MANAGEMENT SYSTEM DESIGN AND IMPLEMENTATION IN THE CARDI FARMING SYSTEMS RESEARCH AND DEVELOPMENT PROJECT

Robert D. Hart
Marcus D. Ingle

Farming Systems Research and Development (FSR/D) requires continuous synthesis of physical, biological and socioeconomic information, and a systematic application of this information to the design and evaluation of agricultural technology. It requires a multi-disciplinary team effort. An innovative feature of FSR/D is that it includes the generation of alternative technology and the delivery of alternative technology to appropriate development and research institutions.

FSR/D projects are difficult to manage. This is because multi-disciplinary research is complex. FSR/D bridges the gap between research and development making FSR/D management even more complex. A project management system that can deliver the necessary inputs to the research process, manage the multi-disciplinary team research, synthesize and deliver outputs to development institutions, and coordinate the input, research, and output management processes is a prerequisite for FSR/D. Design and installation of a project management system is a key question that must be addressed by anyone recommending a FSR/D approach. This question provides the focus for this paper.

The paper is divided into the following four sections:

1. FSR/D Management Needs: a systematic assessment of the management requirements for FSR/D projects.
2. A FSR/D Project Management System: a description of a general FSR/D project management system that meets the needs identified in the first section.
3. The CARDI FSR/D Project Management System: a description of the project management system of a real FSR/D project that illustrates the characteristics of the general project management system described in the second section.
4. Installation of FSR/D Project Management Systems: a description of an approach to the development of appropriate management systems and the identification of principles that can guide their installation.

FSR/D Management Needs

A FSR/D project is a system with inputs and outputs. The first step in analyzing the management needs of a FSR/D project is determining what management systems are needed to insure critical inputs are available, the research process operates, the outputs are delivered in a usable format, and the project as a whole functions as a system. The four categories of management needs are: (1) Input Management Needs; (2) Research Management Needs; (3) Output Management Needs; and (4) Coordination Management Needs.

Input Management Needs

All farming systems research and development projects require the following inputs: (1) human resources, (2) physical resources, (3) financial resources, (4) appropriate FSR/D methodology, and (5) basic agricultural technology.

Human, physical, and financial resources are interrelated since financial resources can be converted, to a limited extent, into human or physical resources by hiring people or buying commodities. However, in most projects, this decision is made at the project design stage with the budget already divided by line item (sometimes arbitrarily) before a project manager is given control over the project resources. For this reason, in the following analysis, the three types of resource inputs are discussed separately.

Human Resources

In most projects, the quantity and general qualifications of the individuals hired or assigned to the project are defined at the project design stage. Most project managers have little control over the number and type of people hired. However, they do have some control over three human resource management activities that can be important to the success of a project. These are: (1) internal organization of staff, (2) upgrading of the skills of project staff, and (3) selection of outside technical consultants.

Staff organization is relatively inflexible since once an organizational hierarchy has been installed any major changes can be disruptive. Minor changes in the amount of power given to different positions can have important management implications. Training of staff and selection of technical consultants do not add to the quantity of human resources available to a project, but can significantly affect the quality.

Physical Resources

The quantity and quality of most of a project's physical resources (vehicles, agricultural chemicals, etc.) are also defined at the project design stage and the acquisition of physical resources is not usually the responsibility of the project management staff. A major problem is that donors often require that physical commodities be purchased from a specific country and often require complex procurement procedures that can cause a delay in the acquisition of urgently needed commodities. Because procurement procedures are complex, projects are often not given the responsibility for procurement and individuals who do not feel the effect of a lack of commodities are given the responsibility for management of this input.

While projects may not be given the responsibility for the initial procurement of physical inputs, they usually are required to install a

management process to insure the re-supply of expendable items (as opposed to fixed assets). Ideally, a project needs a storage area, an inventory process to quantify how quickly items are used, and aN ordering system for replenishing supplies. It is sometimes assumed that these input processes will be managed at the program or institution level rather than at the project level; however, many of the institutions implementing FSR/D projects do not allocate central funds to the management of expendable items. As a result, lack of inexpensive items, such office supplies, can sometimes be more of a problem than lack of expensive fixed assets.

Financial Resources

Financial resources for operating expenses, travel, per diem, etc., are usually managed through three inter-related processes: (1) budgeting, (2) accounting, and (3) reimbursement/disbursement.

Most project budgets are developed during the design stage, but project managers usually have flexibility in moving money between years and, more important, in allocating funds among different research teams. Accounting is probably the central financial resource management process since an understanding of past patterns of expenditures is needed to develop realistic future budgets and is essential for managing a reimbursement/disbursement process. A reimbursement/disbursement process is needed to keep cash flowing into the project and to the researchers. If the funds for a project come from outside an institution, a system for reporting expenditures and receiving reimbursement is essential. Money available in theory (in the budget) but not in practice (in the bank) is worthless to a research scientist. Once the money flows from the donor to the project, the funds should be disbursed funds to the research teams.

Methodology

Methodology is quite different from the resources discussed above, but it is an essential input to any FSR/D project. Unfortunately, the management of this input is not often systematically considered. FSR/D is a set of techniques that do not belong to any one discipline and the selection of these techniques depends on the specific situation. For this reason the selection and updating of the techniques is usually left to individual members of the multi-disciplinary team. For example, agricultural economists review the literature on survey methodology, while plant pathologists keep track of new techniques for estimating disease infestation. Often, the project neglects to systematically update its methodology. When members of the research team leave, part of the methodology is lost to the project and to the institution. A project library and a documented project methodology that is systematically updated are key components of the methodology.

Technology

Agricultural technology is an important project input because FSR/D is a type of applied research. In FSR/D it is assumed that constraints or opportunities will suggest a specific type of technology. In most cases

this technology will be developed by adapting known technology to the situation.

Management of technology inputs can also benefit from a project library since technology includes physical products such as seeds or chemicals and knowledge of how to combine natural resources and physical agricultural technology to produce a desired product. A management process to systematically acquire, evaluate and store technology (both physical products and information) is a requirement for a FSR/D project.

Research Management Needs

FSR/D is a specific type of applied systems analysis. In most cases research is directed at a system. The objective is understanding the system so alternative components can be identified and inserted into the system. The resulting system should function "better" than before. Because the target system for FSR/D is a specific type of farm system, and farmers manage the farm systems, the definition of what is "better" is defined by the farmers.

In most situations, the farmers have a good understanding of how the target farm system operates. Since the adoption of any new technology will ultimately depend on the farmers, most FSR/D projects have incorporated farmers into the FSR/D research team. The team follows a systems analysis process of description and analysis of the target system, followed by the design and evaluation of alternative components. The alternative technology is then made available to farmers with similar farm systems in similar ecological and socioeconomic environments.

The analysis-design-evaluation sequence within the FSR/D methodology is an iterative cycle. A superficial analysis can be sufficient to design preliminary alternatives. In evaluating these alternatives, information is collected that improves the analytical understanding of the system and quantitative models can be developed. These models can be used to design alternatives that can be evaluated and lead to an improved understanding of the system.

When farmers participating in the research are sufficiently impressed with the alternatives to make changes in their own farm systems, the research team can further evaluate the new technology by transferring it to other similar farms. If the technology is appropriate for this larger sample of farms and the farms are representative of a large population of farms of a certain type, the alternative technology can be communicated to all farmers who could use the new technology.

Two characteristics of FSR/D must be considered in the design of a research management system. The first is that FSR/D includes an iterative analysis-design-evaluation process. Since farms include biological processes that usually operate on a yearly cycle (wet season/dry season or summer/winter), the iterative research cycle also operates on a yearly cycle. This suggests the management of this process should operate on a yearly cyclical basis.

The second characteristic affecting the design of research management systems is that it is a model-building process. Rather than operating on a one-year cycle, model-building occurs over the life of the project. This suggests projects need management systems that systematically collect and update what is known about the target farm systems and the effect of inserting alternative components .

Yearly Review, Plan, Budget, and Monitor Cycles

To systematically guide researchers through the analysis-design-evaluation research cycle, FSR/D projects need a yearly review-plan-budget-monitor management cycle. The analysis phase of the research cycle should parallelthe review phase of the management cycle; the design phase of the research cycle should parallel the planning and budgeting phases of the management cycle; and the evaluation phase of the research cycle should parallel the monitoring phase of the management cycle.

An information management system is needed to link research (analysis-design-evaluation) and management (review-plan-budget-monitor). This information management system must bring together: (1) the justification for the research being implemented, (2) the methods being followed, (3) the necessary financial, human, and physical resources, (4) the results of the research, and (5) the conclusions that can be drawn from the research results. If this information is filed so that both researchers and management have access to the same information, the file can be continuously updated as technical data is collected or as assumptions are revised. When research teams work in widely separated areas, research and management must have copies of the same file, and a monthly and/or quarterly report system must be used to keep files identical.

Life-of-Project Model-Building

The yearly research and management cycle should continuously add to the understanding of how the target farm systems function. This understanding may not be a formal model that can be analyzed on a computer, but it should be in a format that can be updated and easily used to design alternative technology. An advantage of packaging the information in mathematical models is that models can be used to do ex ante evaluation of potential technology before doing biological research.

Model building requires a combination of research and management activities. It is a research activity because it is a synthesis of technical knowledge and requires inductive technical expertise; it is a management activity because it is an information management process. In the case of farm system modeling, the information is in the hands of different research teams and in the minds of different individuals with different disciplinary perspectives.

An information management system is also needed to link the technical model building with the research activities. A farm system file could be opened when target farm systems are selected. Each year, when the yearly

review-plan-budget-monitor cycle reaches the review stage, information can be moved into the farm system file and a synthesis of the information collected could be done. This synthesis could be an input to the planning and budgeting management process, as well as a project output.

Output Management Needs

The two primary outputs from all FSR/D projects are alternative technology and improved methodology. While it is true that if the project inputs are available and if the research process occurs as planned, these outputs will be a natural result, it is not true they will automatically be delivered to appropriate institutions in a usable format. Output management systems are needed to insure that this occurs.

Alternative technology is an FSR/D output that becomes an input to development institutions, while the improved methodology is an FSR/D output that becomes an input to research institutions, including the institution implementing the FSR/D project. The output management systems for these two outputs, although strongly linked, must be different because of distinctly different clientele.

Alternative Technology

One way of identifying the management activities needed to insure output is delivered in a format consistent with the project's purpose is to look at the characteristics of the inputs required by development institutions that might use the technology. It is generally assumed that the primary receiving institution for FSR/D project outputs will be agricultural extension. However, extension institutions must work with many other institutions, including marketing boards, government policy and credit institutions, and private sector agricultural chemical and seed supply outlets. Government extension institutions often play a central role in coordinating other institutions so development can occur, but in many situations the lead role is played by other institutions.

Regardless of which institution plays the lead role in agricultural development in a country, several types of information can be provided by FSR/D projects. These include: (1) a precise recommendation of alternative technology, (2) a description of the type of farm system and the ecological and socioeconomic environment where the recommendation has been shown to be valid, and (3) the technical rationale for the specific recommendation for the specific type of farm system.

The precise recommendation is needed so information can be communicated through mass media or other technology transfer processes. The description of the target farm system and the ecological and socioeconomic environment is needed so development institutions can know precisely where and to whom information should be disseminated. Technical rationale is needed because any recommendation will only be appropriate for a specific prototype case. As the ecological and socioeconomic situation changes from place to place and from year to year, the recommendation must be modified.

Improved Methodology

Methodology is a key input to FSR/D projects. It is also a key output. Some FSR/D projects have produced little alternative technology, but have made significant contributions to FSR/D methodology. Some cynical evaluators of FSR/D projects may be tempted to suggest that methodology is highlighted as an output only when alternative technology outputs do not meet the expectations of the funding agencies. In the long run, improved methodology can have a greater development impact than new technology.

The principal clients for FSR/D methodology are the institution implementing the project and other research institutions that are designing or implementing FSR/D projects. To satisfy the first client, a management system that insures institutional memory is needed; to satisfy the second group of clients, a management system that makes the methodology available to other researchers is needed. Institutional memory requirements can best be met through a manual that includes different methodology options for the steps in the FSR/D process. The manual must be updated on a periodic basis.

Coordination Needs

In addition to management of inputs, research, and outputs, FSR/D projects need a central coordination management system. Unfortunately, all project management processes cannot be installed at the same time and most projects do not have the resources or do not allocate adequate resources to efficiently manage the process. Thus the central coordination office must take on responsibilities for management systems that are not in place or are not functioning effectively.

The central office has a guidance role, a monitoring role, an information transfer role, and an evaluation role. The guidance role requires an analysis, a policy decision, and a communication of the policy to those who are making decisions. It requires clear specification of roles and responsibilities and delegation of authority. Guidance provides incentives for appropriate performance and sanctions for poor performance. If the central office develops a budget and indicates a certain type of research will receive priority, it is acting in an information transfer role and in a guidance role.

The monitoring role of a central project office requires systematic tracking of project management subsystems to determine if the overall project is proceeding as planned. The information transfer role requires passing of information from one subgroup to another. The evaluation role requires a value judgement. The question that must be continually asked is, given the changes in the environment and knowledge acquired as a result of implementing the project, is the project strategy still correct or should changes be made?

A central coordination management office needs an effective communication system. Without one, the office will tend to centralize activities. Most FSR/D projects require decentralized management. Field teams often work in widely separated areas and the individuals and teams

need a decentralized management to make decisions quickly. If an effective communications system is in place, management can be more decentralized since the central office will have confidence it knows what is going on in all parts of the project.

A FSR/D Project Management System

Every FSR/D project has its own specific management needs. However, all FSR/D projects need a management system with the following four subsystems:

1. Input Management Subsystem: to insure the project inputs are available when required
2. Research Management Subsystem: to insure the research process occurs efficiently
3. Output Management Subsystem: to insure the research outputs are delivered to the development institutions
4. Input, Research, and Output Coordination Subsystem: to insure inputs, research, and outputs are coordinated.

In the management needs section of this paper, general management processes that could meet the identified needs were suggested. The management system described below integrates those processes to form a general FSR/D project management system.

Figure 1 is a systems diagram of an FSR/D project with the project management activities depicted as circles that interact with flows of inputs and outputs, and with FSR/D activities. The four types of project management subsystems can be subdivided into more specific management activities.

Input Management Subsystem

This subsystem has five types of input management activities that correspond to the five basic inputs of all FSR/D projects: human resources, physical resources, financial resources, methodology, and technology. Managing human, physical, and financial resources in FSR/D projects is not very different than managing them in other research and development projects. However, since FSR/D is a relatively new approach, training and consultant selection can be especially important human resource management activities. Physical resource management requires a procurement system for fixed-asset commodities, and a storage and re-supply system to insure that expendable items are available as needed. Financial management must include accounting, budgeting, and reimbursement/disbursement systems.

The management of methodology and technology inputs to FSR/D projects requires management activities not typical of other research and development projects. FSR/D methodology is still evolving and a project may find itself in a situation where no methodology is available and research must be conducted to develop needed methodology. Basic technology must be available or FSR/D cannot develop alternative adapted technology.

Research Management Subsystem

As can be noted in figure 1, this subsystem has two management cycles and two information files. The review-plan-budget-monitor management cycle interfaces with the FSR/D research process and produces information that is filed in a yearly work plan, budget, and results file. The model building cycle takes information from the review-plan-budget-monitor management cycle and develops life-of-project farm models and technological alternative files.

During the review phase of the review-plan-budget-monitor cycle, the results and conclusions from the last set of research activities are used to update what is known about the target farm systems being analyzed. During the planning and budgeting phases, specific research activities are identified that will lead to an evaluation of alternative farm system components. At the end of this phase, management should have a work plan and a budget and the researcher should have a work plan and the assurance that money, people, and physical commodities will be available as needed. During the monitoring phase, research scientists are implementing the planned research activities and management is monitoring the progress. Assuming the management and scientists have copies of the same work plans, communication between these groups will be to update the work plan.

The model-building cycle must be tightly linked to the review-plan-budget-monitor cycle. Information gathered during the review process is used to identify priority research areas for the next year and to update farm models. During the planning stage, the models can be used to do ex ante evaluation of potential lines of research. The validated models become an essential part of the files that describe alternative technology, since they are the basis for updating recommendations.

Output Management Subsystem

The output management subsystem takes information from the two files continually updated by the review-plan-budget-monitor cycle and the modeling cycle, and transfers it to research and development institutions in a usable format. Client institutions, and the institution conducting the FSR/D project must define "usable format." Transfer to research institutions requires management activities that generate technical articles and reports.

FSR/D generates site-specific technology. To make it cost effective, information other than a site-specific recommendation must be transferred. A file with a description of other types and locations of farms that can use the technology and the technical rationale for the recommendation must also be transferred. The technology output to development institutions must be a synthesis of the life-of-project farm model and the alternative technology file (see figure 1). This file should be copied and made available to development institutions as soon as it looks likely alternative technology will be produced.

Coordination Office

The central coordination office must: (1) receive information from the

input, research, and output management systems, (2) analyze this information and (3) regularly disseminate directives to the various management subsystems. The common denominator in these activities is information management. The effectiveness of the central project office in coordinating the input, research, and output management subsystems depends upon the efficiency of the communication and information management system.

The CARDI FSR/D Project Management System

To illustrate how this general FSR/D project management system can be applied to a real project situation, the next section of this paper describes the project management system of a FSR/D project currently implemented by the Caribbean Agricultural Research and Development Institute (CARDI) in the Eastern Caribbean.

The Caribbean Agricultural Research and Development Institute (CARDI) is a regional institution financed by 12 Caribbean territories that are members of the board of directors. In addition, international donors provide funds for specific projects. The Farming Systems Research and Development (FSR/D) Project is funded through CARDI core funds and the United States Agency for International Development (USAID). The project serves eight island nations in the Eastern Caribbean: Antigua, Barbados, Dominica, Grenada, Montserrat, St. Kitts/Nevis, St. Lucia, and St. Vincent. The project has a budget of approximately 10 million U.S. Dollars, to be spent over a period of 5 years beginning in 1983. It was preceded by a cropping systems project that allowed CARDI to hire staff and begin many of the activities that became part of the FSR/D project.

As stated in the CARDI FSR/D Project Charter (CARDI 1984a), the project's goal is improving the economic and social well-being of small and medium-sized commercial farm households. The four major partners in implementing the project are (1) the farmers of the Eastern Caribbean, (2) the Ministries of Agriculture of the participating countries, (3) CARDI, and (4) USAID. The primary purpose of the projeact is to develop a sustainable FSR/D programme within CARDI that is responsive to the agricultural research needs of the Eastern Caribbean. The project's expected outputs are: (1) alternative crop, livestock, and crop/livestock technology, (2) a methodology to generate and transfer technology, and (3) the institutional capability to implement FSR/D projects.

The inclusion of the third output (institutional strengthening) makes this FSR/D project different from most FSR/D projects. A significant percentage of the technical support portion of the project (provided to CARDI thorugh a contract between USAID and the South-East Consortium for International Development) is allocated to the development of institutional management capability and the strengthening of the management of this project. The process followed to design the project. The project's general conceptual framework and research methodology have been described by Hart and George (1984). A key event that occurred between the design and implementation of this project was a project implementation workshop (CARDI 1984b). During this workshop, management specialists from the Development

Program Management Center of the United States Department of Agriculatlure, the International Development Management Center of the University of Maryland, and CARDI developed many of the management concepts and learning processes used to implement the project.

The CARDI FSR/D project is probably more difficult to manage than most FSR/D projects, because it serves eight island countries and it is time consuming and expensive to travel between islands. The Ministries of Agriculture on each island have their own political agendas and the project must continually balance regional research needs with national priorities. The islands have different soils, rainfall, levels of economic development, and cultural backgrounds. On many islands environmental diversity is very high, with annual precipitation ranging from less than 1000 mm to over 3000 mm within a short distance.

The different project management systems that have been designed and installed in the CARDI FSR/D project are discussed below. Many of the management systems have only recently been developed and, undoubtedly, will evolve as project staff gain more experience. Emphasis is placed on innovative features of the management systems. The description of CARDI's FSR/D project management system follows the same outline as the management needs assessment in the first section of this paper, and the description of the general FSR/D management system in the second section.

Input Management Subsystem

Like all FSR/D projects, the CARDI FSR/D project has inputs of human resources, physical resources, financial resources, methodology, and basic technology.

Human Resources

Human resources available to the project include about 35 technical and 10 administrative and secretarial staff. There are 3-person country teams on each island with a secretary/administrative assistant working with each country team. The country teams are assisted by specialists (economist, anthropologist, plant protection specialist, etc.) who reside at the project headquarters in St. Lucia, a subregional coordinator for a group of islands north of Dominica (Leeward Islands), and a subregional coordinator for a group of islands south of Dominica (Windward Islands). There is a project manager and secretarial and administrative staff at the project headquarters. The CARDI office in Trinidad is linked to the project through the provision of technical support, and because a key objective of the project is to strengthen CARDI's institutional capabilities.

The project has a limited amount of funds for training at the graduate level. Most training is done in workshops that have multiple objectives. For example, learning to use specific microcomputer software has been combined with the objective of developing budgets. While this type of multiple objective workshop is a necessity due to budget limitations, there are distinct advantages to "learning through doing".

Technical support from outside of CARDI is obtained through an arrangement with the South-East Consortium for International Development (SECID) in the United States. At the project's annual planning meetings, project staff identify needs and the project manager and a resident SECID representative develop job descriptions for the consultants who are needed. Requests are sent to U.S. institutions participating in the SECID arrangement, and qualifications of potential consultants are discussed with CARDI staff.

Physical Resources

Physical resources are an important item in the CARDI FSR/D project budget. Vehicles have been purchased for most of the islands. Tractors, irrigation equipment, etc. have been purchased to improve field station infrastructure on two islands. An item that has had a major impact on the management of the project has been the purchase of microcomputers and software. Most fixed assets were obtained through an arrangement with SECID. An exception was the vehicles, which were purchased by CARDI immediately after USAID provided the funds. This early procurement occurred because of a USAID policy that right-hand drive vehicles could be procured locally rather than requiring purchase in the U.S. A system of local procurement is used to obtain expendable items.

Financial Resources

The CARDI FSR/D project has accounting, budgeting, and reimbursement/disbursement systems. Accounting is managed by an accountant in the central office and the secretary-administrative assistant who works with each country team. Each island submits monthly statements coded by line item and receipts for expenditures. A project-level expenditure statement is developed and the items that USAID has agreed to fund are submitted for reimbursement. This reimbursement is made directly to the project office, which then disburses funds to the country teams.

A general project budget was developed during the design of the project. After the first year of the project, it was obvious that certain assumptions regarding the cash flow and the possibility of increasing the percentage of the budget that would be paid by CARDI territories were not valid. A more realistic budget was developed using the experience of the first year as a guideline. The new budget was more detailed and estimates could be made on projected research costs for each island. Before each yearly research planning session, the budget is updated and each research team is given an estimate of the financial resources available to them for the year.

Methodology

The methodology for the CARDI FSR/D project was developed by a group of CARDI staff and outside consultants during the design of the project. The FSR/D project was preceded by a cropping systems project that allowed many of the staff to gain experience in on-farm trials and other techniques that are part of most FSR/D projects. This experience allowed CARDI staff members to

develop a relatively detailed methodology during the initial phase of the project.

The CARDI FSR/D methodology follows the traditional description, analysis, design, evaluation, and transfer process of most FSR/D projects, except that the process has been subdivided into 11 activity sets that are sometimes sequential, but often simultaneous. FSR/D applied in the Eastern Caribbean situation requires an understanding of island-level, farm-level, crop and livestock production system-level, and crop and livestock species-level phenomena. The first three activity sets in CARDI's methodology attempt to identify and describe these systems. The activity sets are: (1) target area and farmer selection, (2) rapid reconnaissance, and (3) specific problem surveys.

Activity sets 4-7 in CARDI's methodology involve the analysis of crops and livestock at the field station level, on-farm crop and livestock production system trials, farm-level studies, and island-level or area-focused studies. This information is then used to design alternatives (activity set 8), conduct on-farm testing of the alternatives in researcher-managed trials (activity set 9), and conduct further on-farm validation in farmer or extension agent-managed trials (activity set 10). The final stage (activity set 11) is called "applicability trials", since these experiments are done on farms in areas that are similar to the farms and areas where the technology was developed. The objective is to determine the technology can be transferred to this larger population of farms.

The different techniques used in the 11 activity sets have not all been documented, but a document describing the different options for the different activities will be developed as a project output. The manual will probably have chapter headings corresponding to the activity sets listed above. The project has a library that is presently being organized with the documents described in a microcomputer data management system so staff can request documents by key subjects.

Technology

CARDI FSR/D staff members are aware of the necessity of obtaining basic agricultural technology that can be screened and adapted to the situation in the Eastern Caribbean. The first source of technology for the project has been CARDI headquarters in Trinidad. CARDI maintains active commodity and discipline-oriented research programs. It also has strong ties to the University of the West Indies (UWI). Another institution in the Eastern Caribbean that has provided basic technology is the Institut National de la Recherche Agronomique (INRA) in Guadeloupe. On many of the project islands, CARDI collaborates with the French Technical Mission.

The FSR/D project has obtained improved varieties from many of the international centers and from the United Nations Food and Agriculture Organization (FAO). Even though geographically the Eastern Caribbean is closer to the international centers in Mexico and Colombia, the cultural heritage of the region is such that food preferences emphasize roots and tubers rather than maize and beans. For this reason the project has

emphasized the development of contacts with the international centers in Nigeria and India.

Tourism is important in the project islands and vegetables for hotels (as well as local markets) are important cash crops. The FSR/D project has contracted a scientist from the Asian Vegetable Research and Development Center (AVRDC) to reside in St. Lucia and help the project select improved varieties of vegetables to be tested on the different project islands.

Research Management Subsystem

CARDI's FSR/D methodology was described above in the section on methodology input. The challenge in implementing the 11 activity set process is how to systematically move information through the process and deliver the information to development institutions. During the design of the project, it was decided that the alternative technology outputs should be delivered as part of a flexible information file that could be updated assuming these files would move through the 11 activity set methodology and be transferred to extension institutions. The first management question faced was how to move the files through the process.

Yearly Review, Plan, Budget, and Monitor Cycles

To systematically move through the 11 activity set methodology, the CARDI FSR/D project installed a yearly review, plan, budget, and monitor cycle. During the dry season before the yearly cropping season begins, the country teams meet with representatives of the ministry of agriculture on each island. The previous year's research results and next year's research priorities are reviewed. Tentative work plans are developed and discussed with the subregional (Leeward and Windward island) technical coordinators.

After preliminary work plans are developed at the island level, subregional workshops are held and the yearly budgets are given to the country teams. Finally, country team leaders, technical coordinators and project specialists meet in a project-level regional workshop to finalize the work plan and budget. Coordinators and the project manager then monitor implementation of the work plan.

To manage the information produced by the review-plan-budget-and monitor cycle in operational terms, the project developed the Activity Record Sheets (ARSs) concept. ARSs are files with the following subfiles:

1. data management codes
2. title
3. objectives
4. justification
5. budget
6. results
7. conclusions

The first five subfiles are filled in during the planning and budgeting stage; the results (subfile 6) is filled as data is generated. The

technical coordinators monitor this process and provide technical support in the analysis of data. During the review stage, the conclusion (subfile 7) is filled in, and the ARS is complete.

The ARSs are maintained as microcomputer files on diskettes and on paper. There are two advantages to managing information with microcomputer system. The first is that individual islands can develop their work plans and budgets and bring them to the planning workshop on diskettes. Plans and budgets can be updated and electronically combined so both the project management and the country teams can return to their offices with identical copies of the work plans and budgets. The second advantage is that the completed ARSs can be used in multiple documents, including the annual report, the models, and the alternative technology files described below.

Life-of-Project Model Building

To manage the information developed during the process of identifying alternative technology, the CARDI FSR/D project developed the Technological Improvement Files (TIFs) concept. TIFs have four subfiles: These are:

1. A description of the target farm systems and the target ecological and socioeconomic environment
2. The recommended technological alternatives
3. The technical rationale for the recommendations
4. Ongoing research

Information collected during the first seven activity sets of the FSR/D methodology are used to developed the first subfile. The recommendations are written during the "design" stage (activity set 8) of the methodology. Completed ARSs are placed in subfile three. ARSs that are incomplete because the research is still in progress are placed in subfile four.

Before the TIFs move from activity set 9 (researcher controlled on-farm trials) to activity set 10 (extension and farmer-managed trials), a copy of the TIFs will be physically transferred to extension offices. As new research results are available and as the socioeconomic situation changes, the files will be updated. An important characteristic of island economies in the Eastern Caribbean is that prices and market demands are constantly changing. The possibility of quickly updating recommendations has clear advantages. Farm models that would allow researchers to quickly test to see if recommendations are still valid would be useful.

Output Management Subsystem

As stated above, the CARDI FSR/D project has three types of outputs: alternative technology, improved methodology, and improved institutional capabilities to implement FSR/D projects. These outputs are delivered to three types of clients: (1) CARDI headquarters, (2) development institutions, and (3) research institutions.

Alternative Technology

Technology outputs are delivered to the clients and complete copies of the TIFs will be on file at CARDI headquarters. If research or development activities are conducted in any CARDI territory on farms or in areas similar to those where the files were developed, the information files can serve as a source of technology for these projects.

Extension institutions are the key clients for the alternative technology. CARDI and extension staff will use the files to develop fact sheets and other extension materials. The research institutions most interested in the technology generated by the FSR/D project will be the local Caribbean institutions. CARDI staff actively participate in regional professional meetings. Presentations and proceedings from these meetings will probably be the principal way this technology is transferred.

Methodology

The techniques used to implement the 11 activity sets of the CARDI FSR/D methodology have not been documented; however, before the project is completed a methodology manual will be written. As suggested, the manual will probably have chapter headings corresponding to the activity sets and will be in a format that can easily be updated. This methodology manual will be transferred to CARDI headquarters and made available to all CARDI staff and other research institutions doing FSR/D.

Methodology will be transferred to other researchers primarily through annual reports that are sent to other institutions and through technical articles in journals and proceedings of technical meetings.

Institutional Capability

The primary client for this output is CARDI headquarters. This type of output is not typical of most FSR/D projects and the process to systematically transfer management experience gained in the FSR/D project to CARDI as a whole is still evolving. The first priority was to analyze CARDI to determine its capability to provide the inputs necessary to implement a FSR/D project. Progress has been made towards improving financial and human resource management systems.

An important lesson learned during the initial stage of the FSR/D project was that management capabilities and management systems are a prerequisite for FSR/D. The management capability and management systems that will evolve over the life of the FSR/D project will undoubtedly be important outputs from the CARDI FSR/D project.

Coordination Office

The central office for the CARDI FSR/D project is in St. Lucia. St. Lucia is also the residence of most of the project specialists, the Windward technical coordinator, and the St. Lucia country team. The principle components of the central office are: (1) the project manager's office, (2)

the document and report production/wordprocessing center, (3) the financial resource management office, (4) the microcomputer network central office, and (5) the office of the SECID resident responsible for providing consultants and physical commodities.

The CARDI FSR/D management system is not fully installed. It will evolve and undergo changes over the next few months and years, but the present system is operational. It is not easy to put a management system into place and make it operational because it is impossible for everything to be in place at the same time. The next section of this paper describes some lessons learned and general principles of management system installation.

Installation of FSR/D Management Systems

The strategy used to install the CARDI FSR/D project management system can be defined as a "performance improvement approach". Improvement of the research process is the primary objective. This is very different from designing and installing management systems for their own sake. After a management system has been designed, an appropriate process that will lead to a capability to perform the needed management function is identified.

In the CARDI project, workshops to accomplish management needs and develop capability have been important elements of the installation procedure. To date, the most important workshops have been a pre-implementation management workshop, the planning and budgeting workshops held at the beginning of the project and at the second and third years of the project, and a microcomputer application workshop.

Experience in the design and installation of the CARDI FSR/D project management system, experience with other development-oriented agricultural institutions, and the research management literature suggest there may be some general principles that can be considered in applying the performance improvement approach. Four are discussed below.

Maximum Staff Participation in Design of Management Systems

There are two reasons why this guideline should be followed. First, most research scientists suspect that many management activities are bureaucratic busywork that take time away from doing research. Staff participation insures the rationale for management demands will be understood and more likely acted upon. The second advantage of having project staff participate in the design of management systems is that often they are much more aware of their own strengths and weaknesses than are outside management consultants or upper-level management.

One main reason CARDI was able to quickly install different project management systems was that the institution had just completed a project that required similar management systems. Project staff were aware of their own capabilities as well as their management needs. They also knew CARDI's strengths and weaknesses.

Structured Flexibility

This principle is a consequence of seeking maximum staff participation in the design and improvement of management systems. For staff to be motivated to suggest changes they must believe changes are possible. However, to suggest that "structured flexibility" is required is not the same as suggesting that only "flexibility" is needed. The important thing is to identify what is not flexible, such as specific goals, objectives, etc., and allow maximum flexibility in the design and installation of processes that will achieve the required results.

A good example of the application of this principle is the development of the technological improvement files (TIFs). These files were identified as an output of the project during its design. The general structure of the files was also defined, but the detailed outline and format of the files and the processes needed to develop the files were not identified. In project workshops, small groups have begun to develop the TIF format and suggested processes to insure their development.

Combine High-Demand Tools and High-Need Management Systems

One way to motivate project staff to quickly install a management system is to combine installation of the management practice with the installation of a research or management tool that is in high demand by staff. For example, if a management system is needed to make a soil laboratory function more efficiently, the installation of the management system can be combined with the purchase and training on how to use a new piece of laboratory equipment everyone wants.

In the CARDI FSR/D project, the installation of the review, plan, budget, and monitor process was combined with the installation of microcomputers. The ARSs used to keep track of the information generated by this management process were put on microcomputer diskettes. Instructional materials emphasized "how to put together an ARS", rather than "how to use wordprocessing software", but the possibility of learning to use the computers was undoubtedly a strong motivating force. This motivation was reinforced by the experience of developing the first year's work plans without microcomputers and discovering it took six months to put together a typewritten work plan approved by management. With the microcomputers, a draft of the work plan was finished before leaving the planning workshop.

Management and Methodology Must be Linked

All research projects require management systems that are consistent with the research methodology. It would be illogical to design a management system that requires that budgets be revised every six months if the research program is directed at crops that require more than six months to reach maturity. Conversely a project's methodology must be consistent with what is institutionally possible. For example, there is no use adopting a methodology that requires both social scientists and biological scientists if the institution does not have a policy of hiring both types of scientists.

The CARDI FSR/D project began with a methodology designed by staff members on the basis of their understanding of Eastern Caribbean farm systems. A management system was designed that reflected the methodology. Both the management system and the methodology will probably undergo changes as a compromise occurs between what is technically ideal and managerially possible. One of the reasons the present project management system has been successful is that the management system reflects the methodology.

Acknowledgments

Many individuals, too numerous to mention, contributed to the evolution of the ideas and concepts that were beginning to crystallize when we had the opportunity to participate in the design and implementation of the CARDI FSR/D project. Our participation in the CARDI FSR/D project began in 1983, although both of us had contacts with CARDI previously. While the professional challenge of being directly involved in the implementation of a project that we helped design was an important motivating factor, probably the key factor that convinced us to take up residence (Hart) and accept "long" short-term consultancies (Ingle) was the chance to work with the CARDI staff we met during our project design consultancies. These same CARDI staff members have been and will continue to be the force behind the development of the project management system described in this paper. We would like to specifically acknowledge the contributions of Dr. Samsundar Parasram, the Executive Director of CARDI, and Mr. Calixte George, the FSR/D Project Manager. Many senior management staff in Trinidad, and all of the staff of the FSR/D project participated in the development of the project management system described in this paper.

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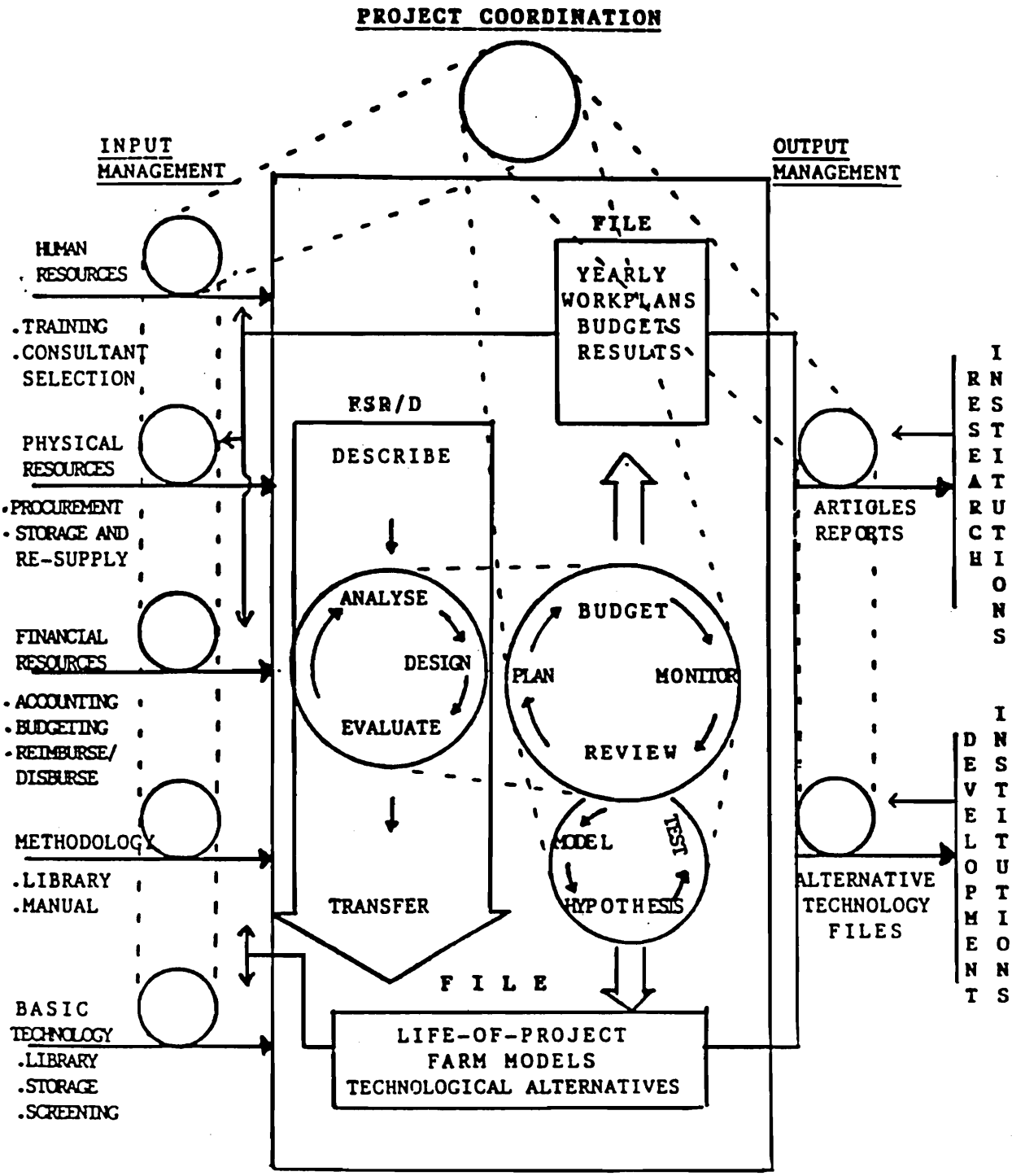

Figure 1. A project management system for a farming systems research and development project.