AN EVALUATION OF THE CARDI/USAID SMALL FARM MULTIPLE CROPPING SYSTEMS RESEARCH PROJECT NO. 538-0015

Prepared by a USAID Evaluation Team
which visited

St. Lucia, Antigua, St. Kitts, Montserrat,
Dominica, St. Vincent and Trinidad

March 17 - April 8, 1982

Team Members

Everett Everson, Agronomist/Plant Breeder, Michigan State University, East Lansing, MI, Team Co-Leader.

Joseph Beausoleil, Economist, USAID/RDO, Washington, DC., Team Co-Leader.

Robert Deans, Livestock Specialist, Michigan State University, East Lansing, MI.

Russell Freed, Agronomist/Plant Breeder, Michigan State University, East Lansing, MI.

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EXECUTIVE SUMMARY

An Evaluation of the CARDI USAID Small Farm Multiple Cropping Systems Research Project No. 538-0015

The objective, scope of work and evaluation of the Small Farm Multiple Cropping Systems Research Project are found in Appendix A. add description - one liner

The evaluation team visited St. Lucia, Antigua, St. Kitts, Montserrat, Dominica, St. Vincent and Trinidad from March 17-April 8, 1982. The team itinerary and a list of the people met are listed in Appendix B. A list of the reports read and utilized are listed in the Bibliography.

Infrastructure for Applied Research and Extension

The Small Farm Multiple Cropping Systems Research Project (SFMCP) was established to develop recommendations for improved farming systems through adaptive, farm based research. Although the ambitious objectives of the project paper were not fulfilled and many of the expected results were not obtained, a sound infrastructure for applied research and extension at the farm level has emerged. Certainly the designers expected some sort of applied research support to develop at the farm level. What was not expected was that FSR would be so readily embraced by the farmers, and become the focal point for ministry programs. In every territory visited, it was obvious in conversations with the Ministers of Agriculture, the Permanent First Secretary of Agriculture and/or the Chief Agricultural Officers that they considered the CARDI Research Program and the FSR Program as their program. In several cases, this is the first tangible Ministry research effort in their country and they plan to support it.

The infrastructure for applied research and extension evolved with the successful establishment of country/CARDI teams on farming systems research. These teams, which are staffed with capable agriculturalists from the Ministries and from CARDI, were to

assess the farmer's current practices, identify the farmer's problem at his level of operation and then conduct on-farm, problem solving, adaptive research. During the survey (questionnaire) process, the country team discovered the great complexity of the existing farming system and became involved in helping the farmer--the target group. The evaluation team was impressed with the rapport that has developed between the country team members, Ministry of Agriculture staff and the farmers. We have seldom seen an infrastructure for development in place in such a short time after the initiation of a research organization.

Implementation Problems and Assets

In the view of the evaluation team, the most serious implementation problems include the following:

(1) The project, as designed, was far too ambitious.

(2) The "state of the art" of farming systems is still in its infancy with most projects targeting on relatively simple monoculture systems--agriculture in the Eastern Caribbean is very complex. Also, most of the farmers are part-time.

(3) The project, from its inception, needed a full-time, outside technical advisor who was knowledgeable about FSR, questionnaires, data analysis, inter-disciplinary and on-farm research.

(4) Poor inter-territorial communications seriously inhibit project planning and implementation.

(5) Early and systematic evaluation of the SFMCP by USAID, while specified in the Project Paper, never occurred. The team found no evidence of quarterly reports, the usual method of tracing a project's progress.

(6) The data collection process has been allowed to dictate project objectives and manpower deployment, not vice-versa.

(7) The project, partly exacerbated by the early decision to begin working in eight territories, has spread itself too thin and has tried to capture far too much detail about a sub-sample of farmers which represents neither a homogeneous group within a country, nor a random sample of the country's farmers.

(8) Ad hoc exploratory interventions do not necessarily represent constraints identified in the informal or formal data analysis process, nor have they been systematically replicated enough to represent either within-farm or intra-zonal variability.

(9) Too much up-front emphasis on data collection and detailed analysis, coupled with a lack of implementation flexibility, led to a cautious, slow approach to field trials (interventions). This is a rather inefficient attempt at implementation to date.

(10) Failure to attain a true interdisciplinary interaction of CARDI core personnel has led to minimal benefits from the potential interaction of the several disciplines involved in the research project.

Despite these problems, there were positive aspects of the project. A few of these are as follows:

(1) A sound infrastructure for applied research and extension has emerged at the farm level.

(2) CARDI/FSR project members and consultants became aware of the complex farming systems of the region.

(3) A number of production constraints were discovered and on-farm adaptive problem-solving research was initiated.

(4) The project discovered several weaknesses in CARDI which must be strengthened.

(5) Established a research presence in several territories where none existed before.

Research Capabilities of CARDI

The Caribbean Agricultural Research and Development Institute (CARDI) was established in 1975 to serve the agricultural research and development needs of the 12-member countries of the English speaking Caribbean community. Initially, research stations were established in Trinidad, Guyam, Jamaica, Barbados and Antigua.

Research decentralization was initiated by CARDI in 1976 and 1977 with the establishment of three regional agricultural research stations, one each in Belize, St. Lucia and St. Kitts, with a $235,000 USAID grant. The latter two stations are in the Windward and Leeward Islands of the Eastern Caribbean.

Those involved in planning agricultural research strategy for the Eastern Caribbean realized new procedures must be used to develop production technologies for the small farmer. To improve small farm productivity, one must first make an assessment of the natural (physical or biological) and economic circumstances which determine why these farmers do what they do. After assessing production constraints, on-farm experiments are then devised to remove or reduce these constraints. Those on-farm experiments initially involve adapting proven technological innovations (developed on experiment stations) to improve the farmer's production.

In the process of conducting on-farm research, variables (production or economic problems) in the farming system are discovered which must be referred to the regional or central research groups for solution through applied or basic research. In 1973, AID provided CARDI with $2,210,700 to develop an on-farm research capability with each host government in the six LDC countries in the Eastern Caribbean.

At this point, CARDI, with AID support, has developed three levels of research capabilities in the Eastern Caribbean Region. It is the only research institute in the

Eastern Caribbean capable of addressing the region's serious food problems with any chance of helping to solve them.

In this report, the evaluation team addresses a number of problem areas that were observed in CARDI. Without a doubt the major problem confronting CARDI is its level of research performance. There are individual cases of good research efforts, but these are not numerous enough to confront the large and growing list of production and marketing constraints. Level of research performance can be affected by research management, inadequately trained staff, lack of sub-professional (technician) support and low research budgets.

Major Recommendations

Phase II of the SFMCR should address the strenghening of research performance. The new project should be research oriented and built on the institutional capability created in CARDI during the SFMCR project (also called Farming Systems Research). It should focus on the following areas:

(1) On-farm research.

(2) Strengthening CARDI's research capabilities:

- Improve research management.
- Strengthen professional research staff.
- Increase technical support staff
- Provide for staff training.
- Increase agricultural research funding.

(3) Research on production/marketing linkages.

(4) Develop and strengthen a new research/extension interface.

Other Supporting Recommendations Are as Follows:

(5) A farming systems agricultural economist or agronomist with hands-on experience in conducting farm trials should be assigned to the project full-

time to work as a technical counterpart to the project director for a period of not less than two years.

(6) An economist should be assigned to each of the Windward and Leeward Island groups.

(7) Each country team should have transportation and a basic set of equipment and supplies for research.

(8) The review team recommends the establishment of a Technical Management Group to assist the Director of Research and Development in the overall management of the technical personnel and resources of CARDI. The composition and functions of the committee are discussed in detail in the text.

(9) For budgeting and operational reasons, the positions of Director of Administration and Director of Finance should be combined into one position, the director of Administration and Finance.

(10) That a system of overhead fees for basic core staff support be identified and budgeted for each externally funded project. Such funds would be earmarked for direct support in areas of basic research relevant to the new project and might also be used to establish a salary contingency fund for staff salaries when cash flow problems develop.

(11) A precise job description should be developed for each staff member of CARDI which clearly states the area of endeavor, accountability and methods of evaluation. The staff members' performance should be reviewed annually by resource people or administrators in the management group who are affected in some way by this resource staff's activities.

(12) Long-term funding be established in phase II to provide support for both graduate student research and UWI staff travel for activities compatible with the CARDI/FSR project. Such activities can include technical research and extension.

(13) In order to provide a broad based communication between country FSR projects and the extension area, the team recommends that an FSR Co-ordinating Group be formed which would meet regularly and rotate among the country projects. This group would consist of the Country Team Leader, the two regional Technical Coordinators, an Extension Advisor from UWI and the Project Leader. It would be advisory in nature to the Project Director, but could form an important linkage between UWI extension and the development of the extension phase of this FSR work.

(14) An effective system of radio or telecommunications be developed to link CARDI units.

(15) Further development of the CARDI Regional Research Stations in St. Kitts and St. Lucia.

(16) Funding of research programs in:

(a) Soil and water management systems.

(b) Simple field implements and power source systems.

(c) Cropping systems and management.

(d) Forage crop and livestock systems.

(e) Production of drought resistant grasses and legume species for dry leaf meal production.

(f) Studies on solar drying and leaf meal production for livestock supplement.

(17) Two pest control specialists be assigned to the Eastern Caribbean region, one each to the Windward and Leeward Island groups. In the future, each territory should have a pest control specialist.

(18) That the CARDI core staff be strengthened in the diciplines of entomology, plant pathology, agricultural engineering (hydraulics and small-farm mechanization), Agricultural Economics--marketing, plant breeding or crop improvement and post-harvest physiology.

(19) Training should proceed at all levels through seminars, workshops, institutes and degree work. The team recommends:

- 30 man months of international travel.
- 40 to 60 man years of diploma training.
- 20 to 30 man years of B.S. degree training.
- 30 man years of advanced degree training.

ACRONYMS

CT	Country Team
SFMCP	Small Farm Multiple Cropping Project
CARDI	Caribbean Agricultural Research and Development Institute
CTL	Country Team Leader
CARICOM	Caribbean Economic community
FT	Field Trials
BUCEN	Bureau of Census
ANOVA	Analysis of Variance
CIMMYT	International Maize and Wheat Improvement Center
FSR	Farming Systems Research

I. APPROPRIATENESS OF THE PROJECT

Purpose of the Project

The purpose of the Small Farm Multiple Cropping Systems Research Project (SFMCP) is "to develop recommendations for improved farming systems through adaptive, farm based research which farmers can and will use, extension agents can explain and credit institutions will finance" (Project Paper). Recommendations will be developed . . . "for improved farming systems among Eastern Caribbean farmers through adaptive research aimed at improving the economic viability of small-scale farming" (Manteiga, 1981).

Project Design

The central feature of the Small Farm Multiple Cropping Systems Research Project (SFMCP) AID/CARDI #538-0015 is the emphasis on on-farm based research, which is itself a part of a broad program of agricultural research and policy analysis designed to improve production and the incomes of farmers.

USAID initiated a program of strengthening regional research in the Caribbean in FY 76 and FY 77 by providing the Caribbean Agricultural Research and Development Institution (CARDI) with US $235,000 in grant assistance to establish three agricultural research stations, one each in Belize, St. Lucia and St. Kitts.

The establishment of the latter stations as regional stations of the Windward and Leeward Islands gave CARDI facilities to carry out traditional adaptive research work in the LDCs. However, those involved in planning agricultural research strategy for the Eastern Caribbean realized new procedures must be used to develop production technologies for the small farmer. To improve small farm productivity one must first make an assessment of the natural (physical or biological) and economic circumstances which determine why these farmers do what they do.

Secondly, after carefully studying the interacting cropping and livestock activities, and all the variables associated with them, the applied scientists should determine which of

the variables are placing greatest constraints on production. On-farm experiments are then devised to remove or reduce these constraints and thereby improve production. These on-farm experiments initially involve proven technological innovations to improve the farmers production. Such innovations have been developed and proven on experiment stations. The on-farm experiments are conducted to adapt these to the actual on-farm situation or the farming system.

In the process of conducting on-farm research, variables (production or economic problems) in the farming system are discovered which must be referred to the regional or central (core) research groups for solution through applied or basic research.

In 1978 AID provided CARDI with $2,210,700 in grant assistance to initiate the Caribbean Small Farm Multiple Cropping Systems Research Project (SFMCP) to develop an on-farm research capability with each host government in the six LDC countries of the Eastern Caribbean.

II. EXECUTION OF THE PROJECT

Background of Project Methodology

The basic framework for development of methodology to implement the SFMCP research was based on the CATIE approach (Project Paper, 1978, p. 29; Hammerton, 1979, p. 1). Various CATIE personnel presented an intensive course on implementation of FSR between the dates of 4/17/79 and 5/6/79. Following this course, CATIE terminology -- including the term "intervention" for farm research -- became the standard for the project. While certain CATIE staff made follow-up visits to CARDI (Moreno, 1979) and while funds were available from USAID for arranging closer ties between CATIE and CARDI (Hammerton, 1979, p. 1), no evidence exists that hands-on farmer's field experiences were ever exchanged between the two institutions.

Implementation of Project Methodology

Data Collection

The methodology proceeded from the initiation and completion of various baseline surveys between March and August of 1979 (based on a sample of 120 farmers per country and done under a contractual arrangement with UWI) to a selection of a sub-sample of farmers (± 25 per country) and initiation of more detailed data collection on a weekly basis between June, 1979 (St. Lucia) and January, 1981 (Dominica).[1]

The criteria used for selecting the sub-sample of farmers, from the original 120, were:

(a) Farm size between 1-5 acres (or 1-15 acres in St. Lucia);

(b) The farm should be representative of those near it;

(c) The farmer must be a willing participant; and

(d) The farm should be near a major road (logistical consideration).

No attempt was made between the baseline survey and the sub-sampling procedure to identify homogeneous sub-samples (or groups) of farmers based on some of the usual criteria, e.g., major cropping systems or predominant cash crop; part-time versus full-time farmers; rainfall and/or soil type classifications; tenure arrangement(s); marketing problems; predominance of bananas; etc.

A decision was made to have the country teams (CTs) collect agro-socio-economic data for a period of one year per country, with analysis of such data by the economic resource group in Trinidad to provide the quantitative basis for selecting interventions for farm research. Such a base of data was to complement the qualitative impressions and observations of each country team, so that major constraints could be identified and interventions designed to relleve such constraints.

The collection of the detailed agro-socio-economic data began in July 1979 in some of the project territories and proceeded through 1980 basically unchanged. Any interventions

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[1] Hurricane David was responsible for setting back FSR in Dominica.

done at this time were ad hoc in nature -- specific and repeated requests from individual farmers. Multiple problems in the data collection (Manteiga, 1980; 1981; Rosen, 1981; Cuevas and Weber, 1981; Goodhue and Ferraiuolo, 1981; CARDI, March 1981) led to a modification of both timing of farmer interviews (to fortnightly) and format (BUCEN forms, 1981).

Interpretation of Data

Farm Profile

In August, 1981, the methodology was further revised to begin a concentrated effort to finish the farm profile (FPs) (Manteiga, 1981). These FPs, which do not appear in the project paper, are basically case studies of the farming operations of some of the ± 25 farmers in the sub-sample (Jessee, 1981, p. 16). Depending on the country, between zero (Dominica) and eight (Montserrat) FPs have been written by the CT members and edited by the respective country team leader (CTL). CARDI seems to have settled on five FPs per territory -- not selected or using any homogeneous grouping criteria -- to represent the major visible project output before the end of phase I in November, 1982. Unfortunately, the nonsystematic selection of the FPs for completion means that the synthesis of a country's given FPs will not necessarily "represent" the farmers of that country, nor will a summary of FPs across countries necessarily represent the farmers of the Eastern Caribbean.

Identifying Farmer Constraints

Too much data has been collected, coded and stored to meet one of the key objectives of the project, namely, the rapid identification of key farmer constraints to allow design and implementation of initial farm trials. Three broad types of data exist. The first, the two baseline surveys, were both completed relatively early in the project life. However, the final reports (Henderson, and Gomes, 1979; Rankine, et al., 1980) are quite long on tabular presentations and quite short on analysis. In addition, neither set of data was available until the project had progressed beyond the need for the general information they provided. The

fact that both surveys were contracted out to UWI may have been a good political move, but for quick turnaround and a greater understanding of the 120 farmers surveyed in each country, CARDI staff have very little feeling.

The second type of data generated, representing the in-depth farmer interviews, was originally a good idea whose timing and objectives have been consistently misinterpreted. In the first place, such interviews should take place (if at all) only after the farm universe has been stratified into homogeneous groups of farmers. Such interviews should either coincide with, or follow (not precede) implementation of farm trials.

However, this second type of in-depth data also exists at two different, and not wholly compatible levels:

(a) The memories, notebooks and worksheets of each CT enumerator, and

(b) UWI's computer and subsequent printouts.

However, the various CTs either consider their own personal recollections (level (a) data) more "valid" than CARDI's centralized data (level (b) data), or they feel that the printouts and subsequent analysis will corroborate their impressions of the various farming realities of their particular territory. Neither view is totally correct. The sad facts are that (1) the complexity of the data already collected is such that levels (a) and (b) can never be reconciled (Chang, personal communication, 1982), (2) the reason for collecting the data in the first place has never been made clear to each CT, and (3) it is much more difficult to see the forest for the trees given the incredible quantity of data which exists. Too much emphasis initially was placed on component complexity, and this emphasis tends to obscure the overall project objective of discovering and ranking farmer constraints.

Finally, a new streamlined collection format, as developed by BUCEN and recently implemented in all countries, has made data collection easier for the CTs, but has done nothing to address the basic issue of sampling methodology. The new format is being used to extract yet more time series data from the same sub-sample ($n = \pm 25$) of farmers who were chosen using ad hoc criteria in the first place.

The detailed project data (based on FP formation to date) has failed to characterize either the Caribbean farmer in general (sample size too small and nonrandom), or to assist in identification of some groups of homogeneous farmers (ad hoc selection of sub-sample of farmers for formal FP preparation).

Interventions

Introduction

Interventions have been identified in all project countries. Such interventions have never been identified from "official" data analysis (i.e., computer printouts of data summaries), but have arisen from (1) informal observation and/or prior researcher opinions as to what the farmer's real problems are, and (2) informal brainstorming sessions (or workshops) during which CT members interact to extract constraints from their memories, notebooks and worksheets. As if the term "intervention" is not bad enough, the project has evolved a modification, known as "exploratory intervention". This term refers to a very small, simple change in the farmer's crop system practice, which is unreplicated and truly ad hoc in origin and intent (i.e., it is exploratory).

The number of interventions identified vary from about 7 to 15 per country, and include mixtures of prior shelf technology (the tech-pack concept) -- examples include introduction of virus-free Lisbon White Yam and a fusarium wilt-resistant tomato variety -- and constraints identified by the CT because of the data collection exercise. Without screening both types of potential interventions through a selected, homogeneous group of farmers, no CT can possibly hope to develop rankings of farmer-perceived constraints. Without such tentative rankings, intervention (or farm trial) design becomes a more random process than it should be, and the probability of introducing a significant improvement into the farmer's cropping system, which will achieve a self-sustaining adoption on his farm, is reduced.

The team saw very little data on the results of the interventions. Appendix C lists the titles of the interventions for the eight islands along with the status of the trial and number

of farms. The interventions, started in St. Lucia in 1980, involved planting legumes on farmers fields. These legume trials, including blackeye peas, peanuts, kidney beans and bodie beans, were conducted on ten farms. Some of the farms had just one legume while others had two or three. Data collected included yield, consumption on the farm, planting and harvest dates. There was no replication nor was plant population recorded. Many of the legumes were planted into mixed cropping areas. The major objective was to increase protein consumption of the farm family. The amount of protein consumed per family was calculated and ranged from 2.6 to 28.8 pounds.

The objective to increase protein consumption was very good but the data collected will not enable the CT to make recommendations for other farmers. Is it better to grow tannia and sell it and buy imported legumes or should the farmer grow cowpeas? If comparisons were made of the amount of protein produced by growing cowpeas as compared to tannia, the results would be more dramatic. With a little refinement in technique, some very useful information could be obtained.

Identification of Crop Production Constraints

In May 1981, several core CARDI staff met along with all the members of the SFMCP to identify the crop production constraints on the different islands. The publication for St. Lucia by George, et al. lists the general as well as specific constraints. Most of the constraints involve pest control, water problems, seed problems, fertility problems, etc. As a result of this meeting each country team was to make a report for each of the interventions. The report was to include the title, objective, justification, procedure and results. This was a very good exercise. However, there was no systematic consideration of the consequences of these interventions.

In addition, the workshop participants agreed (CARDI, 1981, Appendix C) that three of the major constraints facing Eastern Caribbean farmers are (1) labor, (2) water and (3) marketing-related issues. In following up these approved interventions, Table 1 reveals that a total of 40 trials of 8 major agronomic types were planned for between 163-173+ farms.

Table 1. Agronomic Types of Intervention Trials Selected by CARDI in May, 1981

Type of Trial	No. of Trials	No. of Farms to Receive These Trials	No. of Territories to Conduct These Trials
Improved Variety	6	34-36	4
Fertilizer Levels	5	24-28[2]	4
Pest Control (Weeds, Insects, Diseases)	4	18+	3
New Cropping Systems	2	20	2
Livestock Intervention	2	5+	2
Density (Plant Population)	1	6	1
Intercropping/Planting Pattern	9	48+[2]	4
Tech-Pack Approach	11	8-12+[2]	5
TOTALS	40[1]	163-173+	

[1]This total includes counting 6 combination trials twice. Thus, actually 34 trials were to have been planted in 1981.

[2]These trials exclude all combination trials. Thus, the total of this column represents the total number of farms (locations) with intervention trials in 1981.

SOURCE: CARDI. 1981. "Summary of Intervention Workshop Held on May 18-23." Small Farmers Multiple Cropping Systems Research Project CARDI/USAID 538-0015, Trinidad, W. I.

Trials based around the tech-pack approach (n = 11, or 27.5% of the total) and intercropping and/or planting pattern (n = 9, or 22.5% of the total) represent 50 percent of all interventions designed (n = 20). More traditional trials, based on introduction of new varieties (n = 6, or 15%), fertilizer levels (n = 5, or 12.5%) and pest control (n = 4, or 10%) represent about 31.5 percent of the remaining trials. The remaining trials -- 12.5 percent of the total -- represent new crop system introductions (n = 2), livestock interventions (n = 2) and density (plant population) trials (n = 1). With the exception of the weed control trials, the livestock interventions, the density trials and the intercropping/planting pattern interventions, it is not clear that the remainder of the trials were planned from identified farmer constraints.

The depth of on-farm research proposed by CARDI is better documented in Table 2. Here, 19 different crops and/or livestock systems are proposed for research. Sweet potato, with a total of six trials on 36-38 farms in five territories has twice as many trials as the next most prevalent crops, yam and peanuts (proposed for three trials each in two and three territories, respectively).

Finally, Table 3 records a territory-by-territory presentation of number of farms for interventions and number of crops and/or livestock systems. With the exception of St. Lucia (proposing 45-49 farm trials) and Montserrat (proposing more than 30 farm trials), the other territories appear to have selected a manageable number of farm trials to monitor. However, perhaps those territories proposing interventions in 5-6 different crops and/or livestock systems (St. Lucia, St. Vincent, Antigua, Montserrat and St. Kitts) are over ambitious in their goals. The tendency appears to be the same as at the onset of the project -- the manpower of the CTs will be spread too thin in these cases. Table 3 also shows implementation of 1981 interventions. These took place on approximately 90 farms throughout project territories.

Design of On-Farm Research

Intervention design is based on introducing simple technology or variety changes to small areas of farmer's cropping or livestock systems. With the exception of the CT in

Table 2. Specific Crops and/or Livestock Systems for Intervention Trials by CARDI, May, 1981

	Specific Crops and/or Livestock System	No. of Trials	No. of Farms	Specific Territories to Host Trials
1.	Yam	3	16-22	St. Lucia, Antigua
2.	Cabbage	1	6	St. Lucia
3.	Tomato	2	10	St. Lucia, Antigua
4.	Sweet Potato	6	36-38	Antigua, Montserrat, St. Kitts
5.	Grain Legumes	2	20	St. Lucia, St. Kitts
6.	Sheep	1	5	St. Lucia
7.	Peanuts	3	6+	St. Vincent, Nevis, St. Kitts
8.	Cowpea	1	6	St. Vincent
9.	Tannia/Dasheen	1	6	St. Vincent
10.	Arrowroot	1	6	St. Vincent
11.	Rabbits	1	+	St. Vincent
12.	Tannia	2	12	Grenada, Montserrat
13.	Carrots	2	10-12	Antigua, St. Kitts
14.	Beans	1	6	Antigua
15.	Banana/Intercrops	2	12+	Montserrat, Dominica
16.	Hot Pepper	1	+	Montserrat
17.	Forage Legume	1	+	Montserrat
18.	Cotton	1	+	Nevis
19.	Banana	2	+	Dominica, St. Kitts

SOURCE: CARDI. 1981. "Summary of Intervention Workshop Held on May-18-23." Small Farmers Multiple Cropping Systems Research Project CARDI/USAID 538-0015, Trinidad, W. I.

Table 3. CARDI Intervention Trials by Territory, May 1981

Territory	No. of Farms with Intervention Trials		No. of Crops and/or Livestock Systems	
	Planned	Actual	Planned	Actual
St. Lucia	49	31	6	5
St. Vincent	24	12	6	3
Grenada	14	12	2	2
Antigua	30	6	5	2
Montserrat	30+	10	5	4
Nevis	8	6	2	2
Dominica	10	8	1	1
St. Kitts	20	4	5	2

SOURCE: CARDI. 1981. "Summary of Intervention Workshop Held on May 18-23." Small Farmers Multiple Cropping Systems Research Project CARDI/USAID 538-0015, Trinidad, W. I.

Montserrat, trials are placed in farmer's fields without replication. In Montserrat, three replicates each of corn (+ peanuts) and peanut spacing were observed on two different farms. Interventions are basically viewed as observation trials for new technology.

Execution of On-Farm Research

Mechanics: -- Finally, farm trials (interventions) are in place in all countries, but only on an ad hoc basis (George, undated). Homogeneous groupings of farmers have not been formed on a sufficiently large scale to allow intervention to be implemented on a statistical basis to assure area representability (Jessee, 1982, p. 17). As far as the evaluation team can ascertain, no formal methodology exists within CARDI to direct the individual CTs beyond the point of constraint identification and ad hoc intervention development.

Benefit to Small Farmer: -- The interventions have benefitted some of the small farmers associated with the project. However, this phase of the project is of such recent origin that no multiplier effect yet exists. In addition, not all interventions have resulted in net benefits to the small farmers (e.g., the fusarium-resistant Calypso variety of tomato introduced on some farms in southern St. Lucia has not solved the wilt problem there), nor have all interventions been accepted by the recipient farmers. More explicitly, in the case of Antigua, a logical agronomic intervention introduced by the CT is mulching with Guinea grass. This intervention conserves moisture on an island which received relatively little rainfall, helps to keep weeds in check, and may reduce vegetable losses to diseases. However, some of the farmers are not ever using the mulch supplied by the CT, arguing that is is too much work. In fact, it would not be too much work if each farmer had a ready supply of Guinea grass close at hand at the beginning of the cropping cycle before the weeds begin to grow. However, they do not have a nearby supply of mulch material, so they perceive the riskiness of spending time looking for a source of mulch too great when compared to the known risk of weeding every day. Thus, they opt for the known drudgery of weeding.

In general, since the project has not progressed to the verification phase of technology -- to say nothing of the demonstration phase -- it is unreasonable in the

evaluation to look beyond the sub-sample of collaborators for evidence of technology spread. Under ideal conditions of project implementation, with interventions in 1980, verification in 1981 and demonstration in 1982, little multiplier effect would have been expected until 1983.

Linkage With Extension

The evaluation team sensed that a new dimension has been added to the agricultural research-extension relationship on which we can now build. We view the FSR effort of CARDI in the Eastern Caribbean as an applied research infrastructure to the bridge between research and extension. The bridge is built by getting the involvement of the extension service in all phases of this project from planning to execution and evaluation. By involvement of the extension worker in the on-farm testing program from the onset, technology dissemination is made without any time delays. Once the experiments have been evaluated, the extension team member is familiar with it and can communicate the appropriate technology to a larger group of farmers.

Summary of Implementation Problems

Lengthy sections of several documents are devoted to many of the implementation problems of SFMCP (Jessee, 1982; Manteiga, 1980, 1981; Rosen, 1981; Cuevas and Weber, 1981; Goodhue and Ferraiuolo, 1981; CARDI, 1981; Chang, 1981). Although on-farm experiments form the core of FSR, extension personnel acquainted with programming and technology dissemination should be consulted in the initial stages of the on-farm program as to how to maximize multiplier effects and farmer acceptance. The evaluation team recommends that the FSR project director establish a FSR Program Operations Group composed of the director, the two technical coordinators, a technical extension advisor from UWI and the seven country team leaders. The Technical Extension Advisors Position should be a part time consultative position. We recommend that this Program Operations Group meet once a month for two days to consider project programs, methodology, and progress. We feel the group should meet in a different project territory each time, prioritizing the

visits on the basis of the needs of the territory programs. In view of the evaluation team, the most serious of the problems encountered include the following:

(a) Early and systematic evaluation of the SFMCP by USAID, while specified in the Project Paper, never occurred. The team found no evidence of quarterly reports, the usual method of tracing a project's progress.

(b) The data collection process has been allowed to dictate project objectives and manpower deployment, not vice-versa.

(c) The project, partly exacerbated by the early decision to begin working in eight territories, has spread itself too thin and has tried to capture far too much detail about a sub-sample of farmers which represents neither a homogeneous group within a country nor a random sample of the country's farmers.

(d) Ad hoc exploratory interventions do not necessarily represent constraints identified in the informal or formal data analysis processes, nor have they been systematically replicated enough to represent either within-farm or intra-zonal variability.

(e) Too much up-front emphasis on data collection and detailed analysis, coupled with a lack of implementation flexibility, lead to a cautious, slow approach to field trials (interventions). This is a rather inefficient attempt at implementation to date.

(f) Failure to attain a true interdisciplinary interaction of CARDI core personnel has led to minimal benefits from the potential interaction of the several disciplines involved in the research project.

(g) Centralized decision making, as distinct from true research team concensus, has led to a certain fragmentation (or compartmentalization) of expertise and formation of the attitude of "we-them", particularly between (1) central leadership and the socio-economics resource unit, (2) the CTs and the rest of the project, and (3) a given CT and other CTs.

Recommendations for Future Implementation

The important thing is not to spend time dwelling on past problems of the project, but to build on the impressive CT bases in each territory in a more efficient and systematic manner.

Identification of Target Crops and Animal Systems

The first step in continuing the SFMCP is to identify, using secondary data, major import and export crops and animal products by territory (Mohammed, undated, pp. 4-5; Mohammed, 1981, p. 5, item 5; Mohammed, 1982; Ali, 1982). CARDI has direct access to this information for certain years during the 1970s (Barker, 1981) but a 5-year trend, using the most current statistics, should be used for decision making. Next, CARDI should identify major import crops for which reasonable expectations for successful import substitution can be expected through applied on-farm research. In addition, current export crops with an assured expansion market overseas (or interisland) could be added to the list of research priority crops. Then the CARDI multidisciplinary team could assist each CT in identifying those farmers in the current sub-sample who produce such crops or animal products, in whatever systems exist. Finally, groupings of homogeneous farmers can be formed for farm trial implementation, augmenting the sub-sample of approximately 25 farmers whenever necessary to form some reasonable approximation of a statistically representative sample (Carew, 1982, pp. 2, 6).

Identification of Homogeneous Farm Groups

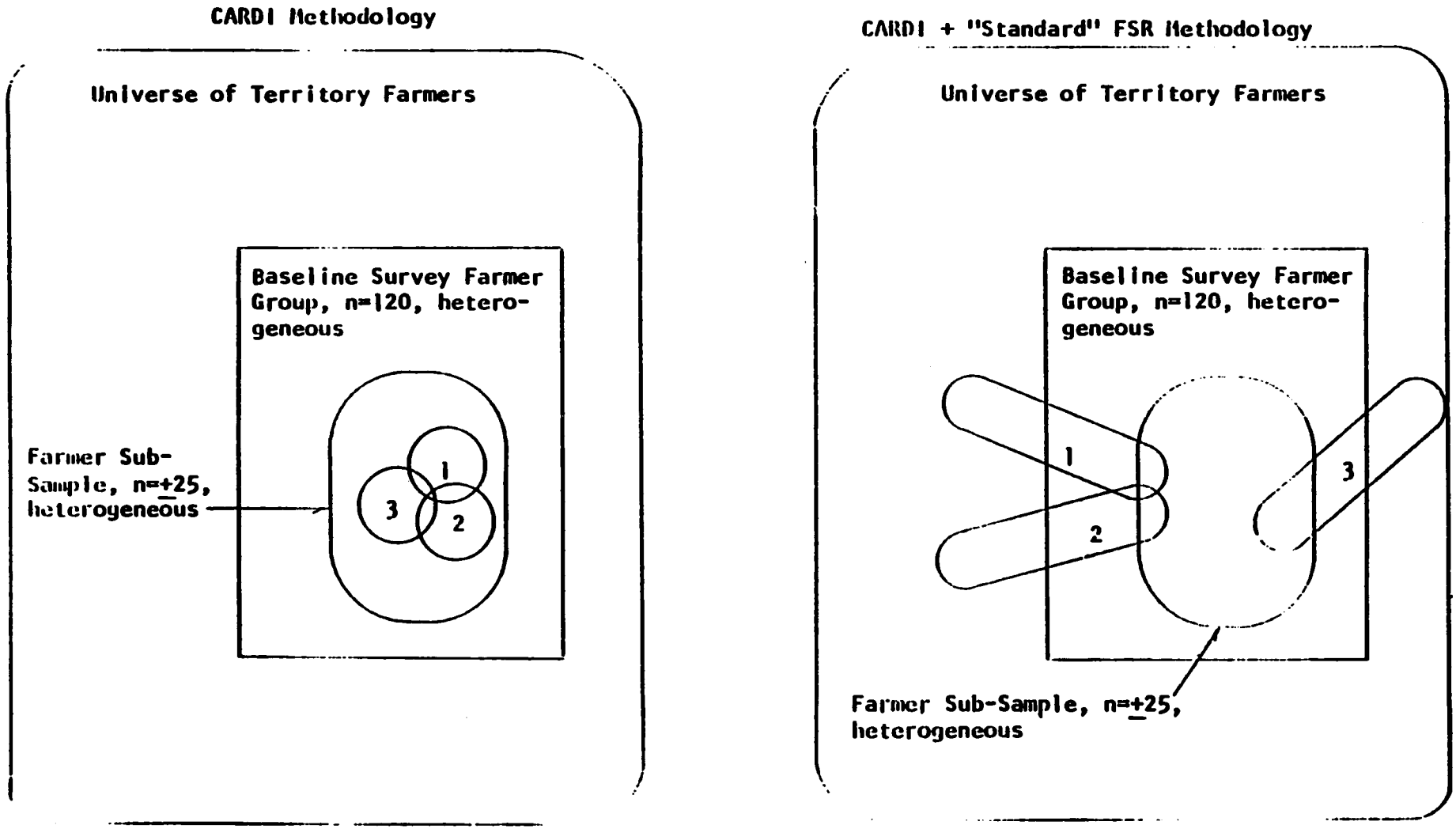
Current CARDI sampling methodology has been dealt with in a previous section, but the main framework can be summarized as follows: (1) from the entire territory (island) of full and part time farmers, 120 were selected for the baseline survey; (2) from these 120 farmers, approximately 25 were selected for detailed weekly data collection; (3) certain ad hoc exploratory interventions or interventions have been implemented, or will be implemented within sub-groups of these approximately 25 farmers without thought of homogeneity or statistical representability; and, (4) a revised, streamlined data collection format

is being used to continue extracting agro-socio-economic data from this group of farmers (Figure 1). The heterogeneity of the farmer sub-sample may well mean that insufficient numbers of homogeneous systems can be identified for interventions. In such cases, the SFMCP collapses to an extension exercise with little or no multiple effect potential, since statistical conclusions about the acceptability of the improved technology cannot be made due to small sample size (Figure 1).

However, once the crops or animal systems for research priorities have been identified, the CTs can select homogeneous groups of farmers, based on these priority systems, from (1) the sub-sample of approximately 25 farmers and (2) augment the number to 8-25 by selecting additional farmers from either the baseline survey group of the territory universe of farmers, or both (Figure 1). The number of farms to include in each homogeneous group varies between 8-25 according to (1) the underlying homogeneity of the new sub-sample, (2) the manpower of the particular CT, and (3) the expected magnitude of the improvement being introduced into the system. From a statistical point of view, items (1) and (3) should be used in determining the number of farm trials. From a practical point of view, most CTs should begin by assessing their own internal capabilities, determine the total number of farms they believe can be managed, and then decide how many homogeneous groups of farmers to whom they can introduce farm trials during 1982.

For example, if the CT is composed of four members (a CTL, two CARDI employees and one government counterpart), probably a maximum of 20 farms with replicated trials can be managed well. Thus, the choice would be between working with one homogeneous group of farmers (n = 20) on a single farm trial type with a very high chance of extendability via statistical confirmation of results, or working in two teams of two CT members with two homogeneous groups of farmers (n = 10) with a fairly good chance of observing statistically different results across farms. However, working in three homogeneous groups with three teams on 6-7 farms each may (1) dilute the effort of the CT too much by increasing travel and (2) making statistical conclusions from any of these sets of farm trials less likely.

FIGURE 1: TWO FARMER SAMPLING METHODOLOGIES



= Intervention Group 1-3, n=4-12, may be heterogeneous or homogeneous

= Farm Trial Group 1-3, n=6-25, is homogeneous by selection

The CARDI personnel need to address the issue of whether six farms -- especially six farms not selected for their homogeneity -- is a large enough sample to allow statistical inferences to be drawn from on-farm trials (the proposed number of locations, or farms, per trial ranges from 4 to 12, with a mode of 6). While CARDI administration may believe that the interventions will increase yield (or decrease labor inputs) by a factor of two or three times per intervention, experience in other FSR programs would indicate that such magnitudes of benefits are rarely, if ever, attained. More likely an intervention will lead to a 10-30 percent advantage. In this latter situation, many more sites are required to prove the statistical advantage of the intervention than in the former.

On-Farm Trial Design

Unless the project selects 20-25 sites (farms) for trials, much thought should be given to trial replicates on each farm site. Two or three replicates of each trial add somewhat to the time required for design, layout, planting, observing, harvesting and analyzing each trial, but no other mechanism will enable the research team to evaluate the importance of intra-farm variability, or to provide a compensating mechanism if a section of the trial is inadvertently destroyed. Some good general outlines for addressing particular trial design and replication are contained in the CARDI publication "Design and Layout of Field Experiments in Conditions Experienced in the CARICOM Area" (Lauckner, 1980).

Implementation of On-Farm Trials

The methodology for on-farm testing is outlined very well by Dr. K. A. Gomez in her 1977 paper entitled "On Farm Testing of Cropping Systems." She discusses the technology-development research as well as technology-adoption research. The first seeks to develop technology while the second tests the acceptability of the technology to the farmers. She addresses several key issues (1) the need to test on several farms, (2) selection of test sites, (3) precision of on-farm trials, (4) measurements of environmental factors, (5) technology to be tested, (6) choice of factors to be tested, (7) test criteria, (8) farmer participation, and (9) data to be collected.

Figure 2 provides a simplified summary of the CARDI SFMCP methodology flow from project inception through March, 1982. Given the fact that the farm characterization stage should be less a formal exercise (via farm profile development) and more of an interdisciplinary workshop exercise, the evaluation team would recommend this step be completed during the month of April, 1982. In addition, each CT which has exploratory interventions, either from last planting season (May-August, 1981) or from this season (November, 1981 - January, 1982), should be ready by the end of April to summarize their observations about such trials (Figure 2).

Figure 3 begins by demonstrating how CARDI can move from the phase of pre-analysis of farm profiles to design of farm trials (FTs) in two months. Note that this figure provides a time frame for field events and three columns dividing SFMCP activities into three areas: (1) data collection, (2) decision-making (or analysis) and (3) farm-level trials. A quick comparison of Figures 2 and 3 reveals a much heavier emphasis on field actions -- farm trials and interaction with collaborating farmers about such trials -- in the future. However, the greatest change is in the center column -- decision making and/or analysis. The project cannot function with the efficiency required of it during a massive farm trial campaign unless much greater emphasis is placed on efficient use of manpower and time, or unless much greater reliance is placed on multidisciplinary team consensus.

After a centrally-directed workshop analysis to define major country restraints is held (end of April or early May), each CT will be able to perform the next three steps: (1) selection of homogeneous farming groups, (2) definition of their major constraints and (3) design of farm trials (Figure 3). (More specific details on farm trial implementation have been provided in Table 4.) By July, 1982, each CT will be ready to implement replicated farm trials statistically representative of the underlying homogeneous sub-sample of farmers (refer to Figure 1, right-hand side). While these trials are in the field, the CT will need to be performing three activities:

FIGURE 2: CARDI SFMCP METHODOLOGY FLOW, 1978 - MARCH, 1982

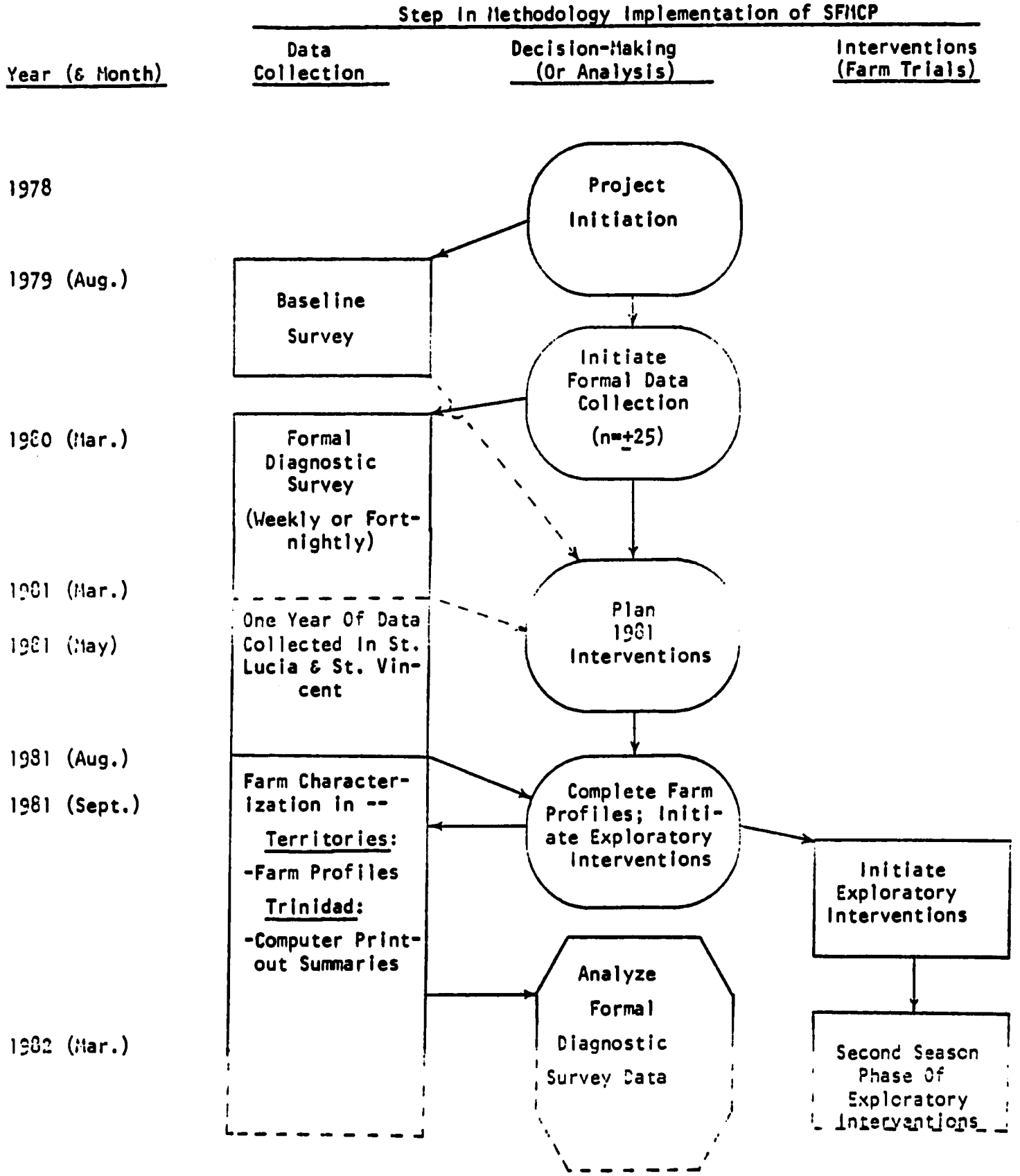


FIGURE 3: PROPOSED CARDI SFMCP METHODOLOGY, MARCH, 1982 - PHASE II

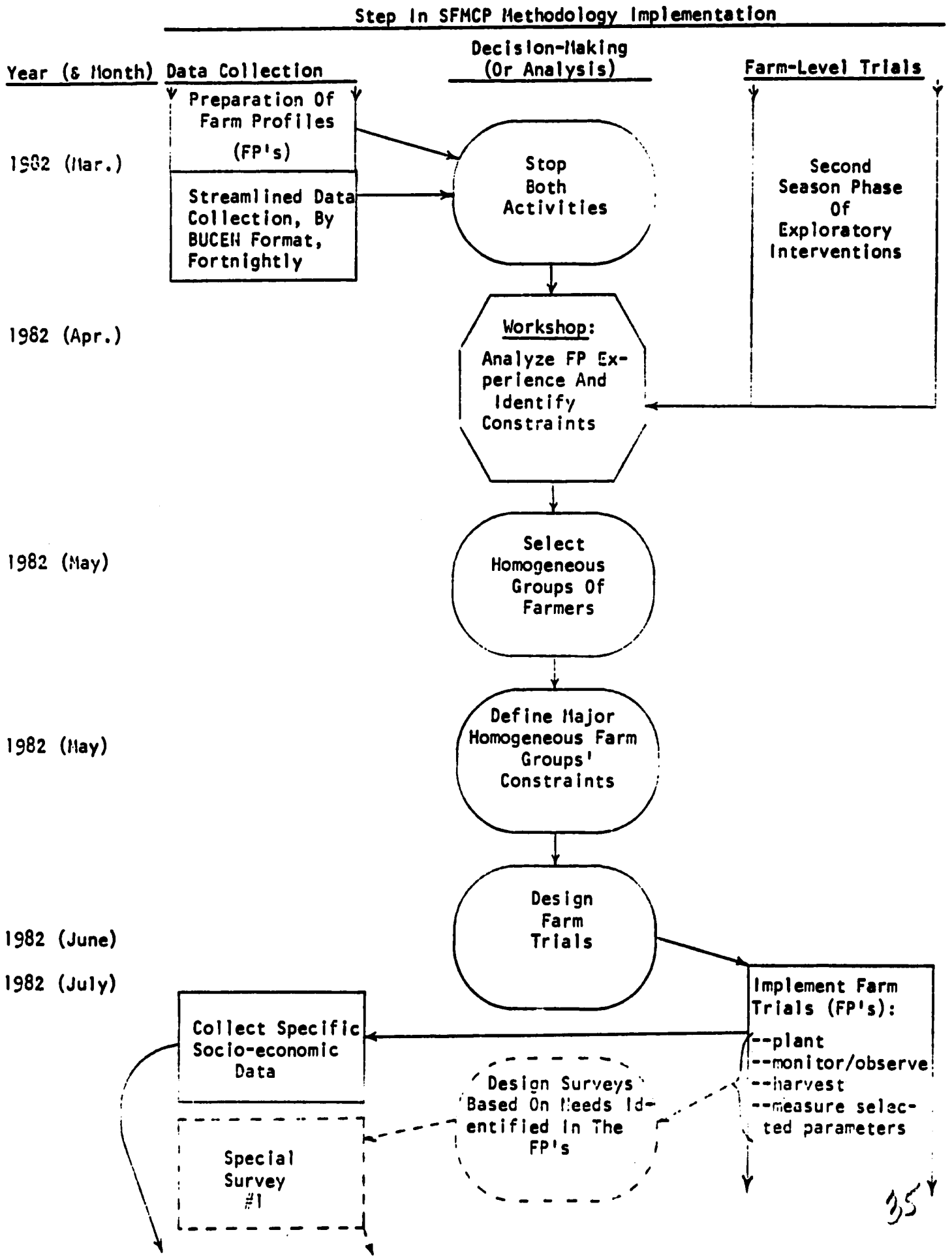


FIGURE 3, CONT.

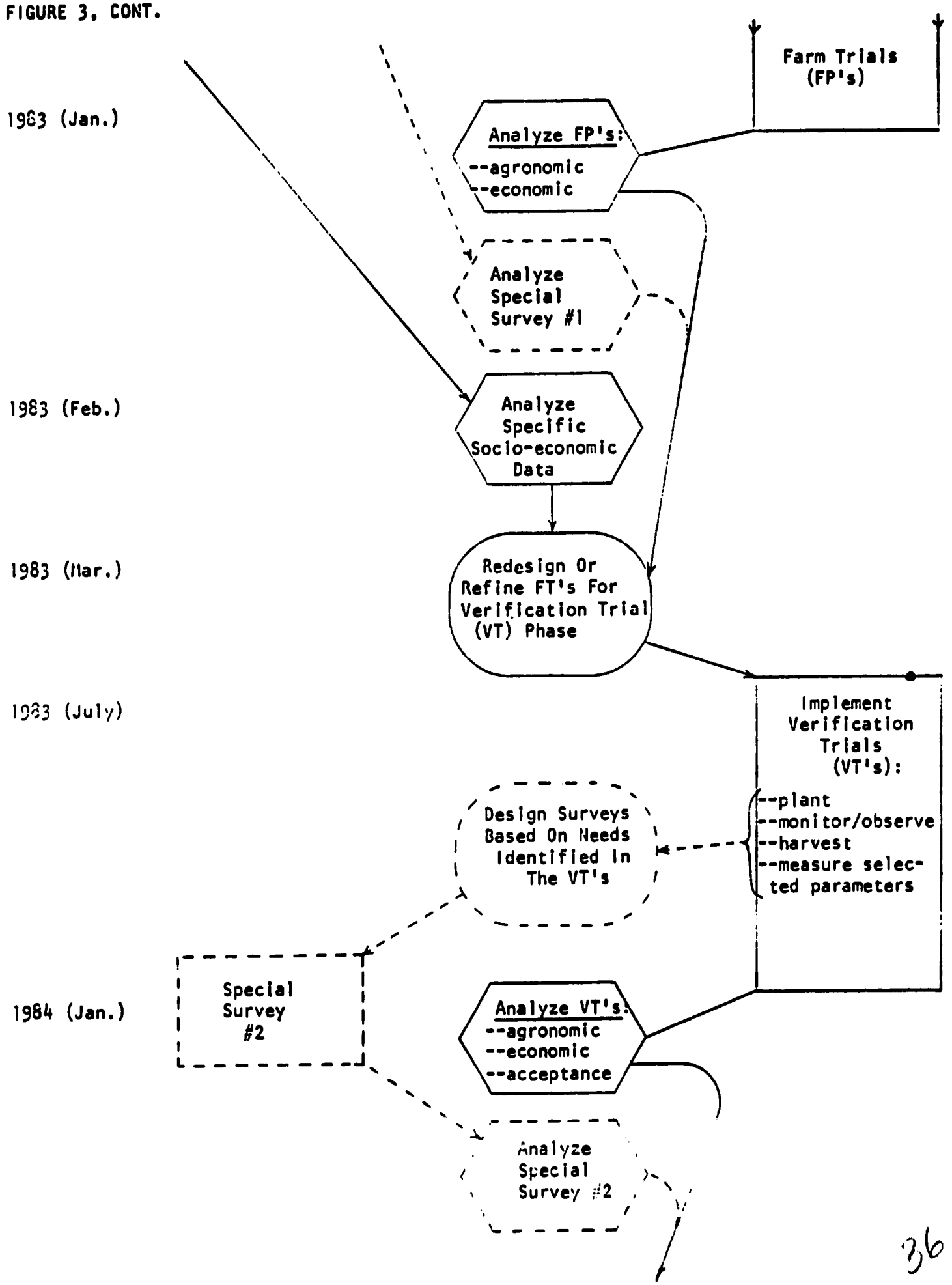


FIGURE 3, CONCL.

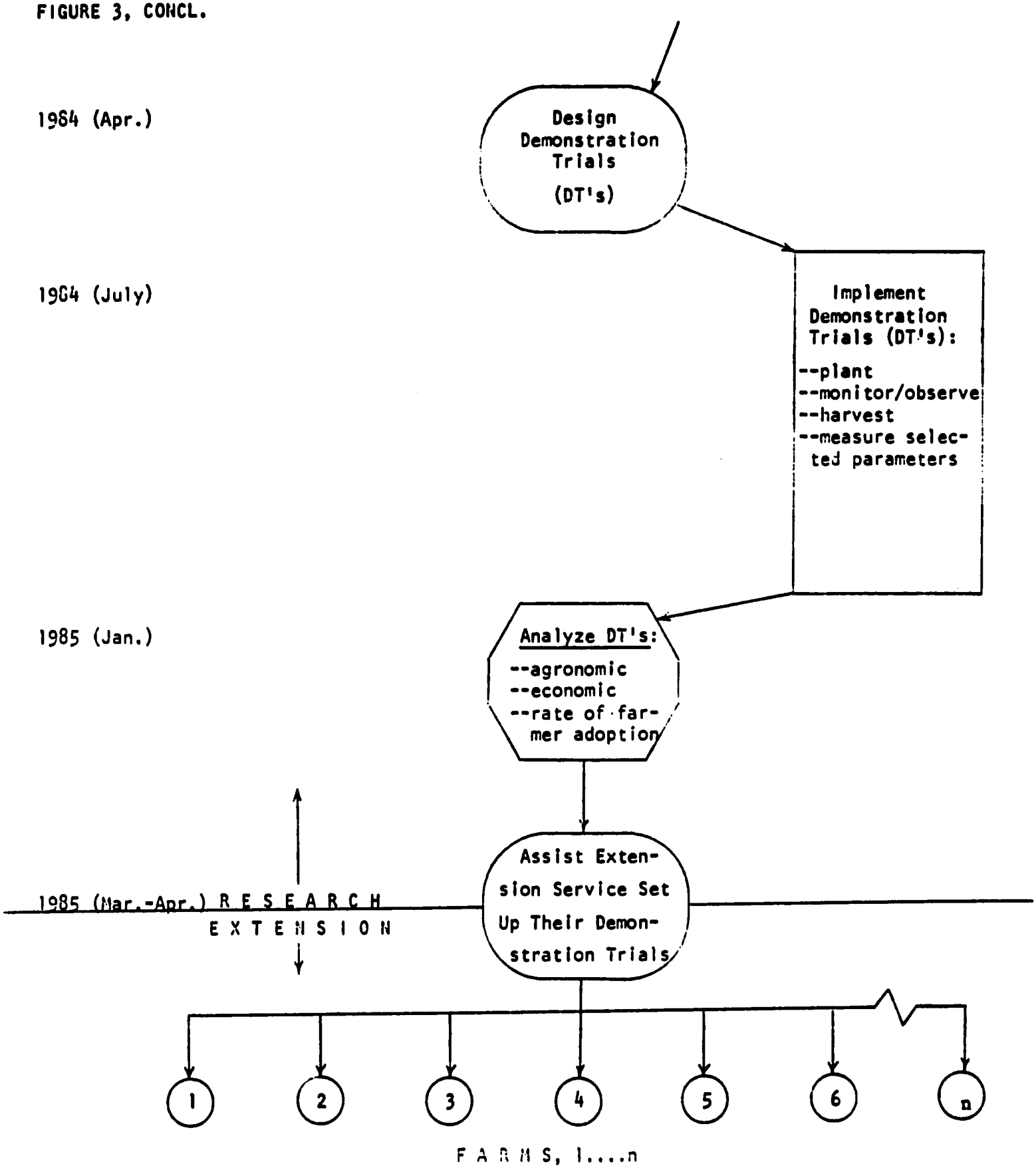


TABLE 4. Implementation Details of On-Farm Trials, March 1982 - Phase II

Step	Decision Format	Time Frame	Personnel Involved
1. Identify priority crops/livestock systems	Workshop	April, 1982 (2 wks)	CT
2. Identify major farmer constraints	Workshop	April, 1982 (1 wk)	CT
3. Select homogeneous group(s) of farmers	Reconnaissance On-farm	May, 1982 (1-2 wks)	CT
4. Identify specific constraints of homogeneous farmer group(s)	Sondeo followed by Workshop	May, 1982 (1-2 wks)	CT
5. Develop list of parameters to monitor in trials	Workshop	June, 1982 (1 wk)	Technical Coordinators, Project Coordinator, CTL's
6. Design Farm Trials	Workshop	June, 1982 (1 wk)	CT
7. Review Farm Trial designs and objectives	Workshop	June, 1982 (2 days)	CT with Biometrician and Technical Coordinator
8. Finalize Farm Trials	Workshop	June, 1982 (2 days)	CT
9. Acquire needed inputs, supplies and equipment per team	Purchasing	June, 1982 (1-2 wks)	Ct, Ad. Assistant
10. Set detailed planting schedule and reconfirm dates & times	On-farm	June, 1982 (1 wk)	CT

TABLE 4. Continued

Step	Decision Format	Time Frame	Personnel Involved
11. Plant (and re-plant) Farm Trials	On-farm	July-Aug., 1982 (2-4 wks)	Ct, Technical Coordinator Agricultural Economist
12. Monitor Farm Trials using agreed-upon parameters, and observing any unanticipated phenomena	On-farm	July-Dec., 1982 (every week until harvest)	CT and any disciplinary expert as the need arises
13. Collect necessary socio-economic data (date of sale, amount sold and price received)	On-farm	Aug-Dec., 1982 (every week until harvest)	CT and agricultural economist (at first)
14. Schedule harvests precisely with farmers and re-confirm	On-farm	Oct.-Dec., 1982 (1 wk)	CT
15. Perform pre-harvest measurements	On-farm	Oct.-Dec., 1982 (1 wk)	CT
16. Harvest Farm Trials	On-farm	Oct.-Dec., 1982 (3-6 wks)	CT
17. Analyze Farm Trial results statistically: ANOVA	Office	Dec., 1982 (2-4 wks)	CT plus Biometrician if needed

TABLE 4. Continued

Step	Decision Format	Time Frame	Personnel Involved
18. Analyse Farm Trial results economically (CIMMYT method)	Office	Jan., 1983 (1-3 wks)	CT plus agricultural Economist if needed
19. Draw conclusions from the Farm Trials	Workshop	Jan., 1983 (1 wk)	CT
20. Write up results of Farm Trials and send to Technical Coordinator	Office	Feb., 1983 (3 wks)	CT
21. Present results of (1) a particular farm and (2) the homogeneous area to each farmer individually	On-farm	Mar., 1983 (2 wks)	CT
22. Determine which treatments to advance to verification phase, which to drop, and which to modify (and how)	Workshop	April, 1983 (1 wk)	CT with Technical Coordinator, Biometrician, Agricultural Economist
23. Redesign Farm Trial to become verification trial	Workshop	April, 1983 (1 wk)	CT

5/0

(From here on, implementation details follow above, beginning with Step 7)

(1) Weekly monitoring of trials to observe and measure predetermined crop parameters (incidence and severity of diseases; infestation and damage by insects; weed types and densities; rainfall; animal damage; sales or consumption of thinned plants; etc.);

(2) Collection of any socio-economic data the SFMCP predetermines as necessary (date of sale, quantity sold, and price received for each crop sold, for example); and

(3) Decide whether any special surveys (on land preparation, tenancy history, cropping history, marketing constraints, etc.) are needed to assist in understanding the farmer group or for redesign of the FTs next year (Figure 3). (Note that the special survey and its subsequent analysis are both optional, and the realities of the area and farm trials will determine whether the CT thinks the step a necessary one).

The next three steps -- two analyses and one heavy planning (design) session -- are crucial for passing from the testing stage to the verification stage. A well-done but quick analysis of the agronomic and economic differences for each FT has to be accompanied by a rapid analysis of the abbreviated sales data collected during the year. These two types of information must then be brought together (around March, 1983) by the CT to allow design of verification trials. A synthesis of agronomic and economic data must be made this time, because an improvement causing a doubling of yield is only beneficial if the farmer can sell his product at a price which is sufficiently higher than his costs. If not, the improvement may cause the farmer to be worse off than his neighbor, especially if his input, harvest labor and transport costs are all marginally higher.

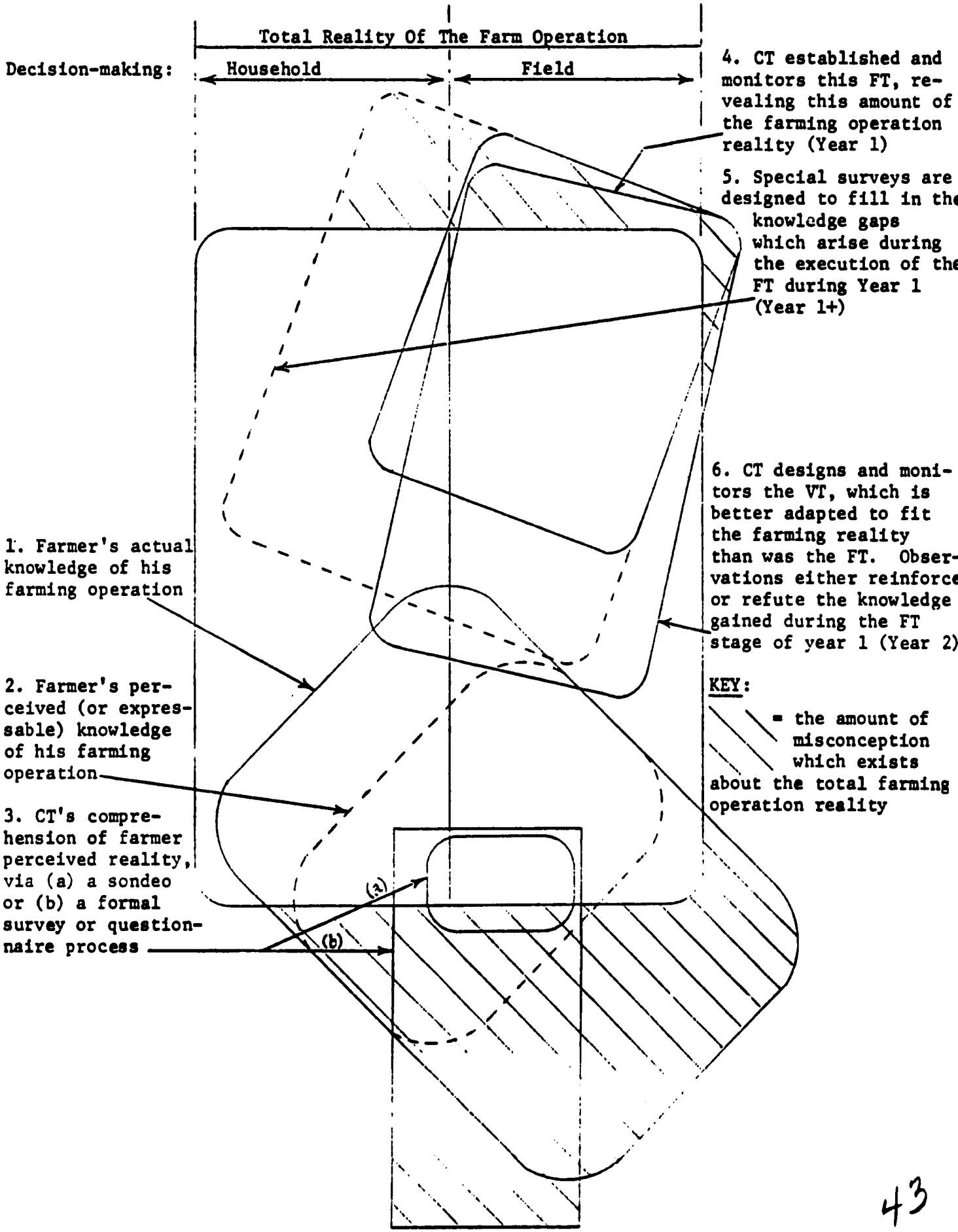
The remainder of Figure 3 presents the evolution of the SFMCP farm research from the stage where each CT has developed and implemented demonstration trials (May-July, 1984), to where they have analyzed the results of the demonstration trials (January, 1985). At this point (and preferably much before), the extension service must be involved with the project so that the information multiplier effect can take place (Figure 3).

In concluding the implementation of farm trials section, it is important to stress two major issues which have not been given enough emphasis by project leadership.

(1) Implementation of all stages of any FSR project should be flexible. Such flexibility includes the ability to shape the implementation around available staff, as well as around the predominant farmer conditions in general, and the specific farmer parameters as evidenced in each territory and homogeneous zone within each territory. Evidence of flexibility in implementation should be the willingness of project leadership to go ahead with the field work, even if all the background "homework" may be incomplete. The key to FSR is hands-on experience (Krantz, April 1981), which can only come about if each CT receives explicit directions from central project leadership to proceed with the farm trial stage.

(2) FSR is an iterative process allowing closer approximations to the farming reality across a predefined homogeneous group of farmers and some common farm system and its identified constraints. This point is closely related to (1) above, as the research group at first admits it does not know what the farmers are actually doing, then devises methods (questionnaires, farm trials, specific surveys, verification trials, demonstration trials, etc.) to add, step by step, to a better scientific understanding of the practices and decision-making criteria of the whole farm. Figure 4 presents a graphic illustration of this iterative approach to FSR. Note that the farmer (and his/her spouse) do not know all there is to know about the total reality of their farm operation (Figure 4, 1.), because they have access to only limited information on (a) technical agronomic/livestock relationships and interactions and (b) macroeconomic relations, such as territorial demand for each crop produced by the farmer, and demand for substitute commodities produced by other farmers and imported from external sources. In addition, the amount of knowledge which is actually transferable

FIGURE 4: APPROXIMATIONS TO FARM REALITY BY SURVEYS AND FARM TRIALS



from the farm family to outsiders -- the CT -- is less than that known by the family because of time limits, forgetfulness, the personal nature of certain types of information, etc. (Figure 4, 2.: dashed rectangle).

Thus, regardless of the amount of time spent questioning farmers, just so much knowledge representing the farm reality can be extracted in a second-hand manner (Figure 4, 3.). This is true whether the CT uses an abbreviated sondeo instrument (a) or a more detailed and lengthy questionnaire (b). Note that for field trial implementation, the shorter sondeo provides nearly as much information as the questionnaire, while avoiding the potential problem of collecting too much data to analyze properly. (The cross-hatched areas of Figure 4 represent the misinformation which exists at each step of the FSR process, beginning with the farmer's misperceptions of his/her farm operation reality and ending with the incorrect results of either the sondeo, the questionnaire, or both).

The next stage of FSR, then, involves focusing on solutions for the reality constraints of the homogeneous farms, as shown by the farm trial (FT) and subsequent monitoring (Figure 4, 4.). Again, being based on either a sondeo or questionnaire, and with no prior experience in farming in the homogeneous area, the FT of year one covers a portion of the constraints which affect farm field reality, but must inevitably contain certain misinformation (e.g., exact depth of seeding, depth of seed coverage, exact amount of pressure used to cover seeds, etc.). The CT should view this step as a critical learning experience to improve farm trials during year two. In addition to recording detailed observations and field measurements in year one, the FT and interactions with the farmer and his family may lead the CT to design a simple "special survey" to allow the collection of even more verbal information, systematically across the homogeneous farmer group, which is focused on a specific farm operation problem or constraint (Figure 4, 5.).

The results of the FT (and the optional special survey) are used by the CT, along with their informal observations and farmer suggestions, to design the verification trial (VT). The VT contains fewer experimental treatments and larger treatment plots, and should be an

even closer approximation to the solution of the particular constraint on farm operation reality (Figure 4, 6.). This is shown by the fact that the VT covers a larger segment of the farm operation reality than does the FT, and contains slightly less misinformation (Figure 4, 5. versus 6.). Therefore, it is absolutely crucial that the CARDI CTs be urged, and assisted as needed, to begin replicated, systematic FTs as soon as possible, so that the relief of homogeneous farmer constraints can move from being an office exercise to the field with collaborating farmers.

Summary

(1) All host territories, CARDI CTs and collaborating farmers are anxious to get on with farm trials.

(2) Plenty of data exist for each CT to select homogeneous groups of farmers and identify perceived major constraints.

(3) Little consideration has yet been given to the issue of field logistics of implementing full-scale farm trials. This is a vital, complicated step which requires a good deal of coordination and advanced planning. If not carried out well and efficiently, farm trial implementation will be sloppy and late in comparison to the farmer's practices.

To assist in alleviating this potential bottleneck, the evaluation team recommends providing each CT with: (a) guaranteed transportation to each homogeneous group of collaborating farmers, and (b) a set of basic equipment and supplies (twine, cutlasses, tapes, seed bags, plastic bags, tags, markets, field scale, etc.) for each sub-group handling a set of homogeneous farm trials.

(4) Each CT should decide, in consultation with the respective technical coordinators, how many farms statistically represent the homogeneous area, such that meaningful results from trials may be extended to other similar farmers.

(5) CARDI core staff must resolve the statistical issue of whether the farm trials are viewed as reps across a homogeneous area, or are also to be designed to gather information on intra-farm variability.

(6) Since much less emphasis is to be placed on immediate analysis of the socio-economic data in Trinidad, the evaluation team recommends that members of the economic resource unit join either the Leeward or Windward groups. This will allow more interaction between the economists and the CTs and farmers, as well as providing CTs, when needed, additional manpower for field trial implementation and trial analysis.

(7) Each CT should receive a programmable, hand-held calculator capable of performing: (a) traditional ANOVA analyses of replicated agronomic trials, and (b) CIMMYT-type economic analyses of the benefits of the improved farm trial.

A workshop should be given by the CARDI biometrician and the resource economists to familiarize each CT member with the use of these calculators.

(8) A farming systems agricultural economist or agronomist with hands-on experience in conducting farm trials should be assigned to the project full-time to work as a technical counterpart to the project coordinator for a period of not less than two years.

III. ORGANIZATIONAL AND FUNCTIONAL PATTERNS OF CARDI

The basic commitments and organization of CARDI are well reprsented in various documents (appendix) and therefore this section is directed toward a functional analysis of CARDI and particularly at those components of its structure that can be strengthened. This discussion considers the overall organization of CARDI as well as its specific involvement in farming systems research.

CARDI Administration Structure

CARDI's administrative structure at the time of this evaluation is shown in Figure 5.

Policy Level - Executive Director

The Executive Director's functions in policy making and liaison with regional governments seem quite clearly defined. The present Executive Director has developed a communication pattern with other institutions effective in broadening the resource base of externally funded projects.

Technical Guidance and Coordination

The Director of Research and Development is involved in matters of technical coordination, guidance and in operational and management concerns. This covers a very broad scope of projects and territories and presents a formidable challenge for a Director who must allocate his time to integrate people and resources into effectively functioning teams for research.

The technical management involving the surveillance of staff activities, projects and communications does not appear to be clearly organized. A clear line of management should be established at each level for communication purposes.

Recommendation

Some administration linkage between the Director of Research and Development and the various staff and projects needs to be added. The team recommends that CARDI consider establishing a Technical Management Group to assist the Director of Research and

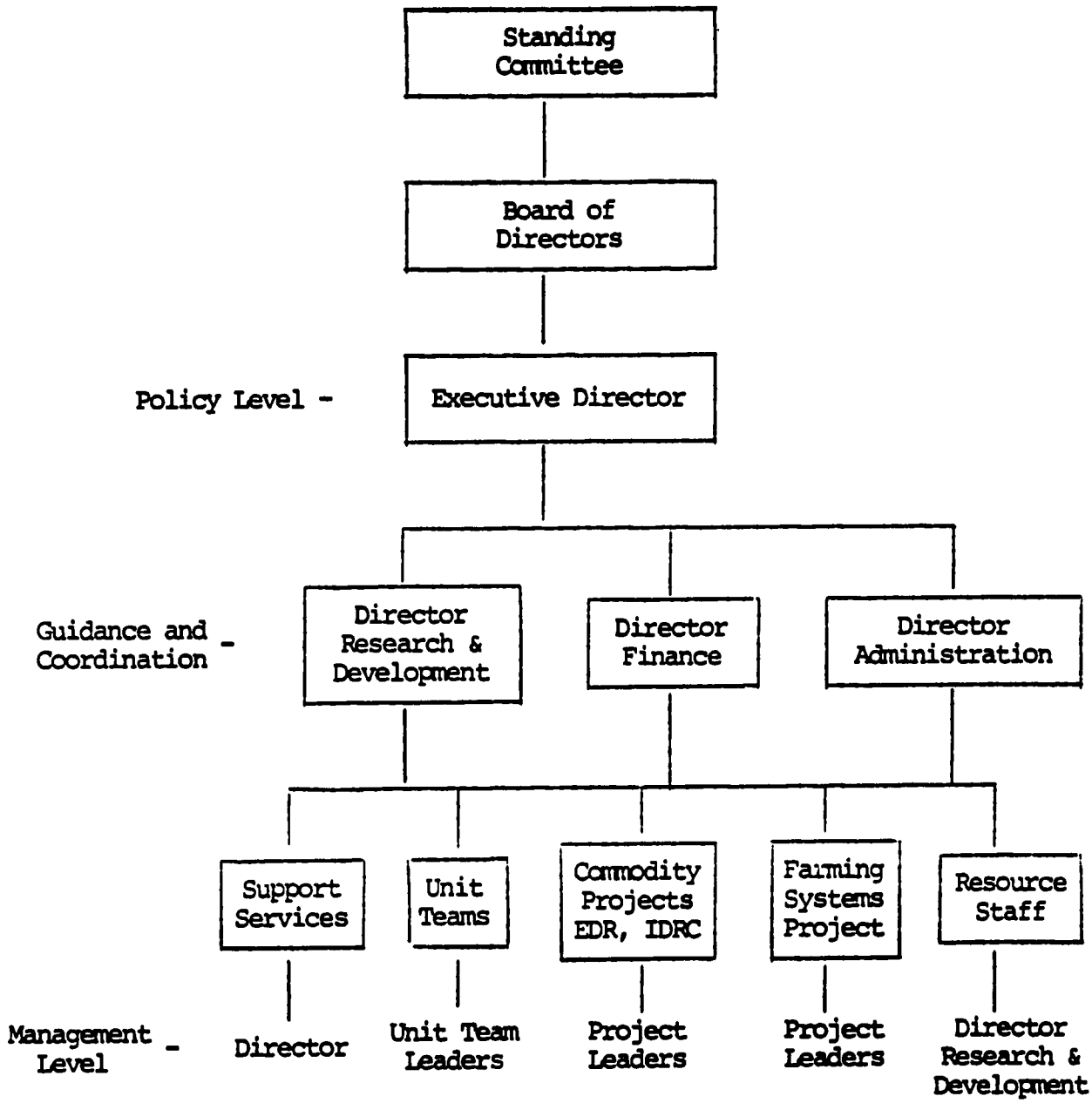


FIGURE 5

CARDI ADMINISTRATIVE STRUCTURE

Development in the overall management of technical personnel and resources of CARDI. This group should consist of each externally-funded Project Leader (Small Farming Systems Peanuts, etc.) and a leader of each in the following disciplines: plant sciences (agronomy, breeding, soils, physiology, weeds, etc.) plant protection, (plant path, virology, nematology, entomology, etc.), animal science, socio-economics (economics, anthropology, marketing, data processing, etc.), and the head of supporting laboratory services. These people would function (1) as a group for interdisciplinary communication among themselves and with the Director of Research and Development, and (2) as individual leaders to evaluate and monitor the various staff in their own disciplines. Such management positions would carry the responsibility of making recommendations for salary increments and for reporting the achievements and progress of each staff member to the Director. It may be necessary to include unit heads of territories in this group. This management group should probably meet 4-6 times a year. This is shown graphically in Figure 6.

Operational Guidance

At the present time two positions, Director of Administration and Director of Finance, have been established by the CARDI Board of Directors.

Recommendation

For budgeting and operational reasons, the positions of Director of Administration and Director of Finance should be combined into one position, the Director of Administration and Finance.

The specific responsibility of this position should be clearly defined especially in matters of administration where project leaders and country team leaders involved in the same territory are concerned. This position has to be concerned with the business functions which support and maintain staff and overall communications.

An upgrading in the quality of the financial control systems in the various territorial projects can be expected with this administrative structure.

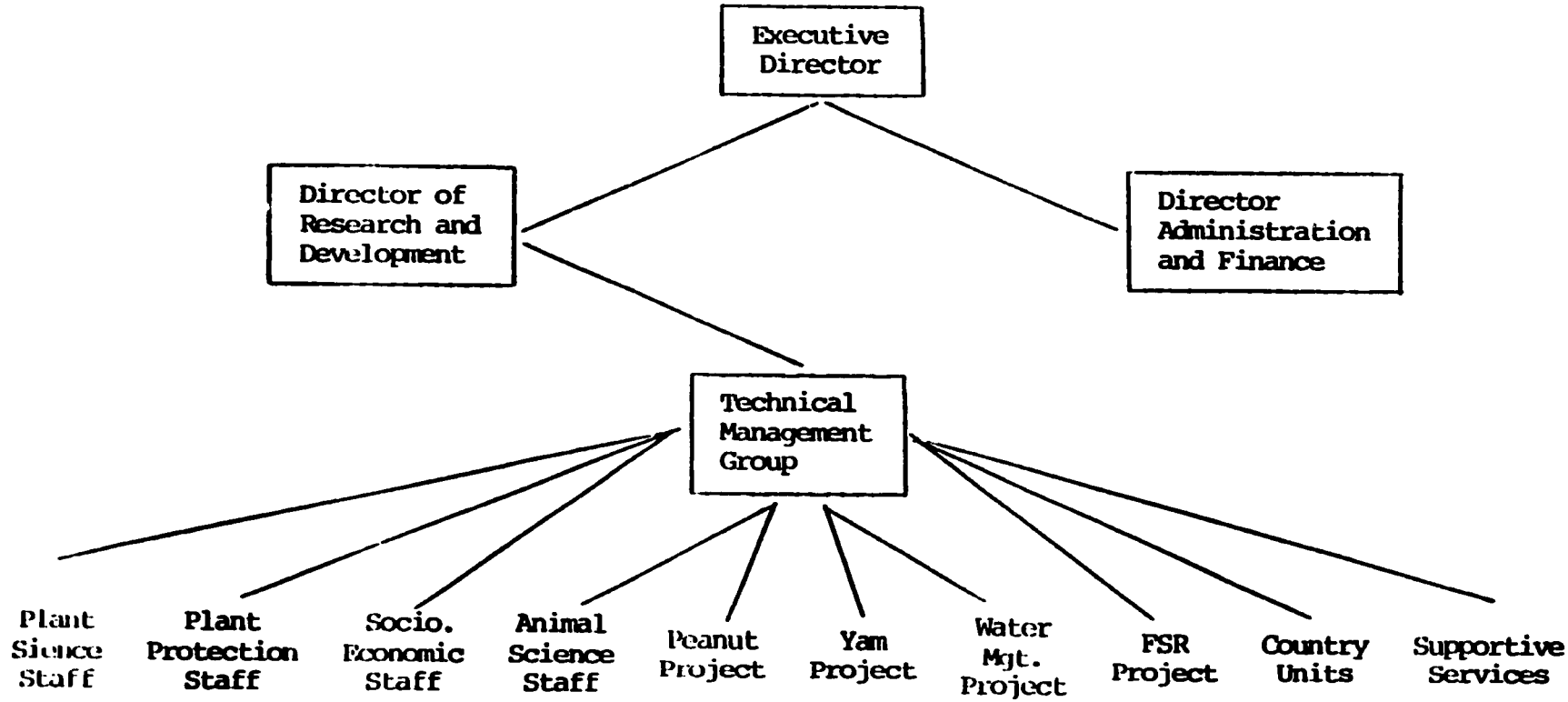


FIGURE 6

ORGANIZATION DIAGRAM OF TECHNICAL MANAGEMENT GROUP

Project Coordination

As a Regional organization CARDI must interact with Government. Ministries, Universities, Private Sector Organizations, Cooperatives and individual farmers. This interaction occurs both at the institutional/administrative level and at the individual resource staff level. There are concerns, particularly within the University group that CARDI, in its effort to meet these growing demands of the field for development assistance, is going to become more autonomous as the research and development organization in the Caribbean and will likely interact minimally with the other institutions. Some of this concern stems from the interest being shown within CARDI to reduce its financial payments to UWI for supporting services. There is a trend within this complex of institutions toward each functioning in a different pattern in order to more effectively meet the demands being put upon it. CARDI must respond to the field system on a daily or on call basis and this sometimes precludes the use of university experts who must remain in Trinidad for teaching commitments. However, UWI does have a resource which is important to the agricultural sector and access must be maintained.

There are presently two coordinating groups in the field sector which guide and coordinate CARDI activities.

A Policy and Review Committee has been established at the Trinidad Unit and is being considered for Guyana and Jamaica.

This committee is composed of policy level representatives of CARDI, the University and the Ministry of Agriculture and has the authority to coordinate, review and approve all project activities in the particular country. This administrative unit is an important component in linking the institutional components in the MDC's where CARDI is operating.

A Territorial Advisory and Review Committee functions at the country level and involves the Ministry of Agriculture, CARDI, agribusiness groups and farmers. This group agrees on project areas and reviews ongoing project activities.

CARDI Resource Staff

Resource staff are located in units in Trinidad, Guyana, Belize, Jamaica, Barbados and Antigua. Country teams are located in Antigua, St. Kitts-Nevis, Montserrat, Dominica, St. Lucia, St. Vincent and Grenada. Currently, there are 65 CARDI field staff, including the technical officers in this system.

The professional level resource staff consists of 3 animal scientists, 5 economists, 5 entomologists, 1 pesticide specialist, and 20 plant science specialists, including forage agronomy, plant breeding, plant virology and nematology. Some of these professionals are in central administrative positions and are not actively working in their specialties (i.e., 2 economists, 1 entomologist, and 1 soil scientist). In addition, the support services for CARDI include 3 biometricians and 2 analytical laboratory specialists.

Thus, CARDI has a rather broad base of scientific resource personnel, with a numerical bias toward the plant sciences, which is logical considering the major tradition of cropping development characterized by the Eastern Caribbean territories.

CARDI needs to have its core staff strengthened in the areas of plant protection, agricultural engineering (hydrology and small implement development), post-harvest loss technology, plant breeding, and weed control. As the animal production component becomes integrated into the CARDI FSR project, additional professional resources in animal science may be needed.

The agricultural economic component of CARDI will need more advanced skills. This requirement may be provided for either through further education of resident staff or by additions to staff. At present, the agricultural economics staff members are not involved regularly with other resource staff or CT's in project planning, execution and evaluation. The team recommends deploying two of the current economists to regional positions -- one to the Windward and one to the Leeward Islands.

As CARDI accepts more outside funded projects, it will assume a growing pressure upon its resource or core staff. The tendency has been for core staff knowledgeable in

certain disciplines to be given administrative responsibility for an outside contract and soon find themselves being unable to employ the skills of their discipline. This is a serious problem which could result in CARDI having increasing problems in supporting their field targets. CARDI will require core staff resources or access to a scientist on call in the areas of plant protection, agricultural engineering, and possibly animal science now included in the Phase II of Farming Systems Project activity.

A more difficult question involves planning for long-range CARDI regional staff needs. CARDI relies heavily on externally-funded projects for a financial base and is likely to continue to do so. CARDI member territories are severely limited in increasing support contributions. In fact CARDI suffers cash flow problems in its core operations as a result of the failure of some member territories to forward their cash commitments on a timely basis.

Long-range planning for staffing and the ability of CARDI to make long-term staff commitments is essential to the development of a strong research organization. Most external donors may recognize these facts but are limited by agency regulation to short-term (3-5 year) commitments.

Recommendation

The team recommends that a system of overhead fees for basic core staff support be identified and budgeted for each externally funded project. Such funds would be earmarked for direct support in areas of basic research relevant to the new project and might also be used to establish a salary contingency fund to be used for staff salaries when cash flow problems develop.

CARDI Staff Performance and Evaluation

The evaluation team recognizes CARDI's need to foster a more challenging attitude within its staff to bring about a commitment on their part of excellence and diligence in research. One of the approaches is to effect better communications at the local headquarters of CARDI by holding regularly scheduled monthly meetings for all staff to discuss operations.

Recommendation - Resource Staff Organization

It seems reasonable to suggest that all resource staff have an understanding of their responsibilities and how they will be evaluated annually. The team recommends that each staff member of CARDI have a precise job description stating clearly the areas of endeavor, accountability and methods of evaluation. Furthermore, it is recommended that the annual review include resource people or administrators in the management group who are affected in some way by this resource staff's activities.

Linkages with the University of West Indies

There are certain linkages actively functioning between UWI and CARDI. In most instances, such linkages stem from a logical need of a given CARDI project to secure the support and counsel of the expertise available in UWI. These linkages often involve a direct arrangement for consultation with UWI staif. This arrangement is preferred by UWI staff in lieu of a collaborative inter-institutional agreement. It is not likely that any substantial collaborative arrangement between UWI and CARDI would function considering the attitude within the faculty at UWI regarding overhead resources being placed in a University contingency fund in which they do not participate directly.

An important linkage exists between CARDI and UWI in the graduate student program. The UWI graduate students involved in CARDI research can foster a better relationship between CARDI and UWI staffs and develop a more effectively trained staff who can be hired by CARDI.

The university statutes require that graduate student programs be under the direct guidance of UWI major professors. Graduate students may work on projects within the CARDI network if the project fits within the research standards of the University and if the graduate student's skills and research activity further the goals of a CARDI project.

Recommendation

The team recommends that long-term funding be established in Phase II to provide support for both graduate student research and UWI staff travel for activities compatible with the CARDI FSR Project. Such activities can include technical research and extension.

CARDI may have to buttress its long-range demands for technical skills by having access to specific resource institutions familiar with the CARDI program and which can supply critical skills when needed. CARDI should enter into a long-term technical assistance agreement with one or more U.S. universities or a Consortium of Universities.

The FSR Project Organization

This will deal with the FSR project as it is presently organized. Figure 7 describes graphically the structure of the group as it relates to technical service and project analysis.

Project Leader

The Project Leader bears the final responsibility for the project to meet its goals and is accountable to the funding agency, USAID. The Executive Director and the Director of Research and Development would be informed on all reporting. There is an administrative linkage to be formed here with the Director of Administration and Finance.

Administrative Assistant

An Administrative Assistant is needed for effective budgetary control and report/data coordination. Such a position is essential. The Administrative Assistant would report directly to the Project Leader and be officed with the Project Leader. This is illustrated in Figure 8.

The Administrative Assistant would be responsible for all financial control, report documents and, data processing coordination.

The Regional Technical Coordinator

This position has three overall responsibilities:

1. To ensure technical soundness and methodological correctness in the project.
2. To provide linkages and cross reference of ideas to country teams.
3. To provide regional communications with the project director's office.

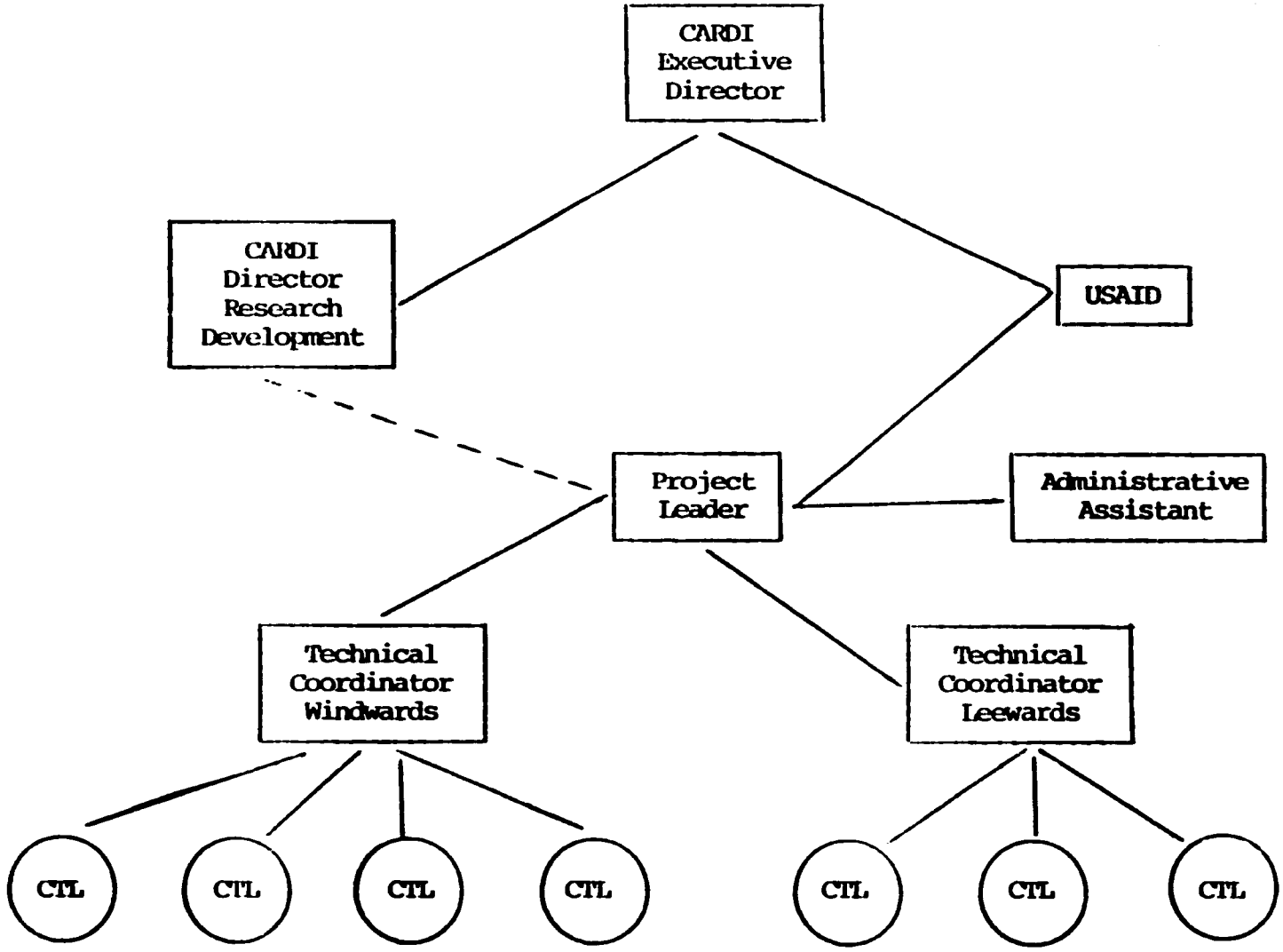


FIGURE 7

FLOW PATHS OF TECHNICAL AND PROJECT SURVEILLANCE

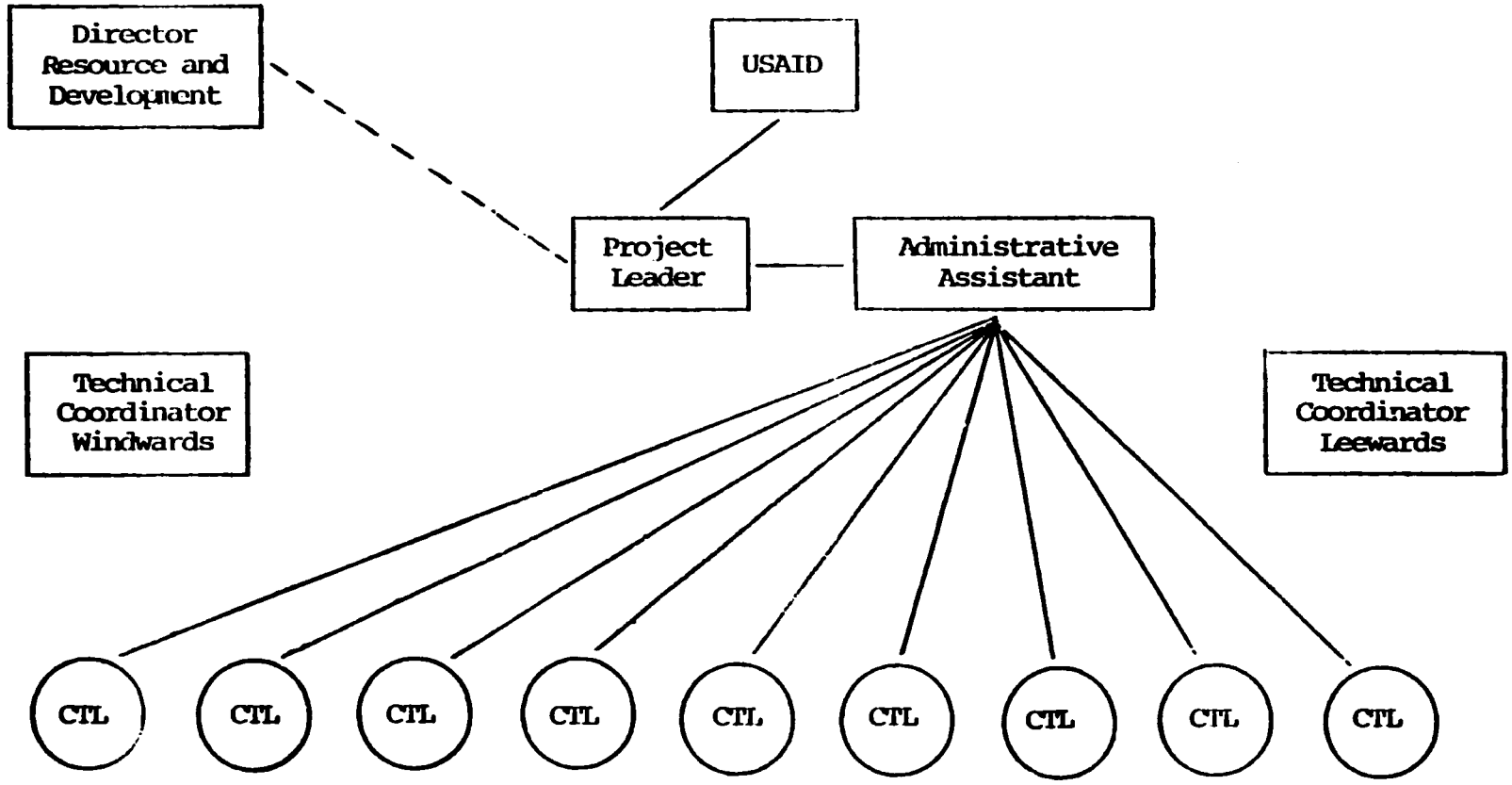


FIGURE 8

PROJECT BUDGETARY ORGANIZATION

The specific responsibilities should be to:

1. Certify the research soundness and accuracy of each field trial.
2. Plan the regional research station programs and certify their technical soundness.
3. Secure needed technical skills for various country projects.
4. Be responsible for all reporting and data submission to the Project Leader.

The Country Team Leader

The CTL has the following responsibilities:

1. Direct the country team and is responsible for all FSR activities within the country.
2. Communicate directly with the Regional Technical Coordinator on design of on-farm experiments, FSR methodology, data collection and analysis and reports.
3. Authority to manage and activate all FSR funds budgeted for in-country use.
4. Communicate directly with the Project Director on all budgeting items and authorization for regional travel, etc.
5. Serve on the FSR Coordinating Group described below.

Recommendation

In order to provide a broad based communication between country FSR projects and the extension area, the team recommends that an FSR Coordinating Group be formed which would meet regularly and rotate among the country projects. This group would consist of the Country Team Leader, the two Regional Technical Coordinators, an Extension Advisor from UWI and the Project Leader. This is shown in Figure 9. It would be advisory in nature to the Project Director but could form an important linkage between UWI extension and the development of the extension phase of this FSR work.

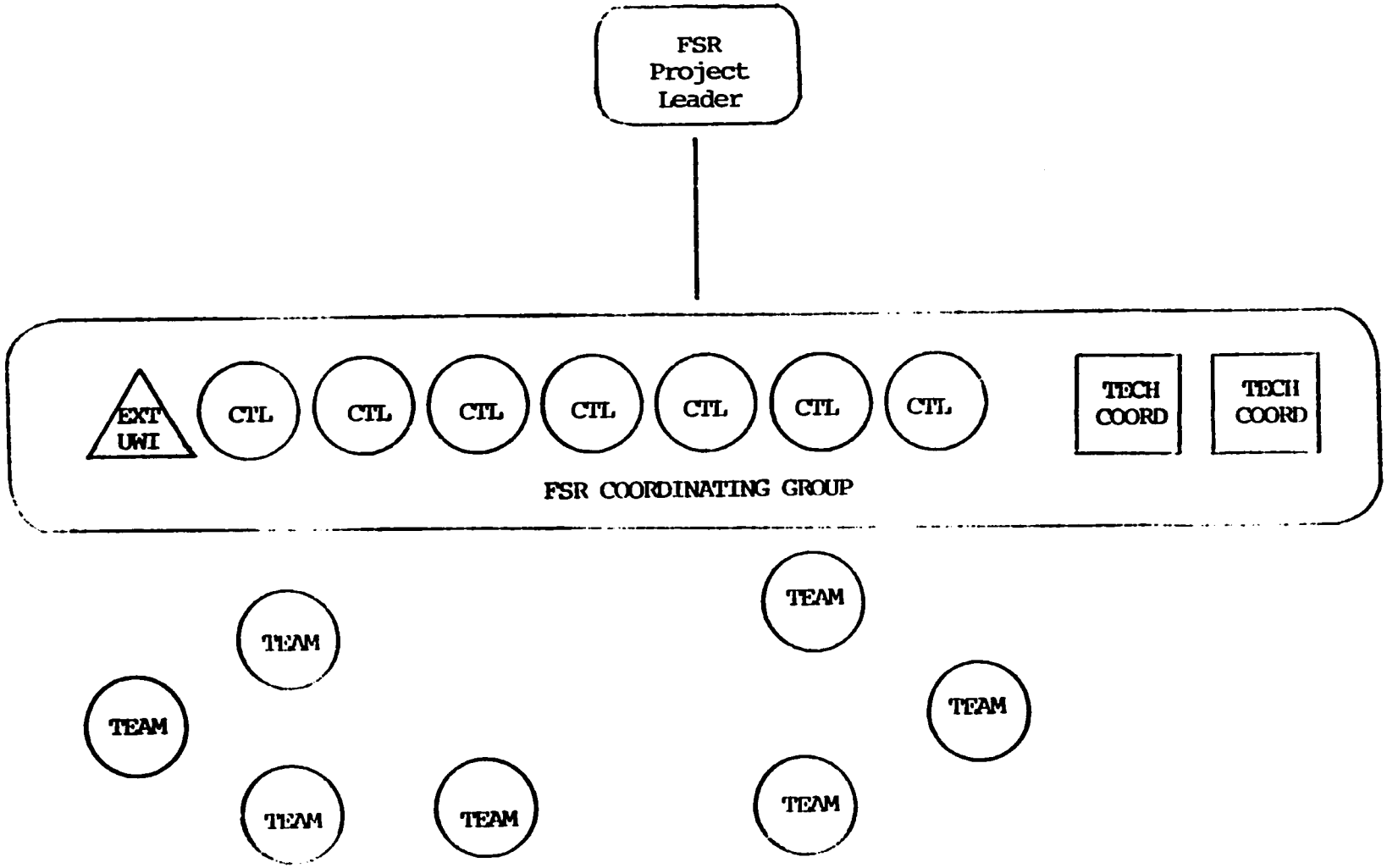


FIGURE 9

FARMING SYSTEMS RESEARCH COORDINATING GROUP

The FSR Field/Territorial Network

The very important characteristic of CARDI is the existence of the territorial network of field experienced staff which provides the flow of information and activity to the target area. CARDI has "field presence".

The guidance network for these country or territorial units appears to come from (1) a local committee system (the territorial Advisory Review Committee) relating to key people in the host territory/country and (2) communication with the Regional Coordinator, the Project Director and the Director of Research and Development.

There are questions on how well the resource staff relates to these territorial units and how well they are used. Communications are sometimes difficult and there are definite lapses in effectiveness. At times there are problems with authority and responsibility arising when administrative structure is overlapping. It is very difficult to eliminate this in a regional institute when communications are inconsistent. However, the team believes that it is necessary to improve the administrative linkage between the Director of Research and Development and the field units.

The team believes that by including the unit leader and the Project Director as members of the Technical Management Group it may be possible to more efficiently coordinate the country programs and especially the use of resource staff.

The Small Farm Multiple Cropping Project is presenting new challenges to the CARDI system since the signals for new information and action on the part of the resource staff are becoming much more field oriented and are being formed on more objective bases. The country teams are regularly involved with the farmer and his problems and the needs for new technology and problem solving are being frequently encountered.

These research needs can often be anticipated by the project leadership which brings up a very important factor from the research organizational point of view. The administrators of CARDI need to have a technical background and administrative capability if the field system is to be effectively coordinated. The technical management (Project Leaders) must be very conversant with the field technology.

Where CARDI cannot supply the skills needed by the field team, it should have a stand-by arrangement, perhaps from UWI or from another institution, for quick access to skills for a or "quick fix" situation.

The Farming Systems Project also presents new challenges to CARDI in terms of the scope of the activity level. If the systems approach to farming is to be considered literally, then CARDI will have to consider activities in extension or diffusion as well as the problems of marketing and credit.

Since the field teams are actively developing innovations in extension techniques it has been recommended that a member of the UWI extension staff (e.g., P. I. Gomes) be included in an FSR Coordinating Group. This group would meet regularly under the guidance of the Project Leader and serve to cross communicate between region and between CARDI research and UWI extension.

CARDI is directing resources at three major types of field targets. These are:

1. The technical field problem activity.
2. The commodity project dealing with one commodity in all aspects of production.
3. The overall farm sector development scheme which deals with many commodities and in all aspects of the system in which they are produced and utilized.

CARDI traditionally has been directing most of its resources toward the target of the technical field problems and had developed its resources to service this. This has been and will continue to be the important function of CARDI in servicing its member country constituency.

As CARDI has moved into the complexes of the rural setting, its resources are being challenged to deal with new activities. The question arises as to whether CARDI can provide effective support for basic research while dealing with a broad base of activities and challenges required for systems research.

If CARDI continues to move toward farming systems research and commodity type projects, then it is going to have to find ways to reinforce its resource staff capability through arrangements with other institutions or by committing some funds from external projects to core support. It is presently not realistic to expect an increase in core budget funds from member countries.

CARDI will have to develop a research system functioning with the infrastructure of the farming systems projects. Marketing and credit are two notable examples of areas of effort to be researched by some institution or group. CARDI may have to assume some of the responsibilities of a CARDATS type function in which case it will have either to expand its resource capability or seek supplemental assistance.

Support for Communication

There is definitely going to be a limit to the degree of excellence in organization, support and staff quality achieved by CARDI with the present difficulties in communication. This is a very critical factor in CARDI's future growth and potential.

Recommendation

The team recommends that discussions presently underway on radio or telecommunications be accelerated and that every effort be made to provide for effective communication.

IV. RECOMMENDATIONS FOR NEEDED APPLIED RESEARCH IN THE REGION

Importance of Applied Research

The evaluation team feels that research is the most important component of the SFMC project. The generation, adaptation, verification and ultimate dissemination of improved technology which will benefit the small farmer is the general purpose of this project. If appropriate technology is not generated, the project will fail to achieve its goal.

This project will be relying on two sources of technology generation. One is the technology generated by research at CARDI, Trinidad and its regional experiment stations, as well as other national and international research institutes. The second source will be the adaptive research generated by on-farm testing conducted by the CARDI country teams. Sometimes technology generated at the research institutes should be modified to meet the needs of different farmers. Both types of research must be verified before delivery to the extension mechanism.

CARDI is the major source of agricultural field expertise in the Caribbean region and has the responsibility for problem solving and the generation of new technology for the agricultural sector. The establishment of the country teams has given CARDI a very effective mechanism to transfer and adapt the technology generated at its various research stations. CARDI, through its publications and workshops, has been effectively transmitting new research developments. The SFMCP has also served as a mechanism to feed research priorities back into the CARDI network.

CARDI Trinidad has generated several important technologies which have been tested on the various islands through the SFMCP. These include virus-free yams, several improved legume cultivars, improved cabbage seed, new tomato cultivars and improved forage grasses. CARDI Barbados has been working with pest control programs on several islands. These programs have dealt with the release of predatory insects to control some

important insect pests. The CARDI country teams have also generated technology which is very important for the smallholder farmer. These would include recommendations on soil fertility, crop mixtures, plant spacing, cultural practices, pest and disease control and date of planting. CARDI, through its network, is in position to transfer useful research results to other CARDI units, which in turn can cooperate with extension officers in disseminating the technology to the small farmer.

Most of the interventions observed by the team could only be classified as observation trials, not research trials. There appears to be very little data gathering on the on-farm trials. A major reason seems to be the scattered nature of the trials. The country teams had only three or four persons and this makes it physically impossible to closely monitor the trials. Efforts should be made to get more help to monitor the trials, such as local personnel from the Ministry of Agriculture.

CARDI has been interacting with NACO (St. Kitts) to check the feasibility of intercropping/relay planting in sugarcane. The technology is available for this practice, but the difficulty is in making arrangements for the farmers to compensate NACO for the use of the land. By relay planting a 60 day crop at the beginning of sugarcane planting, NACO and the farmer would get additional income. This type of research could add a significant amount of vegetables/legumes to the economy of St. Kitts.

The all year-round vegetable gardens started in several of the islands is an excellent idea. The improved nutrition for the family will be the major benefit. The project has also made an effort to educate the farmer on the importance of a balanced diet with respect to vitamins, minerals and protein. This type of project also gives the farmer an introduction to several new crops. A major problem is the difficulty of data collection. How do you measure the impact of this type of experiment?

The mulching experiments started on several of the islands helped the farmer in many ways; soil moisture control, weed control, soil temperature reduction and enhanced soil structure. The increased production and/or labor saving due to weed control are very easy to document.

The introduction of new cultivators or disease-free seed through this project has had a major impact on many of the islands. CARDI is conducting some varietal screening for dry beans, tomatoes, peanuts and rootcrops in Trinidad. However, more effort is needed in this area since the introduction of new cultivars is one of the easiest interventions, as well as giving some very dramatic production increases. The disease-free yam seed, the heat-treated cabbage seed and improved peanut cultivars are just a few of the important interventions identified and tested in the first phase of this project.

Many of the interventions have just been identified and are in the initial stages of testing. There is a very important need to reduce the number of interventions and to do thorough research on those. The expectation to develop 12 different systems for each island is unrealistic. There is not enough staff to monitor many experiments; therefore, only a few important cropping systems should be tested.

Because of CARDI's added visability in the islands, there will be more demand for their problem solving abilities. This is already evident in the area of pest control with problems involving insects, diseases and weeds. At the present time, CARDI does not have the staff to carry out very thorough research in all of these areas.

Applied Research Capabilities

In the second phase of this project there is a need for strengthening the technical research capability of CARDI. Success will depend on the technology generated through experiment stations and on-farm research. Professional research staff must be added in the areas of plant protection, agricultural engineering (hydrology and small implement development), postharvest physiology and crop improvement.

In the area of plant protection there should be an individual trained in crop protection for each of the islands, or at least one in the Windward and one in the Leeward Islands. This specialist would monitor pest populations and be able to diagnose insect, disease and weed problems and suggest control measures. Agricultural engineering research is needed in the layout of watersheds and the design and construction of check

dams and water impounding structures. Research on small implement development is also urgently needed. Postharvest losses are a serious farm-to-market problem requiring research on time of harvest, produce handling and preservation. Disease and insect resistance, better plant type and greater adaptation are characteristics which can be readily added to most crops through plant breeding. Initially, special emphasis should be spent on the improvement of food legumes and vegetable crops.

To enhance the potential of trained and experinced research scientists and thus their research productivity and value to the project, CARDI should have a research technician (B.S. degree) working with each senior scientist. Several scientists currently in administrative roles or directing projects could continue productive research if provided with a research technician.

The problem of financing research positions is discussed in the section on CARDI administration. However, at this point a statement should be made as to the necessity of providing research projects and stable financing with continuity. The amounts need not be large, but must be dependable from year to year.

There is a need for a more active participation of UWI in the FSR project. There are some excellent personnel and institutional resources available at UWI. UWI personnel were used in the present project mainly on a consulting basis. Dr. Ferguson wrote a report on the root and tuber crops and supplied some cultivars for testing in the project. Other personnel were also involved in the baseline survey.

UWI has four commodity programs which can serve as a valuable source of information and backstopping for the project. Besides the development of improved varieties, there is some component technology being developed which needs on-farm testing.

There is a need for an allocation of funds to support research projects outside of CARDI. This could involve regional or local agencies. UWI and WINBAN would be two possible funding recipients. If there is a problem where an agency other than CARDI can

best do the research project, then a contract would be drawn up between CARDI and the agency to do the work. The technical advisory board could decide on the dispersement of funds. There should be a certain amount of funds dispersed through this project to organizations other than CARDI to help promote the project. There are other organizations which can also produce technology for the small farmer, and adaptive research should be strengthened.

The team observed several farmers who were impressed with some of the multiple cropping experiments and designed some of their own. One we noticed was the intercropping of cabbage and corn. The only problem was that the area was entering the dry season and the corn did not produce because of water stress. When working with farmers, the research teams should do their best to discourage "unwise" practices. With the increased exposure to the farmers, the CARDI teams must be properly trained so they can respond to farmers' needs.

V. CROP PRODUCTION IN THE EASTERN CARIBBEAN

Situation

Agricultural production in the Caribbean region varies from the sugar estates of St. Kitts to the complex mixed-cropping patterns of the small Montserratan farmer. The crops grown are mostly tropical and include: Banana, Papaya (Pawpaw), Vegetables, Coconut, Breadfruit, Avocado, Citrus, Macambou, Tannia, Sweet Potato, Mango, Dasheen, Cassava, Lettuce, Yam, Plantain, Cucumber, Guava, Tomato, Golden Apple, Spice, Cocoa, Cabbage, Carrot, Sugar Cane, Cashew, Pineapple, Corn, Pumpkin, Beans, Sweet Pepper, Pigeon Peas, Blackeye Peas, Celery, Eggplant, Onion, Peanut, Christophene, Okra, Coffee, Ginger, Elephant Grass, Turnips and Chive. The farmer is usually a part-time individual who is working with one to several small plots of land. The agro-ecological zones also vary considerably within the region. This mix of elements makes agriculture a very complex phenomenon in the Eastern Caribbean.

Surveys have revealed that most farmers on the islands are over 40 years old. This will have a serious impact on the region if something is not done to bring young people into farming. The two problems which we need to address are (1) the drudgery of farming and (2) the economic viability of the people. If these two problems are not addressed within 20 years, most of the region's food will need to be imported because of the lack of farmers. The complexity of the farmers' needs demands a holistic and realistic problem solving approach.

The constraints to crop production are as follows (CARDI, Undated, "Major Constraints Identified from Farm Characterization Phase").

Production Constraints

Agronomic Environmental

(1) Total dependence on hand labor for all farm operations, especially very hard time consuming activities such as land preparation and weed control. Very

often land preparation is inadequate for the crop to be grown. There is a complete lack of labor-saving devices for crop harvesting, handling and postharvest operations.

(2) A wide range of crop protection problems including:

  (a) The abundance of a wide diversity of weed species.

  (b) Rapid regrowth and survival of many weed species, especially during the rainy season.

  (c) High incidence of pests and disease, especially during the rainy season.

(3) Inefficient utilization of crop protection measures such as:

  (a) Variable rates and frequencies of application of chemicals.

  (b) Improper timing of application in relation to incidence and/or level of infection or infestation.

  (c) Use of wrong chemicals.

  (d) Lack of reliable information on the choice and use of chemicals.

(4) The frequent unavailability of input supplies for efficient crop production and management. This is particularly the case with fertilizers, vegetable seed and pesticides.

(5) The very variable unselected and poor quality of planting material used in cereal, legume, root crop and fruit crop production.

(6) Poor sowing, planting and nursery techniques resulting in the:

  (a) Waste of funds for purchase of larger quantities of seed than actually required.

  (b) Use of higher or lower plant populations than the optimum for a particular crop.

(7) The use of marginal land for agricultural activities leading to:

  (a) Drainage problems in low-lying areas of heavy soils.

(b) Poor soil fertility in certain areas.

(c) Severe erosion in steep areas under high rainfall conditions.

(8) The predominance of rainfed agriculture with little control of water resources. There can be an oversupply of water during the rainy season, leading to drainage and disease problems, and an undersupply during the dry season, leading to drought conditions.

(9) Unplanned and/or unorganized systems of production often result in a mosaic or amalgam of crops which makes proper management difficult.

(10) Poor handling at harvest, poor postharvest handling, packaging and transporting, leading to damage and loss of marketable produce.

(11) The complete lack of proper on-farm storage facilities resulting in high storage losses.

Socio-Economic

(1) The dominance of "family land" as the major tenurial system has led to severe fragmentation of holdings often in areas too small for economic utilization.

(2) The scattered nature of land holdings or parcels belonging to a single farmer results in a substantial amount of time traveling from parcel to parcel.

(3) The relatively high average age of farmers reduces labor productivity for on-farm activities usually arduous.

(4) Dependence on off-farm employment for supplementing income reduces time devoted to on-farm activities.

(5) Overall unfavorable attitude toward farming and provision of incentives/tourism, industrial and manufacturing subsectors leads to the young generation moving off the farms and thus creating a shortage of labor in some rural areas.

(6) Low educational level of farmers making it difficult for farmers to understand the scientific principles involved in new, improved practices. This leads to low adoption rates of improved technology.

(7) Poorly organized marketing systems to meet the demands of domestic agricultural operations--both food crops and livestock.

(8) Lack of agricultural information channels for effective communication of input and output prices resulting in inefficiencies of operations at the farm level.

(9) Absence of on-farm roads and feeder roads linking parcels to each other or to main roads.

(10) Low utilization of available credit facilities due to strict collateral conditions required before disbursement of funds, as well as trouble and time involved in obtaining loans from agricultural banking institutions.

(11) Insufficient numbers of trained agricultural extension personnel and inadequate back-up facilities required to have an effective delivery system to meet the varied and multiple needs of widely dispersed farms located in difficult terrain.

Areas of Research

Singh suggests "to set meaningful goals or targets of development and to formulate feasible action programs," the following requisites should be met:

(1) Study of existing production systems, their potentials and constraints.

(2) Study of available resources (both men and materials), their existing and potential utilization.

(3) Study of the support services and infrastructures available to utilize and sustain the proposed production (develop such infrastructures)."

("A Perspective for Agricultural Development of St. Kitts-Nevis," July 29, 1981.)

The evaluation team observed slides of an on-farm experiment in Nevis on intercropping in cotton, along with unpublished yield data from that experiment for the major cotton crop and the short-term crops--peanuts, corn and beans. The cotton yields were not reduced, whereas considerable income was generated by the interplanted crop. Laxman Singh stated that similar results were obtained when sugarcane was intercropped on St. Kitts. In the case of cotton, the intercropping is initiated when the cotton is planted. In the case of sugarcane, the intercropping is initiated following cane planting or following cutting when the crop is being ratooned. The National Agriculture Corporation (NACO) of St. Kitts, which controls the production on approximately 12,000 acres of government land, is opposed to intercropping probably because it would require greater management output. The team was told that NACO lost more than 12 million EC dollars last year. One of the contributing causes is labor. Each laborer working for NACO is guaranteed three days of work a week at $13/day, irregardless of whether there is any field work or not. It would appear that double-cropping of NACO land would better utilize labor and increase revenue.

Considerable effort should be exerted on on-farm research in St. Kitts-Nevis to extend intercropping. This could provide a major breakthrough in crop production in a territory with a considerable need for food legumes and corn. Possible land rental arrangements for intercropping should be explored for laborers on the NACO controlled land. This example is cited as a Farming Systems Research output which is ready for verification on a larger group of farms.

In Phase II, several general areas of agricultural development should be considered. These areas include (1) agronomy and nutrition, (2) water management, (3) livestock and (4) economic issues.

(1) **Agronomy Nutrition.** The area of production (including multiple and intercropping of food and fodder crops) should be extended wherever possible. Great care should be taken to examine the nutritional balance (or imbalance) on each island so that crops which

will enhance the diet of the population (particularly those crops high in protein) can receive higher research priorities. The FSR project should play a major role in this area of nutritional enhancement.

(2) Water Management. The reports of Bert Krantz (Krantz, B.A., 1981, Consultant Report No. 6) consistently stress the need for identifying areas where small, low-cost catchment reservoirs can be constructed. The general problem in the region is not lack of sufficient rainfall, but poor distribution (Ibid.). Thus, the major thrust of a water management project would be to even out water availability during the crop year by making use of supplemental irrigation.

(3) Livestock. As Dr. Laxman Singh suggests (personal communication, 1982), an effort should be made to increase the productivity per unit area or per head of livestock to increase the proportion of the supply of animal products and by-products produced intra-regionally. A very high percentage of these commodities are now being imported. Agronomic research must parallel livestock research and development.

(4) Economic Review. The FSR project should focus on the agricultural commodities which can be successfully produced in the Eastern Caribbean, but are now in short supply. A comprehensive study should be made of territorial imports and total imports by commodity across the region. Thought should be given to the need for organizing exports of some surplus unprocessed and processed fruit or vegetable products. Farmers must receive assistance in producing and delivering high quality produce. The project must take an active role in fostering the development of an agro-industry which would generate more employment through intensive farming systems and better utilization of fruits and vegetables.

Major Problems of Small Farmers (Observations by the Evaluation Team)

(1) Drudgery of farm work, especially in land preparation and harvesting operations. Almost without exception most field work and produce transport is done by human labor. Unless some mechanization occurs, young people will continue to leave the farm.

(2) Lack of water. There is an insufficient or variable supply of water for supplemental irrigation, pesticide spraying, human and livestock use.

(3) Severe erosion. This is especially serious because steep slopes are being farmed.

(4) Undependable markets. This includes variable demand and low or severely fluctuating prices.

(5) Marketing infrastructure. Poor quality roads make it especially difficult for farmers to get produce to major cities/hotels/restaurants in first class condition.

(6) Lack of dependable inputs (seed, fertilizer, pesticides).

(7) Reduction of crop yields by pests (diseases, insects and weeds).

(8) Unavailability of good quality seed of improved cultivars.

Recommended Activities for the CARDI-FSR Project in Phase II

The project evaluation team strongly recommends the further development of the CARDI Regional Research Stations in St. Kitts and St. Lucia. At present, these are not research stations in the true sense, but plant propagation and seed increase stations. The level of research commitment at the St. Augustine Research Centre was not impressive, but the station will soon be phased out.

The evaluation team visited the Small Farm Research Center near Betty's Hope, Antigua. Dr. B.A. Krantz (Report of Advisor to CARDI-USAID Project #538-0015, April 1981) has given a very complete description of this site, the objectives of the research to be conducted on the station and the sub-programs on farming systems research which could be conducted on that station. Reinforcing the conclusions of Dr. Krantz, the evaluation team encourages USAID to assist in the funding of these developmental research programs at the Antigua Research Station: (1) Soil and Water Management Systems, (2) Implements and Power Source Systems, (3) Cropping Systems and Crop Management, (4) Forage Crops and Livestock Systems and (5) Socio-Economic Systems Research.

In addition to the recommendations by Dr. Krantz, the evaluation team further recommends funding of crop research at St. Kitts-Nevis and Antigua on the production of drought resistant legume species, such as Dolichos lablab and the improved legume species identified by Dr. John Keoghan for leaf meal production. Interdisciplinary studies on solar drying and the production of high protein leaf meal for livestock feed should be conducted with the objective of reducing the importation of feed supplements. Low cost methods of drying legumes, reduction of legumes to leaf meal and storage should be developed to permit the construction of local farmer-owned facilities financed by low level investments.

On-Farm Research

A list of interventions (on-farm tests) was approved by FSR Workshop participants in May 1981 (Summary of FSR Project Intervention Workshop, Trinidad, May 18-23, 1981).

These interventions can be classified using the following categories:

General Intervention Type

(1) Varietal
(2) Fertilizer type and rate
(3) Date of planting
(4) New crop or crop system introductions
(5) Pest control
(6) Stand improvement
(7) Pattern of planting
(8) Intercropping
(9) Minimum tillage
(10) Mulching
(11) Livestock improvement
(12) Livestock management

On-farm research involving the above type of trials (simply and in combination) will always be an important part of FSR. Much research technology is already available in these categories and is ready for on-farm adaptative research. These alterations in crop and animal production should provide immediate, tangible improvement. Efforts in phase II should concentrate on interdisciplinary efforts to involve the disciplines of micro-economics and nutrition at the field level of crop and livestock systems development to strengthen the logical evolution of the FSR project.

VI. ANIMAL PRODUCTION

Situation

The inclusion of the animal in the farming systems research project is important considering both the role of the animal in the family farm system and the substantial importation of animal products into the various territories. The percentage of small farmers in the Eastern Caribbean who keep animals is shown in Table 1.

The productivity of the animal systems in the Eastern Caribbean has been estimated by Archibald, et al., (1981). While the currentness of this data has not been established, patterns are indicated which show marked territorial differences (Table 2). Antigua is markedly higher in milk production, Antigua and St. Lucia excel in beef production; pork and poultry production are most prevalent in the Windward Islands. Pork accounts for one-half of all the red meat production in the Eastern Caribbean.

There is a shortfall in animal production considering the importation of animal products and the local demand. The degree of self-sufficiency in animal production as a percent of market size has been estimated and is shown in Table 3.

The potential for growth into these markets is obviously substantial given the fact that less than 50 percent of the market is being supplied from local production. However, not all of this market can be penetrated by local animal products considering the specialty demands of hotels/restaurants and the customary local systems of animal production which yield a different type of product.

Types of Animal Production Systems

There are a number of different systems in which the animal is used in the Eastern Caribbean. The most predominant is that in which the animal is a simple complement to the cropping activity and converts wastes and residues into a high value animal product. The animal has a very important function in these systems, being a savings or cash building mechanism readily converted into cash or barter for other products. Most of the

Table 1: Percent of Small Farmers Keeping Animals[1].

Territory	Percent of Small Farmers Keeping:					
	Cattle	Sheep	Goats	Poultry	Pigs	Rabbits
St. Kitts-Nevis[2]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Antigua	4	3	2	0.8	4	0.8
Montserrat	27	31	21	10	12	--
Dominica	32	18	27	46	26	4
St. Lucia	48	39	17	11	39	11
St. Vincent	39	22	22	53	17	n.a.
Grenada	27	15	15	64	33	3
Average	30	21	17	31	22	--

[1]Source: Calculated from the Baseline Survey; Archibald, et al., 1981.

[2]St. Kitts-Nevis was not included in the Baseline Survey.

Table 2. Estimated Meat, Milk and Egg Production, Metric Tons[1]

Territory	Beef	Lamb	Goat	Pork	Poultry	Milk	Eggs
St. Kitts-Nevis	136	55	41	182	52	327	77
Antigua	287	72	45	147	130	3,409	191
Montserrat	50	16	22	49	11	136	16
Dominica	120	18	29	430	134	259	196
St. Lucia	303	68	53	455	366	655	544
St. Vincent	200	46	23	241	56	430	79
Grenada	191	15	43	470	320	409	496
Total	1,287	290	256	1,974	1,069	5,625	1,599
Market Value 1000 EC$[2]	8,500	1,750	1,550	10,850	5,980	5,625	8,650

[1]Source: Adapted from East Caribbean Common Market -- Livestock Sector, Caribbean Community Secretariat.

[2]Calculated from the average current market prices within the region: EC$/kg, beef, 6.60; lamb, 6.05; goat, 6.05; pork, 5.50; poultry, 5.50; milk, 1.00; and eggs, 5.40.

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Table 3. Degree of Self-Sufficiency in Animal Products in Percent of Market Size[1]

Territory	Beef	Lamb/ Mutton	Goat Meat	Pork	Poultry Meat	Milk
St. Kitts-Nevis	45.6	60.0	100	46.8	6.4	16.7
Antigua	52.2	53.8	100	25.6	10.3	76.9
Montserrat	63.2	84.8	100	32.8	3.3	28.5
Dominica	12.0	20.8	—	35.8	9.4	0.6
St. Lucia	23.0	36.1	91	31.1	18.5	14.1
St. Vincent	53.8	62.5	100	41.6	3.9	9.1
Grenada	39.6	30.0	100	48.8	18.0	7.6
Average	41.3	49.7	98.5	37.5	10.0	12.8

[1]Source: Adapted from the Livestock Sector Report -- The East Caribbean Common Market. Caribbean Commidity Secretariat.

baseline studies give data on animals in this type of system. Farmers who produce animals in this type of system are more likely to commit inputs to the cropping system and allow the animal component of the farm to seek a balance with this. They are not looking for substantial increases in animal numbers but are interested in increased output per animal if the requirements to do so are not high. Increases in animal populations will be considered if farmers can maintain them on their cropping output. The manure produced by animals is very important to these farmers. It is obvious that interventions with these types of farming systems must involve simple low capital requiring concepts.

A second type of animal production system is the herd or group type in which capital and labor investments are more intensive and from which output levels are higher. Examples of these are the small dairy schemes in the Leeward Islands and the swine and poultry production units in the Windward Islands of St. Lucia, Dominica and Grenada.

Archibald, et al. (1981) have suggested the following animal use pattern for the Eastern Caribbean:

- Cattle are used primarily for generating income. The general absence of refrigeration and meat preservation techniques precludes slaughtering of cattle entirely for home use.

- Sheep and goats, because of their smaller size, are used to a greater extent than cattle for home consumption.

- Pigs raised in semi-confinement or confinement by small farmers are used primarily for income generation purposes.

- Poultry kept in the loose, backyard system are used primarily for home consumption with occasional sales of birds or eggs. Small farmers utilizing more intensive poultry production systems, particularly if imported feed is used, do so for revenue purposes rather than home use.

- Rabbits are kept mainly as pets. End-use is principally for home consumption.

- Milk production at the small farmer level is geared for home consumption. Excess production is either left for the calf or sold to immediate neighbors.

- Hides, manure and draft power are of little or no commercial importance to the small farmer that keeps livestock.

When considering the overall goals of the Farming Systems Research Project to increase food production, the development of animal production schemes must be an integral part of the program.

It is important at this point to note the marked difference in FSR methodology (see Methodology, p. 7) which will be employed in dealing with these two very different systems of animal production.

Constraints to Animal Production

There are obviously constraints to animal production as evidenced by the market gap. Osuji (1982) has outlined the most limiting of these constraints as follows:

1. Poor nutrition due to the seasonality and unavailability of local feed, poor quality pastures and high feed costs.

2. Parasitism in animals. Both ecto and endo parasites are a problem. Lack of information among farmers, lack of an adequate supply and high cost of antiparasitic drugs have limited the productivity of most animal species.

3. Marketing. The market structure, lack of adequate transportation, big differentials between farm gate prices and retail prices, and the absence of market information to farmers are the areas needing

attention. Animals are sold by sight and pricing policy is consumer oriented.

4. Distance to processing facilities. The availability of processing facilities may increase the farmer's earnings through the value added to processed products.

5. Unavailability of suitable land for pasture expansion. Most farmers are willing to expand only if they could get access to more suitable land.

6. Unavailability of suitable breeding stock especially in ruminants.

7. Predial larceny and predation by dogs, especially with the small ruminant populations.

8. Poor management expertise on the part of the farmers. Housing, nutrition, and health seem to be the main areas of concern.

It is important to elaborate on several of these points, as they play such an important role in limiting the livestock productivity.

Nutrition

Research at the various stations and projects in the region indicate that a very marked response in productivity can be obtained with the indigenous animal by inputs in feeding levels both in quantity and quality. Seasonality of grazing and the resultant variation in grass nutritive content seriously limits the output levels of growth and milk production of ruminants.

Monogastrics (swine and poultry) require more nutritionally complete and complex diets in order to function efficiently. The feed supply sector in the Caribbean poorly services this need for monogastric diets in its failure to utilize local feeding materials and in not supplying supplemental critical nutrients which allow the farmer to effectively use his basic farm-produced feeds.

A number of private sector feed mills import food grains and protein concentrates to prepare their complete mixed feeds and thereby become subject to world market prices, high transportation costs, foreign exchange availability and product quality fatigue factors in attempting to suppy feedstuffs to local farmers in a consistent manner. Such a system is subject to external manipulation. The result often translates into higher costs

of blended livestock feed (imported feed costs are two and one-half times the U.S.-based cost) and inconsistent animal performance, thereby cutting into the profitability and interest on the farmer's part in continuing his/her production program.

In most instances the present commercial feed supply system requires the farmer to use substantial levels of capital for a livestock production system because it requires the farmer to purchase both bulk energy and concentrate requirements.

Processing Facilities

Processing facilities for livestock and livestock product are critical in determining the group patterns of production, the kind of animals and animal products coming to the consumer market and also its share of the import market which may be penetrated by local production. Meat from animals processed in local abatoirs is offered for sale on a fresh basis and the local market must absorb this product during a short period. There is little opportunity to equitably match supply with demand. Small-scale secondary processing units are not available for converting, at a low cost, animal products into more stable and more attractive consumer products.

Recommendation for Inclusion of Livestock into the FSR Program

Methodology

Baseline data and profile information on livestock has been included in some of the country surveys. While an organized approach to this was not included in the Phase I FSR plan of work, there seems little justification at this point in embarking upon such an extensive exercise for livestock as there have been a number of survey-type inputs conducted (Archibald, Singh and Osuji, 1981; Ahmed, 1980; Osuji, 1980). Furthermore, the country teams and the livestock coordinator for CARDI have an excellent perception of the in-country situation of the existing livestock patterns.

Since animals occur in small numbers on farms and function differently in the farm unit as contrasted to the cropping system, it will be necessary to aproach the research and field testing of interventions quite differently. It will be advisable to consider approaching FSR methodology for animals along two different lines of approach.

The following suggests the procedures which could be initially pursued for a small farm system:

A. Methodologies for Systems in which animals are few in number and are not produced in groups.

1. Develop several simple dynamic models of livestock cropping systems which show how the system functions over time and describe the interactive linkages. The models should be selected so as to provide representative farm types and especially multi-faceted activities in cropping/animal production (multiple crops, several species of animals vs. mono-crop single species). This should include seasonality effects. These would be included in the overall sampling picture of the project.

2. Estimate the present constraints in terms of:

   a. the performance of individual animals.

   b. factors affecting species, or herd or group type animal systems as if they were presumed to exist.

3. Determine at the station level, the growth and feed utilization response patterns of animals to interventions which are developed from the study of constraints. This would involve measuring the actual productivity of indigenous type animals being fed the various cropping residues or mixtures of these produced on the small model farms.

   It would also include varying nutritional levels and measuring the responses obtained from appropriate supplemental inputs. New interventions which have a mandatory animal component such as forage legumes for land conservation should be involved in getting measurable responses at the station level.

4. If the intervention developed in "3" indicates the need for a supply requirement (minerals) or a simple processing input, then these must first be developed and be accessible for the introduction of these innovations to the farm system.

5. The "tech-pack" and intervention can be diffused into the sector through "model" scheme or by simply letting the farmer introduce them to his animals. It will be difficult to obtain comparative measures of intervention responses in such single animal systems because we cannot set replicates.

B. Methodology for farm systems where animals are involved in groups or herds (i.e., housed poultry or swine), the methodology would involve some change.

1. The station testing could be done with groups similar in size, sex, age, etc. and environment (housing). These interventions can be quantitatively identified because of the availbility of large enough numbers for more reliable estimation. A number of different treatments or variables can be measured in this research.
2. Field application can involve dividing animal groups on the farm for comparative testing. "Parallel" trials in which similar animals and other inputs being used by the farmer are actually sampled and monitored on the station level serve to provide excellent guides for measuring farmer management and to provide a measure of defending the validity of a new intervention. Farmers can observe at the station what levels of performance occurred with the same source of animals and feeds that they were using.

Specific Intervention Targets

The following are provided here to assist in preparation for Phase II activities in animal production. They encompass the following major areas of emphasis:

1. Animal utilization of cropping residues and marketing surpluses.
2. Production of lower cost animal feeds through utilization of locally available feedstuffs and industrial by-products.
3. Developing a supplemental-type feed supply system for small farms.
4. The utilization of soil conservation-type plants by animals.
5. Emphasis on increasing the reproductive animal function in all species through nutrition and management inputs.

6. Developing mini-management "tech-packs".
7. Developing solutions to the problems of marketing and credit.

Windward

Station Trials

1. To develop a practical feeding program emphasizing the use of copra meal, banana, fish meal, legume. Note: This will target supplemental-type interventions which can be provided in small packet form for farmer supplementation of "succulents" and other farm feeds.
2. To determine feeding values of crop residues from a trial.
3. Develop feeding programs to effectively utilize larger quantities of market surplus crops. This includes low cost storage.
4. Evaluate forage legume feeding values and develop feeding systems. Note: Leaf meal production could be included in this target activity.
5. Measure response in reproductive function of both ruminants and monogastries with varying feeding levels of crop residues and supplements.

On-Farm Trials

1. Develop legume planting and other erosion control plant systems and involve ruminants to monitor yield, seasonality of supply, mineral supplementation and parasite control response.
2. Test feeding the input of cropping residues to reproducing animals and monitor reproductive functions.
3. Initiate a mini-herd production scheme with farmers in poultry and swine. This would involve feed supply, tech-pack and marketing support.
4. Develop mini animal-processing units.

Leeward

Station Trials

1. Determining animal feeding values of cropping residues of intervention.

2. Develop supplemental packs for animals utilizing these residues.
3. Measure reproductive animal response to feeding/management inputs based upon cropping residue and industrial by-product feeding systems.
4. Develop mini group systems from poultry based on by-product policy system.

Field

1. Develop mini equipment for watering grazing animals.
2. Introduce bended schemes to utilize cane residues with molasses urea supplementation.
3. Distribute daily supplemental feed packs for animals.
4. Develop mini animal-processing units.

VII. TRAINING

Workshops and Seminars

As required in the project grant agreement, a number of research-oriented workshops and seminars were conducted for the MCSRP staff to acquaint them with the project. Subjects covered included the farmer survey and assessment phase of the project, the methodology of farming systems research, crops and livestock constraints, on-farm research and other topics. The following list illustrates the type of training sessions presented.

15/1/79	Training of Enumerators for Baseline Survey of Small Farms for selecting sample for participation in Small Farm Multiple Cropping Systems Research Project.
17/4/79-6/5/79	USAID/CARDI Small Farm Multiple Cropping Systems Research Project Workshop held in Trinidad.
22-23/10/79	Seminar on Activities to date in Samll Farm Multiple Cropping Systems Research Project held at Hotel La Toc.
21/1/80	Seminar on Small Farm Systems in India conducted by B.A. Krantz, Consultant to CARDI/USAID Small Farm Multiple Cropping Systems Research Project.
9-15/3/80	Data Collection Workshop for the Multiple Cropping Project in St. Vincent.
16-18/4/80	Animal Production Workshop in St. Augustine, Trinidad.
21-25/4/80	Weed Control Workshop for the Small Farm Multiple Cropping Systems Research Project held in Grenada.
1-7/6/80	Intervention Workshop for the Small Farm Multiple Cropping Systems Research Project held in Trinidad.

25/6/80	Plant Diagnosis Course as part of Small Farm Multiple Cropping Systems Research Project conducted by B.A. Krantz, Consultant, Laxman Singh, Systems Agronomist and Winston Small, Plant Pathologist.
17-24/5/81	Small Farm Multiple Cropping Project Intervention Workshop in Trinidad.
22-26/2/82	Enumerator Training Workshop for New Questionnaire conducted by Carol Weber of BUCEN.

In addition, several CARDI "In-House" meetings were held. The following three reports represent this group of activities:

22-23/10/79	"In-House" Meeting on General Project Progress, St. Lucia.
11/2/81	Summary Report of an Internal Evaluation Workshop, St. Augustine, Trinidad.
12-14/3/81	Report of an "In-House" of the CARDI/USAID Project, St. Kitts.

The review committee commends the CARDI-SFMCP staff on the number and quality of their workshops and seminars. However, the evaluation team found little evidence of application or follow-up after these meetings to indicate they were a part of the total project development process. We recommend these activities be continued in phase II with the addition of monitoring tours as a part of each workshop. This will give the participants an opportunity to observe the FSR project on several islands. This type of networking will facilitate the exchange of experiences and ideas and strenthen the project. The evaluation team recommends that each scientist prepare a trip report following inter-territorial travel, recording his observations and comments on problems, technology, methodology or ideas.

Training Abroad

The following personnel were provided training abroad in multiple cropping research techniques (the list includes dates and place of training):

J. Hammerton	June 1978	CATIE, Turrialba, Costa Rica
S.Q. Haque	June 1978	CATIE, Turrialba, Costa Rica
St. C. Forde	June 1978	CATIE, Turrialba, Costa Rica
S. Parasram	June 1978	CATIE, Turrialba, Costa Rica
J. Hammerton	July 11, 1979- August 9, 1979	ICRISAT, IITA, IRRI, PCARR,MARDI, AUAP, IARI
C. George	November 26-30, 1979	CATIE, Turrialba, Costa Rica
A. Ali	November 26-30, 1979	CATIE, Turrialba, Costa Rica
N. Kirton	November 26-30, 1979	CATIE, Turrialba, Costa Rica
R. Carew	November 26-30, 1979	CATIE, Turrialba, Costa Rica
R.H. Phelps	November 26-30, 1979	CATIE, Turrialba, Costa Rica
K. Donawa	February 11-18, 1979	CIAT (Colombia)
J. Hammerton	January 2-5, 1979	CATIE, Turrialba, Costa Rica
V. Sargeant	January 2-5, 1979	CATIE, Turrialba, Costa Rica
J. Cropper	January 2-5, 1979	CATIE, Turrialba, Costa Rica
S.Q. Haque	August 1979	International Congress, WA
M.M. Alam	August 1979	International Congress, WA
C. Madramootoo	1979	CIAT, CATIE
J. Lowery	1979	CATIE
S. Parasram	November 1979- January 1980	IRRI, AVRDC, INCRISAT, IARI, IITA
H. Harricharan	July 1980	Dairy Development Center, Guyarat Anan, India
J.A. Bergasse	September 17-19, 1980	CATIE, Turrialba, Costa Rica
M. Alam	November 17, 1980- December 13, 1980	India

R. Carew	1981	WINROCK International, Arkansas, USA
A. Ali	1981	WINROCK International Arkansas, USA
G. Mohammed	1981	WINROCK International Arkansas, USA
R. Carew	1982	CATIE
L. Singh	1982	CATIE
J. Hammerton	1982	CATIE

Recommendations

A number of farm systems research workshops, seminars or conferences will be held throughout the world during the next several years. Phase II should budget for at least 30 man months of international travel and expenses for conferences and visits to FSR projects in other countries. FSR scientists need this exposure.

The project evaluation team recommends that USAID fund 40-60 man years of study at one of the regional agriculture diploma schools for secondary graduates of the LDCs of the eastern Caribbean. Candidates for this training would be required to spend at least six months as a field assistant in one of the national FSR programs to be eligible for this training. The returning trainees would be required to work as a field assistant for at least one year before being considered for further training. USAID funds should be provided for these field assistants as this is considered part of his/her training.

The team further recommends that USAID fund 20-30 man years of training beyond the diploma level terminating in a B.S. degree. This training should be in Caribbean institutes if the training is available. Staff of the FSR or Ministry staff who have spent at least six months on the field staff of a FSR country program would be eligible for this training.

To strengthen the development of FSR in the Caribbean, 30 man years of advanced degree training in the agricultural disciplines, which focus on FSR, should be funded for current staff. Much of this training would be in U.S. universities.

VIII. REVIEW OF THE LOGICAL FRAMEWORK--SMALL FARM MULTIPLE CROPPING RESEARCH PROJECT

Inputs

The project has been extended through November 1982. At this time, all AID funds will have been spent. The line items were adjusted in August 1981, to reflect programmatic changes. The CARDI contribution was not reviewed, nor was that of the LDC countries.

Outputs

(A) The most significant output of this project was the eight teams established in seven countries (St. Kitts and Nevis each have one team). Approximately 25 farmer cooperators had been or were being interviewed for the characterization survey on each of the islands. Interventions were being conducted with about 20 percent of these farmers. The country teams were integrated into the respective Ministries of Agriculture. In most countries, a Ministry counterpart worked as a team member. The evaluation team was impressed with the enthusiasm of the country teams. With some additional training most of the personnel on the country teams will be able to carry out their FSR responsibilities.

(B) The baseline survey and the year-long weekly interviews with the farmers have provided a better understanding of the complexity of the farm for CARDI core and country staff. This project has also helped the extension personnel understand the small farmer. The information collected is now being documented through the farmer profiles; however, these deal with each farmer individually and do not provide information which can be used by larger groups of farmers. The socio-economic data base is incomplete. A redesign of the data processing effort has been made, but the evaluation team questions the value of repeating this process because there is simply too much data to manage efficiently and it continues to be collected from a heterogeneous sub-sample. A number of specific studies have been completed which provide ample insights into the resources, constraints and objectives of the farmers.

(C) The project never developed any improved smallholder systems. On-farm tests was conducted on many farms, but they were designed as observation and not research trials. Preoccupation with data collection through surveys has delayed moving into replicated on-farm testing. Whatever on-farm work done added little knowledge about the farming system. Most of the on-farm testing involved varying only one component of the system. The on-farm testing, however, did give the teams experience in conducting on-farm tests. This experience is necessary to refine the methodology for on-farm testing in the Eastern Caribbean.

(D) Two baseline surveys for six of the territories are available, as well as specific studies. The information contained in these documents is of use to planners and policymakers, but is of little use to extension agents and credit officers.

Purpose--End of Project Status

(A) The project has not met its purpose, nor will it do so by November 1982. If any farmer recommendations are forthcoming, they should be validated at least through one more cropping season.

End of Project Status

(A) The research method has not yet been formalized. The teams have been formed in the seven territories and are starting to function. CARDI now has a visible presence in the seven territories, and because of this presence, is having an impact with the farmers and the Ministry people on the islands.

(B) There is no indication that country contributions can absorb the field personnel costs.

(C) No recommended practices, but some observation trials were implemented. Some of the farmers were planting the virus-free yam seedstocks which is a direct result of this project. Black-belly sheep have also been introduced onto St. Lucia. The vegetable garden and mulching interventions may have an impact once they are properly evaluated.

(D) There has been very little impact on noncooperating farmers.

(E) CARDI has not formulated any recommendations, practices or systems which can be used by the credit institutions.

Goal

The purpose has not been met and, therefore, the goal has not been affected by this project as yet.

APPENDIX A

TERMS OF REFERENCE FOR THE EVALUATION OF THE CARDI/USAID SMALL FARM MULTIPLE CROPPING SYSTEMS RESEARCH PROJECT NO. 538-0015

A. OBJECTIVE

I. To evaluate the effectiveness of the Small Farm Multiple Cropping Systems Research Project in improving the income and well-being of small farmers by development of appropriate management and production technologies by examining:

i. acceptability of proposed interventions by experimental groups and the potential of these interventions for wider application;

ii. methodology and the results of small farm surveys and analyses; and

iii. net benefits to small farmers of project interventions.

II. To evaluate the appropriateness of the Project, as a basic model for applied research in small farm agriculture in the Eastern Caribbean, including the institutional framework at both the regional and national levels.

III. Provide specific recommendations concerning further assistance in the area of applied agricultural research, particularly as it relates to improving the income and livelihood of the small farmer in the Eastern Caribbean.

B. SCOPE OF WORK

I. To achieve objective I, the evaluation team will:

i. assess the effectiveness of CARDI's efforts to date, to collect data, interpret this data, and determine appropriate interventions for project target groups;

ii. examine interventions underway and recommend improvements, if needed, or changes in agronomic approach; and

iii. analyze the ability, to date, of CARDI to transmit information on improved technologies to extension personnel, farm groups, and other clientele.

II. To achieve objective II, the evaluation team will:

i. examine the ability of CARDI to coordinate and adapt its institutional structure to perform appropriate small farm adaptive research, particularly as it relates to the CARDI multi-disciplinary approach;

ii. examine the institutional and absorptive capability of public and private agricultural organizations in the LDCs of the Eastern Caribbean to utilize existing applied research;

iii. examine the priority needs of various islands relating to applied agricultural research; and

iv. discuss the effectiveness of the project in addressing these needs.

III. To achieve objective III, the evaluation team will:

i. make recommendations for appropriate areas of applied research, both regional and country-specific, for AID involvement in the future; and

ii. recommend appropriate institutional arrangements and procedures for such applied agricultural research activities and programs.

APPENDIX B

TEAM ITINERARY AND PEOPLE MET

DATE	PLACE	TEAM MEMBERS	PEOPLE MET
3/16-17	Washington, DC	Beausoleil, Galt Everson, Freed	Filipe Manteiga, Bill Baucom, Jeff Rosen, Carol Weber, Miguel Cuevas, Mike Weber
3/17-20	St. Lucia	Entire Team	Calixte George, John Hammerton, Jim Hughes, Vasantha Narendran, Julio Chang, Arthur James, Ron Pilgrim, Burnette Sealy, Greg Avril
3/21-25	St. Kitts	Freed, Deans, Everson	Laxman Singh, Charles Williams, Jennifer Lowery, Austin Farrier, Howard Batson, Roger Francis, Ken Martin, George Bradley
3/21-24	Antigua	Beausoleil, Galt	Lenny Daisley, Leo Nicholas, Vincent Belle, Daryl Roberts, Francis Henry, John Keoghan, Roberta Anthony, R. Edwards, Robin Yearwood, Ted Burleigh, C. Young
3/24	Montserrat	Beausoleil, Galt	John Pittman, Marcus Pitter, Peter Lake, Jammi Kumar, Jasmeed Adam, Claude Gerald
3/25-28	Dominica	Beausoleil, Galt Freed	Colin Bully, Herman Adams, Ismanie Roger, Gregory Robin, Earl George, Munir Alam, Roger Harris
	St. Vincent	Everson, Deans	Noel Kirton, Clairmont Cordice, Glenroy Browne, Carlton Williams, Lenford Sampson, C. Antrobus, D. DeFreitas, Boyer
3/29-4/6	St. Augustine	Entire Team	Joe Bergasse, Sam Parasram, Richard Carew, Ghiasudeen Mohammed, Ashraf Ali, Ralph Phelps, Brian Cooper, St. Clair Forde, Syed Haque, Pascal Osuji, Haymchal Harricharan, T.U. Ferguson, Lawry Wilson, T.H. Henderson, M. Patton, P.I. Gomes

APPENDIX C

STATUS OF INTERVENTIONS

ANTIGUA

TITLE	# of farms	# of Reps.	Ident.	Status Ongoing	Completed
Eval. of NPK fert. on Eggplant production	2	3			x
Eval. of NPK fert. on Yam production	2	3			x
Eval. of increasing pl prop. on yield of S. Potato	2	2			x
Eval. of NPK fert. on Banana Production	2	2		x	
Eval. of increasing pl prop. in Bush Beans	2	2			x
Eval. of NPK fert. on Okra prod.	1	1			x
Eval. of NPK fert. on S. Potato Production					x
Control of Pests in Cotton			x		
Intercropping of Corn with Legumes	3	4		x	
Intercropping Sweet Potato with Legumes			x		
Intercropping Yam with Legumes	1	1		x	
Control of Cylas in Sweet Potato			x		
Eval. of mulching in Veg. Crop production:					
Thyme	1	1		x	
Onions	2	2		x	
Sweet Peppers	3	3		x	
Cabbages	4	4		x	
Squash	1	1		x	
Tomato	2	2		x	

MONTSERRAT

TITLE	# of farms	# of Reps.	Status Ident.	Ongoing	Complete
1. Introduction of Protein/Energy feed Banks for Cattle Production	3	3		x	
2. Yield exploitation in Peanut Production by increasing plant prop.			x		
3. Intercropping Sea Island Cotton with Legumes and Corn	2	2			x
4. Evaluation of fertilizer application on Sweet Potato Production	1	1			x
5. Evaluation of ridge and bed systems for Thyme Production					x
6. Intercropping Sweet Potato with short duration legumes.			x		
7. Banana Intercropping System	1	1			x
8. Reduction of infestation of Sweet Potato weevil by a field sanitation/crop rotation approach			x		
9. Intercropping Peanuts with Beans				x	
10. Reduction of Weed Population in Hot Pepper by intercropping	1	1			
11. Yield response of peanuts cultivated on beds vis-a-vis ridges	1	5			

DOMINICA

1. Evaluation of Year Round Vegetable Prod.	7	7		x	
2. Evaluation of Yam/Legume Crop mix	1	1		x	
3. Evaluation of Multiple crop mix - Dasheen and Cucumber	1	1		x	
4. Evaluation of Vegetable Crop mix					
5. Evaluation of staking in Tomato Prod.	4	1			

ST. KITTS

TITLE	# of farms	# of Reps.	Status Ident.	Ongoing	Complete
1. Intercropping Rootcrops with Legumes	10	10		x	
2. Evaluation of Mulching on Sweet Pepper Production					x
3. Evaluation of Staking on Tomato Prod.	4	4		x	
4.Plant Population Control in Carrot Prod.	4	4		x	
5. Evaluation of Yams Round Homeyard Vegetable Production Systems.	3	3			
6. Introduction of Improved NC-2 Peanut Cultivars	4	4		x	
7. Introduction and evaluation of short-duration Pigeon Peas	6	6		x	

NEVIS

1. Establishment and evaluation of Protein/Energy Bank to Cattle feed in dry season			x		
2. Evaluation of fertilizer application on Cotton Production	12	17		x	
3. Evaluation of an Improved Peanut Production Package	3	5			x
4. Control of Sweet Potato Borers	3	5			
5. Intercropping of Sweet Potato with short duration Pigeon Peas			x		
6. Evaluation of an Improved Sea Island Cotton Production Package					

ST. LUCIA

TITLE	# of farms	# of Reps.	Ident.	Status Ongoing	Complete
1. Introduction and evaluation of Recommended Virus Tested Yam with White Lisbon	10	10		x	
2. Introduction of Black Belly Rams to upgrade local sheep	8	8		x	
3. Control of Fusarium Wilt in Tomato by introduction of wet-resistant cultivars	5	5		x	
4. Validating Control of Black bug of Cabbage by hot water treatment	5	5		x	
5. Introduction and evaluation of Improved Cassava Cultivar	1	1		x	
6. Introduction and evaluation of short-duration legumes with existing Multiple Cropping Systems	10	10			x
7. Poultry Management Improvement			x		
8. Evaluation of Multiple Crop Systems based on Yams			x		
9. Intercropping of Sweet Potato with Legumes and Corn			x		
10. Intercropping of Cassava with short-duration legumes			x		
11. Evaluation of alternate crop protective methods for control of Sweet Potato weevils			x		
12. Evaluation of Small Machines and implements and tools in land preparation activities for crop prodn.			x		
13. Evaluation of alternate weed control methods on Multiple Cropping Systems			x		
14. Evaluation of mini-dams for irrigating vegetable crops				x	
15. Evaluation of Recommended High Yielding Sweet Potato Cultivar A 26/7			x		

ST. VINCENT

TITLE	# of farms	# of Reps.	Status Ident.	Ongoing	Complete
1. Introduction of new Banana Variety	1	1		x	
2. Intercropping Bananas with Legumes	3	3	x		
3. Introduction and evaluation of new Peanut variety	8	8		x	
4. Evaluation of Increasing peanut Population on Peanut Production	4	4		x	
5. Minimum Tillage of Aroids	3	3		x	
6. Validating use of insecticide on Control of Diamond Back Moth in Cabbage	5	5			x
7. Cowpea Population Increase in Sweet Potato/Corn Intercropping Systems	4	4	x		

GRENADA

1. Improved Eggplant Production Package	10	10			x
2. Poultry Management Improvement	6	6		x	
3. Variety/Fertilizer introduction into Sweet Potato	4	4			x
4. Evaluation of fertilizer application in Cocoa	4	4		x	
5. Evaluation of fertilizer application in Tannia	4	4		x	

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