do, INFORM allows depreciation charges to be included in the budget (see Part 3 of these guidelines);

- the cost of technical assistance experts funded by donors. These are treated in INFORM as costs in kind. Otherwise the high level of their cost in relation to local salary cost would seriously distort the research program budget;

- the cost of obvious and identifiable nonresearch activities. Many institutes have other functions besides research. Extension is a common one, and it may be difficult to determine where research stops and extension begins. Where institutes are heavily involved in activities such as reforestation, vaccine production or diagnostics (as in animal research institutes) and where the costs of these activities can be separated from the budget, such costs should be deleted. This may show that not all of the budget is used for research, which may strengthen the case for additional research funds.

Again, at this stage a main concern is that the information included in INFORM is correct and complete. The following example shows what type of work is required:

> An Institute starting INFORM had a total government budget of $324,000 for the year under study. Foreign funded activities at the institute amounted to $39,000, giving a total funding of $363,000. In discussions with the director, a series of adjustments were agreed upon so that the total recurrent budget eventually used in INFORM was $275,000, a difference of $88,000 with the original grand total of $363,000. The following adjustments were made:
>
> - The original figure in the budget was $238,000 for personnel. However, the payroll showed that no more than $196,000 would be spent on salaries and benefits. The difference of $42,000 was mainly for positions approved but unfilled, and most of these

were unlikely to be filled during the year. The extra $42,000 was taken out of the budget.

- One of the foreign-funded special projects provided mainly capital and equipment. The amount of $28,000 allocated to that project was removed from the budget.

- A $10,000 "works" allocation in the government budget was for capital. It was not included in INFORM.

- One researcher was funded by a donor. His cost appears on the budget but not on the payroll. His budget cost was deleted and he was assigned the average salary of a Principal Researcher on the payroll. This reduced the budget by $1,000.

- The institute was involved in seed production activities. No cost figures for seed production were available, but the director estimated that four technicians and 20% of the laborers were involved full-time in seed production. The corresponding cost of $7,000 was taken out of the budget.

Thus the total adjusted budget amounted to $363,000 – $42,000 – $28,000 – $10,000 – $1,000 – $7,000 = $275,000.

3 Researchers and Their Activities

After secondary data have been collected, checked and rearranged (Chapt. 2), the next step in the INFORM process is the collection of new information from researchers. This is obtained through a questionnaire that deals with two types of information:

a. researchers' biodata and characteristics (who they are);

b. researchers' time allocation (what they do).

This chapter discusses, first, basic biodata information to be included in INFORM. It then discusses why it is important to measure the use of researcher time and how to collect such information through a questionnaire. A sample questionnaire is presented in Figures 3.1 - 3.3. The chapter concludes by discussing how the information on (planned) researchers' time allocations can play a role in program formulation at the research institute.

3.1 Researcher Biodata

INFORM relates research activities to the financial and human resources that are essential for conducting research. An information base on human resources is needed for effective implementation of research activities. Examples of questions that a research institute director may ask are listed below:

- How many researchers will retire in the next five years, in which divisions do they work, and what are the implications for recruitment?

- What is the balance between researchers with BSc, MSc and PhD degrees? What are the implications for training?

- What is the balance between the number of one-person, one-discipline experiments and multidisciplinary research work? Can some of the one-person experiments be consolidated into multidisciplinary projects?

- Which researchers are involved in the implementation of specific experiments? What is the total number of person-years allocated to each experiment?

It is important to focus on the minimum essential information required for management and planning. A lot of information that is routinely kept in personnel files is not needed for the planning and management of research and should not be entered into INFORM. Some examples are names of parents, place of birth, religion, primary school attended, marital status and number of children, pension entitlement, etc. This information is important for the personnel department to, for example, calculate benefits and allowances. It is not, however, essential for research program management.

3.1.1 Basic Information on Human Resources

This section deals with the core information that has to be collected for INFORM. The list presented is not exhaustive. Individual institutes and countries may want to vary it to meet their specific needs.

1. PRIMARY NAME
This may be the family name or first name, depending on custom in the country.

2. OTHER NAMES OR INITIALS
This is a secondary descriptor. When there are many identical primary names, initials or other names become essential in identifying individuals. If initials are also similar, it may be necessary to give each researcher a unique identification (ID) number.

3. BIRTH YEAR
The full date of birth is normally not required for INFORM. Most databases have special field types, called *date fields*, that allow easy manipulation of temporal data. If such a field is used, the entire date of birth may have to be entered.

4. SEX
Female (F) or male (M).

5. HIGHEST DEGREE
A research manager is interested in the highest academic degree obtained. Knowledge of earlier degrees is usually not essential.

6. UNIVERSITY
The university where the highest degree was obtained.

7. DEGREE COUNTRY
The country of the university where the highest degree was obtained.

8. DEGREE SUBJECT OR DISCIPLINE
This is the subject or discipline of the highest degree obtained. The disciplinary focus of the researcher's work at the research institute is discussed below. This may not be the same as the discipline of his/her study. Appendix 2 provides a checklist of disciplines used in INFORM.

9. ENTRY YEAR
The number of years of experience of a researcher may be measured by recording either the year of recruitment to the civil service or the start of work in the research system.

10. WORK SUBJECT OR DISCIPLINE
This variable may be used to allow researchers to indicate their field of specialization as far as discipline or work subject is concerned. This information may be the same as, or different from, the subject of the degree study. For comparative purposes a standard list of subjects may be useful. The list of disciplines presented as Appendix 2 may be used as a starting point.

11. COMMODITY FOCUS
At research institutes that work on a number of different crops or commodities, this information may be used to indicate the most important crop, commodity or group of commodities that the researcher works on.

12. PROGRAM/DIVISION
The name of the program, division or department to which the researcher belongs.

13. SHORT-TERM TRAINING SUBJECT
If the institute wishes to keep track of short-term training activities attended, it is useful to record subject, institute, year and duration of the training event. The title of the most important short-term training activity in which the researcher participated during the last five years is recorded here.

14. SHORT-TERM TRAINING YEAR
The year in which the short-term training took place.

15. SHORT-TERM TRAINING INSTITUTE
Where the short-term training event took place.

16. DURATION SHORT-TERM TRAINING
The number of weeks of the training event.

17. CURRENT GRADE, POSITION, CLASS OR SCALE
Most organizations have a hierarchical structure, with grades ranging, for example, from Director to Principal Research Officer, Senior Research Officer and Research Officer. Every organization has its own terminology that can be entered into INFORM.

18. ACTIVITY STATUS
This information indicates whether the researcher is active at the institute or whether he, or she, is on long-term study leave, outposted to another institute (while remaining on the payroll) or otherwise on leave with pay.

The following additional questions are asked only if the researcher is away from the institute on degree study leave.

19. EXPECTED DEGREE
This allows analysis of what the balance between researchers with different degrees will be, say, five years from now when researchers have returned to the institute.

20. SUBJECT EXPECTED DEGREE
Similarly, this provides information on the future balance between disciplines at the institute.

3.1.2 Optional Information

Some categories of additional information on human resources that may be included are listed below:

- **RESEARCHER IDENTIFICATION NUMBER**
  This may be useful, and sometimes essential, especially at an institute where there are many researchers with similar or identical names.

- **ADDITIONAL SHORT-TERM TRAINING**
  If an institute is active in providing short-term training opportunities to its researchers, a second series of data may be recorded.

- **PAST POSTINGS**
  This information may be useful if the assignment of staff to more favorable versus less favorable duty stations is an issue.

- **TRAINING CONDUCTED**
  Subject, duration and year of training events conducted by a researcher should be indicated.

- **PAPERS, PRESENTATIONS AND PUBLICATIONS**
  Many database programs have extra long fields, called *note fields* or *memo fields*, in which a list of papers, etc., may be entered.

3.2 Researcher Activities

This section discusses why it is important to analyze the use of researchers' time and how to measure it.

3.2.1 Why the Use of Researchers' Time Matters

A research institute's most valuable resource is its staff, especially its scientists. Most agricultural research institutes in developing countries spend 60% to 80% of their budget on salaries and wages. Yet, in many cases personnel costs are ignored when the costs of research are discussed. One of the underlying principles in INFORM is that it is built around the use of staff time. There are two reasons:

- **Researchers' time is money,** and must be included in the cost of research. More precisely, the cost of a researcher participating in a particular activity needs to be calculated. The principle is straightforward. Assume that the total cost of a researcher's salary, benefits and allowances (SBA) is $10,000 (this information was obtained from the payroll as discussed in Section 2.2). If the researcher spends 40% of his time on a particular experiment, the cost of that participation in that experiment equals $4,000. If a more senior scientist with a SBA cost of $25,000 spent 10% of his time on the same experiment, the scientist cost of the activity would increase by $2,500.

  The total researcher cost of an experiment is the sum of the cost of all researchers participating:

  $$\begin{aligned}\textit{TOTAL}\\ \textit{RESEARCHER COST}\\ \textit{OF EXPERIMENT A} = {} & (COST_{\text{researcher 1}} \bullet TIME_{\text{researcher 1}})\\ & + \ldots + (COST_{\text{researcher n}} \bullet TIME_{\text{researcher n}})\end{aligned}$$

- **The use of researchers' time is a management issue.** It is the task of the manager or director to ensure that researchers devote their time to priority activities. INFORM provides the manager with information on actual or planned use of time and, thus, with the information to effect change. Information on researchers' time allocation can be used as an instrument for personnel and performance evaluation. Making researchers plan and keep track of their time allocation is a tool for planning

programs of work and for monitoring and evaluating program implementation.

3.2.2 *Time Allocation*

Section 2.1 discussed the development of an accurate list of researchers and support staff, and Section 2.3 described how to arrive at a similar list for research activities. These lists are needed to ensure that the collection of time allocation information through a questionnaire proceeds smoothly.

The list of experiments should be printed as part of the questionnaire. Researchers can then mark the proportion of time they allocate — or plan to allocate — against the titles of the experiments. Ideally, if the list of experiments has been prepared carefully, all experiments in the relevant year will be on the list. However, researchers often find that some of their experiments are not listed. Space should be provided for additional experiment titles. It is also common to find that no researcher claims to be working on some of the experiments on the list. And sometimes there is confusion over the titles of experiments. As a result, the list of experiments can usually be finalized only after all questionnaires have been returned by the researchers and inconsistencies have been resolved.

For practical reasons, researcher time allocation is best recorded as a percentage of a work year. Assuming that a year has 50 workweeks, one week constitutes 2% of a year. This is a simple, yet reasonably accurate, measure to use. It should be kept in mind that the purpose of the exercise is related to the programming of research activities. It is not an accounting exercise where great precision is required. At a later, more advanced stage, more detailed ways of recording time allocation information may be considered.

The researcher is asked to divide his, or her, time into specific research and nonresearch activities. There are two steps:

a. First, total time is allocated to the following five main activities, the total of which must always add to 100%.

   - RESEARCH
   - MANAGEMENT AND ADMINISTRATION
   - EXTENSION
   - TRAINING OR TEACHING
   - DEGREE STUDY

   The list of main activities may be altered to suit the requirements of individual institutes. For example, *teaching* (conducting training) and *training* (being trained) may be considered as separate categories.

b. The next step is to divide RESEARCH time among the experiments that the researcher works on.* For example, if a researcher spends 20% of his/her time on extension and 80% on three experiments, his/her activity sheet will look as follows:

Experiment A:	30%
Experiment B:	10%
Experiment C:	40%
Subtotal research:	80%
Extension:	20%
TOTAL TIME:	100%

An error which must be avoided is that of totalling all research projects to 100% of time and then adding additional percentages for management, extension, etc.

Research time. There are sometimes difficulties in defining what is meant by research time. Examples of problems encountered are listed below:

- Some researchers, such as biometricians, may have no research projects of their own, but they may work on the research projects of many other researchers. There are two options for allocating time: the first is to allocate the biometrician's time to all projects worked on. This is often impractical because many experiments may be involved. The other option is to create a dummy "biometrics support project" and allocate 100% of the biometrician's time to it. This is usually a more practical solution and also provides an alternative way of dealing with other research support functions, such as an analytical laboratory.

- There are cases where a research institute has separate nonresearch departments, such as extension, vaccine production or operation of a production facility. If the persons working in these nonresearch departments do not do research, they are best excluded from INFORM. How-

*In the INFORM system presented here, only research time is subdivided into specific research activities. No details are presented on nonresearch activities such as extension and training. In principle there is no reason that total extension time, for example, could not be assigned to specific extension projects in the same way as total research time is assigned to research activities. The same could also be done for training and teaching, provided activities were structured as projects to which time could be allocated using the questionnaire. Currently, INFORM is structured as two databases: one on personnel and one on research projects. If, for example, extension activities were incorporated in INFORM, an extension project database would have to be added to the system. ISNAR has not yet field-tested this possibility and it is therefore presented here only as a possible refinement of the approach.

ever, where researchers work part time on nonresearch activities, they are included in INFORM. The cost of nonresearch activities can often be identified and separated from the research budget, as was discussed in Section 2.4.

Management and administration time. Researchers often manage a program or have administrative duties. Directors of institutes may spend 80% to 100% of their time on research management and institute management and administration. Such time is different from, for example, the chief accountant who is also a full-time administrator. Accountants are support staff, not researchers.

Extension time. A researcher may participate in extension activities. In addition, technical services, such as diagnostics or vaccine production, may be included under the heading of extension. If technical services activities are substantial, they may be considered as a separate category.

Training or teaching time. This category includes teaching (conducting training) and short-term training (receiving training). Long-term training for a higher degree is discussed below under "degree study time." Again, if more detail is required, training and teaching may be separated.

Degree study time. This relates to those researchers on long-term leave to study for a higher degree, and it includes only researchers absent from the institute for a substantial part of the year. If a scientist leaves from, or returns to, the institute in mid-year, 50% of his/her time can be allocated to study and the remainder to other research or nonresearch activities.

Figures 3.1 to 3.3 provide an example of a completed time allocation questionnaire. It concerns a researcher from a fictitious Agricultural Research Institute (ARI). The researcher's name is C. Danao, a pathologist. The first page provides his biodata. Page 2 includes a note that explains how the researcher should fill in the time allocation questionnaire. Should the researcher be away, the questionnaire must be filled in by the personnel officer on behalf of the absent researcher.

On page 2 it can be seen that Danao spends 90% of his time on research and 10% on management. Page 3 of the questionnaire lists all the institute's research activities by program. Danao works on three experiments, one in the Grain Legumes Program and two in the Rice Program. The three experiments take 25%, 40% and 25% of his time, respectively, and add up to the 90% indicated as total time for research.

SECTION I: PERSONAL INFORMATION

LAST NAME: *Danao*

INITIALS: *C*

SEX: *Male*
YEAR OF BIRTH: *1950*
GRADE: *II*

YEAR OF JOINING PUBLIC SERVICE: *1979*

YEAR OF APPOINTMENT TO PRESENT POST: *1989*

PRESENT POSITION: *Research Officer*

HIGHEST ACADEMIC DEGREE: *B.Sc.*
UNIVERSITY: *Los Baños*
COUNTRY: *Philippines*
YEAR RECEIVED: *1977*
SUBJECT: *Pathology*

PRIMARY DISCIPLINE OF WORK: *Pathology*

PRIMARY CROP OF WORK: *Rice*

OTHER CROPS: *Soybean*

SHORT-TERM TRAINING: *None*

Figure 3.1. Personnel questionnaire, page 1

3.2.3 Data Quality Issues

Because the allocation of researcher time is crucial to INFORM, every effort should be made to ensure that the researchers provide good-quality data. Three points regarding the quality of information are listed below:

C. Danao

SECTION II: RESEARCHER TIME ALLOCATION

Listed immediately below are five categories of work in which you may be involved. Please indicate the percentage of your annual time you expect to spend on each of these five in 1990. Your total must equal 100%.

	% of Annual Time
Research	90%
Management	10%
Training/Teaching	____
Extension/Information	____
Full-time study?	____
	100%

NOW, a related request . . . . The following page contains the titles of all research projects proposed by researchers at ARI for 1990. Beside each project on which YOU work indicate the percentage of your total time that you spend on it.

Remember: One week = 2%.
Remember: Include ALL projects on which you work, whether you are in charge of the project or you are working on someone else's project. For example, a breeder might be working on a pathology project concerned with disease resistance.

Remember: Your total time for specific projects must equal the percentage that you indicate for your overall research (ABOVE). For example, if you indicate there that you spend 70% of your time on research, your total on the list of projects must also equal 70%.

Figure 3.2. Personnel questionnaire, page 2

- Estimating the use of time is a learning process. When researchers are asked for the first time to estimate how they have used, or will use, their time, many find it difficult because they have never previously been asked to provide such information. Experience shows, however, that most researchers quickly become used to the idea.

C. Danao

SECTION III: TIME ALLOCATION TO EXPERIMENTS

LIST OF EXPERIMENTS BY PROGRAM, ARI 1990

	% TIME
1. AGROFORESTRY	
alley cropping	____
fuelwood trees	____
home garden agroforestry	____
nitrogen fixation, effects of leucaena	____
2. FRUITS	
effect of spacing and cultural practices on yield of banana	____
mango collection and evaluation	____
mango fertilizer trial	____
mango flower-inducing hormones	____
passionfruit evaluation	____
3. GRAIN LEGUMES	
groundnut — epidemiological studies of rust	____
soybean — breeder seed and seed multiplication	____
soybean — germplasm selection and evaluation	____
soybean — hybridization and breeding lines	____
soybean — on-farm selection trials	25
4. RICE	
coordinated varietal trial of rice	____
fertilizer trial 1, irrigated N K	____
fertilizer trial 2, rainfed N K	____
fertilizer trial 3, rainfed Zinc	____
hybrid rice varietal trial	40
residual effects of P and K in dry season on paddy rice in wet season	____
rice - computer model for pests	____
rice - insecticide screening for leaf folder	____
rice - varietal evaluation for grain moth	25
rice germplasm evaluation	____
rice spacing trial 1	____
rice spacing trial 2	____
5. VEGETABLES	
chilli — fertilizer response	____
chilli — insecticide screening for pod borer	____
chilli — intercropping	____
chilli — narrow leaf disease study	____
soybean — evaluation of vegetable type	____
vegetable seed production	____

Figure 3.3. Personnel questionnaire, page 3

- The quality of the data improves if managers use the information and regard it seriously. Time allocation information can be used by the institute director to appraise the performance of the researchers. If researchers know they may be held accountable for the information they provide, they will take the exercise seriously.

- The quality and value of information improve if the data collection exercise involves consultation and consensus building. The exercise should not be seen as threatening to individual researchers. Consensus building is especially important if the INFORM exercise is undertaken to design a program and budget for the following year.

3.3 Time Allocation and Program Formulation

Time allocation information can play an important role in research program formulation. Assuming that an institute is developing a research program and budget for the coming year, there are two main stages in the process:

- In the first stage, the list of research activities to be implemented in the next year is developed. This answers the question of what research will be conducted.

- In the second stage, researchers allocate their time to a selected number of activities. This answers the question of who will implement the planned activities.

Both stages should involve the director, program leaders and all researchers. The purpose is to build a consensus on the shape of next year's program with responsibilities for its implementation assigned to individual researchers.

3.3.1 List of Planned Research Activities

To create such a list for the coming year, the following steps must be taken:

- First, eliminate any experiments listed for this year but which are not being worked on. It is common to find planned experiments that are not being implemented (they may have been included for several years but without any activity, because of lack of funds or for other reasons). Discussions with research directors and program leaders are required to identify experiments that fall into this category. Often, experiments that are not implemented in the current year remain on the planned activity list for the following year if they continue to hold a high priority. This, however, should not be assumed. One goal of INFORM is to take a fresh

look at next year's program. Neither current nor planned activities should automatically be carried forward.

- Second, determine which experiments and studies will be completed in the current year. These are eliminated from the activity list for next year.

- Third, add new experiments planned for the following year. Developing a list of new experiments is a process that needs to go through several iterations. In the first stage, researchers will probably submit long lists of new activities. After several rounds of consultation with management, a final list of new experiments will be arrived at, taking into account such factors as the progress of experiments currently under way, any changes in the institute's objectives and priorities, and the level of funding likely to be available. The word **likely** is stressed. It is all too common for researchers, and even institutes, to submit long lists of new activities for the following year without relating this to the possible level of funding. If new projects will require 50% additional funding at an institute where, in recent years, the annual budget has grown by no more than 5%, there is clearly something wrong. Realistic estimates are required.

  At this stage it is useful to conduct a systematic assessment of proposed research activities in view of their priorities. Section 4.5 suggests the use of three qualitative criteria that may be used: the urgency of the problem addressed by the project, the probability of success, and the likely time before results can be utilized.

- Finally, the list of research activities must be checked against the activity questionnaires completed by the researchers to ensure consistency. Sometimes, individual researchers will add experiments to the list printed on the questionnaire. On the other hand, if no researcher claims to be working on a listed experiment, it must be deleted.

3.3.2 Researchers' Planned Time Allocation

There are three steps in the assignment of research responsibilities to individuals:

- Information on researchers' proposed time allocation is collected through the questionnaire. This information then serves as a proposal for individual work plans.

- Researchers' proposals are reviewed and agreed upon, or amended as necessary. The reviews can be in the form of meetings between individual researchers and the director or as meetings involving all researchers of a

specific department or of the whole institute. The size of the institute and the personal style of the director will determine the consultation process.

- Once the formulation of a program of work has been completed, the last step is to assign costs to the proposed activities, resulting in a budget. This is the subject of Chapter 5.

Time allocation information can be summarized in a research activity matrix, an example of which is presented in Table 3.1. It shows a matrix with the proposed experiments of the banana program at a research institute. There are four experiments and four researchers, one of whom is on study leave. Researchers' times are allocated to experiments and nonresearch activities. Small institutes may summarize all activities in one matrix, but larger institutes will need to develop individual matrices for different programs or departments.

Table 3.1. Example of a Research Activity Matrix

RESEARCHER TIME ALLOCATION
(% of person-year)

RESEARCHER:	A	B	C	D	TOTAL TIME
EXPERIMENT					
BANANA FERTILIZATION	10	10	0	0	20
BANANA CULTIVATION	10	40	0	0	50
BANANA PROPAGATION	10	20	0	10	40
BANANA MULCHING	0	5	0	50	55
SUBTOTAL RESEARCH	**30**	**75**	**0**	**60**	**165**
MANAGEMENT	60	0	0	10	70
EXTENSION	10	15	0	10	35
TRAINING	0	10	0	20	30
STUDY (LEAVE)	0	0	100	0	100
TOTAL	**100**	**100**	**100**	**100**	**400**

4 Research Program Analysis

Information on research subject matter and the contents of experiments, projects and programs is an essential part of INFORM. Such information provides research managers with answers to a number of important questions, such as the following:

- Which experiments are being done?
- What are the objectives of the experiment?
- What is the focus of the experiment in terms of discipline, research theme and commodity?
- Where is the experiment being conducted?
- When did the experiment start and when is it expected to be completed?
- Who is involved in the experiment and what are their costs?

Information on the substance of experiments, projects and programs is useful and important in itself. It becomes a tool for **management and programming** when information on planned research activities is linked to data on **costs** (for budgeting and financial planning) and to information on **people** (for human resource planning). This chapter begins a discussion on some principles of information collection and structuring. It also presents information requirements on scientific, management and the locational aspects of research. The last section introduces the use of INFORM for **monitoring and evaluation** of research activities and for priority setting.

4.1 Information Collection and Structuring

There are two issues relating to the collection and structuring of information for INFORM:

- What information on research activities is to be collected?
- How and to what extent should the information be structured?

4.1.1 *Information to Be Collected*

What information on research activities is needed for INFORM? One principle is to include only the **minimum essential information** required for program and resource management and for planning. A focus on essential information will result in a simple and practical information system that research managers and institute directors can use for management, programming, and planning.

Deciding what is essential information is not easy. Individuals may have different preferences, and research managers' requirements may differ depending on the size of the institute, how research programs are structured, etc. Nevertheless, it is important to try to achieve a consensus on the minimum essential information to collect. Beyond that, additional (optional) information may be collected. Sections 4.2 to 4.4 discuss the categories of information to be used in INFORM. The variables included are the result of research done in a number of different countries. Some of the variables discussed are optional and are best included after some experience with INFORM has been obtained. In any case, individual countries should adjust the lists to suit their particular requirements.

4.1.2 *Structuring the Information*

The question here is: to what extent and how should the data that go into INFORM be structured? Essentially this is a question of whether an unlimited number of different entries is allowed in a database field, or whether the data are recorded so that entries fit neatly into a limited number of preconceived categories. Take, for example, information on the crop or the commodity that the experiment deals. There are several options:

- Information may be entered into the database just as the researcher supplies it. Thus, one may obtain the following entries: rice, paddy, upland rice, basmati. This is not very helpful.

- Such a problem can be solved by adhering to a standard list of crops; thus, for example, "ladyfinger" becomes okra and "brinjal" becomes eggplant. The use of such a standard list for INFORM is essential, not only to ensure that everyone refers to the same crop by the same name, but also to standardize the spelling of names. For example, a database program would consider "eggplant" to be a different crop than "egg plant."

- Even when a standardized list is used, a large number of different entries may be obtained. To eliminate a number of minor crops from the list, one may decide to group some of them into a smaller number of commodity

groups, e.g., orange, lime, lemon, and pomelo into citrus. There are advantages and disadvantages to this. Standardizing and summarizing information facilitates the analysis and presentation of information in tables and graphs, especially when the results from a number of institutes are aggregated. On the other hand, it may be necessary to be able to pick out just those experiments that deal with a particular crop.

Three general observations are made on structuring information:

- First, when INFORM work starts, it is advisable to allow freedom in structuring. Meaningful categories in which to summarize information will suggest themselves as work proceeds. Standard lists of commodities, disciplines, etc., should be developed as work goes along, and individual institutes within the same NARS should use those lists as much as possible.

- Second, the level of analysis should be considered. At individual institutes, considerable detail may be desired. At higher levels of aggregation, when information from a number of research institutes is pooled, data will have to be summarized and presented in a more structured manner.

- Third, structured information is especially required if data analysis involves a number of different institutes. It is advisable to design the database to include both structured and nonstructured information. This is achieved by reserving certain variables (fields) for data that are coded in an established format, while other variables are of a free-format type. The latter type of information is intended to deal with detailed information categories that are often specific to an individual institute.

Information on research activities is discussed in three sections below: scientific aspects, administrative aspects and locational aspects.

4.2 Scientific Aspects*

Each variable or category of information discussed here represents a field in the experiment database. Research institutes may wish to add specific categories of information, depending on their information requirements.

1. EXPERIMENT TITLE

The title of a research activity is its most important identifier. Usually an experiment title is straightforward and follows exactly the description in

*An example of a completed experiment form, including information on substance and costs, is presented in Table 7.3.

the institute's research program documents, but three practical problems do occur:

- Titles may be too long, which is a problem when they are printed. Some sensible abbreviation will be required.

- Titles may be repetitive. It is common to find a number of identical experiment titles where the same research activity is undertaken in different locations by the same researcher. It is a matter of judgment whether to consider this as different experiments or whether to treat this is as one research activity conducted at several sites. Unless there is a large number of small experiments, it is generally best to follow the classification used by the institute itself. Replicated trials are considered as one research activity.

- Titles may not indicate the nature of the activity. For example, the experiment title "Zn trials" is not nearly as complete as "Effects of three levels of Zn on yield of two tea clones." The more specific a title is, the better. In this context it is a useful exercise to review the titles of experiments in consultation with program leaders and researchers before data entry.

2. MAIN CROP OR COMMODITY

Although often straightforward, the main crop or commodity variable may present some problems:

- A research activity (such as one dealing with intercropping or farming systems research) may deal with more than one crop. In this case the most important crop should be listed here and secondary crops should be listed in the "other crops" field.

- Some research (such as soils research) does not deal with any specific crop or commodity. In this case one could choose to classify this as "natural resources" (where appropriate) or be more specific and enter (somewhat incorrectly) "soils." In forestry research, a question would be whether a commodity is, for example, teak, or whether it should be included under natural resources research.

- Care has to be taken that crop names are entered consistently. Consistency can be ensured by checking crop names against a standard list. Using such a list ensures that spelling of names is correct. This means that a list of acceptable crop entries has to be developed. Such a list is most useful if it is adapted to the specific terminology and vocabulary of the country concerned. Creating such a list is an activity that may best be done by a national coordinating organization, such

as a research council. The most practical strategy is probably to conduct the initial INFORM work at a number of research institutes, then review the data and establish a standard list. A basic list of the most important crops, commodities and commodity groups in Asian agriculture is presented as Appendix 1. This can be used as a starting point to build country-specific lists.

3. OTHER CROPS OR COMMODITIES

If an experiment deals with more than one crop, the crop or commodity field provides an opportunity to enter additional information, e.g., "Marketing of soybean and blackgram." Multiple-cropping experiments are another situation where more than one crop is involved. It may be difficult, for example, to find out which is the "main crop" and which the "other crop" in a maize-beans intercropping experiment. In this case subjective judgment is necessary.

4. COMMODITY GROUP

The purpose of this field is to summarize crop information into a number of categories that will facilitate analysis across institutes. This requires a standardized list of commodities used in a given country. For a start, one may assume that the list will contain between 10 and 20 groups. Appendix 1 provides a list of commodity groups.

How to classify crops and commodity groups is a matter of judgment. "Cereals," for example, is a major commodity group. In many Asian countries, however, rice research is several times larger than the research on all other grains combined. One may decide, therefore, to enter rice both as a crop and as a commodity group (and have "other cereals" as a separate commodity group).

5. SEASON

The season variable indicates the seasons when an activity is implemented. Each country will do this differently, using established names such as *wet* and *dry* season, *summer* and *winter*, or *Aman*, *Aus* and *Boro* in Bangladesh. A crop that has a duration of more than one crop year is identified as *P* (for perennial) in the season field. Nonseasonal activities (soil analysis, tissue culture) may be entered as *N* (for nonseasonal).

6. DISCIPLINE

Discipline covers the main discipline of the experiment. A problem may occur if more than one discipline is involved. If so, the most important one should be entered in the database. To facilitate comparison, a standardized list of disciplines is preferable. Such a list, reasonably comprehensive for agricultural research, is presented as Appendix 2.

The relationship between "discipline," "program" or "department," and "service" is specific to each research institute. Some have disciplinary programs or departments; at others the program structure is based on crops. Programs may be supported by disciplinary services such as biometrics and by nonresearch services such as seed multiplication and vaccine production.

The experiment database should contain separate fields for the "discipline" of the research and the "program" ("department" or "division") at the institute, even where programs are based on disciplines, since the match is seldom perfect. For a disciplinary service such as biometrics, where one scientist may provide limited assistance to a large number of experiments, it is best to create a fictitious "biometrics support project" that pools the time and cost of this activity. The discipline of this project would be biometrics and the program may be classified as "support". Nondisciplinary services would be classified as "support" both in the "discipline" and the "program" field.

7. MAIN OBJECTIVE

Objectives as presented in experiment protocols or project documents may be imprecise ("to find profitable methods of cultivation of sugarcane") or more specific ("economic analysis of sugarcane yield response to different levels of applied N). For inclusion in a database, experiment objectives must be presented as concisely as possible.

8. CARIS 1

In order to provide more depth to the analysis of research programs, INFORM makes use of an adapted version of FAO's AGRIS/CARIS system (Prince-Perciballi 1990) to describe research thematic areas. AGRIS (Agricultural Research Information System) is a documentalist's tool used in many agricultural libraries. CARIS (Current Agricultural Research Information System) uses the same classification as AGRIS. INFORM classifies research into 12 broad *program areas* (CARIS 1) and, at a second level (CARIS 2), into about 80 *subjects or themes*. The 12 main themes at the first level are denoted by a letter, e.g., *F* for **crop production** and *H* for **crop protection**. An example that shows the different levels and how these are related to the keywords discussed below is given in Table 4.1. Program area subjects and keywords are linked in a hierarchical manner, allowing a look at research subject matter with different levels of precision. Appendix 3 presents all the primary and secondary CARIS codes.

The use of keywords and CARIS research themes is discussed in detail in Part 4 of these guidelines.

Table 4.1. An Example of CARIS Research Themes and Keywords

CARIS 1: PROGRAM AREAS (12)
EXAMPLE: *H PLANT PROTECTION*

CARIS 2: SUBJECTS (80)
EXAMPLE: *H60 WEEDS AND WEED CONTROL*

KEYWORDS: ABOUT 600 GROUPED BY CARIS SUBJECT
EXAMPLE: KEYWORDS FOR
H60 WEEDS AND WEED CONTROL

BIOLOGICAL WEED CONTROL	WEED ECOLOGY
WEED STRUCTURE	WEED PHYSIOLOGY
WEED BIOCHEMISTRY	WEED TAXONOMY
WEED COMPETITION	HERBICIDE RESISTANCE
INTEGRATED WEED CONTROL	WEED CONTROL

9. CARIS 2

CARIS 2 is the **detailed**, subject or theme level, of which there are some 80 entries in the INFORM system. Each second-level theme is denoted by a number. Thus, the **plant protection** main theme has detailed entries covering, for example, **pests of plants** (H10) and **plant diseases** (H20).

10. CARIS CODE

The CARIS codes identifying the research themes (e.g., H10 and H20) are entered in the database for each experiment. The letter *H* denotes the CARIS program area and the number 10 indicates the secondary research theme. Because this coding is used by many agricultural research institutes and by agricultural libraries, it is useful to enter the code of the activity into the database in addition to its verbal description.

11. KEYWORDS

Linked to CARIS 1 and CARIS 2 is a system of about 600 keywords for agricultural research. These have been selected from the FAO AGROVOC thesaurus and provide an opportunity to classify the subject matter of an experiment in a detailed manner. The keywords used in INFORM are not a closed list but represent a selection of CARIS keywords that ISNAR has found useful for classifying agricultural research. Users of INFORM, particularly specialized institutes, may need to modify this core list to meet their own specific needs. All keywords are listed in Part 4 of these guidelines, both alphabetically and by theme. When the keyword analysis is done consistently, it is a powerful tool to

identify which experiments on viral diseases in rice, for example, are conducted at which institutes, and by whom.

Note that the keyword field should only be used for entering research descriptors. Information on crops should not be entered here, nor should any information on pest, disease, pathogen or biological control agent be entered into the keyword field. There are special fields for these types of information.

12. PEST/DISEASE
Many experiments deal with some kind of pest, disease, pathogen or biological control agent. Information of this kind is best entered in a separate field and not under the keywords. The name of the species concerned should be entered: e.g., brown plant hopper, rats or mosaic virus. Entries may be common, local or Latin names, but they must be consistent within a country.

13. TECHNICAL LINKAGES
The linkage field may be used to indicate any technical or scientific involvement of other institutions in the planning and implementation of the project. Possible partners are national research institutes, universities, international agricultural research centers, international networks, etc. This field may be combined with the financial linkage field discussed later in this chapter.

4.3 Administrative Aspects

This section deals with information on the institutional and management aspects of research activities.

1. IDENTITY (ID) NUMBER
It is useful to identify each research activity in the database with an ID number. A small institute with only a few experiments can probably do without such numbers. As a database grows bigger, however, an ID number may become essential.

One can use an ID number to provide information on different aspects of a research activity, such as program, center and ministry. However, one easily ends up with a 10-digit number, which is difficult to handle and may be a source of error in itself. An individual institute can number research activities sequentially or by program, starting from 001. Additional digits, which may be required for comparisons across institutes, can be added later simply by recoding.

2. PROGRAM, DEPARTMENT OR DIVISION

Research institutes normally group their activities into programs, departments or divisions. These are often discipline based (e.g., the breeding division) and sometimes crop based (e.g., the maize program). Some research institutes classify their research activities first by experiments, then by project, then by subprogram and finally by program. If this is the case, one needs to know the subprogram and program for each experiment. The database will then need to contain a field for each of these categories. Many institutes have particular, and sometimes peculiar, lists of programs. At one institute one may find programs dealing with crops (rice program), disciplines (breeding) and techniques (tissue culture program). The program names in use at the institute should be followed in INFORM. This is a category of information that is meant for use at the individual institute, not for comparison across institutes.

An additional variable, *Program Number*, may be useful for purposes of data presentation. This allows information to be presented on a program-by-program basis in the order that the institute has become accustomed to. If an institute presents the budget with the breeding program first, followed by the agronomy program, these programs should be given numbers 1 and 2, respectively. Otherwise, most database programs will print the list of programs in alphabetical order.

3. CENTER/INSTITUTE

The name of a center is the same for all experiments. Most database programs allow this information to be put in as a constant, so it is entered only once. Substations are part of the center and are included in the analysis.

4. ORGANIZATION

Organization is the ministry, agency, university or other entity that is the parent body of the center or institute. Thus, for example, the Ministry of Plantation Industries in Sri Lanka is the parent body of the Rubber Research Institute.

5. YEAR

Because budgeting is an annual exercise, the year of the current analysis should be identified. The year 1990, or 1990/91, can be entered just once as a constant in the database. Where financial year and agricultural year are very different, a decision on which one to use for the INFORM analysis will have to be made.

6. STARTING YEAR

The starting year of each research activity has to be entered. In combination with expected completion year, it will provide basic information on project implementation. Database programs have a special type of variable, called *date fields* for this type of information.

7. EXPECTED COMPLETION YEAR

This information complements the starting year and will allow research managers to know which activities are nearing completion, have been completed or should have been completed. The completion year is the year of output delivery (in the form of a report, the release of a variety, etc.).

8. FUNDING LINKAGES

Funding linkages provides information on any financial involvement of outside institutions, such as financial assistance by external organizations, either national or international. This field may be combined with the technical linkages field.

4.4 Location of Research

There are several ways to describe where an experiment or project is conducted. Managers may need to know on which station an experiment is conducted. They may wish to have information on the village, town, district or province where on-farm research or surveys are conducted. They may also wish to relate research activities to specific agroecological zones if that information is available. The latter two variables may be considered as optional information in the early stages of INFORM.

1. LOCATION

The purpose of the location field is to identify where research is done in terms of institutions. The standard classification proposed here is simply:

- Headquarters (main station)
- Substation or station of another institute
- Off-station (on-farm)

Additional categories may be required. In Sri Lanka, for example, a substantial amount of rubber and tea research is done on estates.

2. PLACE

The place field is different from the location field in that it may be used to indicate the topographic name of the place where the research is

conducted. This can be the proper name of the station or substation, the estate, the province, district or village where the experiment is being conducted.

3. AGROECOLOGICAL ZONE
Information on the agroecological zone is useful, especially when there are big differences in climate and soils in a country. This information can only be used if some classification or mapping of the country into agroecological zones is available.

4.5 A Note on Priority Setting, Monitoring, and Evaluation

The INFORM experiment database may be used for planning and priority setting, as well as for monitoring and evaluating research activities. ISNAR's work in these areas is still at an early stage and has not yet been adequately field-tested. This section is, therefore, a preliminary note, suggesting some variables or fields that may be included in the INFORM database.

Priority setting deals with the planning and program formulation stage, monitoring deals with the implementation stage, and evaluation is conducted after completion of the project. In practice, the current project database will contain new and on-going experiments. Completed experiments should be taken out of the current database and included in a database on completed activities.

4.5.1 Priority Setting

Three indicators will be useful as a starting point to assess the priority of a research activity: the urgency of the problem addressed by the experiment, the probability of success and the likely time before the results can be used. The indicators may be combined in a priority index since they have to be jointly analyzed: an urgent problem with a low probability of success may not receive high priority. Each of the indicators can be scored in a simple, qualitative manner on a scale from 1 to 4. To ensure consistency, the scoring should be done by a planning unit or a senior manager or scientist.

- **URGENCY**
  The urgency of the problem is related to how widespread it is (how many farmers are affected) and how severe it is (e.g., the percentage yield decline). A simple scale could be as follows:

Very high	4
High	3

Moderate	2
Low	1

- **PROBABILITY OF SUCCESS**
  This field indicates the likelihood that the expected result will be achieved. The same scale as above may be used.

- **LIKELY TIME LAG**
  This is an indicator of the expected time before the result will be utilizable. Again a simple four-point scale may be used:

0-2 years	4
2-5 years	3
5-10 years	2
10+ years	1

4.5.2 Monitoring

During the implementation phase of a project, managers will want to know whether the project is on schedule and whether the quality of the work is acceptable. The following indicators provide this information:

- **DATE OF MONITORING**
  If more than one monitoring exercise is carried out, this provides the date of each exercise.

- **STATUS OF BUDGET USE**
- **STATUS OF WORK**
- **STATUS OF REPORTING**

  These three status fields may be scored on a simple scale. The scoring should be done by the director or by a monitoring and evaluation unit. The following scale may be used:

Ahead of schedule	4
On schedule	3
Somewhat behind	2
Badly behind/nonoperational	1

- **TECHNICAL QUALITY OF WORK**
  Again, a simple scale may be used:

Outstanding	4
High	3
Moderate	2
Low	1

4.5.3 Evaluation

After completion, experiments will be moved to a database for finalized projects. When an evaluation of these projects is carried out, the following indicators may be used:

- **TECHNICAL QUALITY OF RESEARCH**
- **APPROPRIATENESS TO USERS' NEEDS**
- **ADOPTION BY USERS**

The following scale may be used:

Outstanding	4
High	3
Moderate	2
Low	1

5 Research Costs

Chapter 2 stressed the importance of including **all recurrent costs** in INFORM: salary costs, benefits and allowances paid to staff, operational costs from government and other sources, and overhead costs. This chapter discusses in detail the different types of costs and their classification. This constitutes a subject that is more likely to be of interest to accountants than to researchers.

5.1 INFORM Cost Codes

One of the requirements for INFORM is the development of a budget for each research experiment. Such budgets form the building blocks for the development of program budgets which can be used for planning purposes. A budget by crop, for example, allows a comparison to be made between crop research priorities and crop resource allocations.

For program and resource management, the research manager also needs information on the cost or budget of the resources used in the research process; for example, supplies and labor. The accounting literature refers to these as **objects of expenditure** (Shilanglaw and Meyer 1983: 572). Research institute budgets provide object-of-expenditure information but usually not in a way that is useful for agricultural research management because of the following:

- Government line-item budgets often pool all salaries and wages, regardless of whether they are paid to researchers, technical support staff or administrative staff.

- Government line-item budgets do not relate research staff to research activities (experiments) and nonresearch activities (management, extension, etc.).

INFORM seeks to improve upon the traditional budget format by presenting the budget in a set of **cost codes** specifically adapted for agricultural research institutions. Specifically, the INFORM cost-code system seeks to provide more detailed information on the large cost of personnel (which may amount to over 80% of an institute's budget) by breaking personnel costs down into a number of different cost codes that relate to the activities of the staff.

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The INFORM cost codes are **not** meant to replace existing budget and account codes (which may represent public-sector accounting requirements), but rather to complement them in a way that will assist agricultural research managers. Autonomous research institutions which are free to change their accounting system, may, at a certain stage, decide to convert the existing accounting system to the INFORM system, or to a similar system in which accounts and program budgets are integrated. Tables 5.1 and 5.2 present examples of a traditional budget and a revised budget based on INFORM cost codes. Note that the total institute budget is the same in both tables.

The revenue and cost codes used in INFORM are discussed in detail in Part 3 of these guidelines. They present a system for classifying costs into eight primary codes for operating costs (and one for nonoperating expenditures), about 30 secondary codes and 100 tertiary codes. The tertiary codes are detailed codes actually used by NARS. What INFORM does is to aggregate these into a smaller number of groups. Analysis at the primary cost-code level should suffice for most management purposes.

Table 5.1. Traditional Line-Item Budget

DESCRIPTION	COST
SCIENTISTS SALARIES	37,000
SUPPORT STAFF	13,000
LABOR	6,000
SUPPLIES	7,000
TRAVEL	5,000
PUBLICATION	1,000
MAINTENANCE	3,000
ELECTRICITY	1,000
OVERHEAD	2,000
TOTAL	75,000

The INFORM system is one option for coding costs and is intended to be flexible. If research institutes wish to group costs in a different manner, they can do so. INFORM uses the primary and secondary cost codes listed on the following page.

Table 5.2. Revised Budget Using INFORM Cost Codes

CODE	DESCRIPTION	COST
100	*RESEARCH PERSONNEL*	*29,000*
110	RESEARCHERS*	15,000
120	TECH. SUPPORT STAFF	8,000
140	LABOR	6,000
200	MATERIALS/SUPPLIES	7,000
300	TRANSPORT/TRAVEL	5,000
400	REPAIRS/MAINTENANCE	3,000
500	TECHNOLOGY TRANSFER*	9,000
600	MANAGEMENT/ADMINISTRATION*	12,000
700	UTILITIES	1,000
800	MISCELLANEOUS*	9,000
	TOTAL	75,000

* Includes personnel cost elements.

100 RESEARCH PERSONNEL
- 110 researchers' research time
- 120 technical support staff
- 140 labor

200 MATERIALS AND SUPPLIES
- 210 research materials
- 220 research support

300 TRANSPORT AND TRAVEL
- 310 subsistence
- 320 conveyance
- 330 vehicles

400 REPAIRS AND MAINTENANCE
- 410 physical plant
- 420 research equipment

500 TECHNOLOGY TRANSFER
- 510 researchers' extension time

520 researchers' training and teaching time
530 publications staff
540 publications
550 promotion
560 linkages

600 MANAGEMENT AND ADMINISTRATION
610 researchers management time
620 administrative support staff
630 board of directors or governors
640 departmental support

700 UTILITIES AND FACILITIES
710 utilities
720 facilities rental

800 MISCELLANEOUS
810 study leave time
820 services
830 finance
840 other

Part 3 of these guidelines (Revenue and Cost Codes) shows about 100 tertiary cost codes. In practice, tertiary codes will be used mainly for aggregation purposes. An example is primary code 300 for Transport and Travel. This contains the following secondary and tertiary codes:

310 SUBSISTENCE
311 local travel
312 overseas travel
313 change of station/holiday travel

320 CONVEYANCE
321 air tickets
322 bus/train tickets
323 car hire

330 VEHICLES
331 fuel and lubricants
332 maintenance
333 insurance
334 licensing
335 depreciation

Other options exist for grouping tertiary codes into different secondary or primary codes. The classification presented here includes all costs related to mobility in the 300 series. Research institute accounts often treat these costs differently. Vehicle maintenance, for example, may be considered part of general maintenance, and fuel and lubricants are often classified as supplies. If a research institute prefers to retain some of its traditional accounting codes in its version of INFORM, it is feasible to do so.

The transformation of a traditional line-item budget to a budget using INFORM cost codes is not a matter of simply changing the titles of the line items. It is an integrated part of INFORM because it uses information on scientists' time allocation collected through the questionnaire. The cost of researchers is entered into different primary and secondary cost codes. For example, the cost related to the time researchers spend on extension and on training or teaching is entered into the category TECHNOLOGY TRANSFER (500). The use of INFORM cost codes also requires information on whether support staff are technical or administrative in function since their costs are entered in different codes. (The treatment of personnel costs is discussed in more detail in Section 5.3.)

In cases where pension costs, departmental overhead, and inposted staff are included in INFORM, the totals of the original institute budget and the INFORM budget will obviously be different.

5.2 Direct and Indirect Costs

One of the principles of INFORM is inclusion of **all** recurrent costs in the analysis of research activities. Direct costs are defined as those for which an actual figure is available for each experiment. Indirect costs, or overhead costs, are those that cannot be traced to experiments. The distinction is not absolute and, in practice, there are three situations:

a. A direct cost estimate may be available for each experiment. An example is the cost of researchers participating in experiments. Time allocation information is collected through the questionnaire, and the cost of the researcher is derived from the payroll. Similarly, information on the quantities and costs of seed and fertilizer may be available for each experiment.

b. For some costs, a direct estimate at the experiment level is never possible. These are indirect, or overhead costs. For example, the cost of utilities and communications are virtually impossible to relate directly to experiments. The cost of management and administration (it is not possible to link the cost of an accountant to an experiment) and the costs related to

the time a researcher spends on management activities are also indirect costs.

c. Between these two extremes, there are costs that, at least in principle, can be traced to individual experiments but are treated as indirect costs. The reason for this is that either the effort and expense of tracing them to experiments would be prohibitive or the information obtained is not of great enough importance for management to warrant tracing them. For example, the cost of glassware broken in the laboratory could be linked to experiments, but the information is not important for management.

The INFORM principle that all research costs are included in the analysis implies that not only the direct, but also the indirect, costs must be related to experiments. Indirect cost are **allocated to** experiments in such a way that each experiment receives an appropriate share of all indirect costs. The rationale for apportioning an indirect cost such as utilities to each experiment lies in the fact that a research institute exists to conduct research. Experiments are the foundation of the research program and each must bear a part of the indirect costs. The allocation of indirect costs in INFORM follows standard accounting practices, described in textbooks on management accounting (Chadwick 1991).

How indirect costs are allocated depends on whether the outputs are all the same or all different. With identical outputs, each unit of output (a situation referred to as *process costing*) is allocated an equal share of the indirect costs. If a factory produces sugar, each kilogram produced is allocated an equal share of indirect costs. Where there are no identical outputs, such as in research where each experiment is different, another approach, known as *job costing*, is more appropriate. A good analogy from the private sector is the job of repairing a car. The customer is usually charged for parts and labor. The charge for labor (the mechanic's time) is always much higher than the direct cost of the mechanic (salary, benefits and allowances). The reason is that the company buries its indirect costs (overheads such as rent, utilities, advertising, etc.) in the costs of labor. The more time a mechanic spends on a job, the larger the share of total overhead costs allocated to that job. The key point is that each repair job is allocated a share of the indirect costs that is directly proportional to the time the mechanic spends on the job.

The same principle can be applied to research. INFORM allocates indirect costs to experiments in proportion to the time that all participating scientists allocate to the experiment. Suppose, for example, that the total supply budget of an institute is $50,000 and no data are available on how these costs are related to specific experiments. Supplies then have to be treated as an indirect cost.

If experiment *A* has a total of two person-years of researcher time (information obtained from the questionnaire) and if the total number of person-years allocated to research at the institute is 40 years, then experiment *A* is allocated 2/40 = 5% of the supply cost of $50,000 = $2,500.

This example shows that, up to a point, additional data may be collected for some cost items to allow them to be treated as direct rather than indirect costs. An institute may have a travel budget at the institute level without assigning it to experiments. During the year, the institute travel funds are used by the researchers without anyone really knowing how much is used by the different experiments. If this is the case, the institute director may select one of three options:

- The director may decide that more detail is needed and that henceforth estimates will be made of how much money each experiment needs for travel.

- The director may decide that this is too difficult (at least for the time being) and that the travel budget will be kept as a lump sum. Travel remains an indirect cost.

- The director may decide on an intermediate solution, whereby each program or department is assigned a travel budget. Travel is then an indirect cost within each program.

The INFORM approach is flexible and can handle both the simple and the complex budget situations. When an institute first develops INFORM, the analysis of the budget should be kept as simple as possible. After experience has been gained with a simple format (i.e., allocating several cost items to experiments in proportion to the research time), an attempt may be made to budget items such as supplies and travel in a more direct way; for example, to assign budgets for supplies, travel, etc., to departments or programs and to subsequently allocate these totals within the program or department.

A situation may occur where part of the cost included in a cost code will represent costs that can be allocated directly to experiments, but the balance has to be allocated using a formula. For example, an institute laboratory may keep records of the use of chemicals and other supplies for each experiment, while none of the other units of the institute records how supplies are used. Such a situation complicates calculations and requires more work. A rule of thumb is that sorting out these problems is only worth the extra work if at least 75% of the costs in an account code can be allocated directly to experiments. Otherwise it is better to consider all costs as indirect.

Institutes setting up INFORM for the first time are advised to consider most costs as indirect costs.

5.3 Personnel

The cost of researchers can be related to experiments on the basis of the information on time allocation provided in the questionnaire. Researchers, however, are a relatively small part of the personnel employed at any institute. Support staff and labor are usually much larger in numbers and their total cost may be much higher than the total cost of all researchers. Personnel can be divided into the following categories:

- researchers;
- technical support staff;
- administrative support and general services staff;
- labor.

There are some general points to consider regarding the classification and costing of personnel:

- Not all personnel costs can be traced to specific research activities. This is the reason why the different categories of support staff are differentiated. The accountant and the librarian, for example, serve the entire research institute and it is impossible to allocate their time to specific research activities. The same applies to security staff, cleaners and other general service support staff. Technical support staff (and sometimes labor) can — at least in principle — be related to research activities.

- Administrative support staff (accountants, secretaries, etc.) and general services staff (security staff, cleaners, etc.) are grouped together in INFORM because both categories serve the institute as a whole and are not involved in research activities. Sometimes, especially at large institutes, administrative support staff may be assigned to specific departments. In such a situation it is possible to calculate the cost of administrative support staff on a department-by-department basis, rather than for the institute as a whole. This is only worth the effort if **all** administrative staff costs can be traced to departments, which is usually not the case.

- Labor and support staff may or may not be regarded as different categories. At institutes where labor is on a different payroll than support staff, the director may wish to separate labor costs and support staff costs in INFORM.

The cost of different categories of personnel are assigned to different cost codes. Figure 5.1 presents a matrix with the relevant cost codes as columns and the personnel cost elements (secondary cost codes) as rows. The costs of researchers are allocated to different cost codes. The cost related to the time researchers spend on research is allocated to research personnel. The cost of the time they spend on extension and on training and teaching is allocated to technology transfer. Management and administration is a cost code made up of the costs of the researcher time allocated to these activities plus the total of the cost of administrative and general service support staff. The cost related to a researcher on full-time study is treated as a miscellaneous cost.

	COST CODES			
	RESEARCH PERSONNEL (100)	TECHNOL TRANSFER (500)	MANAG/ ADMIN (600)	MISCELL. (800)
RESEARCHER COST				
research	X			
extension		X		
teaching/training		X		
management/admin			X	
study				X
TECHNICAL SUPPORT STAFF COST	X			
ADMINISTRATIVE AND GENERAL SERVICES STAFF COST			X	
LABOR	X			

Figure 5.1. Relating personnel costs to cost codes

The following sections look at cost elements and discuss how personnel costs are calculated and how they are treated in INFORM.

5.3.1 The Cost of Researchers

The cost of researchers consists of their salary, benefits and allowances (SBA). There are two options in the calculation and use of researcher SBA

cost: (a) the use individual salaries or (b) the use the average cost for each grade of researcher. This means that **each researcher is assigned the average cost of all researchers in his/her grade.** If information on a researcher's grade is available, it is the preferred option because of the following:

- It reduces the number of different costs from the number of researchers to the number of grades, usually not more than four or five. This simplifies data entry and data checking.

- Using grade averages protects the privacy of researchers because their individual salaries do not appear in print.

- For planning and programming purposes, individual costs are less important than the cost per grade. Individual researchers may leave or be reassigned, while the position remains.

To calculate the average researcher SBA cost for each grade the following steps are required:

a. **Obtain the individual gross salary for each researcher.** For each scientist on the staff list, the salary is obtained from the payroll. Monthly salaries are converted to annual salaries.

b. **Add the cost of pension contributions and other personal allowances to the salary.** Researchers may receive various benefits, which may include the pension contribution that the institute or government pays for each researcher, an education allowance, a travel allowance and a cost-of-living allowance. At some institutes these benefits may be identifiable from the payroll. Some benefits, however, may not be handled by the institute at all; for example, the pension fund contribution is often handled by the central government and research institutes may not have it in their records. In that case, pension cost is included by adding an appropriate percentage to the researcher's salary. Pension fund contributions are usually the most important benefit. If the amount of other allowances is small, it may also be added to the researchers' salaries as a percentage.

c. **Calculate average gross salary and direct benefits for each grade (based on individual costs in steps a and b).** Instead of having an individual cost for each researcher, the number of different cost figures is reduced to the number of grades in the institute. An institute director (and his/her deputies) may be in a separate grade. Then, typically, a number of grades follow, such as principal research officer, senior

research officer and research officer. Actual names of grades may vary between institutes and countries. Often there is some confusion about recent graduates who, in some cases, have the status of a junior researcher and, in other cases, are considered support staff. Each institute has its own practice, and INFORM is flexible enough to handle different arrangements.

Once information is gathered on the gross annual salary, benefits and grade of the individual researchers, the average salary and benefit cost is easily calculated. By now most of the researcher cost is captured. There may, however, be some indirect costs that have been overlooked because they are not in the payroll or personnel administration but are in the institute's operational budget.

d. **Identify indirect benefits that accrue to researchers** (e.g., subsidized staff housing and utilities). The institute's operational budget may include costs that are best considered as part of researcher costs. These indirect costs can be substantial, especially if staff are housed at the institute and have their houses and utilities paid by the institute. It is possible to attribute expenditures such as housing maintenance, electricity and water to researcher cost. Often, however, an institute budget does not provide details on, for example, which part of the overall maintenance budget is used to maintain staff housing. In that case the institute accountant will normally be able to provide a reasonable estimate. Once all indirect benefits are identified, they are divided among the researchers.

e. **Add indirect benefits (step d) to the cost of a researcher on a grade-by-grade basis (step c) to determine the average total cost for each grade.** If the total amount of indirect benefits is small, it may be divided equally among all researchers. In cases where the indirect costs are substantial, a more refined approach may be to argue that senior staff, for example, have bigger houses and consume more electricity and that, therefore, a larger part of the indirect cost should be attributed to them. One may allocate these costs using a weighting system, where senior staff are allocated, for example, two times the amount of a junior researcher. **It is important to include all costs of salaries and benefits.**

The remainder of this section discusses the different components of the SBA and how each is related to the cost codes presented above.

Researcher research time. The time allocation questionnaire directly links researchers' time to experiments. The total cost of a researcher is attributed to experiments in proportion to the time allocated to each. If researchers

spend 25% of their time on an experiment, 25% of SBA cost is allocated to it in Research Personnel (110).

Researcher extension time. The researcher questionnaire provides information on the time a researcher works on extension activities, and the cost is proportional to the time. The cost is entered into Technology Transfer cost code 510.

Researcher training and teaching time. This cost is obtained from the questionnaire and calculated in the same way as the cost of research time. It is also entered into Technology Transfer cost code 520. Technology transfer costs are indirect costs, allocated to experiments using a formula based on the researcher's time as the allocation principle.

Researcher management and administration time. The time researchers allocate to management and administration is obtained from the questionnaire. The cost is calculated in the same way as that of research time and entered into Management and Administration cost code 610. This cost is allocated indirectly to experiments.

Study leave time. This information is also obtained from the questionnaire and entered into cost code 810 (Miscellaneous).

5.3.2 *Administrative and General Service Support Staff*

The total cost of all administrative support staff includes gross salaries, benefits and allowances and may include indirect benefits (housing, etc.)

Information on the cost of support staff is usually obtained from the same payroll that was used to get the researchers' salaries. As discussed in Chapter 2, support staff is classified either as administrative and general services, or as technical support. The costs of the two groups are entered into different cost codes: the cost of administrative and general services staff is part of Management and Administration costs (code 600), and technical support staff is considered part of research personnel (code 100).

5.3.3 *Technical Support Staff*

This category includes laboratory technicians, field technicians and technicians' assistants. It is important to note that technical support staff activities can, in principle, be traced to research operations. If information on technical support staff activities is available at the experiment level, it is a direct cost. If this data is not available, it has to be considered an indirect cost.

For some technical support staff (laboratory technicians, etc.), it is feasible to record their allocation of time to experiments in the same way as is done with researchers. Often, however, it turns out to be difficult in practice, for two reasons:

a. This would add a large number of people to the group that needs to complete the questionnaire, considerably increasing the amount of work.

b. Technicians and assistants are likely to spend small amounts of time on a large number of different activities. This makes the use of the questionnaire cumbersome, and data collection problems, with a lot of missing data, are likely.

If information on numbers and costs of technical support staff is available only for the institute as a whole, it may be allocated to experiments in proportion to the total researcher time allocated to the experiment. If technical support staff are linked to programs or departments, a somewhat more refined approach is to calculate the technical support staff cost for each program or department and then allocate these costs to experiments within the department.

As mentioned above, indirect costing of all technical support staff (and this applies to other operational costs, too) is best done in all situations where less than 75% of the support staff can be related directly to experiments.

5.3.4 Labor

The total labor cost is obtained from the payroll (maybe different from the one used for support staff). The cost of some laborers, e.g., field laborers, may be related directly to research activities. An agronomy program may have five laborers and 20 experiments, and it may be possible to link persons and costs to different experiments. Others, however, may be difficult to relate to research activities. Again, if less then 75% of the labor cost can be related directly to experiments, the cost should be allocated to experiments in proportion to the time that researchers allocate to experiments.

5.4 Materials and Supplies

The cost of materials and supplies includes items related directly to research (animals, seed, fertilizer, glassware, etc.) and research support materials (stationary, office supplies, etc.). The cost code manual (Part 3 of these guidelines) provides detailed cost codes under code 200. In principle, some of the costs of research materials (e.g., fertilizer) could be available for each experiment, but research support materials, such as office supplies are

indirect costs. When INFORM is established for the first time, it is probably wise to consider all materials and supplies as indirect costs.

5.5 Travel and Transport

The Travel and Transport cost code (300) includes all costs related to mobility. It includes the cost of tickets, per diem, vehicle operation and maintenance, and the cost of transport or haulage. Although some of these costs can be traced to experiments, many research institutes will have the information only for the institute as a whole. In most cases this will be considered an indirect cost.

5.6 Repairs and Maintenance

Costs of repairs and maintenance (code 400) may be separated into two groups. The first includes those related to the repairs and maintenance of the physical plant (code 410), such as buildings (office, laboratory and housing), infrastructure (roads, bridges, canals, etc.) and utilities. The second (code 420), includes repairs and maintenance of research equipment (laboratory equipment, agricultural machinery, etc.).

Physical plant costs (code 410) cannot be directly related to research activities, and a formula is used to allocate them. Repair costs for research equipment may or may not be available for individual experiments. A standard figure for repairs is often put against each piece of expensive equipment. Small, inexpensive pieces of equipment are best considered as indirect costs.

5.7 Technology Transfer

Technology Transfer costs (code 500) include both personnel and nonpersonnel costs. The personnel costs included in this cost code are listed below:

- the cost related to the researcher's time spent on extension activities (code 510);
- the cost related to the researcher's time spent on teaching or training (code 520);
- the cost of support staff engaged on a full-time basis in extension, training, publications and promotion activities may also be added to codes 510, 520 or 530.

Nonpersonnel costs include the following:

- the cost of publications: editing, printing, and publishing (code 540) (if substantial, this may be divided into technical publications, traceable to specific research projects, and general publications, such as annual reports);

- the cost of activities, such as field days, workshops and conferences, and the cost of memberships of and subscriptions to local or international organizations (code 560);

- Promotional activities, such as publicity and hospitality may be included in this cost code (550) or under miscellaneous costs (code 800).

Again, by nature, few of these costs can be directly related to individual research experiments. In practice they are considered to be indirect costs.

5.8 Management and Administration

Management and Administration (code 600) includes the following secondary codes:

- the cost related to the time that researchers spend on management and administration activities (code 610);

- the cost of the administrative support and general service staff (code 620);

- the costs related to governance (board of governors, etc.) (code 630);

- where applicable, the cost of departmental support to the institute is entered in code 640. This situation occurs, for example, where a division or section in the Department of Agriculture headquarters handles most of the administration of its research institutes. The easiest way to handle this is to add a small percentage as departmental overhead cost to each experiment.

Management and administration are indirect costs, allocated to research activities.

5.9 Utilities and Facilities

Utilities and Facilities costs (code 700) are overhead, which can form a substantial part of an institute's budget. These are indirect costs allocated to experiments.

5.10 Miscellaneous

The 800 code includes all costs not covered under any of the codes listed above:

- It includes some personnel costs: the SBA costs related to staff away on study leave for degree training (code 810).

- It also includes miscellaneous costs such as those for telecommunications, insurance, legal and audit fees, bank charges, etc. A detailed list of costs that may be included is provided in Part 3 of these guidelines.

6 Database Formats

The INFORM process has two stages:

a. First, a budget is developed and qualitative information is provided on discipline, commodity, etc., for each experiment.

b. The second stage consists of building up the budget in ways that provide information to research managers. The budget can be built up by any of the descriptors attached to the experiments: commodity, discipline, research themes, location, etc.

The tool used for disaggregation and aggregation of information is a microcomputer database program. A general description of the use of database programs is provided in this chapter (building a database and generating outputs from it). Because there are differences in the characteristics and use of microcomputer database software, only general aspects are discussed.

ISNAR used a software package called Reflex* for database construction, data entry, and output generation for INFORM. This software was selected for its ease of learning and use, especially for the ease with which printed tables and graphs can be generated for presentation to senior research managers. It is not essential to use Reflex for INFORM; any other database software may be used. The general discussion of database matters in the following sections may be used as guidelines by those who use a database program other than Reflex.

6.1 INFORM Databases

Database programs break up information into **records** and **fields**. A *record* is the case or the unit of analysis on which information is presented. If, for example, one library card is maintained for each borrower, every borrower is a record in the library's database. The *fields* or *variables* refer to the information contained on card: title of book, date borrowed, etc.

In the INFORM system, information is collected on **researchers** and on **experiments**. Therefore, two databases are built: one where each individual researcher is a record or case (the personnel database) and one where

*Reflex (version 2.0), Borland International, Inc., 1989.

information is presented on each experiment (the project or experiment database). Some of the information discussed in the previous chapters is entered in only one of the two databases; other information is shared by both databases.

The personnel database contains information on the following:

- biographical data (Chapt. 3);
- scientists' time allocation to research and nonresearch activities (management and administration, training or teaching, extension and study);
- The title of, and the time allocated to, each experiment in which the researcher participates, the total of which adds up to the research time allocation mentioned above;
- salary, benefit and allowance (SBA) costs of the researchers' activities (the total SBA cost of a researcher is distributed to activities in proportion of the time spent on each of these activities);

The project or experiment database contains information on the following:

- research program content (see Chapter 4);
- the names of all researchers participating in the experiment and the time that each of them spends on the experiment;
- the cost of each researcher participating in the experiment;
- the cost of support staff and labor;
- operational costs and overhead costs, such as travel, supplies, maintenance, utilities, management and administration, etc.

Biographical information is unique to the personnel database, and information on research program content is entered only in the project database. Costs other than researcher costs are entered only in the project file. Information on researchers' time allocation and the cost of researchers' participation in experiments is shared between the personnel and the project database. This sharing of information can be achieved in several ways.

Simple, so-called *flat-file*, database programs require shared data to be entered separately in each database. When using such a program (Reflex and

PCfile are examples), two different database files are created with the shared information entered into each of them.

Programmable relational database programs (such as dBASE and Paradox) allow several files to be linked so that information may be entered only once. These programs are, however, more difficult to learn and use. When creating INFORM using a relational database, three files are set up. The first contains researcher biodata, the second file contains program content data and the third contains researcher names, experiment titles or numbers, time allocations and researcher costs. Researcher name and experiment title or number would be designated the *key fields* that link the three files together.

Research institutes with considerable experience in the use of relational database programs may wish to develop INFORM using such programs. In any case, database files created in Reflex (or any other comparable program) can easily be converted to relational database programs.

In the following sections, information on personnel and experiments is presented using printed database forms from a fictitious agricultural research institute (ARI) to summarize all the information from one record on a page. The forms presented were derived using Reflex. The field type is indicated with the description. The two most important field types are

- text fields, for entering words;
- numeric fields, for entering numbers.

Both text fields and numeric fields can either be data-entry fields or calculated fields. Data-entry fields are typed at the keyboard. Calculated fields depend upon a formula. Example: one may create a field called DURATION which is calculated by the database program as the difference between the END year and the START year (DURATION = END – START). END and START are data-entry fields entered from the keyboard. Once this is done the DURATION field is calculated by the database program.

A calculated field can also be a constant; this avoids having to enter data for fields that do not change. The name of the institute and the current financial year are fields that remain the same for the entire file. The conventions for entering a constant field differ from program to program.

6.2 The Personnel Database

In the personnel database, each researcher is a record or case. Table 7.1, for example, provides a sample personnel form for H. J. Chaudry, a staff member

at ARI. The form presents all the fields (variables) on one researcher on one page. The fields, which are followed by a colon, are discussed below:

NAME:	A text field with the researcher name.
INITIALS:	A text field with initials or other name.
ID:*	Researcher ID number—used at big institutes where there are double or similar names. (This is a numeric field.)
CENT INST:	A constant with the name of the research center or institute.
ORGANIZATION:	A constant with the name of the parent organization.
TITLE:	The title of the researcher position. (This is a text field.)
CLASS:	A text field with the grade or class.
FIRSTAPPTYEAR:	A numeric field with the year of first appointment to the civil service or the research institute.
PRESAPPTYEAR:	A numeric field with the year of appointment to the current post.
BIRTHYEAR:	A numeric field.
SEX:	M or F.
HIDEGREE:	The highest academic degree obtained (text field).
UNIV:	University where above degree was obtained.
SUBJECT:	Subject of highest degree.
COUNTRY:	Country where highest degree was obtained.
YEAR:	Year when highest degree was obtained (numeric).
STUDNOW?:	Yes (Y) or no (N) answer to the question whether the researcher is away on study leave.
EXPDEGREE:	The expected degree when the answer to the above question is positive; the present degree if the person is not on study leave.
SUBJECT?:	The subject of study. Blank if the person is not studying.
TOPIC:	A field to indicate recent short-term training. The subject or topic is entered as a text field.
INSTIT:	The institute where the short-term training took place.

*Not used in the sample form in Table 7.1.

WEEKS:	The number of weeks of the short-term training activity in which the researcher participated.
DISCIPLINE:	The researcher's discipline.
MAIN CROP:	The commodity group on which the researcher works.
SCISBA:	The amount of the **SCI**entists **S**alary, **B**enefits and **A**llowances — a numeric field.
RESTIME:	The total of the researcher's time allocated to research experiments, expressed as a percentage of a work year. This should be equal to the total time of all experiments.
RESCOST:	The cost of the researcher's total research time. This is a calculated field, the formula of which is RESCOST = (RESTIME * SCISBA) / 100 Dividing by 100 is necessary if the time is expressed as a percentage.
MGTTIME:	The time that a researcher allocates to management and administration expressed as a percentage of a work year.
MGTCOST:	The cost of the researcher's time allocated to management and administration. The formula is MGTCOST = (MGTTIME * SCISBA) / 100
TRAINTIME:	The time allocated to training or teaching expressed as a percentage of a work year.
TRAINCOST:	The cost of training and teaching: TRAINCOST = (TRAINTIME * SCISBA) / 100
EXTTIME:	Researcher's time allocated to extension activities.
EXTCOST:	The cost of extension: EXTCOST = (EXTTIME * SCISBA) / 100
STUDTIME:	The time the researcher is away on long-term study leave (not short-term training).
STUDCOST:	STUDCOST = (STUDTIME * SCISBA) / 100
TOTTIME:	TOTTIME = RESTIME + MGTTIME + TRAINTIME + EXTTIME + STUDTIME This field is used for checking purposes. The result must equal 100.

NO1 – NO15:*	Experiment ID numbers for all experiments in which the researcher participates. In a flat-file database, a (numeric) field for each experiment has to be created. Fifteen experiments per researcher are usually sufficient.
TIME1 – TIME15:	Time as a percentage of a work year allocated to each experiment in which the researcher participates (numeric).
PROJ1 – PROJ15:	The title of each experiment in which the researcher participates (text field).

6.3 The Project (Experiment) Database

Table 7.3 provides a sample project summary form that has all the information on one particular research activity at ARI: Alley Cropping. All field names on the form are preceded by a colon, and information regarding the Alley Cropping project follows the colon. Below is a brief description of each field. Remember that each individual experiment in the project or experiment database is a *record* or *case*, and the characteristics of the experiment are the *fields* or *variables*.

CENT INST:	A constant text field with the abbreviated name of the institute.
ORGANIZATION:	The parent body to which the institute belongs (constant text field).
FY:**	The current financial year (numeric constant).
TITLE:	A text field with the title of the activity.
ID:	A numeric field with the identification number of the research activity.
START:	A numeric field with the starting year.
END:	Expected year of completion (numeric field).
OBJECTIVES:	A long text field.
MAIN CROP:	Text field.
OTHER CROPS:	Text field.
COMMODITY GROUP:	Text field.
DISCIPLINE:	Text field.

* Not used in the sample form in Table 7.1.
**Not used in Table 7.3.

DEPT DIVN:	Department, Division (or Program) (text field).
SEASON:	Text field.
LOCATION:	Text field.
CARIS1:	The main CARIS research theme (text field).
CARIS2:	The secondary CARIS theme (text field).
CARIS CODE:	The CARIS code (text field).
KEYWORDS:	Text field.
PEST DISEASE:	This field lists any pest, disease, pathogen or biological control agent that the experiment deals with. It is left blank where it does not apply (text field.)
LINKAGES:	Text field to indicate funding or technical cooperation institutions.
SCI1 – SCI5:	Name and initials of the first to the fifth researcher participating in an experiment. The number of researchers per experiment will have to be determined beforehand when using a flat database (a field has to be created for each name). In a relational database program, the number of researchers per experiment is unlimited (text field).
TIME1 – TIME5:	The percentage of a work year that the first to the fifth participating researchers spend on this research experiment. This is a numeric field where 40 indicates that 40% of a work year is spent on the activity.
SCITIME:	A calculated, numeric field that represents the sum of the times of the individual researchers. The formula is SCITIME = TIME1 + TIME2 + TIME3 + TIME4 + TIME5
SCISBA1 – SCISBA5:	The SCIentist Salary Benefits and Allowances for the first to the fifth scientist. This represents the total cost of each researcher, which is allocated to experiments based on the time allocated to the experiment by each researcher. The formula is discussed below (numeric field).
SCICOST1– SCICOST5:	A calculated numeric field representing the cost of a researcher's participation in an experiment. The formula is different for each of the five scientists, e.g., SCICOST2 =(SCISBA2 • TIME2) / 100

Dividing by 100 is necessary if time is expressed in percentage (40), but not if it is expressed as a fraction (0.4).

SCICOST: A calculated field that represents the sum of the costs of all scientists participating in an experiment. The formula is

SCICOST = SCICOST1 + SCICOST2
+ SCICOST3 + SCICOST4
+ SCICOST5

TECHCOST: The technical support staff cost of an experiment. This may be a direct entry or a calculated field, depending on data availability. If no direct estimates are available at the experiment level, the total amount of technical support staff may be allocated to experiments using the formula discussed in Chapter 5. Using scientists' time as a basis to allocate this cost, the formula is

TECHCOST = (SCITIME / total research time at institute) • total cost of technical support staff

Total research time may be obtained from the personnel or experiment file; total cost of technical support staff is obtained from the budget.

LABCOST: The labor cost of an experiment. If no direct cost data are available at the experiment level, a similar formula to the one discussed above may be used:

LABCOST = (SCITIME / total research time) • total labor cost

MATERIALS: The cost of materials and supplies. If no direct costs are available, the following formula is used:

MATERIALS = (SCITIME / total research time) • total cost of materials and supplies

TRANSPORT: The cost of travel and transport of an experiment. The formula that may be used if no direct cost figures are available is

TRANSPORT = (SCITIME / total research time) • total cost of transport and travel

REPAIRS: The cost of repairs and maintenance. Few institutes will budget this cost for each experiment; hence, a formula will normally be used to allocate the cost:

REPAIRS = (SCITIME / total research time) • total cost of repairs and maintenance

TRANSFER: The total cost of technology transfer is derived from the budget. It is a mixture of researcher costs (scientists' time allocated to extension and training) and nonpersonnel costs (e.g., publications). The formula used to allocate this cost is

TRANSFER = (SCITIME / total research time) • total cost of technology transfer

MANAGEMENT: The cost of management and administration is all personnel costs (scientists' time allocated to management and administration and the cost of administrative support staff). The formula is

MANAGEMENT = (SCITIME / total research time) • total cost of management and administration

UTILITIES: The cost of utilities and facilities. This is an overhead cost that has to be allocated to experiments. The formula is

UTILITIES = (SCITIME / total research time) • total cost of utilities and facilities

MISCELLANEOUS: This is an overhead cost that includes those costs that cannot be classified in the above categories plus the cost of a researcher being away on study leave. This cost is always allocated to experiments using a formula:

MISCELLANEOUS = (SCITIME / total research time) • total cost under miscellaneous

TOTALCOST: A calculated field representing the total cost of the experiment. The formula is

TOTALCOST = SCICOST + TECHCOST + LABCOST + MATERIALS + TRANSPORT + REPAIRS + TRANSFER + MANAGEMENT + UTILITIES + MISCELLANEOUS

7 Answering Research Managers' Questions

Chapter 1 indicated the type of question that an institute director, planner, or policymaker might want to ask. This final chapter provides some examples of the answers that INFORM, using the methods and procedures discussed in the previous chapters, can give. A more detailed presentation of the different uses of INFORM is provided in Part 1 of these guidelines. The design of the tables, forms, and graphs is discussed in the INFORM training materials.

The following sections relate different outputs of the two databases to specific questions, using data from a fictitious Agricultural Research Institute (ARI).

7.1 Information on Personnel

Different types of questions can be answered using the personnel database:

- The **personnel form** presented in Table 7.1 is an example of a simple form that can be useful to a director of a research institute. It is a convenient format to provide the director with information for each researcher. It answers questions on the individual researcher's work program, education, recent training, etc. Dr. Chaudry's form, presented in Table 7.1, shows that he spends a quarter of his time on varietal evaluation for grain moth in rice. The director may use this information to find out what results this researcher can show for the time spent on this experiment. The director may also use this information to query the logic and consistency of individual researcher's work programs.

- **Table 7.2,** generated from the personnel database, provides the ARI director with an overview of the main activities of all his researchers and the corresponding costs. It answers questions about how many of the staff's work years are dedicated to research, management or administration, extension, and training or teaching. The table shows, for example, that out of 17 person-years available, 12.6 are allocated to research, 2.8 are spent on management and administration, 0.25 are allocated to train-

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Table 7.1. Sample Personnel Information Form

```
                                ARI 1990

NAME:  CHAUDRY      INITIALS:   HJ              ORGANIZATION: DEPT.AGRIC
                              CENT INST:        ARI

TITLE: RO
CLASS: I   PRESAPPTYEAR:        74                BIRTHYEAR:      31
           FIRSTAPPTYEAR:       59                SEX:             M

EDUCATION
HIDEGREE:  P        UNIV:       HYDERABAD         COUNTRY:   INDIA
                    SUBJECT:    AGRONOMY          YEAR:      55

STUDNOW?:  N        EXPDEGREE:  P               SUBJECT?:

SHORT-TERM TRAINING
TOPIC: PLANT PROTECTION
       INSTIT:      THAILAND                    WEEKS: 1       YR1: 85

RESEARCH FOCUS
MAIN DISCIPLINE:    BREED/GEN                   MAIN CROP:     RICE

TIME ALLOCATIONS AND COSTS
SCISBA:3772
                                  RESTIME:     80     RESCOST:  3018
                                  MGTTIME:     20     MGTCOST:   754
                                  TRAINTIME:          TRAINCOST:   0
                                  EXTTIME:            EXTCOST:     0
                                  STUDTIME:           STUDCOST:    0
                        TOTIME:               100

RESEARCH:
TIME1:   5   PROJ1:   COORDINATED VARIETAL TRIAL OF RICE
TIME2:  20   PROJ2:   RESIDUAL EFFECTS OF P AND K IN DRY SEASON
TIME3:  25   PROJ3:   RICE - VARIETAL EVALUATION FOR GRAIN MOTH
TIME4:  15   PROJ4:   RICE - GERMPLASM EVALUATION
TIME5:  10   PROJ5:   RICE - COMPUTER MODEL FOR PESTS
TIME6:   5   PROJ6:   HYBRID RICE VARIETAL TRIAL
TIME7:       PROJ7:
TIME8:       PROJ8:
TIME9:       PROJ9:
TIME10:      PROJ10:
TIME11:      PROJ11:
TIME12:      PROJ12:
TIME13:      PROJ13:
TIME14:      PROJ14:
TIME15:      PROJ15:
```

Table 7.2. Scientists at ARI, 1990 — By Activity and Cost

page: 1

NAME	INITIALS	RESEARCH TIME	RESEARCH COST	MANAGEMENT TIME	MANAGEMENT COST	TRAINING TIME	TRAINING COST	EXTENSION TIME	EXTENSION COST	FULL-TIME STUDY TIME	FULL-TIME STUDY COST	SBA SCIENTISTS	TIMECHECK
ALAM	MS	85	1595	15	282		0		0		0	1877	100
BANDARA	C	80	1502	20	375		0		0		0	1877	100
CHAUDRY	HJ	80	3018	20	754		0		0		0	3772	100
DANAO	C	90	1689	10	188		0		0		0	1877	100
HOSSAIN	MA	90	2732	10	304		0		0		0	3036	100
KARIM	A	90	2732	10	304		0		0		0	3036	100
LIU	L	40	1509	40	1509	20	754		0		0	3772	100
MEHTA	V	95	2884	5	152		0		0		0	3036	100
PANDA	N	90	2732	10	304		0		0		0	3036	100
RAO	K	0	0	100	4140		0		0		0	4140	100
SINGH	RP	80	2429	20	607		0		0		0	3036	100
SISON	P	80	1502	0	0		0	20	375		0	1877	100
SOETOPO	R	80	3018	20	754		0		0		0	3772	100
SUBRAMANIAN	P	0	0	0	0		0		0	100	3036	3036	100
THAVEETHAI	S	100	3036	0	0		0		0		0	3036	100
VIRULRAK	C	100	3036	0	0		0		0		0	3036	100
ZADOKS	JC	80	1502	0	0	5	94	15	282		0	1877	100
		1260	34916	280	9672	25	848	35	751	100	3036	49129	1700

SBA = Salaries, Benefits & Allowances

ing and teaching, and 0.35 is given to extension, while 1 person is on full-time study leave.

ARI is a small institute, so names have simply been printed in alphabetical order. It is also possible to sort the names and print them by department or program, with subtotals for each. This is especially useful at large institutes — it allows the director to review activities on a program-by-program basis and to compare programs.

- Reflex (as well as some other database programs) allow a variety of **graphs and charts** to be produced directly from the source data. Such graphs are useful for highlighting specific characteristics of the pool of researchers at the institute. The graph presented as Figure 7.1 illustrates the mix of researchers with different academic degrees. At large institutes, it is very useful to produce this information, not only for the institute as a whole but for each of the programs. This will help the director identify training needs for specific programs and disciplines. Similarly, tables may be produced showing the age distribution of researchers in specific programs, highlighting where there will be losses of staff from retirement and where recruitment and or training will be needed.

Additional examples of the use of information from the personnel database are presented in Part 1 of these guidelines.

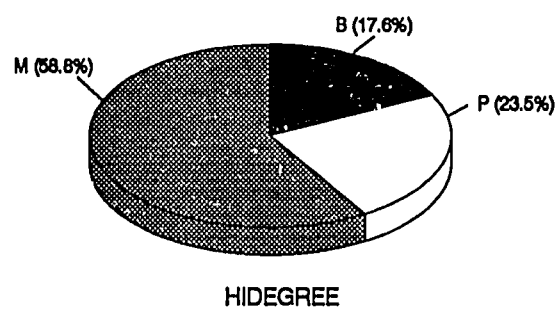

Figure 7.1. Researchers at ARI, 1990, by highest academic degree (B = BSc, M = MSc, P = PhD)

7.2 Information on the Research Program

The project database can be used to create forms, tables, and graphs that will provide answers for different kinds of questions.

- The **project form**, included here as Table 7.3, presents the research manager with all the information on a specific research activity, conveniently printed on a single page. The form for the "Alley Cropping" project at ARI allows the director to review substantive aspects of the project as well as the human resource and financial aspects. It tells the director who is involved in the project and for how much of their time. If a director needs to know which projects should be near completion he/she will filter the database to produce a subset of projects that have the current year as their END year in the database.

- The **participation of researchers in all research projects** is summarized in Table 7.4. This table not only shows who is involved in specific activities, it also sorts the projects by department and prints subtotals for each. It shows the director, for example, that the grainlegumes program at ARI has 5 projects, involving 4 different researchers for a total of 3.0 person-years.

- The **cost of research projects** is summarized in Table 7.5. It shows the cost of each project broken down into a number of cost components. It also shows subtotals of cost for each department. (The table could easily be sorted by each discipline, region, or any other descriptor included in the project database, and reprinted with subtotals each.) If the director wishes to see which projects are particularly costly, he could look at Table 7.6, which presents the project list sorted by total cost in descending order.

- At large institutes, tables such as those discussed above run into many pages and may become hard to interpret. Additional information summarizing key aspects in **graphs or charts** is then essential. Figure 7.2 shows the total cost of research by department. Similar graphs can be produced to answer questions about the allocation of resources to disciplines, stations, or themes.

Again, other types of outputs, answering different questions, are presented in Part 1 of these guidelines.

Table 7.3. Sample Project Summary Form

```
                    CENT INST: ARI 1990
                ORGANIZATION: DEPT.AGRIC.
-------------------------------------------------------------------------
TITLE: ALLEY CROPPING                                          ID:    110
                                                               START:  88
                                                               END:    90
-------------------------------------------------------------------------
OBJECTIVES: TO ASSESS THE IMPACT OF DIFFERENT PLANTING DISTANCES AND
FERTILIZER PRACTICES ON THE YIELDS OF BOTH MAIZE AND GLYRICIDIA WHEN
THE TWO CROPS ARE GROWN IN AN ALLEY CROPPING SYSTEM
-------------------------------------------------------------------------
MAIN CROP:  GLYRICIDIA                    OTHER CROPS:   MAIZE
COMMODITY GROUP:  FORESTRY

DISCIPLINE: AGRONOMY                      DEPT DIVN:     AGROFORESTRY
SEASON:P                                  LOCATION:      MAIN
-------------------------------------------------------------------------
CARIS1:FORESTRY                           CARIS CODE:    F08
CARIS2:AGROFORESTRY
KEYWORDS:   ALLEY CROPPING, SPACING, PLANTING DATE,
            INORGANIC FERTILIZERS, INTERCROPPING.

PEST DISEASE:
LINKAGES:
-------------------------------------------------------------------------
SCIENTIST          TIME                SALARY          SCIENTIST COST

SCI1:  PANDA N      30      SCISBA1:    3036      SCICOST1:      911
SCI2:  ZADOKS JC    30      SCISBA2:    1877      SCICOST2:      563
SCI3:                       SCISBA3:              SCICOST3:        0
SCI4:                       SCISBA4:              SCICOST4:        0
SCI5:                       SCISBA5:              SCICOST5:        0
                                                  --------------------
       SCITIME:     60                             SCICOST:      1474

                                                  TECHCOST:      198
                                                  LABCOST:      1238
                                                  --------------------
                            TOTAL RESEARCH PERSONNEL            2910

                                                  MATERIALS:     262
                                                  TRANSPORT:     119
                                                  REPAIRS:       143
                                                  TRANSFER:      119
                                                  MANAGEMENT:   1519
                                                  UTILITIES:     395
                                                  MISCELLANEOUS: 192
                                                  TOTALCOST:    5659
```

Table 7.4. Research Projects at ARI, 1990 — By Scientist Participation

page: 1

PROJECT TITLE	NAME	TIME	NAME	TIME	NAME	TIME	NAME	TIME	NAME	TIME	TOTAL STAFF TIME (in % of year)	
ALLEY CROPPING	PANDA N	30	ZADOKS JC	30							60	
FUELWOOD TREES	PANDA N	10	ZADOKS JC	15							25	
HOME GARDEN AGROFORESTRY	PANDA N	40	ZADOKS JC	15							55	
NITROGEN FIXATION EFFECTS OF LEUCAENA	PANDA N	10	ZADOKS JC	20							30	
SUBTOTAL FOR AGROFORESTRY												170
EFFECTS OF SPACING AND CULTURAL PRACTICES ON YIELD OF BANANA	HOSSAIN MA	20	THAVEETHAI S	20							40	
MANGO COLLECTION & EVALUATION	HOSSAIN MA	10	THAVEETHAI S	10							20	
MANGO FERTILIZER TRIAL	HOSSAIN MA	20	THAVEETHAI S	20							40	
MANGO FLOWER INDUCING HORMONES	HOSSAIN MA	20	THAVEETHAI S	20							40	
PASSIONFRUIT EVALUATION	HOSSAIN MA	20	THAVEETHAI S	30							50	
SUBTOTAL FOR FRUITS												190
GROUNDNUT — EPIDEMIOLOGICAL STUDIES OF RUST	MEHTA V	95									95	
SOYBEAN — BREEDER SEED & SEED MULTIPLICATION	VIRULRAK C	25	SINGH RP	20							45	
SOYBEAN — GERMPLASM SELECTION & EVALUATION	VIRULRAK C	15	SINGH RP	40							55	
SOYBEAN — HYBRIDIZATION & BREEDING LINES	VIRULRAK C	20	SINGH RP	10							30	
SOYBEAN — ON FARM SELECTION TRIALS	VIRULRAK C	40	SINGH RP	10	DANAO C	25					75	
SUBTOTAL FOR GRAINLEGUMES												300

Table 7.4. Research Projects at ARI, 1990 — By Scientist Participation

page: 2

PROJECT TITLE	NAME	TIME	NAME	TIME	NAME	TIME	NAME	TIME	NAME	TIME	TOTAL STAFF TIME (in % of year)	
COORDINATED VARIETAL TRIAL OF RICE	SOETOPO R	10	CHAUDRY HJ	5							15	
FERTILIZER TRIAL 1	SOETOPO R	10									10	
FERTILIZER TRIAL 2	SOETOPO R	10									10	
FERTILIZER TRIAL 3	SOETOPO R	10									10	
HYBRID RICE VARIETAL TRIAL	SOETOPO R	10	CHAUDRY HJ	5	DAHAO C	40					55	
RESIDUAL EFFECTS OF P AND K IN DRY SEASON ON PADDY RICE IN WET SEASON	CHAUDRY HJ	20									20	
RICE — COMPUTER MODEL FOR PESTS	KARIM A	40	BANDARA C	50	CHAUDRY HJ	10					100	
RICE — INSECTICIDE SCREENING FOR LEAF FOLDER	KARIM A	40	BANDARA C	20	LIU L	10					70	
RICE — VARIETAL EVALUATION FOR GRAIN MOTH	KARIM A	10	BANDARA C	10	CHAUDRY HJ	25	DAHAO C	25			70	
RICE GERMPLASM EVALUATION	SOETOPO R	10	CHAUDRY HJ	15							25	
RICE SPACING TRIAL 1	SOETOPO R	10									10	
RICE SPACING TRIAL 2	SOETOPO R	10									10	
SUBTOTAL FOR RICE												405
CHILLI — FERTILIZER RESPONSE	SISON P	10	ALAM MS	20							30	
CHILLI — INSECTICIDE SCREENING FOR POD BORER	SISON P	20	LIU L	10							30	
CHILLI — INTERCROPPING	SISON P	10	ALAM MS	5							15	
CHILLI — NARROW LEAF DISEASE STUDY	ALAM MS	60	LIU L	20							80	
SOYBEAN — EVALUATION VEGETABLE TYPE	SISON P	20									20	
VEGETABLE SEED PRODUCTION	SISON P	20									20	
SUBTOTAL FOR VEGETABLES												195
TOTAL STAFF YEARS IN ALL RESEARCH PROJECTS (x 100)												1260

Table 7.5. Research Projects at ARI, 1990 — By Program and Project Cost

page: 1

PROJECT TITLE	SCIENTIST RESEARCH	TECHN. SUPPORT	LABOR COST	MATERIALS /SUPPLIES	TRANSPORT /TRAVEL	REPAIRS /MNTNCE	TECHNOL. TRANSFER	MANAGE-MENT	UTILITIES /FACILITIES	MISCEL-LANEOUS	TOTAL
ALLEY CROPPING	1474	198	1238	262	119	143	119	1519	395	192	5659
FUELWOOD TREES	585	82	516	109	50	60	50	633	165	80	2329
HOME GARDEN AGROFORRSTRY	1496	181	1135	240	109	131	109	1392	362	176	5332
NITROGEN FIXATION EFFECTS OF LEUCAENA	679	99	619	131	60	71	60	759	198	96	2772
SUB-TOTAL FOR AGROFORESTRY	4234	560	3508	742	337	405	338	4303	1120	545	16092
EFFECTS OF SPACING AND CULTURAL PRACTICES ON YIELD OF BANANA	1214	132	825	175	79	95	80	1013	263	128	4005
MANGO COLLECTION & EVALUATION	607	66	413	87	40	48	40	506	132	64	2002
MANGO FERTILIZER TRIAL	1214	132	825	175	79	95	80	1013	263	128	4005
MANGO FLOWER INDUCING HORMONES	1214	132	825	175	79	95	80	1013	263	128	4005
PASSIONFRUIT EVALUATION	1518	165	1032	218	99	119	99	1266	329	160	5006
SUBTOTAL FOR FRUITS	5768	626	3921	829	377	452	378	4810	1252	609	19022
GROUNDNUT — EPIDEMIOLOG-ICAL STUDIES OF RUST	2884	313	1960	415	188	226	189	2405	626	304	9511
SOYBEAN — BREEDER SEED & SEED MULTIPLICATION	1366	148	929	196	89	107	89	1139	296	144	4505
SOYBEAN — GERMPLASM SE-LECTION & EVALUATION	1670	181	1135	240	109	131	109	1392	362	176	5506
SOYBEAN — HYBRIDIZATION & BREEDING LINES	911	99	619	131	60	71	60	759	198	96	3003
SOYBEAN — ON FARM SELEC-TION TRIALS	1987	247	1548	327	149	179	149	1899	494	240	7219
SUBTOTAL FOR GRAINLEGUMES	8818	989	6190	1310	595	714	596	7594	1976	961	29744

Table 7.5. Research Projects at ARI, 1990 — By Program and Project Cost

page: 2

PROJECT TITLE	SCIENTIST RESEARCH	TECHN. SUPPORT	LABOR COST	MATERIALS /SUPPLIES	TRANSPORT /TRAVEL	REPAIRS /MNTNCE	TECHNOL. TRANSFER	MANAGE-MENT	UTILITIES /FACILITIES	MISCEL-LANEOUS	TOTAL
COORDINATED VARIETAL TRIAL OF RICE	566	49	310	65	30	36	30	380	99	48	1612
FERTILIZER TRIAL 1	377	33	206	44	20	24	20	253	66	32	1075
FERTILIZER TRIAL 2	377	33	206	44	20	24	20	253	66	32	1075
FERTILIZER TRIAL 3	377	33	206	44	20	24	20	253	66	32	1075
HYBRID RICE VARIETAL TRIAL	1317	181	1135	240	109	131	109	1392	362	176	5153
RESIDUAL EFFECTS OF P AND K IN DRY SEASON ON PADDY RICE IN WET SEASON	754	66	413	87	40	48	40	506	132	64	2149
RICE — COMPUTER MODEL FOR PESTS	2530	330	2063	437	198	238	199	2531	659	320	9505
RICE — INSECTICIDE SCREENING FOR LEAF FOLDER	1967	231	1444	306	139	167	139	1772	461	224	6850
RICE — VARIETAL EVALUATION FOR GRAIN MOTH	1904	231	1444	306	139	167	139	1772	461	224	6786
RICE GERMPLASM EVALUATION	943	82	516	109	50	60	50	633	165	80	2687
RICE SPACING TRIAL 1	377	33	206	44	20	24	20	253	66	32	1075
RICE SPACING TRIAL 2	377	33	206	44	20	24	20	253	66	32	1075
SUB-TOTAL FOR RICE	11866	1335	8357	1768	804	964	805	10252	2668	1297	40116
CHILLI — FERTILIZER RESPONSE	563	99	619	131	60	71	60	759	198	96	2656
CHILLI — INSECTICIDE SCREENING FOR POD BORER	753	99	619	131	60	71	60	759	198	96	2845
CHILLI — INTERCROPPING	282	49	310	65	30	36	30	380	99	48	1328
CHILLI — NARROW LEAF DISEASE STUDY	1881	264	1651	349	159	190	159	2025	527	256	7461
SOYBEAN — EVALUATION VEGETABLE TYPE	375	66	413	87	40	48	40	506	132	64	1770
VEGETABLE SEED PRODUCTION	375	66	413	87	40	48	40	506	132	64	1770
SUBTOTAL FOR VEGETABLES	4229	643	4024	851	387	464	388	4936	1285	625	17831
TOTALS	34916	4152	26000	5500	2500	3000	2505	31896	8300	4036	
										GRAND TOTAL	122805

Table 7.6. Research Projects at ARI, 1990 — By Project and Total Cost

TOTAL PROJECT COST (in descending order)	PROJECT TITLE
9511	GROUNDNUT – EPIDEMIOLOGICAL STUDIES OF RUST
9505	RICE – COMPUTER MODEL FOR PESTS
7461	CHILLI – NARROW LEAF DISEASE STUDY
7219	SOYBEAN – ON FARM SELECTION TRIALS
6850	RICE – INSECTICIDE SCREENING FOR LEAF FOLDER
6786	RICE – VARIETAL EVALUATION FOR GRAIN MOTH
5659	ALLEY CROPPING
5506	SOYBEAN – GERMPLASM SELECTION & EVALUATION
5332	HOME GARDEN AGROFORESTRY
5153	HYBRID RICE VARIETAL TRIAL
5006	PASSIONFRUIT EVALUATION
4505	SOYBEAN – BREEDER SEED & SEED MULTIPLICATION
4005	EFFECTS OF SPACING AND CULTURAL PRACTICES ON YIELD OF BANANA
4005	MANGO FERTILIZER TRIAL
4005	MANGO FLOWER INDUCING HORMONES
3003	SOYBEAN – HYBRIDIZATION & BREEDING LINES
2845	CHILLI – INSECTICIDE SCREENING FOR POD BORER
2772	NITROGEN FIXATION EFFECTS OF LEUCAENA
2687	RICE GERMPLASM EVALUATION
2656	CHILLI – FERTILIZER RESPONSE
2329	FUELWOOD TREES
2149	RESIDUAL EFFECTS OF P AND K IN DRY SEASON ON PADDY RICE IN WET SEASON
2002	MANGO COLLECTION & EVALUATION
1770	SOYBEAN – EVALUATION VEGETABLE TYPE
1770	VEGETABLE SEED PRODUCTION
1612	COORDINATED VARIETAL TRIAL OF RICE
1328	CHILLI – INTERCROPPING
1075	FERTILIZER TRIAL 1
1075	FERTILIZER TRIAL 2
1075	FERTILIZER TRIAL 3
1075	RICE SPACING TRIAL 1
1075	RICE SPACING TRIAL 2
122805	TOTAL COST OF ALL PROJECTS

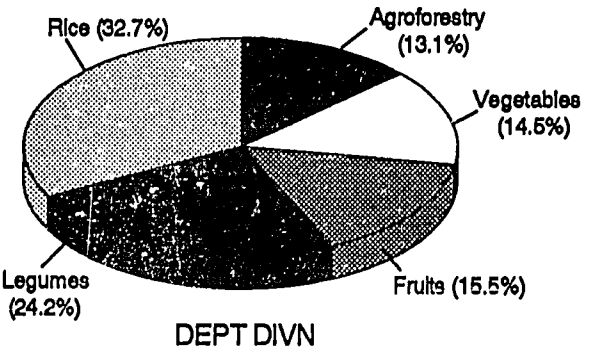

Figure 7.2. Research cost by department at ARI, 1990

Appendixes

Appendix 1 Commodity Groups and Crops

Introduction

This list divides about 140 commonly used species of crops, livestock and fish produced by developing countries into 14 **commodity groups** plus one group dealing with **resource-based research.**

These commodity groups are similar to those used in the FAO AGRIS/ CARIS system in most instances. However, some changes in terminology have been made in order to:

- keep the total number of commodity groups small enough to facilitate an analysis at the aggregate level;
- ensure a closer fit with the organization and structure of research systems that exist in the NARS;
- facilitate understanding by using the common rather than the Latin name in some cases.

Thus, oil palms, coconut and rubber are grouped as tree crops, tobacco is found in the fibers group and soybeans and groundnuts are shown as grain legumes rather than as vegetables. These groupings can be modified as required in INFORM (as long as the changes are consistent). For example, because of the importance of rice in Asian agriculture, countries in that region may wish to list this crop as a commodity group in its own right, so that, for example, comparisons can be made between the rice and the grain legume programs.

Appendix 1 Commodity Groups and Crops (continued)

COMMODITY GROUP	CROPS
1. CEREALS	Barley (*Hordeum* sp.) Maize (*Zea mays*) Millet Oats (*Avena*) Rice (*Oryza*) Sorghum (*Sorghum* sp.) Wheat (*Triticum* sp.)
2. FIBERS	Abaca (*Musa textilis*) Bamboos (*Bambusaceae*) Canes and Rattans Cotton (*Gossypium* sp.) Hemp (*Canabis sativa*) Kenaf (*Hibiscus cannabinus*) Jute (*Corchorus* sp.) Kapok (*Ceiba pentandra*) Ramie (*Boehmeria nivea*) Sisal (*Agave sisalana*) Tobacco (*Nicotiana* sp.)
3. FISHERIES	Carp Catfish Crabs Frogs Lobsters and Crayfish Milkfish Mullet Mussels Octopi and Squids Oysters Prawns Sharks Shrimp Sturgeon Tilapia Tuna Turtles
4. FORESTRY	*Acacia* sp. Eucalyptus (*Eucalyptus* sp.) Gliricidia (*G. sepium*) Leucaena (*L. leuocephala*) Pine* (*Pinus* sp.) Teak* (*Tectona grandis*)
5. FRUITS (and Nuts)	Apples (*Malus*) Apricots (*Prunus armeniaca*) Avocados (*Persea americana*) Bananas and Plantains (*Musa* sp.) Cashews (*Anacardium occidentale*) Citrus (Other) Currants (*Ribes* sp.) Durians* (*Durio zibethinus*) Grapefruit Grapes (*Vitis*) Guavas (*Psidium guajara*) Lemons Limes Litchis (*Litchi chinensis*) Mangoes (*Mangifera indica*) Melons (*Cucumis melo*) Oranges Papayas* (*Carica papaya*) Passion fruit (*Passiflora* sp.) Peaches (*Prunus persica*) Pears (*Pyrus*) Pineapples (*Ananas comosus*) Watermelons (*Citrullus lanatus*)
6. GRAIN LEGUMES	Beans (*Phaseolus vulgaris*) Rice Beans (*Vigna umbellata*) Lima Beans (*Phaseolus lunatus*) Broad Beans (*Vicia faba*) Chickpeas (*Cicer arietinum*) Cowpeas (*Vigna unguiculata*) Lentils (*Lens esculenta*) Mung Beans (*Vigna mungo, V. radiata*) Peas (*Pisum sativum*) Pigeon Peas (*Cajanus cajan*) Winged Beans* (*Psophocarpus tetragonolobus*) (For Soybeans and Groundnuts, see OILSEEDS)

COMMODITY GROUP	CROPS
7. LIVESTOCK	Beef Cattle Bees Buffalo Camels Chickens Dairy Cattle Ducks Equines Goats Llamas and Alpacas Pigeons Rabbits Sheep Silkworms Swine Turkeys
8. OILSEEDS	Castor Beans (*Ricinus communis*) Groundnuts (*Arachis hypogaea*) Mustard Sesame (*Sesamum indicum*) Soybeans (*Glycine max*) Safflowers (*Carthamus tinctorius*) Sunflowers (*Helianthus annuus*) (For cotton, see FIBRES; for coconut and oil palms, see TREE CROPS)
9. ROOTS AND TUBERS	Arrowroot Cassava (*Manihot esculenta*) Sago Palms (*Metroxylon laeve*) Sweet Potatoes (*Ipomoea batatus*) Potatoes (*Solanum tuberosum*) Yams (*Dioscorea*)
10. SPICES	Cardamom (*Elettaria cardamomum*) Chilli (*Capsicum annuum*) Cinnamon* (*Cinnamomum zeylanicum*) Cloves (*Eugenia caryophyllus*) Coriander (*Coriandrum sativum*) Ginger (*Zingiber officinale*) Lemon Grass* (*Cymbopogon* sp.) Nutmeg (*Myristica fragrans*)

COMMODITY GROUP	CROPS
10. SPICES (cont.)	Oregano (*Origanum* sp.) Pepper (*Piper nigrum*) Saffron (*Crocus sativus*) Turmeric (*Curcuma domestica*) Vanilla (*Vanilla fragrans*)
11. STIMULANTS	Betel (*Piper betle*) Cacao (*Theombroma cacao*) Coffee (*Coffea* sp.) Tea (*Camellia sinensis*)
12. SUGAR	Sugar cane (*Saccharum officinaeum*)
13. TREE CROPS	Coconut (*Cocus nucifera*) Hevea Rubber (*Hevea* sp.) Oil palms
14. VEGETABLES	Asparagus (*Asparagus officinalis*) Cabbage (*Brassica oleracear* var. capitata) Carrots (*Daucus carota*) Cauliflower (*Brassica oleraceae botrytis*) Celery (*Apium graveolens*) Eggplant (*Solanum melongena*) Garlic (*Allium sativum*) Lettuce (*Lactuna sativa*) Okra (*Hibiscus esculentus*) Onions (*Allium sepa*) Pumpkins (*Cucurbita* sp.) Spinach (*Spinacia oleracea*) Squash and Marrow (*Cucurbita maxima* and *C. pepo* vars.) Sweet Peppers (*Capsicum annuum*) Tomatoes (*Lycopersicum esculentum*)
15. NATURAL RESOURCES (noncommodity)	Soils Irrigation Watershed Management Post-Harvest (noncommodity) Economics (noncommodity) Sociology (noncommodity)

*Denotes that there is no Latin name in the AGROVOC descriptors.

Appendix 2 List of Major Disciplines

MAJOR DISCIPLINE	INCLUDING
AGRONOMY	Botany
PARASITOLOGY AND PEST	Sentomology, nematology, zoology
BREEDING AND GENETICS	
NUTRITION	
PATHOLOGY	Bacteriology, virology, mycology, toxicology, microbiology, immunology
PHYSIOLOGY	Tissue culture
SOILS	Soil chemistry, soil physics
TECHNOLOGY/ ENGINEERING	Processing, chemistry, mechanization, food technology
SOCIO-ECONOMICS	Economics, sociology, anthropology
SUPPORT SCIENCES	Geology and geography, hydrology, mathematics and computer science, meteorology and climatology, statistics and biometry, information and communication
SERVICES	Seed production, vaccine production, diagnostics, quality control

Appendix 3 CARIS Primary and Secondary Research Themes

E ECONOMICS, DEVELOPMENT AND RURAL SOCIOLOGY

E11 Land economics and policies
E14 Development economics and policies
E16 Production economics
E20 Farm management, organization, administration
E21 Agro-industry
E40 Cooperatives
E50 Rural sociology
E70 Trade, marketing and distribution

F PLANT SCIENCE AND PRODUCTION

F01 Crop husbandry
F02 Plant propagation
F03 Seed production
F04 Fertilizing
F06 Irrigation
F07 Soil cultivation
F08 Cropping patterns and systems
F30 Plant genetics and breeding
F60 Plant physiology and biochemistry
F61 Plant physiology — Nutrition
F62 Plant physiology — Growth and development
F63 Plant physiology — Reproduction

H PLANT PROTECTION

H10 Pests of plants
H20 Plant diseases
H50 Miscellaneous plant disorders
H60 Weeds and weed control

J POSTHARVEST TECHNOLOGY

J11 Postharvest technology — Plants
J12 Postharvest technology — Forests
J13 Postharvest technology — Animals
J14 Postharvest technology — Fisheries
J15 Postharvest technology — Non-food

K FORESTRY

K10 Forestry production
K50 Forestry — Processing of forest products
K71* Forestry — Pests
K72* Forestry — Diseases

L	**ANIMAL SCIENCE — PRODUCTION AND PROTECTION**
L01	Animal husbandry
L02	Animal feeding
L10	Animal genetics and breeding
L20	Animal behavior
L50	Animal physiology and biochemistry
L51	Nutritional physiology
L52	Animal growth physiology
L53	Animal reproductive physiology
L70	Veterinary science — General
L72	Pests of animals
L73	Animal diseases
L74	Miscellaneous animal disorders
M	**FISHERIES AND AQUACULTURE**
M01	Fisheries and aquaculture — general
M11	Fisheries production
M12	Aquaculture production
M13*	Pests of fish
M14*	Diseases of fish
M15*	Miscellaneous disorders of fish
N	**AGRICULTURAL MACHINERY AND ENGINEERING**
N01	Agricultural engineering
N10	Agricultural structures
N20	Agricultural machinery and equipment
P	**NATURAL RESOURCES AND ENVIRONMENT**
P01	Nature conservation and land resources
P05	Energy resource management
P06	Renewable energy sources
P10	Water resources and management
P11	Drainage
P30	Soil science and management
P31	Soil surveys and mapping
P32	Soil classification
P33	Soil chemistry and physics
P34	Soil biology
P35	Soil fertility
P36	Soil erosion and conservation
P40	Meteorology and climatology
Q	**PROCESSING OF AGRICULTURAL PRODUCE**
Q02	Food processing and preservation
Q03	Food contamination and toxicology
Q04	Food composition
Q52	Feed processing and preservation
Q53	Feed contamination and toxicology
Q54	Feed composition
Q55	Feed additives
Q60	Processing of non-food, non-feed agricultural produce
Q70	Processing of agricultural waste
Q80	Packaging
T	**POLLUTION**
T01	Pollution
U	**METHODOLOGY**
U10	Mathematical and statistical analysis
U30	Research methods
U40	Surveying methods

* Not an original CARIS code.

Glossary

CARIS: Current Agricultural Research Information System. An FAO-developed system to classify research, it uses themes and keywords to describe ongoing research. CARIS uses the same coding as the library-and-documentation system AGRIS.

COST CODE: INFORM uses a specific set of codes to classify research-related costs (see Part 3 of the guidelines). The cost-code system differs from standard government line-item budgets in the following ways:

- It is optimized for agricultural research.
- It is optimized for research management purposes.
- It is based on cost codes used in several NARS.

The cost-code system is not meant to replace the government accounting system.

INFORM: *INFO*rmation system for agricultural *R*esearch *M*anagers, integrating data on the research activities (experiments, projects and programs) and resources required for program implementation (human resources, financial and physical resources). (Note: Physical resources are not yet included in the INFORM guidelines.)

KEYWORDS: Grouped by CARIS theme, the set of about 600 keywords is presented in Part 4 of the guidelines. It allows the detailed description and classification of a research activity in terms of research content.

LABOR: Sometimes distinguished as permanent or temporary (casual) labor. Casual labor is often on a weekly payroll. It may be possible to relate part of the labor budget to research activities.

MIS: Management Information Systems. Used in a generic sense to indicate information for use by agricultural research managers.

PBS: Program Budgeting Systems. The part of INFORM that presents the program of work and budget disaggregated to the level of individual research activities.

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PROGRAM:	A group of related research activities. (At some institutes referred to as DEPARTMENT or DIVISION.)
RESEARCH ACTIVITY:	A generic term indicating the smallest discreet unit of research. Individual institutes refer to it as experiment, project or study.
RESEARCHER:	A scientifically qualified person leading or participating in research activities. The term *researcher* is preferred over *scientist.* (There may be scientists who do not participate in research activities, e.g., a librarian.)
SBA:	Salaries, benefits and allowances — the cost of a researcher to the institute.
SUPPORT STAFF:	Personnel providing services to individual scientists and the institute as a whole. Support staff can be divided in several categories: technical, administrative and general services. Often, support staff is distinguished from labor.
TECHNICAL SUPPORT STAFF:	Personnel providing technical services to researchers in their research activities — laboratory staff and field technicians. Technical support staff activities are linked to research activities.
ADMINISTRATIVE SUPPORT STAFF:	Personnel serving the research institute as a whole in the field of administration and management. Examples are accountants, secretaries, storekeepers, etc. Their activities are not directly linked to research activities.
GENERAL SERVICE STAFF:	Similar to administrative staff — drivers, cleaners and security staff. In INFORM, general service staff is usually included with administrative support staff.
$:	This is a general currency symbol and is not intended to represent any particular currency.

Selected Readings

Much of the management literature in this field is peripheral to agricultural research. The following publications have been found to be useful.

Caiden, N. 1988. Budgeting in developing countries: A review of recent literature. *International Journal of Public Administration* 11(3): 251-269.

Chadwick, L. 1991. The essence of management accounting. Prentice Hall International (UK), Ltd.

Coombs, P. H. and Hallak, J. 1987. Cost analysis in education, a tool for policy and planning. Baltimore and London: Johns Hopkins University Press.

Corbett, D. C. M. 1989. A current research information system for the management of agricultural research. *R&D Management* 19(3): 251-263.

Prince-Perciballi, I. 1990. AGRIS/CARIS: Categorization scheme. Rome: FAO.

Shilinglaw, G. and P. E. Meyer. 1983. Accounting: A management approach. Homewood: Richard D. Erwin, Inc.

Sumner, N. R. and A. A. Curtis. 1988. REMISS: Research management information system. Canberra: CSIRO, Division of Land and Water Resources.