Final Evaluation

National Cereals Research and Extension

Phase I

Project No 631-0013

by

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

I. Project Description

Project goal was to increase agricultural production and rural development. The sub-goal was to build an institutional capacity for applied research. The project purpose was to develop Cameroonian capacity to provide quality research on maize, rice, sorghum and millet, and to facilitate utilization of research results by farmers. An effort was made to evaluate only Phase I, that is from 1981 through 1985, and to that end information that only became available well after Phase I was utilized. The Team found that the project was well designed and implemented in a relatively timely and effective manner. In the report both the accomplishments and specific instances of deficiencies are presented. The goal was appropriate and the project contributed to that goal, as well as to the sub-goal. It also made a good beginning in serving the purpose of developing Cameroonian research capacity to provide quality research on important cereals. It has been more effective than is common in this type of project.

A grant agreement between USAID and the GRC was signed in 1979, in which USAID granted $7.7 million and the GRC agreed to contribute $6.6 million. Subsequently, IITA was contracted to provide technical assistance, limited supplies and short term training. USAID was responsible for all long term academic training, construction and most of the commodities.

Recommendations, of course, apply only to Phase II, and they aim to build on strength as well as to correct deficiencies. The defects noted caused considerable inconvenience and at times extra work on the part of project personnel. Generally, these defects were compensated for in one way or another, and the final effect on project accomplishment was not great.

II. Achievements

A. Research Activities

The maize breeders conducted research with the goal of producing varieties which are disease and lodging resistant, drought tolerant, adapted to three agro-ecological zones and earlier maturing and higher yielding than the indigenous varieties. The maize agronomists studied fertilizer application, plant population (especially that related to cropping systems) and residue management. The TLU has taken these innovations and used them as a basis for on-farm tests.

Breeders worked on improving rice varieties for each of the three agro-ecologically different zones. At the end of phase I, they had developed varieties for field production in all three zones. Since most of the rice produced in the country is grown under irrigation, they placed most of their efforts on irrigated rice, but did do some work on rainfed or upland rice. The agronomists conducted research on improved practices of fertilizer application, soil preparation, time of planting and pest control. Information developed by them has been tested and disseminated to farmers.

The sorghum and millet program emphasized varietal selection and improvement. The breeders have made sorghum varieties available for increase and distribution to farmers. These are higher yielding and possess other improved plant characteristics. In addition to work on varietal improvement, they did some work on agronomic practices.

The primary accomplishments of the crop protection workers have been to work with other scientists in identifying important diseases and screening for resistance.

The TLU was engaged in testing new technology on farms and in developing linkages between IRA, the extension service and the parastatal agencies. It

has played different roles, depending on the linkage partner. One role it performed was to train extension workers, which has proven beneficial and not difficult. Extension service response has been good in terms of getting new technology to farmers and collaborating in on-farm tests. Significant progress has been made in developing a farming systems methodology, which is adapted to IRA's needs and the Cameroon situation. IRA has been effective in integrating the activities of donor projects into a single FSR program. The TLU provides a function essential to research and is an innovation in research management that probably has more significance than is immediately apparent.

B. Technical Assistance

Since the beginning of the project, a qualified and motivated NCRE/IITA staff has been conducting research, training inexperienced IRA/NCRE staff and participants, and to a limited extent, improving physical working conditions. The contractor has complied with the requests for short term consultants in most cases.

C. Commodities

USAID and IITA have provided much of the equipment and supplies requested by the NCRE/IRA personnel. In most instances the staff has been able to use these items. The contractors have completed three of the six houses and some laboratory/storage/preparation facilities.

D. Training

All of the planned short term and academic training was initiated during Phase I, during which 31 persons participated in short term training at the IARCs. Of the 13 persons planned to receive degree training, nine have returned after this training and four began their study in Phase I.

III. Lessons Learned

A. Research Linkage

It appears that linkage of research with conventional extension is not particularly difficult if research management will take determined action to: a) provide an adequate structure; b) develop appropriate job descriptions and make personnel assignments and c) provide resources to get the job done. This has been accomplished and is the main reason for the initiation of a potentially successful extension program.

B. Structure and Motivation

Linkage between research, TLU and extension (and other entities performing an extension-type function) is improved when research's linkage partners also have an adequate structure and a motivation for linkage. MINAGRI extension is markedly deficient in these two aspects. Some of the parastatals are markedly strong. IRA and UCD will face similar needs in developing effective linkage as the UCD developes its research program.

C. Institutional Management

This project demonstrates the importance of institutional management in project achievement and the potential to strengthen the host institution when institutional management is skillful in exploiting the opportunity and resources made available by the project.

IV. Problems

A. Research

The main problems the research workers encountered are listed below and vary from region to region. Most of these are inevitable in a project of this nature, but perhaps with a bit more concerted effort they could have been lessened or corrected.

1. Inadequate funding within IRA for extensive travel by research workers and for hiring temporary labor;
2. Shortage of trained technicians at experimental sites;
3. Inadequate transport;
4. Lack of statutes which would enable IRA management to compensate personnel on the basis of performance;
5. Lack of personnel resources in IRA management;
6. Lack of soil analysis facilities and services for supporting research workers;
7. Lack of a formal policy and system for variety release and inadequate procedures for seed multiplication.

B. Technical Assistance

About the only problem related to the Team was that IITA has not provided adequate technical backstoping. Requests by NCRE/IITA members for short term consultants were not filled in a few instances.

C. Commodities

The evaluation carried out in 1983 identified commodities (equipment and supplies) which had not been delivered in a timely fashion. In some cases the very same commodities still had not been received by the end of Phase I and the general situation still exists.

Requests were forwarded to the contractor for items authorized in the contract. Undue delays and losses resulted from this procedure. Spare parts and maintenance of vehicles have always been a problem and were more acute with the first shipments of American made vehicles.

Requests with specifications for those supplies and equipment for which USAID reserved the funds and authorization have taken much longer to fill than planned for or expected. Equipment has been received in an inoperable condition, not usable because of differences from original specifications or lack of accessories. Apparently, responsibilities for procurement tend to be fragmented, making it difficult to assign accountability.

The delay in completion of the houses, and more importantly, the physical facilities at the research sites has caused some inefficiencies, ineffectiveness and inconveniences of the research workers.

D. Training

The Team heard of a few study plans which may not have been appropriate to the needs of the NCRE program. Part of the NCRE/IITA scientists expressed their frustration because of their small role in the selection of participants for academic training during phase I.

V. Recommendations

These are divided into two categories: Critical and Important. The first consists of those that require action in a persistant and vigorous manner in the immediate future, and the second contains those which should also be addressed but perhaps over a longer time period. The Team, to the best of its ability, has made an effort to identify the institution(s) responsible for corrective action and to rank the issues by priority within each category.

A. Critical Issues

Recommendation 1. Provide soil analysis services, either on a national or regional scale for research workers, IRA;

Recommendation 2. Review and revise where necessary the system for procurement of both USAID and IITA authorized commodities and make the system known to all personnel affected, USAID/IITA;

Recommendation 3. Expedite the completion of the three houses and construction of other buildings scheduled for the research sites. USAID/IRA.

Recommendation 4. Review procedures for managing the participant degree training program.

Recommendation 5. Develop an in-house training program for sub--professional personnel, IRA, IITA.

Recommendation 6. Take positive action in identifying and correcting the provision of short term consultation both in direct response to NCRE/IRA requests and to provide general support in disciplines in which IRA lacks expertise. IITA.

B. Important Issues

Recommendation 1. Provide additional management resources to IRA.

Recommendation 2. Develop a plan to build an appropriate research capacity in such subjects as soils and plant protection. IRA.

Recommendation 3. Make use of a substantially greater capacity in agricultural economics than is currently evident or anticipated. More sophisticated, but reasonable, economic analysis of research results are necessary for a national policy concerning imported inputs, manufactured inputs, price support and subsidy, export of crops, and research investment. IRA/USAID/IITA.

Recommendation 4. Name small work group to determine IRA needs in data analysis.

Recommendation 5. Give continued attention to the development of institutional capacity of IRA. The following factors should be considered (but not listed by priority):

a. An institutional plan that would be useful for making decisions, acquiring resources and establishing linkages, IRA;

b. A personnel plan, IRA;

c. A plan and strategy for linkages with sources of science and technology, IRA/IITA;

d. A finance acquisition plan and strategy which could facilitate obtaining adequate resources, IRA;

e. An inventory of IRA institutional resources and facilities to serve as a benchmark to measure phase II progress, IRA/USAID/IITA;

f. Development of statutes and policies for compenstating personnel in a manner consistent with the IRA mission, IRA/MESRES

g. Addition of staff resources in the office of IRA top management, MESRES/IRA.

Recommendation 6. Develop a set of working practices and improve linkage with Semencier for seed multiplication.

Recommendation 7. Develop an internal policy of variety release and take lead to define Cameroon's/seed certification needs.

Recommendation 8. Consider alternating regional research planning conferences with the national research planning conference.

The transition from Phase I to Phase II has been made smoothly. If the deficiencies that persisted through Phase I can be alleviated, the GRC has a good chance of achieving its institutional development objectives of building and supporting a fully multi-disciplinary agricultural research staff. As this development occurs improved technology will be made available to farmers and lead to increased agricultural production.

EVALUATION REPORT

I. Methodology Used in Conducting the Evaluation

The evaluation of the National Cereals Research and Extension Project (NCRE), USAID No. 631-0013 was carried out by three consultants from February 2 through February 27, 1987. The consultants did an in-depth, final evaluation of Phase I of the NCRE, which was from mid-1981 through calendar year 1985. Phase II was started immediately after the end of Phase I and it is obvious that it was difficult at times during the evaluation to separate the two phases.

The Evaluation Team, consisting of a Research Administration Specialist, Robert Jackson (team leader); Research/Extension Specialist, J.K. McDermott; and an Applied Agronomy Research Specialist, David Knauft; conducted the second and final evaluation by making project site visits and interviewing personnel associated with the National Cereals Research and Extension Project (NCRE), Phase I.

The three consultants, hereafter referred to as the Team, reviewed project related documents. The basic ones were the Project Paper, the 1983 Evaluation Report and the NCRE Terminal Report, 1981 through 1985. Several other documents were made available to the Team and these are listed in the report.

1 NCRE/IITA-staff members, hired by IITA

2 NCRE/IRA staff members hired by IRA

The Team visited all NCRE Phase I research sites and interviewed NCRE/IITA1 and NCRE/IRA2 research workers and participants. The Team also interviewed selected target groups of the NCRE project which included collaborating research workers, extension staff of the Ministry of Agriculture and development societies, seed multiplication units and farmers.

The Team analyzed and documented the progress and achievements made under phase I of the project. These included the following:

Institution development;

Delivery of supplies and equipment for project use;

Construction of houses and physical facilities;

Professional-technical staff, both expatriate and national;

Participant training program, both academic and short course;

Institutional relationships with other Cameroonian and international agencies;

Operation of the Testing and Liaison Unit (TLU);

Maize variety development program, including its strengths and weaknesses.

A draft Executive Summary was prepared early in the preparation of the report. This was discussed at three separate meetings with USAID, NCRE/IITA and IRA. The exchange of ideas from these meetings were considered in preparing the report. However, the bases of the report were the site visits, observations and interviews carried out by the Team while in Cameroon.

II. Project Related Issues

A. Technical Accomplishments

1. Maize

A program of varietal development has been established in all three ecological zones where maize is grown. The objectives of these programs have been developed in cooperation with IRA agronomists, TLU's, and parastatal organizations. Design of the projects includes screening introduced germ plasm and development of populations which are selected for yield, yield stability, disease and lodging resistance, drought tolerance, early maturity, suitability for intercropping, and acceptable quality for the consumer. Each research activity has established population inprovement techniques and procedures for the development of hybrids. The program also has developed cooperative ties with IRA antennas (substations), parastatals, and TLUs for multilocation screening of material, both on-station and on-farm. Cooperation with parastatals also exists for foundation seed production of new varieties. The NCRE scientists have obtained maize germ plasm from IITA, CIMMYT and other national programs in Africa and Asia for incorporation into their breeding and selection programs. Research in maize agronomy has included studies on planting dates, fertilizer and residue management, plant populations, weed control and intercropping. These studies have been conducted both on-station and on farmer fields. Recommendation have been made to and adopted by farmers through the activities of IRA agronomists, TLU, MINAGRI extension and parastatals such as SODECOTON and MIDENO.

2. Rice

A varietal improvement program with ties to IRRI, IITA, WARDA, and CIAT has been established at the IRA Dschang experimental station with the goal of producing cultivars adapted to three areas of rice production in Cameroon. Strong ties between NCRE and SODERIM, UNDVA, and the Karewa Experimental Farm have produced networks for the on-farm testing of material for local adaptability. In each of the zones, material which has been identified as superior to local checks has been increased for possible cultivar release. This material was higher yielding and disease resistant and had better grain quality. On-farm trials have also been carried out in traditional irrigated rice producing areas of the North West Province in close cooperation with the TLU at Bambui, the village community Project at Bafut and the Catholic Mission at Bankim. Preliminary studies indicated higher potential for production of improved cultivars.

Agronomic research has been conducted, primarily on irrigated rice, for cultural practices and fertilizer requirements of different material being tested by the breeders. These studies have been verified on farmers' field and have been disseminated to the farmers through an extensive network involving MINAGRI extension agents and the parastatals SEMRY, UNVDA, SODERIM, AGRILAGDO, and the Bafut Project.

3. Sorghum and Millet

Major emphasis in Phase I was on genetic improvement of sorghum in three ecological zones in northern Cameroon, in cooperation with sorghum breeders from ICRISAT and national programs in Africa. Multilocation testing on IRA stations and substations identified genetic material with stable yields higher than local varieties. A long-term genetic improvement program has also been established for both sorghum and millet. Some agronomic work on sorghum has

been carried out, although the primary effort of this unit has been the development of a variety improvement program.

4. Crop Protection

Disease surveys conducted in the highlands have identified blight, rust, and smuts as major problems in maize production. In the lowlands, important maize diseases were found to be blight, rust, and maize streak virus. Sorghum and millet diseases included gray leaf spot, long smut, grain molds, and downy mildew. Sheath rot, leaf scald, and blast were found to be important rice diseases. Seed mycoflora were also characterized for the four cereals. The unit has also cooperated with the maize breeder in screening for resistance to blight in the highlands.

Entomological surveys were conducted on grain storage insects and on agronomic trials affecting incidence of storage insect pests.

III. Specific Issues

A. Institutional Relationships

Two sets of institutional relationships are significant. One of these sets involves donor, host institution, and contractor. These relationships have developed quite well. In spite of certain implementation problems, explained later in this report, the institutional relationships are strong and productive.

The second set of relationships are those between IRA and extension and parastatals which serve an extension function. Those relationships relevant to Phase I which the team observed were quite good. Some parastatals rely heavily on IRA for technology, and IRA relationships with them are remarkably strong. These are described in detail later in the report.

B. Goals and purposes of project

The goal of Phase I of the National Cereals Research and Extension (NCRE) Project was to increase agricultural production and rural development. Phase I covered the period 1981 through 1985. From information presented to the evaluation team by research workers and others, it is apparent that there was an increase in production of the four major cereal crops addressed in the project. Several factors are responsible, such as good weather and public investment. Research carried out under the project contributed to both an increase in yield and an increase in total area under production. Yield increases are estimated on the order of 40 percent for rice and 20 percent for maize and sorghum.

Two examples of rural development are the UNVDA and SODERIM projects, both parastatals producing rice. The village at Ndop exists because of the increased production of irrigated rice. The village is rapidly expanding and municipal services such as water and electricity have recently been made

available to the inhabitants.

The subgoal was to build an institutional capacity for conducting research on each of the four cereal crops and to develop the Testing and Liaison Unit (TLU). This institutional capacity building was initiated during Phase I, and plans for expansion are part of Phase II. There has been interaction between the research workers within the cereal program and TLU as well as with those working on other crops, such as legumes and roots and tubers. There has been little evidence of a multidisciplinary approach which is one of the major factors in institution building. Largely, this is because staff is lacking in important disciplines other than plant breeding and agronomy.

The major support for research has been for the cereals program and this came primarily from USAID. USAID funds have been allocated for research work on legumes where they are a part of the system of cropping involving cereals. Other donors have funded research on other agricultural crops and farming systems.

The Project purpose has been to develop Cameroonian institutional capacity to provide quality research on maize, rice, sorghum and millet, and to facilitate utilization of research by farmers. Cereals research was to be integrated into a cropping systems approach to food production and be aimed at the problems of small farmers.

Phase I was planned for five years with a follow-on Phase II for an additional three years. The intentions were to phase out or reduce the number of expatriate staff members and for trained counterparts to take over the research programs during Phase II. When the design of Phase II was completed, however, the expatriate positions were increased from nine to twenty and the time frame for Phase II was increased to ten years, all because of the success of phase I. Phase I demonstrated the great potential of research, through the

performance of both the technical staff of the project and the institutional management of IRA.

The Team observed and discussed results of research and found that they are both relevant and applicable to solving the constraints of the small farmers. The TLU and crop research workers are developing improved cropping systems in most of the agro-ecological zones. At the same time, they are introducing improved cultivars to the farmers.

It is obvious that institutional linkages have been developed with IITA since it is the prime contractor. IRRI, ICRISAT, CIMMYT, WARDA and CIAT have provided germ plasm and some have assisted in short term training. Several of the national agencies, particularly the parastatals, such as UNDVA, SODERTM, and SODECOTON have formed close ties to the project.

C. Project Outputs

The technical staffs of the research institutions associated with the project have been upgraded through long and short term training. This has increased the capacity to carry out applied research and on-farm testing. The expatriate staff has been able to initiate research and fill the gaps when counterparts have been sent abroad for training and have also provided training for their national counterparts.

The national agencies, and particularly the parastatals, have welcomed these changes in cropping systems and improved varieties and have almost clamored for more. In many instances there has been effective communication to small farmers who have been receptive to these changes.

It appears to the Team that the development of institutional capacity to plan, implement and evaluate applied research has made significant progress but has not been accomplished to its fullest. It is true that planning and implementing at the specific crop level has been and is being carried out at a

satisfactory level. However, on an overall basis, the process has not been completed. More specifically, there has not been the element of the multidisciplinary approach to solving agricultural constraints of the farmers. This is part of the institution building capacity that is lacking. The Team has not been able to locate any present or future staffing pattern for IRA at any of the Center visited. If there were to be an institutional building component in Phase I, it appears that there should have been a staff organization plan more than simply an objective to train 13 participants.

A significant output is a yearly conference on cereals at which past research results are presented along with plans for the coming cropping season. Plans are discussed and it is during this process that the research is evaluated and modifications in plans are made. The conference started out as simply a project implementation activity. It is now well along the way to becoming an institutional function and is being utilized in other research programs.

The Log Frame calls for 13 graduate degrees, 2 Ph.D. and 11 M.S., to be complete by 1984. Thirteen were sent, but only one for the Ph.D., and one candidate, we understand did not get the degree. The schedule was missed widely. It was 1986 before the last three were sent.

The Team did not count the number of field trials, but have no concern over their adequacy, either in number or quality.

With the very important exception of buildings and equipment, we find the outputs to be consistent with the Log Frame.

D. Project Inputs

The project was to provide adequate facilities for conducting research. Commodities, especially vehicles, have not met the needs of the staff. There have been relatively long delays from the time a research worker developed and submitted the specifications until the commodities were at the research site. In some cases the equipment received has not met the original specifications. In other instances the equipment has not been put into service for lack of spare parts. One of the biggest problems has been the lack of available spare parts for vehicles. The construction of the houses and buildings has been far behind the schedule.

The number of participants to be trained under Phase I has been met even though three were sent later than anticipated.

There were minor delays in assembling the expatriate research team at the initiation of Phase I, but there have been no appreciable gaps in the continuity of the staff. Each staff member was to be assigned at least one counterpart and the GRC has fulfilled this requirement.

It was reported to the Team that IRA provided only limited funding for travel of national counterparts, hiring temporary labor and support staff. All of the expatriate staff would have liked more counterpart and technical staff with whom to work and train. It must be noted, however, that funding is always "limited" and that researchers can always use "more help and facilities". The Team finds that IRA probably did quite well in providing both personnel and finances. The project caused an expansion in IRA which added to its budget burden.

Other comments the team noted were inadequate seed processing and storage facilities and or limited areas for growing murseries under irrigation during the off season. On equipment and facilities, the team is not so

understanding. Financial resources were available and are still unused, and no satisfactory explanation was found.

E. Institutional Inputs

The quality of the technical long term staff provided by IITA has been good, as has the quantity. There have been only a few short breaks in the continuity of staff once the original one was recruited and on board. The Team heard of a few inadequacies in fielding short term consultants. Either they were not supplied on a timely basis or not supplied at all. Provisions are made in the contract to provide these consultants once they are requested.

The contractor has project funds to purchase some equipment and supplies. Although these were requested from IITA, an unduly cumbersome ordering and supply procedure was in effect. The Team understands that some of this has been corrected in Phase II. This needs to be the concern of both NCRE and IITA as Phase II continues.

IITA and its sister IARCs have done a good job in training participants in their short courses. Every effort should be made to continue this training.

IV. Technical and Economic Analysis of Applied Research and TLU Components

A. Applied research

All of the evidence from reports, miscellaneous data, and interviews indicate that:

1. Relevant and significant research was done by agronomists, breeders, and on-farm researchers;
2. Research was completed largely as planned but with some problems in analysis of data in timely fashion;
3. Research was reported in written form; and
4. Results that were applicable were communicated to appropriate audiences.

Most work in Phase I was devoted to agronomic and varietal improvement problems. Relatively little attention was given to economic problems and analysis with the exception of surveys. Only one agricultural economist was included in the IITA team, and he served as team leader for much of the project period. Another was qualified both as an agricultural economist and and an agronomist and spent much of his time working as an agronomist. Out of 28 IRA counterparts listed in the terminal report, two were described as "socio-economist". Of 13 participants trained in Phase I, only one was an agricultural economist and did not begin until 1986, virtually after Phase I ended. Finally, in both written and oral reports presented to the team, attention paid to economics was limited to partial budgeting.

Given the conditions that prevailed during Phase I, it is likely that the lack of economic input did not hamper project accomplishment. Consumer demand for cereals was high relative to supply. Farmer technology was at such a level that NCRE Phase I technology was clearly superior, both economically and agronomically.

Phase I conditions are not likely to continue indefinitely, however. Indeed at that time of this evaluation, most cereals and some legumes were in excess supply. The excess was due more to favorable weather and unusual market conditions than to improved technology. As the level of technology improves, however, economic analysis becomes more important.

Dealings with the target audiences have been quite productive, even though the nature of the audiences vary widely. Some parastatals are energetic in pressing IRA for technology. The case of rice is particularly instructive. Rice production in Cameroon has expanded rapidly. Expansion is due largely to investment in irrigation facilities and the subsequent conversion from upland to irrigated rice. All our evidence indicates that the technical capacity provided to IRA by NCRE Phase I played a significant role in helping the irrigated rice parastatals achieve a level of production that could justify the huge investment required in irrigated agriculture. IRA is providing full support to the Kerawa station which is developing technology for another irrigation project coming on stream. It will deal with several crops, not just rice.

Work with the Ministry of Agriculture has followed a different course. Ministry of Agriculture extension is a passive agency, and NCRE developed a different strategy. That strategy was modified to fit new conditions when MIDENO became active as the MINAGRI extension service energizer. More discussion is found in section B on TLU.

In its dealing with target audiences NCRE has been effective. IT's programs are relevant and appropriate. In cases where they are not adequate it is because of lack of financial and personnel resources to meet demand.

In summary, we find the performance and achievements of NCRE phase I to be quite satisfactory, greater, in fact, than could probably have been expected.

However, two problems have been identified that need the attention of management.

One is the simple problem of adequate NCRE support to its field personnel. Frolick and Alcorn, in the 1983 evaluation, reported that IITA personnel were not receiving rather simple equipment. In 1987 they were still lacking the same items even though there are adequate resources in the project for such support. One support service which may not be regarded as adequate is soil testing. As technology reaches higher levels, the lack of ability to deal with soil problems will become more serious. Finally, short-term consultant support was not adequate.

The second problem deals with institutionalization. The achievements of NCRE Phase I are due largely to expatriate personnel, who are not only technically competent but are also willing to work hard and work off-station on farmers fields, where their technology receives its final test. The evidence we can develop from interviews and observations is that Cameroonian technicians are willing to do this work but that as training levels rise, interest and willingness to work hard and with the farmer decreases. This problem, to the extent it is a problem, needs attention of IRA management.

All parties to this project put a high value on Institutional development. However, no statement was found in Phase I documents on what constitutes "institutional development."

B. Testing Liaison Unit (TLU)

Only one TLU was included in NCRE Phase I Northwest Province. However, at least three other experiences were relevant to this analysis -- one in the Extreme North Province, one in the North Province, and one on the Nkolbisson station. In summary, the TLU concept holds promise to be a significant breakthrough in research management, especially in regard to organizational

structure and to research entity function. Whether TLU will realize its promise depends on certain other aspects of management, and only time, of course, will finally test the viability and durability of the concept.

TLU is an additional component in the research structure, one rarely, if ever, found in developing country research systems. This component enables the research entity to accomplish two important functions that are normally neglected. The name accurately reflects these two functions. One is testing and adaptation of the new technological alternatives proposed by research. This function enables research to complete the research job. The research job is not complete until technology is tested in the production system or systems in which it is expected to perform. IRA with the TLU is now able to provide "farmer-ready" technology to extension and other diffusion entities. The second function is liaison. Completing the research job does not discharge IRA (or research entity) responsibility. IRA must transfer the technology to other entities for delivery to producers. To neglect this transfer would be akin to a relay runner who after a good race failed to pass the baton to the next runner. The TLU provides the structure and the procedure for making this transfer. The transfer or liaison function is, of course, dependent on IRA having an adequately tested, finished technology.

1. The Pre-TLU Situtation

From evidence the Team developed, two major types of relationships existed between IRA and extension and extension-like agencies. One is characterized by the IRA-MINAGRI linkage in the Northwest Province, and the other is characterized by the IRA linkage with SODECOTON in the North Province.

Up until about 1980 IRA personnel and Ministry of Agriculture personnel, stationed in the Northwest Province had virtually no contact with each other. IRA worked only on its own stations and reported its results to IRA in

Yaounde. After some lapse of time some of this research would find its way to Ministry of Agriculture in Yaounde, and after more time had elapsed some found its way from Ministry of Agriculture Yaounde to Ministry of Agriculture personnel in the Province. Much either never did get through or it was not quite "farmer ready". The situation was not so much a lag between research and farmer as it was a block. Perhaps this exaggerates the distance between IRA and Ministry of Agriculture personnel, but it still seems to be reasonably accurate, and is substantiated by other accounts. An improved maize variety developed by IRA, had very little dissemination before TLU. A survey conducted by IRA showed that most farmers and most other government agencies hardly knew that the IRA station existed and knew even less of what it did. The characterization seems accurate, in part, because it is typical of so many situations.

The pre-TLU situation in the North Province was different. In that province, SODECOTON was largely responsible for extension. SODECOTON is an energetic (if not aggressive) organization. It was well-financed and had its own technological capacity. The story we are able to piece together is that SODECOTTON took the initiative and kept constant pressure on IRA for research results, and for answers to problems it was encountering. As a result IRA was better known in the area and made a substantial contribution to development. As SODECOTON interest in cereals increased so did the pressure on the IRA cereal program.

It is reasonable to expect that the relationships that existed between IRA and other provincial extension entities and extension-like entities fell somewhere between these two characterizations.

2. The TLU experience

This analysis draws on four experiences that IRA had during NCRE phase I. One is the experience with the only TLU labeled as such, in Northwest Province. Two others are with SODECOTON. One of these was in Extreme North Province in which was located a SAFGRAD Accelerated Crops Production Officer (ACPO) who operated in a fashion compatible with TLU operation. The second SODECOTON experience was in North Province which had neither a TLU nor an ACPO. The fourth experience was on the Nkolbisson station where there was neither a TLU nor an ACPO and which was under no pressure from an extension or extension-like entity.

a. Northwest Province

The idea of TLU, was born in this province on the IRA station. IRA personnel, frustrated by the fact that the station was virtually unknown, and its research was not getting to farmers, were seeking a structure that would facilitate the transfer of technology to the farmer. At least one farmer survey was reportedly completed well before the NCRE project, and IRA had a standard position described as "extension agronomist". The "extension agronomist" concept may have anticipated the TLU, but apparently it did not develop its potential because of lack of resources, particularly transportation, and because of a general weakness in extension. This is an inference we draw from scanty data.

At any rate when NCRE phase I began developing the TLU it found MINAGRI extension exceptionally weak in the area of food grains. The training of the monitors was scanty to begin with, and it was out of date. The TLU in Northwest Province went through two distinct phases even in NCRE Phase I. In the first phase, it was decided that TLU would have to help strengthen extension and even perform some limited extension function. Along with its

survey and on-farm testing activities IRA provided training for local agents. The on-farm tests served as result demonstrations. Later MINDENO, the Northwest Province Development Authority, was established. MINAGRI extension is a major implementing agency for MIDENO. MIDENO took over responsibility for training local agents and provided transportation and financing so that extension could discharge its proper function. In MIDENO phase IRA relations with MINAGRI changed completely.

MIDENO also developed an adaptive research program, and its adaptive research personnel are responsible for training, which is in the fortnightly interval form of the T and V system promoted by World Bank. IRA helps with training and collaborates with the adaptive research.

A recapitulation of TLU activities shows that it engaged in the following activities.

TLU did a survey of extension agents and an inventory of extension capability. This indicated the agents' unfamiliarity with both the Bambui station and cereal crops technology.

It was decided to provide training to agents, which was done in three sessions of two weeks each. In addition to cereal crops technology, agents were given some training in survey and on-farm testing methods.

A farmer survey was conducted, making use of agents as enumerators. Agents were paid an honorarium for the extra work.

The on-farm trial mini-kit was developed for agents and is in use to this day. The mini-kit contains supplies, directions, and reporting forms for simple on-farm tests of technology virtually proved. Agents do report back data, and in this sense it is a test. However, agents also regard the mini-kit as demonstrations. IRA/TLU sends out several hundred of these and receives useful data from about half the agents.

TLU worked with the agents to put out demonstration plots, apparently largely in the extension format. The technology demonstrated was an improved maize variety developed years before that had had virtually no dissemination.

TLU also initiated its own on-farm testing program, which also continues. It consists of some 40 tests, more complicated than the agent trials. These vary in the ratio of researcher and farmer management.

MIDENO was established a year after TLU and assumed responsibility for training agents. It created training centers throughout the province. TLU then developed collaboration with MIDENO. It helps with agent training, but this assistance is in the form of reporting and interpreting its own research results. It collaborates with the MIDENO training centers in testing and adaptive trials. This collaboration is a clear case of mutual benefit. Both organizations are working in testing and adaptation with no evidence, that the team could pick up, that either agency was concerned about jurisdictional boundaries.

TLU conducted a survey of rice producers. In this case the TLU and the rice team collected the data, using a questionaire. TLU tabulated the data.

The TLU did some agent training and a survey in Southwest Province. The training was well received, but TLU did not have resources to follow up in that area. Mini-kits were also distributed.

TLU continues surveys as problems arise and on-farm testing. These are its two major tools, and of these, on-farm tests are considered the most useful and receive most of the attention.

b. Extreme North Province

Experience in Extreme North Province followed a somewhat different format, but it would be easy to overestimate the difference. Following SAFGRAD practice it was largely an on-farm testing program. There also existed a

strong linkage partner, SODECOTON, which "represented" a large share of the producer sector in the province. This "representation" was a substitute for the survey, and the liaison was accomplished through collaborating with SAFGRAD.

There is one SODECOTON for two provinces, and the headquarters are in North Province. An assistant director for rural development is stationed in Extreme North and manages a substantially different technology program from that of the North, because of ecology variations.

SODECOTON helps plan on-farm trials, and SODECOTON agents are instrumental in carrying them out. The SAFGRAD agronomist and IRA personnel work intensively with the agents from trial site selection through harvest.

SODECOTON reacts almost immediately to on-farm test results. In the case of varieties it can facilitate seed production and is the de facto entity for variety release.

c. North Province

There is no TLU or ACPO in the North Province. An agronomist of NCRE/IITA posted in Garoua, however, operates to a considerable extent as a TLU agronomist. His TLU work is certainly abetted, if not initiated, by the program interest and initiative of SODECOTON which collaborates well with IRA.

In this province, NCRE works with the Kerawa experiment station much as TLU in Northwest Province works with the adaptive research section of MIDENO. The Kerawa station was organized to test and adapt technology for use on an irrigation project being developed. As with MIDENO, there is no evidence of jurisdictional problems.

d. Nkolbisson Station

Nkolbisson station had neither a TLU nor access to one in NCRE Phase I. Nor was there an extension agency pressing for technology. The maize

agronomist developed a package of agronomic practices in on-station research with maize as a monocrop. This package has not been tested in the farming systems of the area, and there has been little if diffusion of the technology. Since many area farming systems deal with intercropping, relevance of the technology has not been tested.

3. Institutional Impacts of TLU

We don't know how to measure the substantive impact on production of the TLU. Production impact is made by better varieties and improved cultural practices, and distinguishing TLU contribution from breeder and agronomic and weather contribution is neither possible nor very useful. It is useful to attempt some qualitative assessment of TLU impact on the general functions of institutions involved in technology innovation. We make these assesments in terms of internal impacts to IRA and external to IRA.

a. Internal Impacts

Several of the subject matter researchers, both breeders and agronomists, have indicated their reliance on TLU to give them a characterization of the farmer clientele, with special attention to constraints. There may well be more value in their interaction than is evident, in that it will facilitate collaboration among subject matter researchers, and such collaboration is essential for problem solving. A single subject matter discipline can seldom solve a farmer problem without help from others. It also makes subject matter researchers more sensitive to farmers and keeps them aware of differences among farmers as a function of geographic area.

TLU, thus helps researchers know what to work on and helps them plan their research. Its also helps the subject matter researchers to evaluate what they have done. The on-farm test is the final test in the research process, and it's only in the farming system that technology can finally be tested. In one

case, the superiority of a new variety was in doubt until it was tested on-farms over several years and over a range of weather conditions. In ideal weather its value was not marked, but in harsher weather its superiority was dramatic. On-farm testing of the same variety also exposed a problem of seedling vigor and pressed researchers to address it. TLU, thus puts the researcher in close, meaningful contact with the industry it is responsible to serve.

From an institutional development point of view, a sense of mission and a proper attitude or doctrine of personnel are essential. TLU cannot be credited with developing a sense of mission within IRA or with the doctrine of serving agriculture. Those existed in IRA before TLU, and indeed were responsible for the creation of TLU.

However, the effective functioning of TLU facilitates the development and maintenance of a sense of mission, and it helps exploit the potential value of doctrine and sense of mission. A sense of mission, in turn, depends on an institutional doctrine that places a high value on hard work and service to the clientele. The TLU is a significant instrument by which IRA management and leadership can motivate personnel and harvest the results.

b. External Impacts

A significant external impact of TLU is the direct impact it had on MINAGRI extension in Northwest Province before MIDENO. With relatively few resources and with relative ease IRA, through the TLU, was able to achieve some significant linkage with MINAGRI extension. Reports of TLU's experience with MINAGRI in Soutwest Province indicate a similar situation.

This impact on MINAGRI defies conventional wisdom, which is that the bureaucratic channels between ministries are so clogged that effective linkage between dependent agencies of two ministries is hardly possible.

We can state two posssible explanations. One is that personal relations at the provincial level permits a sort of "extra-legal" or "extra-bureaucratic" collaboration that may be an aberration with an unpredictable outcome.

The second hypothesis is that two entities, which are inherently mutually dependent, such as extension and research, will have relatively little trouble in establishing linkage if there is an adequate institutional structure to facilitate the linkage. TLU is a component of the research structure that helps make the institutional structure adequate.

Evidence from IRA and TLU could be interpreted to support the second hypothesis. There is even evidence to suggest that program power and structure in one entity can compensate for some program and structural weakness in the linkage partner, whether from IRA to MINAGRI or from SODECOTON to IRA.

IRA has established adequate linkages with a variety of client groups under a variety of administrative forms. Some of these linkages are directly the result of and the work of TLU. Others result indirectly from TLU and perhaps as a part of the TLU mentality but with most participation of subject matter personnel. Still others may result essentially from pressure applied by clientele groups. In any case TLU form and function facilitate the linkage.

Linkages with irrigation-rice schemes may be particularly significant. Only with quite good technology will they ever be able to justify the capital investment. NCRE has helped develop that technology, and quite effective linkages have been established to transmit it to rice producers.

It is clear from the small amount of evidence available that TLU can play a significant role in establishing linkages with organizations such as MINAGRI extension which has a relatively weak program and lacks a linking structure.

The liaison function does not seem to be as important as the testing function when dealing with a powerful organization with multiple interests such as SODECOTON. However, testing is liaison in many cases. In the specialized organizations that deal largely with rice the linkage is established directly by the subject matter researchers. The clientele is of such nature and size that subject matter research almost per se is also testing and liaison.

4. Analysis of the TLU function

This section attempts to explain TLU in an objective systemmatic way. If we are successful, it may be useful in some future decision IRA or others may have to make regarding TLU. We have heard, for example, that there is some interest in moving TLU to the MINAGRI extension service. Such an analysis will also be useful in helping other countries adopt and adapt the TLU concept. It is in our judgment clearly an innovation in technology innovation management and thus merits consideration by other national technology innovation systems.

The Technology Innovation Process (TIP) Model, being developed at the University of Florida, is largely the basis for this analysis. The TIP Model attempts to describe the technology innovation process independent of the arbitrary administrative forms, usually known as research and extension, organized to implement the process. Whether the model accurately reflects the process or not, it does provide a common terminology and some common concepts with which to discuss issues.

The TIP model is set forth in Appendix A.

Figure 1 indicates one assignment of responsibilities for various components (elements or functions) of the process to various components of the structures organized to implement the process.

In IRA, "area-specific research" is performed largely by the TLU.

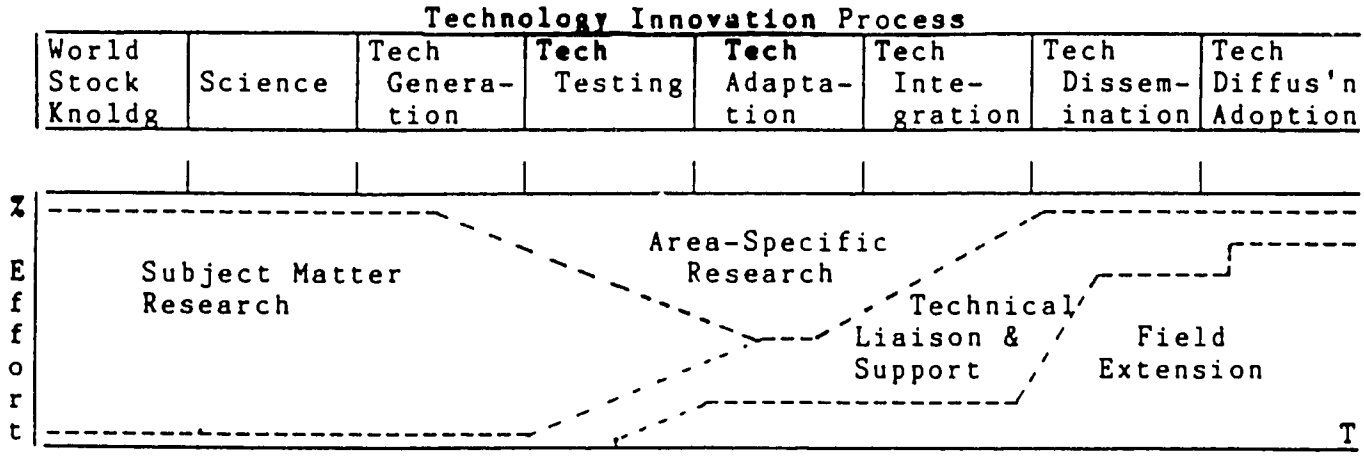

Figure 1 Activity Assignments Corresponding to Functions of the Technology Innovation Process

"Area-specific research" can just as well be called Farming Systems Research or something else. It is the "system of production" that is important, and a production system is to a large extent a function of geographic area.

TLU, through its on-farm testing completes the testing function and contributes greatly to the adaptation or fine tuning of the technology. It in fact completes the research process and enables research to provide a finished product to extension and other diffusion agencies. If research does not complete its work, then on-farm, in-system testing will have to happen by some other means outside the control of research. Farmers will not accept a new technology until it is tested in their farming system(s) by their own criteria.

Farm surveys and knowledge of the systems of production enable research to work on the "right" problems, that is those problems of most importance to the

farmer. This is a major factor in the integrating of new technology into the farmer's system of production.

The next area to the right of area specific research, Technical Liaison and Support, pertains to extension agencies. This is the responsibility (a) to liaison with sources of technology, in one direction, and (b) to provide technical support to the local agent in the other direction. IRA makes its most effective linkage with those entities that are organized to handle those two functions. In linking with MINAGRI extension at the beginning of NCRE, IRA literally had to perform those functions for extension. The parastatals, on the other hand, have strong liaison elements that press IRA for technology. MIDENO currently provides these functions for MINAGRI extension in Northwest Province.

All lines in Figure 1 are slanting. That indicates the need to have overlap among the components of the structure for the components of the technology innovation process, both within research and between research and extension.

The TLU collaboration with a diffusion agency in on-farm trials indicated that both IRA's interests and the other agencies interests are being served. The final on-farm test of an improved technology is an ideal extension demonstration, and at the same time an authentic research test. <u>At the research-extension margin there is no distinction between research and extension, and it's a serious management error to attempt to make a distinction</u>.

In somewhat the same way, subject matter research blends into system or area specific research, and again the distinction is neither possible or useful.

It is significant that we found no case in our observations, our

interviews, and our study of documents that indicated any appreciable concern about jurisdictional boundaries, either within IRA or between IRA and its variety of linkage partners. This situation greatly facilitates internal collaboration and inter agency linkage.

This blurring of functional boundaries and jurisdictional boundaries is an important management concept that needs to be openly recognized and maintained and not lost by default, neglect, or intent.

5. Future of TLU

It is a fact that up until now NCRE/IITA personnel, supported by a generous donor grant, have played a major role in the development of TLU. It is fairly clear that these personnel will continue for a substantial time. However, the TLU concept was developed in IRA, and IRA has made significant management innovations in order to implement the concept. The TLU concept and the management innovations have their origins in IRA rather than in the NCRE/IITA component. It is the Team's judgment that the accomplishments in research and extension linkage are remarkable if not, indeed, unique. Finally, IRA has eight years or so to integrate the TLU into its own institutional personality. If IRA takes reasonable advantage of the time and resources and its own experience, the chances appear quite good that the TLU function will be maintained. There is a good chance that form and procedures may change, and should, as experience accumulates and conditions evolve.

TLU/FSR is under some pressure to be more "holistic" and more "interdisciplinary," two favored concepts of FSR methodologists. It is the Team's judgement that TLU/FSR in IRA has captured most of the advantages that FSR methodologies have to offer, namely knowing and understanding the farmer through survey and interaction and testing new technology in the farmer's system by criteria of that system. Further gains in holism, and

interdisciplinary work in area specific research will likely cost more than can be justified by improvement in research that would result. We find that not only TLU research but IRA cereal research in general is in adequate contact with the farmers and is effectively oriented to their production systems. Inadequacies of interdisciplinary research may be due more to lack of personnel than to lack of appreciation for the concept.

C. Research Planning Conference

The research planning conference reinforces the TLU concept and is also a significant management innovation. The conference, especially if it is repeated annually and researchers can depend on it, can be expected to accomplish three things: Improved selection of research problems, improved implementation and quality of research, and improved motivation of research personnel.

Participation of research personnel in the conference allows IRA management to take advantage of the experience and wisdom of IRA's human resource in the straightforward task of improving the research program.

It also motivates and incentivates personnel. They like and appreciate being able to participate in Institutional decisions. Finally, since their participation is on display before their colleagues, they are pressed to do good work, and maybe even more of it.

The annual research conference was initiated as simply a project implementation activity. It's potential value was recongnized by IRA management, and it is now an IRA-wide activity involving all cereal and all FSR efforts in IRA. As is the case with TLU, the conference is an innovation and a significant factor in IRA's institutional make up. IRA has also begun such conferences in some of its other programs.

The conference enables IRA to discharge another institutional function.

An effective institution is able to influence other institutions and exert leadership in their actions and in the development of their values and standards. The conference has been open to researchers from other donor projects and other national institutions, and their participation increases each year. They not only attend; they give papers and take part in planning meetings. Through these processes, the others are learning the value of participation and the value of on-farm research and close contact with the farmer and are becoming effective collaborators. The conference is an instrument by which IRA is able to coordinate the work of donors and maintain the integrity of its own research program. Also of great potential significance is the emerging participation of UCD in the conference. A few papers were given in 1987, and a senior UCD official expressed his interest both in increased UCD participation and in the possibility that UCD will in the future host the conference. It is significant that UCD is not discussing holding its own conference but in participating in what could be a truly national conference. The optimistic view is what could be. It may be too early to predict that it will be.

There is some discussion of holding the Annual Research Conference every two years instead of every year. If this is done, then IRA has the very viable alternative of holding regional conferences in the off years. Biennial regional conferences would serve two highly important purposes. They would allow regional workers to address their own specific problems much more thoroughly than is possible in a national meeting. Some personnel have expressed a need for such regional conferences. Regional conferences would also allow more chance for subject matter research personnel (maize, rice, sorghum, soils, plant protection) and area or system-specific research personnel to adjust their programs to each other and to establish mutually

beneficial collaboration.

Agricultural research needs to be managed along two dimensions. Subject matter programs often serve several regions, and system specific research has to deal with many subject matters. Each of those groups subject matter researches and area-specific researchers need the other. At the same time each has to maintain its own program integrity. Regional meetings would be helpful in fitting programs together along both dimensions (see Appendix B.). Regional meetings alternated with the national meeting would be more valuable than the annual national meeting with about the same cost in time and money.

D. Unplanned Benefits

The team noted some benefits that were unplanned.

1. One of these is the annual research conference. Started as a project activity with the limited purpose of improving project implementation, it is now embraced as an IRA institutional activity. Participation has increased to include participants from other donor projects and other Cameroon entities, including the University Center at Dschang. Furthermore, IRA holds an annual conference for its personnel in two other of its national research programs. This conference facilitates communication among researchers, and such communication, in turn, not only improves the quality both of research planning and implementation, but also improves morale of research workers and serves as a non-monetary reward for good work.

2. The team heard repeated reports of a significant demonstration effect of the NCRE practical, on-farm research style. Phase I emphasized field work and contact with producers, not only through the TLU, but with other researchers. Personnel from other projects, including expatriates, were contemptuous of this style at first and even antagonistic. Reports to the Team are that the antagonism and contempt have subsided and that the other

expatriates are now going to the field and interacting more with farmers. The Team did observe their participation in the annual research conference and their willingness to collaborate with NCRE/IRA researchers. Incidentally, this imitation by others is evidence of institutional quality in an organization.

3. Another unplanned benefit is difficult to interpret. Cameroon has made huge investments in irrigation. The only hope for justifying these investments is based on adequate production technology. Rice production has increased dramatically. How much of the increase that can be attributed to infrastructure investment and how much to technology, the team cannot say. Technology made some contribution.

4. A fourth benefit, probably not planned, is the potential contribution that this project can make to the implementation of AID's "Plan for Supporting Agricultural Research and Faculties of Agriculture in Africa". IRA ranks among the leading national research institutions in Africa, and its evolution, as we observe, is on a trajectory of steadily improving service to Cameroon agriculture. If it does stay the course it will serve the purpose evisioned for it in the AID Africa Research Plan of providing regional research leadership.

When the IRA potential is joined to the UCD potential, the promise of regional leadership is further strengthened. UCD has an ambitious plan for reforming its academic instruction program and for developing research and extension programs. UCD intends to have 50 staff members with the Ph.D., which is a research degree. IRA can probably never aspire to such numbers. UCD has taken significant steps in curriculum reform but so far has done little in research program development. If IRA and UCD decide, as they should, that Cameroon needs only one agricultural research program that both

participate in, the nation will be exceptionally well served and the country will provide the Africa wide leadership that AID expects of Cameroon. It is clearly possible for UCD and IRA to develop a single research program but it will not be automatic, nor even easy. There is no prescription they can follow. They have to work it out themselves. IRA's experience in developing linkage to the right (in the TIP) will help it develop linkages to the left.

E. Deployment of NCRE Technical Expertise

We have identified several alternatives for the use of expatriate personnel. In some cases the alternative could be achieved by a change in the deployment of personnel already on board or contemplated for recruitment. In other cases, some changes may be necessary in the training and experience of persons recruited. Some changes may also need to be reflected in the training of participants. Incidentally, in a ten-year project it is essential to amend the original project design, because of changing conditions and existence of new information not available at time of design.

We note the assignment of crop specific agronomists and the assignment of TLU agronomists. We also note that in several cases the crop specific agronomists have worked in testing and liaison functions, and TLU agronomists certainly work in crops. They have not allowed arbitrary position titles to impede their flexibility in adapting to the situation and doing what needs to be done. However, it is possible that the position title could be used for a job description that would reduce flexibility. An alternative the team would suggest is to deploy agronomists by area or region, or by some other criteria, without a modifying description, and to expect the person to work on a variety of agronomic tasks.

We anticipate that as experience accumulates there may fairly soon be little more to be learned from what today is important research--date of

planting, spacing, and such like. As new problems become limiting or are identified there may be need to organize the agronomist group in a different manner or to recruit a different mix of capabilities or training.

Specific needs noted by the Team and/or by NCRE staff were found in four areas. They include crop protection, soils, statistics, and economics. Our observations have not been adequate to specify needs. It may be useful for IRA/NCRE to form small ad hoc working groups to determine institutional needs in these areas. This issue is related to institution building and the note on institution building is relevant.

1. Crop protection

Yield losses caused by diseases, insects, and weeds in the tropics are severe. Agronomists, breeders, and TLU members have all identified at least two of these pest areas as problems. However, the development of cropping systems, production practices, or varieties that more effectively control these pest problem is difficult without the contribution of plant pathologists, entomologists, and weed scientists. For example termites and the parasitic weed, Striga, have been identified as serious production problems in northern Cameroon. Yet it will be difficult to identify cropping practices to reduce these problems, or to develop resistant varieties without input from entomologists and weed scientists. The Team was unable to determine whether these crop protection issues would be best addressed by short term consultants, redirection of current staff, or a change in the projected makeup of the IITA team and training of participants.

2. Soils

Rapid soil analysis is critical for studies on cropping systems, residue management, and fertility constraints to production. Although an IRA soil testing laboratory exists at Ekona, it is not responsive to the research needs

of NCRE. Some soil samples have been sent to Nigeria (IITA) for analysis, or long-term field studies are undertaken to answers soils questions that could be solved quickly by soil testing. The Team does not have enough information to determine whether the most effective solution to this analysis problem is to improve conditions at Ekona, or to set up small soil testing laboratories at IRA research stations. Soil testing is not a panacea, and IRA also needs to consider the long-term needs of agronomic research in Cameroon to determine the additional expertise needed in soil science, particularly soil fertility, soil physics, and soil microbiology.

3. Statistics

The NCRE program conducts a large number of research and farmer trials each year. Timely analysis of these research trials is essential for the continued success of the NCRE program. Yet nearly every research group expressed concern over its inability to obtain prompt statistical analysis. IITA technicians frequently resorted to compiling research data, shipping the data to IITA headquarters, and waiting for the analysis to return. Effective research is being hampered by this problem, particularly in programs, such as maize breeding and agronomy in Bambui, where two plantings are carried out each year. The inability to produce timely reports is hindering cooperative efforts with organizations such as MAISCAM, SODEBLE and SODECOTON, all of whom expressed concern with NCRE for not providing the results of this cooperation in a timely fashion.

While the evaluators understand that this problem is partly one of communication, the problem of timely research data analysis can be effectively resolved. The microcomputers (such as the IBM-PC), long on order for most of the stations, can help. Short-term statistical consultants should be able to provide IRA with information on a single software package or

packages of programs that could be used in common by IRA researchers to facilitate experimental design and data analysis and to communicate it throughout the system. The consultants should also provide training with the recommended software for a wide range of IRA staff members.

4. Agricultural Economics

The need for and the opportunities for more economic analysis can also be anticipated. So far, economic analysis is confined largely to partial budgeting. More sophisticated, but reasonable, production economics analysis of agronomic trial data would give more information which could serve a variety of uses.

IRA is the best source of data needed for some national policy formulation and may need to do some economic analysis before the data is sent to the national policy analysis unit. IRA data would be useful in policies dealing with (a) agricultural input importation (fertilizer, machinery, other chemicals); (b) development of national input industries, including seeds; (c) price support and subsidy; and (d) investment in agricultural research. IRA needs a capacity to analyze returns to research in its own resource acquisition strategy. Economic analysis will also be helpful in allocating resources among programs.

It may be possible to provide this expertise by redirecting talent already on board. However, if it is necessary to modify the mix of expatriate talent, there should be no hesitancy to do so.

5. Other

The four subject matter areas discussed above have been indentified as restraints likely to inhibit achievements in cereals research and IRA development. Given the nature of Cameroon agriculture and the evolution in IRA programming, the Team thinks it may be logical for the mission to consider

the alternative of expanding or modifying the project to include other food crops and related items. Its analysis at this time however, leads to no other areas needing attention.

F. Institution Building

An interest in institution building has been expressed by all parties to the project, including the evaluation team in 1983. We find no specific quidelines with regard to institution building. We submit the following list of items that would constitute a systemmatic address to the institutional building opportunity presented by NCRE.

1. An IRA institutional development plan and strategy.

Such a plan can be relatively simple, and it needs to be done by IRA with a considerable participation of its own personnel, including NCRE expatriates. Consultants can be used, but the plan needs to belong to IRA. This plan should present a picture of what IRA wants to look like in 1996 and a simple list of intermediate events or checkpoints. The plan needs to include at least three major components. They can be as simple or as complex as IRA decides it needs and the resources IRA decides to devote to it.

a. The first component needs to be program, and other components are a function of program. Program needs to be in terms of subject matter addressed and area attended, modified by the range of functions of the technology innovation process IRA intends to cover. It is in connection with this program determination that IRA needs to decide what it wants to do about soils, plant protection, agricultural economics, and data analysis. Related to IRA program is the collaboration that is anticipated with UCD. In program planning some estimation of need has to be made in terms of what expertise in the subject matter area could contribute to the total research program; how seriously is the program going to be affected without it; how large an effort

is needed? Another important decision is how much can be done by other entities? For example, with respect to policy, what can be done by the policy analysis unit? Or, how much of the soils or crop protection expertise can be provided by UCD? Small task forces for each of the areas may be able to come up with some judgment or analysis that would help with the decision. UCD should probably have a significant role in long range program planning, since it will be able over time to provide much of the country's agricultural research and technology needs.

b. The second major component is a personnel development plan. This needs to include number of personnel and level of training, depending on program. Level of training is a critical issue. A Ph.D. costs substantially more than an M.S., and is a very high investment in a single individual. Another important consideration in IRA's personnel plan is the linkage developed with UCD, which already has a plan for some 50 trained at the Ph.D. level. The personnel plan also needs to address the technicians and other less-than-M.S. personnel, both in number and in training and capability.

c. The third major component is a schedule of resources needed (land, facilities, annual budgets) to support the program and personnel development. There is obviously an interaction among these three components, and the planning process will need to get them in adjustment with each other.

2. A finance acquistion plan

In implementation a most useful activity would be the development of a finance acquisition plan. The contributions IRA is making to the economy and is likely to make put it in a good position to acquire resources. The plan described above, if skillfully articulated before funding sources, would significantly improve the outlook for adequate financial support. Resource acquisition is an essential component of institutional development. A finance

acqusition scheme could include some or all of the following components.

a. Appointment of a person whose major (or maybe only) responsibility is to acquire financing.

b. Creation of an image within government and elsewhere that the financing of research is an investment not a cost. Economic analysis of IRA's important contributions, (return to research investment) will help.

c. Identification of financial sources and a plan to establish and maintain contact and communication with them. Donors are an important source of financing, and an institutional plan will identify components of interest to most donors and will give them confidence that their funds will be wisely invested. Other sources are government, parastatals, national commercial companies, foreign companies, foundations, and maybe others.

3. Linkage strategy

Another critical element of implementation is the establishing of linkages with sources of agricultural science and technology. The large expatriate team is currently providing effective linkage with the international agricultural research centers and other international sources of technology. It is not urgent, but IRA needs to anticipate the eventual reduction of expatriate personnel and the need to establish other means to interact with IARC's. IARC interest and ability to provide scientific and technological support will likely exist. IRA needs a plan and management system to work with the centers to be sure its own self-determined needs are met.

Another important source of scientific and technological support is going to be UCD. As the UCD development plan is implemented, the University will have an increasing potential for agricultural research. It seems obvious that

in the national interest that potential should be deployed in collaboration with IRA and others in a single national agricultural research program. UCD is just beginning its transition from a teaching tradition to an institution involved in research. How its research evolves will be significant for IRA. We don't know the extent to which IRA will participate in the development of UCD's role in research, but we suggest that IRA exploit whatever opportunity it has. Perhaps not urgent at the moment, this will steadily become more important and merits continuous vigilance. There may be other in-country sources of technology important to IRA.

4. Management resources

A fourth element needed for institutional development is strong management, plus a favorable management environment and adequate personnel resources in management. At various places in this report, we have noted specific cases of what we consider to be highly competent management at the IRA institutional level. These include the development of the annual research conference, development of the TLU, separation of experiment station management from program management, coordination of donor projects into an IRA Farming Systems Research program, among others.

In view of the management performance and evolving needs in IRA, the number of personnel devoted to management is clearly inadequate, as of today, and will be increasingly inadequate. The IRA director has no deputy and almost no staff. The good management performance is due to extrordinary effort of the director. We identify what we consider to be significant needs and opportunities in institutional development. These needs cannot be met nor the opportunities exploited without more personnel and resources invested in management. To ignore this urgent need is to waste or at least under utilize the great national resource represented by IRA as an institution.

Another restricting factor is the lack of statutes which would enable IRA management to compensate personnel on the basis of their contribution to IRA's mission. Good performance at all levels cannot be adequately compensated under current statutes.

These problems are largely outside IRA control and require attention from other levels.

V. The Maize Improvement Program

The maize variety development program of NCRE operates in all 10 provinces in Cameroon. Based on environmental conditions, breeding objectives, and cooperating organizations, this report will consider the program in three areas. They are the savannah zone, a low rainfall area with an elevation below 1000m that includes the northern Adamaoua, North, and Extreme North Provinces, the forest zone, which is also below 1000m in elevation, but includes the higher rainfall areas of the Center, South, Southwest, Littoral and East Provinces, and the highlands zones above 1000m, which includes the West and Northwest Provinces and the southern portion of the Adamaoua Province.

The maize variety development program of NCRE is a stepwise process. First, the major objectives of the breeding program are defined. Next, the breeding program is designed to meet these objectives. The most promising germplasm from this program is then tested in farmers' fields. Germplasm accepted by the farmer as superior to currently grown varieties is then multiplied for distribution. Finally, the seed is made available to the farmer.

This report documents the process for variety development as carried out in Phase I of the NCRE project. For each of the three breeding zones, each step of the process will be analyzed, strengths noted and suggestions made for improvements. The steps required to move through the process require the cooperation of various components within NCRE, as well as linkages with other organizations in Cameroon. These linkages will also be analyzed, describing both their positive achievements and areas where improvements are needed.

A. Savannah Zone

Objectives for maize varietal development in the savannah zone have been determined by the breeder in close cooperation with the NCRE cereal agronomist

in the region. Identification of the farming systems into which new maize varieties must fit, as well as indications of some of the major constraints to production have been furnished to the breeder through the extensive agronomic research program of NCRE, by the extension activities of SAFGRAD, by association with the parastatal organization, SODECOTON, by workers at the Karewa Experimental Farm and by the breeder's own experience and visits to farmer's fields. No TLU worked in the savannah zone.

The cooperation of these various organizations with the breeding program has provided information on a number of objectives that have been incorporated into the major breeding goal of producing a high yielding, stable variety for the savannah.

The germplasm screened for these various objectives was obtained from several sources. Cooperation between NCRE and IITA, CIMMYT, SAFGRAD and national research stations in Africa and Asia provided a wide range of material for the program. Such ties are an important part of the maize improvement program.

The breeding nursery for the savannah zone is in the forest zone. An important question to be answered is whether the most appropriate and efficient selection environment is being used for the production of savannah zone varieties. For some traits such as maturity, selection can most likely be made at one location for both regions. Yet for other characters there may be an environment by genotype interaction, which would suggest that germplasm initially discarded in the forest zone may be adapted to the savannah. A related issue to be addressed is the efficiency of two complete breeding programs (one in the forest and one in the savannah) compared to a program in one location with test plots in the second.

There also appears to be a need for cooperators and/or consultants for the

breeding program to insure efficient selection for some of the objectives that have been defined. Screening is currently being carried out for streak, leaf rust, and leaf blight diseases with little input from plant pathologists. Termites and the parasitic weed, Striga, have been identified as major pests. Although research on resistance to these pests is being conducted at other locations, notably IITA, screening techniques for identifying resistant germplasm in Cameroon will require support from outside the current NCRE structure. One solution would be to have an IRA entomologist and a weed scientist assist the breeder in screening for termite and Striga resistance. IRA plant pathologists at Bambui could assist in the disease screening program in the savannah. An alternative would be to hire consultants through IITA to help establish suitable screening procedures within the savannah breeding program. Eventually UCD may play an important role in the breeding program.

The techniques used by the breeding program appear sound. The TZPB series contained superior germplasm, and population improvement begun during this phase has resulted in the development of high yielding, early, streak resistant germplasm currently being evaluated for release.

Varietal evaluation begins with an experimental variety trial grown at three to four locations on experiment station sites. Other trials are conducted in association with CIMMYT, IITA, and SAFGRAD. Promising populations that are equal or superior to the best local check are evaluated a second year in an elite experimental variety trial with four to six locations at experiment station sites. If material is superior in this evaluation, it undergoes a third year of evaluation in the national variety trial, also using four to six locations. In all three years, germplasm is divided into early maturing (less than 45 days to silking) and intermediate/late maturing nurseries (over 45 days to silking). This evaluation procedure appears

appropriate for assessing both yield and yield stability.

Germplasm with superior performance in the three years of evaluation is then made available to the NCRE cereal agronomist for agronomic trials, and to the TLU for on-farm evaluation. Germplasm at this stage may also be evaluated through other IRA programs or through parastatals, such as SODECOTON, depending on the germplasm and needs of the cooperators.

Promising germplasm is also extracted from this evaluation process and used in the breeding program for initiation of gene pools for further variety development and for the development of lines for synthetics and hybrids. Additional germplasm is added to the breeding program from the international system through IITA. Heterotic patterns of adapted varieties are studied to assist in the identification of appropriate methods for population formation and improvement. The structure of the breeding program should be such that a balance is maintained between population improvement and hybrid development on one hand, and varietal release on the other. Adapted material is available that can have an impact for farmers, and this material should be evaluated and released. Similarly a strong program should be put in place to provide the basis for future varieties. Both are important to the overall success of the breeding program and neither aspect should be stressed to the detriment of the other.

The decision to release a population of a hybrid is determined by the breeder, with assistance from the TLU agronomists and parastatals. This informal process, along with the movement of breeder seed through the seed multiplication process, is the weakest link in NCRE maize variety development. The linkages necessary for varietal release and seed increase have no formal structure to them, causing problems in communication, delays in variety release, and loss of varietal purity.

Criteria should be established to insure the timely release of superior varieties and to prevent poor varieties from reaching the farmers' fields, and to protect varieties once released. These criteria should include acceptable yield superiority over current varieties under farming system production conditions; yield stability, particularly from year to year because of fluctuation in the dates and duration of rainfall; appropriate levels of pest resistance; and farmer acceptability of the taste, color, and endosperm type of the potential variety.

The decision to release a new variety should be made by a variety release committee, composed of a range of individuals. Members could include, but not be limited to, IRA breeders and agronomists, other IRA staff, appropriate members of MESRES and MINAGRI, parastatal representatives, and prominent farmers. The committee, chaired by the director of IRA, would have responsibility for the establishment of a release policy for IRA.

The government of Cameroon should be encouraged to develop a seed certification law which would establish standard procedures for the production of certified seed from breeder seed. This would allow for improvement of communication between breeders and the seed trade, as well as insuring varietal purity and quality, germination, seed size, and freedom from weeds and other impurities.

During Phase I of the NCRE project, production of foundation and certified seed for the savannah was the responsibility of project Semencier, the North Cameroon seed Multiplication Project based near Garoua. The program has adequate land, a high level of production mechanization, and some facilities for processing and storing seed. Although Projet Semencier has been heavily financed so it can provide the structure for seed multiplication, there is little direct communication between breeders and the organization. For

example, foundation seed of one variety was produced from an unknown source of breeder seed. The existence of a variety release committee with members from the Ministry of Agriculture, the Ministry of Higher Education and Research, and private industry, along with the development of seed laws, should reduce this communication problem.

Once Project Semencier has produced appropriate seed of a new variety, the seed distribution process is largely accomplished through SODECOTON. This parastatal has an efficient organization that can provide seed of new varieties through its own extension workers. These workers are the major extension organization in the north. SODECOTON buys a majority of the seed sold by Project Semencier, and has direct contact with approximately 35% of the farmers in the region. Attention should be given to the development of appropriate channels for seed distribution outside SODECOTTON. Policy changes within SODECOTON could reduce its association with food crop production in the area, leaving NCRE and Project Semencier with little opportunity for seed distribution.

B. Forest Zone

There was no maize agronomist in NCRE Phase I to assist the forest zone breeder in the process of identifying the most important constraints for the breeding program. This was balanced, however, by the presence of both a qualified IRA breeder and agronomist based in Nkolbisson, who assisted in the definition of objectives. As described for the savannah zone, definition of the most important objectives for the breeding program are essential for its success. The annual planning conference could be designed to provide the opportunity for the breeders to obtain feedback from agronomists, and the TLU based at Ekona will help determine breeding objectives in Phase II.

As in the savannah, care should be taken to insure that the selection

procedures are most efficient for the development of varieties suitable of maize producers in the area.

The design of the forest zone program and the variety evaluation procedures are the same as those used in the savannah. The superiority of TZPB related germplasm was identified by Phase I of this program. An adapted disease resistant population established in this phase, NCRE 8401, is providing a promising base for further population improvement in this zone. Comments on the design and the on-farm evaluation of varieties for the savannah zone are appropriate for the forest zone program, as the same breeders were involved in both projects.

The opportunity for variety evaluation in farmers' fields is less developed in the forest zone. There is no parastatal like SODECOTON in the North, and under Phase I, no TLU was based in the South. On-farm variety evaluation was conducted with cooperation of IRA agronomists. These on-farm programs will be expanded in conjunction with the NCRE TLU at Ekona.

The decision for variety release is left up to the breeder. Agreement on seed multiplication is made on an informal basis with the MIDEVIV operation at Ntui. Foundation seed is produced by the breeder at the Ntui farm, while the certified seed is entirely under the auspices of MIDEVIV. Seed is sold directly to farmers, to farmer societies, and through the provincial delegates. Although the breeders and those responsible for MIDEVIV seed production are in closer informal contact than the corresponding programs in the North, there is still a major problem of communication and the development of standards for seed release and production. The suggestions for a variety release committee and a national seed law are also important for this zone.

C. Highland Zone

NCRE Phase I maize breeding activities in the highlands were initially

carried out by breeders based in the lowlands at Nkolbisson. Some breeding work, largely recurrent selection within IRA populations, has been carried out by Dr. Ayuk-Takem, in spite of his considerable duties as chief of the Nkolbisson center and as national coordinator of the NCRE project. Highlands work in Phase I of the NCRE project began with the screening of varieties and populations adapted to the high altitudes (above 1000 m) tropics. This material was made available through the international breeding network, largely in coordination with IITA and CIMMYT. Two varieties, Kasai and Shaba, were identified through this work, with Shaba being the first improved variety released for the Adamaoua plateau. Work was also begun on the screening of streak resistant germplasm from a mid-altitude population developed at IITA.

The work in highlands maize breeding was greatly expanded when a second breeding position was filled at Bambui by an NCRE/IITA maize breeder in 1984, allowing an entire breeding program to be established for higher altitudes.

The objectives of the highland maize breeding program have been determined in conjunction with a number of researchers, primarily the TLU at Bambui. Screening of germplasm in 1984 assisted the breeder in further identifying major objectives. In addition to selection for yield and yield stability, ear characteristics, and resistance to Helminthosporium turcicum and Puccinia sorghi, specific populations were designed for the objectives of high altitude adaptability; acid soil tolerance; streak resistance; short, late types for intercropping; and early, white seeded types.

The NCRE program has a unique opportunity at Bambui for close interaction between the maize breeders and the TLU, along with the agronomists. The TLU should have important information, based on its work with farmers in the region, regarding characteristics limiting maize production. The breeder, with close ties to the international breeding network, is aware of the genetic

variability for different characteristics. The TLU should know about the range of variability so they can assist the breeder with accurate definitions of the characteristics in maize that will be most useful to the farmers themselves. Meetings among breeders, TLU, and agronomists to determine the most appropriate objectives of the program will assist the maize breeding program in the development of successful varieties.

The breeding program itself is well designed. One of the strengths of the program is the strong tie with the international maize breeding network through IITA that allows the rapid introduction of the most adapted germplasm from around the world. Germplasm from mid and high altitudes in East Africa, Asia, and the Americas has been screened through this cooperation. This screening has shown the limited amount of germplasm with better adaptation than the populations currently grown by the farmers. Unlike the lowland maize breeding program, where introduced varieties were found to be more adapted than local material, no varieties evaluated in the highlands were better than the check varieties. The most important procedure for the highlands program is the selection of highly adapted germplasm, determining the genetic characteristics of the selected populations, recombination of the selections, and testing of the new populations, The success of introduced varieties and improved populations in the lowlands had led to expectations of the same results in the highlands. The rapidity of success in the lowland program cannot be matched, but the highland program is well designed and should be successful in a relatively short time.

In addition to the links with the international maize breeding system, the highland breeding program has strong institutional ties within IRA and with the parastatal SODEBLE. IRA pathologists are cooperating in the screening for disease resistance, especially for H. turcicum. Evaluating and selecting of

recombined populations can be carried out in environments appropriate for the objectives of each of the populations because of these ties.

As in the lowlands breeding program, the selection of the most appropriate and efficient techniques for evaluation must be determined by the breeder in conjunction with agronomists and the TLU. For example, much of the maize in the highlands is intercropped. Is selection of varieties for intercropping more efficiently conducted in an actual intercropping system, or in monocrop in either standard populations or adjusted populations or both? This question is an important one for the ultimate goal of producing farmer-accepted varieties. Studies of genotype by cropping systems interactions should adequately address this problem.

The evaluation of varieties and the improvement of populations in the highlands zone take place in various locations, depending on the objectives of the evaluation. Sites are either IRA research sites, with IRA site chiefs and technicians cooperating in the evaluation, or at SODEBLE, with the assistance of the director. Institutional communication within IRA and between IRA and SODEBLE appear adequate, although physical communication would assist this process. Cooperators have also indicated they have not received results of tests at their locations in a timely manner. Much of this delay appears to be a problem of delays in statistical analysis, which is addressed elsewhere in this report.

Germplasm from the highland zone has not been sufficiently advanced for agronomic and farmers trials. However, there are mechanisms in place for this type of evaluation in Northwest and West Provinces. An agronomist in Bambui is available for management trials and the TLU at Bambui can participate in pre-extension trials on farmers' fields. Station meetings at Bambui or annual planning meetings at Yaounde are forums where breeders, agronomists, and TLU

personnel should communicate about the status of potential varieties and their performance in farmers fields. Less appropriate mechanisms exist for preliminary farmer testing in the Adamaoua highlands. Breeders may need to coordinate initial on-farm evaluation with IRA agronomists who have farmer connections.

Determination of appropriate policies for elease of new varieties are needed. The formation of a variety release committee, variety release policies, and national seed laws have been previously discussed.

Currently there are several organizations with which the highlands breeder would cooperate in seed multiplication. In the West Province, UCCAO could increase and distribute seed, and in the Northwest Province, MIDENO has the structure for and interest in seed production and distribution. In the Adamaoua Plateau area, there is no active program for seed production. A strong national seed multiplication and distribution program would greatly expedite the procedure. Although the existing parastatals in the highlands, UCCAO and MIDENO, have both seed production capabilities and extension workers to evaluate and distribute seed of new varieties, lines of communication are not always open between the parastatals and the breeders, which could cause delays in variety adoption by the farmers. The establishment of formal communication between the IRA breeders and the MINAGRI seed producers and extension agents will also insure continued cooperation. The efficient structure of support from MIDENO is assured at this point only through the end of its current external funding period of 1988.

D. Summary

The major achievements of the maize breeding programs are a) the ties to the international breeding network, b) the research program for the improvement of populations and extraction of new varieties, and for the

development of hybrids, and c) the extensive ties within IRA stations and substations, parastatals, and private organizations for the selection of material and early and on-farm testing of new varieties.

Consideration should be give to closer coordination between the breeders on one hand, and the agronomists, TLUs, and parastatals in the other hand, in identifying the maize characteristics most important to farmer acceptance of new varieties. As these objectives are identified, further coordination should take place to insure proper screening techniques for these objectives. Elsewhere in this report, we discuss the feasibility of multidisciplinary regional planning conferences. These conferences would be appropriate forums for interchange on objective identification and screening.

A major constraint in the system of variety development and adoption occurs at the interface between the breeders from MESRES and the seed multiplication and distribution under MINAGRI. The informal connections that now exist are ineffective and prevent the timely production and distribution of new varieties. A solution which should open channels of communication is the development of a national variety release committee and national seed certification standards.

VI. Findings and Recommendations

Findings and recommendations are divided into two categories: critical and important. Critical issues are those that can be taken care of in the immediate future and are required to correct defects in project implementation. They will require vigorous and determined management action, but will put no unreasonable demands on available funds. In most cases the funds are and have been available. In the other cases a modest reallocation of grant resources are recommended if there is no other reasonable funding alternative.

Important issues on the other hand are not associated with any project implementation deficiencies. They reflect, in part, institutional strengths on which to base further institutional building actions, actions which can also be accomplished with modest resources and which could have substantial value. These resources can be provided under the grant agreement with minor adjustments in interpretation of the agreement. In most cases, the funding required is for short term consultants, even though not in direct support of project activities. In part, however, the recommendations reflect institutional weaknesses that have become limiting factors because project achievements have removed the more serious limiting factors present at the beginning of the project. For example, now that short run, rather elementary agronomic problems have been largely addressed, more fundamental soils problems are becoming limiting, and after some easy gains in plant breeding have been realized, the lack of capacity in the fields of entomology, and pathology, and weed science have become more important.

The following listing identifies the agency to take primary responsibility. Critical issue recommendations are ranked by priority, but only the first important issue recommendation has a priority.

A. Critical Issues

The goal of Phase I to increase agricultural production and rural development was appropriate for the project. The Team has not found extensive field surveys of household incomes as a means of verification. Production statistics have been quoted by the research workers for the four cereal crops of the project to verify increase in production from research.

The purpose of Phase I was to develop Cameroonian institutional capacity to provide quality research on the cereals. The focus in the past has been to conduct research in the disciplines of breeding and agronomy with little or no emphasis on the other related disciplines or their interaction. As Phase II continues, more emphasis should be placed on developing and training staff who are able to identify improved techniques for cropping systems. Once this is accomplished the project will then include other components of institution building. Some socio-economic surveys have been made, and some socio-economic data were available for use in designing research programs.

The major emphasis of the research program as to alleviate the identified constraints to increased production on farmers' fields through research on the four cereals and to extend this information to farmers through the TLU and various extension agencies. Given the constraints of personnel and budget, the program has clearly met the objectives set forth.

The subject matter specialties of the technical assistance staff have strengthened the cereals research of the IRA. Personnel filling these positions are well trained and qualified and have a high degree of dedication and motivation. In most instances these traits have been transferred to their national counterparts and assistants.

Implementation of the project has been somewhat less than perfect. IITA did a good job of recruiting good technical exports once the project got

underway and did a remarkable job in keeping the positions filled. The Team heard of a few instances where the contractor had not provided the short term consultants who were requested by the long term specialists for backstopping in entomology and program direction.

The training for both academic and short term participants has been pretty much on schedule. It is easy to get the impression that the communication chain from IRA, through USAID, to the university responsible for training is cumbersome. Whether defects in that system cause serious problems we could not determine. Nearly all of the participants interviewed by the Team were satisfied with their training programs. Both NCRE/IITA and IRA scientists stated that the training filled the project requirements. We found two instances where academic training programs for participants did not reflect IRA program needs to the extent that could be expected. Perhaps some of the faculty of the U.S. institutions selected for the academic training could have been more familiar with conditions in developing countries so that students could have been put in more closely related to the problems of Cameroon. We heard some NCRE/IITA frustration concerning their participation in the selection of participants during Phase I. However, selection of participants seems to be a function of the naming and posting of national counterparts. The Team was told that the selection method had been improved in Phase II.

We also heard complaints that some of the IRA technical assistants were not adequately trained. We note the training value of the annual research conference as a form of in-house, in-service training. The Team found a lack of the use of NCRE/IITA staff and IRA personnel in formal or systemmatic in-house, in-service training for personnel at all levels.

Recommendation 1. Provide appropriate and economical soil analysis services, either on a national or regional scale, using grant funds if needed, IRA.

Recommendation 2. Review and revise where needed the system for procurement of both USAID and IITA authorized commodities and make the revised system known to all personnel whose program is affected by the procurement system, USAID and IITA.

Recommendation 3. Expedite the completion of the three houses and the construction of other buildings planned for the research stations, USAID and IRA.

Recommendation 4. Review the procedure for selecting participants and for planning their academic programs, revise if needed, and make the procedure known to all personnel for whom it is relevant, USAID, IITA, IRA.

Recommendation 5. Develop and implement a formal, in-house, in-service training program, especially for sub-professionals (but not necessarily limited to them) appropriate to IRA needs and IRA and NCRE resources, IRA, IITA.

Recommendation 6. Take positive action in identifying and correcting the problem of providing short term consultant services, both in direct response to NCRE project needs and in technical areas in which IRA lack expertise, IITA.

B. Important Issues

In an evaluation it is just as important to recognize the strengths and positive factors as it is to call attention to deficiencies and negative aspects. In project management it is just as important to build on strengths and exploit opportunities as it is to attend to deficiencies and deal with problems. In economic development it is important to look beyond the project and strive for institutional development, which is the only real lasting effect of developmental activities. This project has more pluses than minuses and presents more opportunities than problems. This section attempts to point out the ways to make the most of the opportunities and the pluses.

If judged simply by conventional short term criteria of accomplishment, the NCRE project would be considered a success. But far more has been accomplished. The TLU, which was one of the major elements of Phase I, has been tested and proved as a research organization concept, not only in the area included in project design, but also in other provinces. The concept has spread farther through IRA than anticipated and also through other donor projects.

The annual research conference was initiated as simply a project implementation activity. But it has caught on and has been a major institutional development output with the chance of substantial future impact. IRA now has the alternative of holding the conference every two years and scheduling regional conferences in the off years. The regional conference would offer the chance for a sharper focus on the most important problems.

The management of IRA has used project devices to coordinate projects from a spectrum of donors into an IRA research program with remarkable internal integrity.

Through project concepts and activities effective research-extension

linkages have been established with apparently no jurisdictional issues or misunderstandings.

Even some of the institutional weaknesses are evidence of project success. As limiting factors have been effectively addressed, new factors have become limiting. They are identified as "weaknesses" because they are now limiting as a result of more urgent limiting factors having been solved.

There are still some unsettling aspects. IRA management is responsible for many of the pluses. It has taken advantage of this project to make these important institutional gains. This is in contrast to the common practice in which the host institution in a sense allows the donor and contractor to implement the project as they see fit. This is a plus, but there is a serious risk involved.

Top management, although highly capable and unusually dedicated is what can be called "thin". The director has very limited staff personnel, even to manage his routine program. The fact that so many mangement innovations have been made apparently is due to his dedication and energy. In other words the accomplishments rest with one person. They are personal more than institutional.

Some evidence is interesting. The institutional innovations have been largely opportunistic. There is no plan for systemmatic action of institutional development. The annual research conference presented an "opportunity" which IRA took advantage of. TLU was a concept that could be worked out with SODECOTON in two provinces, one with a SAFGRAD agronomist. This presented another "opportunity".

One "opportunity" has not been exploited, that is the development of effective linkage with Semencier, the seed multiplication unit, which is attached to the Ministry of Agriculture. It is not easy to explain the

inadequate linkage with this unit of MINAGRI in view of the apparent ease with which IRA established linkage with certain provincial extension units of MINAGRI. Perhaps it is because in dealing with extension IRA set out specifically to set up the linkage, developed a special set of activities to bring it about, and assigned someone the responsibility.

A second problem presents a less clear picture. Cameroon reportedly has a variety release program in the Ministry of Agriculture, but it is virtually inoperable. This is not all bad. National variety release programs sometimes are an inhibitor of technology release. With no national program, IRA can then facilitate the release of varieties, and that could offer some advantage. Further, the value of a variety release mechanism is greatly reduced unless there is a seed certification program to protect the variety. Seed certification requires the police power of state for its enforcement, and that is not a responsiblity compataible with the mission of an agricultural research entity. IRA's scope of action is limited. Only one action is clear. Currently, IRA does not have a clear internal policy for its own variety release practice. A clear cut, carefully followed internal IRA variety release policy would capture many of the advantages of a national variety release program. Because of its simplicity an IRA program may even be superior to a national program. However, IRA needs help in protecting its varieties, once they are released. So from IRA's standpoint a national seed certification program is more important than a national variety release program. A seed certification program would address another problem. IRA does not really release varieties. If a parastatal likes a cultivar during the on-farm tests in which it is involved, it can simply multiply the seed, and the "variety"is "released". There is no way to protect genetic purity or protect against disease, weeds, other varieties, or any other problem. Some

sort of seed quality protection is necessary. A seed certification program would be helpful.

The recommendations aim to capitalize on the personal, opportunistic accomplishments, to institutionalize them within IRA, and to develop an institutional capacity to continue institutional development.

Recommendation 1. Provide additional staff resources in the office of IRA top management, since without these resources it will be difficult to accomplish any of the other recommended actions. MESRES, IRA, USAID.

Recommendation 2. Develop a plan and strategy to build an appropriate capacity in such subject matter areas as soils and crop protection, taking into account resources of other entities in the country, IRA/NCRE.

Recommendation 3. Analyze the need within IRA of an agricultural economics capacity and plan the development of an economics program and an economics capacity, IRA, USAID.

Recommendation 4. Name a small work group to decide IRA's needs in such support services as data analysis, IRA.

Recommendation 5. Give constant attention to the systemmatic institutional development of IRA, making reasonable use of project resources. The following factors need to be considered. They are not ranked by priority.

a. An institutional plan, including components dealing with program, personnel, and resources, this plan to be used for making decisions, acquiring resources, and maintaining linkages, IRA, USAID.

b. A personnel development and management plan, either included in (a) or

done separately, IRA.

c. A plan and strategy for developing linkages with sources of science and technology information and competence, IRA, IITA, and (if available) UCD.

d. A finance acquisition plan, strategy, and program, IRA.

e. An inventory of IRA institutional resources and facilities to serve as a benchmark for Phase II evaluations, IRA, USAID, IITA.

f. Development of statutes and policies to allow IRA to compensate its personnel on the basis of their contribution to the ITA mission, IRA, MESRES, USAID

Recommendation 6. Assign an IRA breeder or a small group of breeders to work with Semencier and develop a set of simple practices by which IRA and Semencier can work together more effectively, IRA.

Recommendation 7. Develop and enforce an internal IRA policy and set of standards and procedures for release of new varieties, IRA.

Recommendation 8. Form a small working group under the firm management of IRA, but using non-IRA personnel if needed, to define more precisely the seed certification problem and to develop a strategy for addressing. Use project funds for consultant if needed, IRA, USAID.

Recommendation 9. Consider the feasibility of alternating the national research planning conference with regional research planning conferences, IRA.

VII. Documentation

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U.S. Agency for International Development, "Plan for Supporting Agricultural Research and Faculties of Agriculture in Africa," May 1985.

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VIII. Interviews and Sites Visited

Monday, 2 February 1987

Conference on Assignment

William Judy, Project Officer,
Edward Egbemba, Assistant Project Officer,
John Dorman, Agricultural Development Officer
Michaela Lang, Assistant Project Officer.

Conference on Evaluation

Samuel Scott, PDE Officer,
Robert Schmeding, HRD Officer,
Norman Olsen, PRM Officer,
Alfreda Brewer, Assistant PDE Officer,
Mosina Jordan, Deputy Director, USAID,
Max Williams, Educational Development Officer

Conference

Conference at IRA

Jacques - Paul Eckebil, Director
Jay Johnson, Director, USAID

Tuesday, 3 February 1987

Conference at MESRES

March Bopelet, Director of Division Science and Technology Research

Conference with NCRE/IRA staff, Nkolbisson

Jacob Ayuk,Takem, NCRE National Coordinator,
D. Janakiram, NCRE Rice Breeder,
Edward Egbemba, Assistant Project Officer, USAID,
Laures Empig, NCRE Maize Breeder,
John Poku, NCRE economist
Celicard Zonkeng, IRA Maize Breeder,
George Dimiti, IRA economist
Jean Tonye,. IRA Maize Agronomist

Wednesday, 4 February 1987

Conference with Bambui Station Staff

Edward Ngong Nassah, Bambui Station Chief
Leslie Everett, NCRE Maize Breeder,
Dermot McHugh, NCRE TLU Agricultural Economist,
Joseph Kikafunde-Twine, NCRE Agronomist,
Claude Nankam, IRA Plant Pathologist,
M. Ngoko, IRA Plant Pathologist.

Thursday, 5 February

Conference at MIDENO

David Hughes, Project Manager

Visit with Northwest Province MINAGRI

Monsieur Tata, Provincial Delegate

Conference with PAFSAT

Klaus Zweier, Manager
Wilfred Njeimbah, Deputy Manager
Glayds Ekwoge, Women's Programs

Meetings with Farmers

Angelita Ngwa
Martina Ntamhojow
Emerencia Angafara

Meeting with MINAGRI Agents

Isidor Nkem Asong, Extension Agent
Thaddeus Ngioa

Meeting at Upper Noun Valley Dev. Authority

G.A. Niba, Acting Director

Meeting with Village Community Project

Frank Chauveau, French Volunteer

Friday, 6 February

Conference at IRA/Dschang

D. Janakiram, NCRE Rice Breeder
Jackson, McDermott — Jules Takow, IRA Agronomist
Joseph Terateroua, IRA Pathologist
Joseph Fokou, IRA Agronomist
Animesh Roy, NCRE Agronomist
Samuel Nzietehung, IRA Chief of Station

Friday, 6 February

Meeting with NCRE trainees

Julius Takow, IRA Agronomist
Fabien Jeutong, IRA Breeder
Cletus Asonga, IRA Entomologist

Conference with UF/USAID Project Dschang

Charles Eno, Chief of Party
William Blue, Research and Extension
Ellis Matheny, Curriculum Development
James McGuire, Extension Education
Dee Baldwin, Library Specialist
Randy Bills, Motor pool Superintendent
Kevin Green, Administration Assistant

Knauft	Meeting with NCRE/IRA Maize Breeder
	Leslie Everett
Saturday, 7 February	Meeting with NCRE/IRA Maize Breeder
	Laures Empig
Jackson, McDermott	Conference with SOERIM, Mbo Plan
	Jacques Nga, Director General Laurene Mongo, Chief of Products Pascal Ngnenbeye, Station Technician Emmanuel Fougong, Director of Experimentation D. Janakiram, NCRE Rice Breeder
	Visit IRA/Njombe
	Jim white, IRA/IDRC Agronomist Michael Foyet, Center Director
Monday, 9 February	NCRE/IRA Maroua visit
Jackson, McDermott	N.D. Rao, NCRE Agronomist Om Dangi, NCRE Breeder
	Presentation of TLU Maroua
	Jerry Johnson, NCRE Agronomist Mobi Fobasso, IRA Agronomist

	Conference
	Mobi Fobasso, IRA Agronomist Zachee Boli, IRA Station Director
Knauft	Visit to MAISCAM, Ngaoundere
	M.D. Costas, Director
Tuesday, 10 February	Visit IRA Root and Tuber Project
Knauft	Herman Pfeiffer, IRA Agronomist
	Conference
	Martin Kouebo, SODEBLE Director General
Tuesday, 10 February	Conference, Maroua
McDermott, Jackson	Moffi Ta'ama, Bean Cowpea CRSP
Jackson	Conference, IRA/Maroua
	Tim Schilling, IRA Groundnut Breeder
Thursday, 12 February	Conference
	Henri Talleyrand, NCRE Agronomist Anatole Ebete, IRA Agronomist
	Visit to Karewa Experimental Farm
	Yacoubu Aboobakat, Chief of project
	Conference at SODECOTON
	A.M. Gaudard, Rural Development Director D.A. Espenfol, Experimentation Director
Friday, 13 February	Visit Project Semencier
	Mohamad Haroon, Station Agronomist
Monday, 16, February thru	Cereals Research Planning Conference Yaounde
Thursday, 19 February	
Friday, 20 February	Conference on Evaluation-USAID
	William Judy John Balis Michaela Lang Jay Johnson Sam Scott

Alfreda Brewer

Saturday, 21 February — Conference on Evaluation - NCRE/IITA

Bede Okigbo, IITA
Dunston Spencer, IITA
Leslie Everett
D. Janakiram
Animesh Roy
Susan Almy, TLU Ekona
Joseph Kikafunde-Twine
Dermott McHugh
Emmanuel Atayi, NCRE Chief of party
Laures Empig

Monday, 23 February — Conference on Evaluation - MESRES/IRA

Paul Nkwi, Deputy Director, MESRES
Jacques-Paul Eckebil, Dirctor IRA
Jacob Ayuk-Takem, Coordinator, NCRE

IX. Acronyms

Agrilagdo	Karewa Experimental Farm
CIMMYT	International Center for Maize and Wheat Improvement
CRSP	Collaborative Research Support Program
GRC	Government of the Republic of Cameroon
IARC	International Agricultural Research Center
ICRISAT	International Center for Research in the Semi Arid Tropics
ICTA	Institute of Agricultural Science and Technology (Guatemala)
IDRC	International Development Research Center
IITA	International Institute of Tropical Agriculture
IRA	Agricultural Research Institute
MAISCAM	Maize Cameroon (Private Company)
MESRES	Ministry of Higher Education and Research
MIDENO	North West Development Mission
MIDEVIV	Development Mission for Food Crops
MINAGRI	Ministry of Agriculture
NCRE	National Cereals Research and Extension Project
PAFSAT	Promotion of Adapted Farming System Based on Animal Traction
SAFGRAD	Semi Arid Food Grain Research and Development
SODEBLE	Society for the Development of Wheat
SODECOTON	Society for the Developement of Cotton
SODERIM	Society for the Developement of Rice in Mbo Plain
TLU	Testing and Liasion Unit
UCD	University Center of Dschang
UF	University of Florida
UNDVA	Upper Noun Valley Development Authority
WRDA	West African Rice Development Association

APPENDIX A

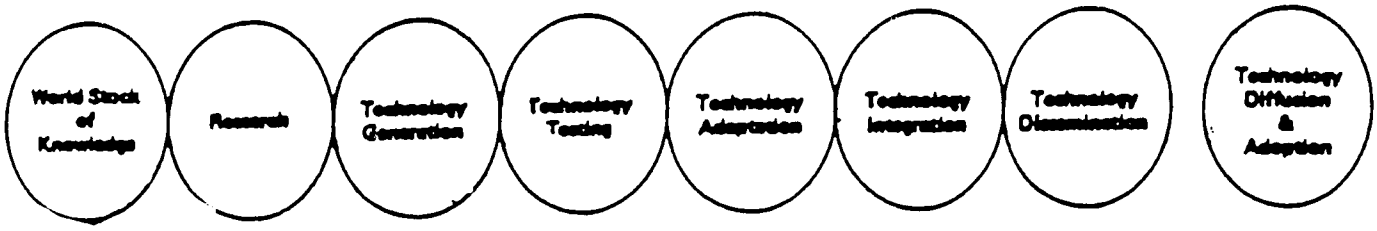
Technology Innovation Process

The Tip Model

The Technology Innovation Process Model is a simplified conceptualization of a process that is more complex than is generally recognized. A conceptual model does not intend to represent reality, but rather to serve as a tool to help you understand and work with reality. It should accomplish three purposes.

1. To help you understand the process (or phenomenon) with which research and extension must deal.
2. To stimulate your thinking and help you gain insights in managing research and extension.
3. To facilitate communication among the persons involved in managing research and extension.

The model has eight components, commonly called functions. The process itself appears as a simple linear sequence of functions. Don't be confused by the fact that operational procedures do not (and cannot) fall into such a near linear sequence. The model makes conceptual distinctions between functions that cannot be distinguished in operations. If the manager understands the conceptual distinctions, however, he will be able to deal more effectively with operational procedures.



The technology Innovation Process

1. The World Stock of Knowledge includes folk wisdom and traditional technology as well as scientific knowledge and advanced technology. Some of it is embodied in products--seed, chemicals, implements; some in manuals and books: and some in the minds, institutions, and traditions of producers and others. Much of it is present in-country. Any country has relatively easy access, nowadays, to the international stock of knowledge and technology. To a large extent, a country does not have to catch UP to the world's technology; it can catch ON to it.

2. Research in this model refers to the gaining of new knowledge, by whatever means, but largely through efforts in science, in contrast to technology. Scientific research seeks new knowledge, and it does so by abstracting from the real world. It seeks as much control over variables as is feasible in order to control quality of results. It is analytical. New knowledge, of itself, has no value to farmers. It has value only when put into use, along

with other knowledge to produce a technology. Farmers can't use science. They need technology and use. Knowledge of a coming rainstorm has no value to a farmer until he uses it in a plan of action.

However, many technological advances, especially so-called breakthroughs, are based on science. Technological advance is often stopped for want of new knowledge.

3. Technology generation puts together knowledge, current technology, folk wisdom, even hunches (or hypotheses) into a new form intended to serve a useful function. This "form" may be a commodity (see, implement); or it may be a practice, such as placement of fertilizer. In contrast to science, technology is a synthesis, and in contrast to scientific research, technology generation synthesizes, it puts things together. It makes knowledge useful by combining it with other elements. Technology must serve in relatively un-controlled conditions and is more useful the wider the range of conditions it tolerates. The role of technology generation is to produce new technology alternatives.

While the conceptual distinction between scientific research and technology generation is extremely significant, the two functions blend into each other in operations. They both use the scientific method and both can make use of highly trained and creative personnel.

4. Technology testing determines the performance of the newly generated technology in relevant conditions. Eventually the new technology must be tested on farms--i.e. in the production system and by criteria of that system. This is a critical function of the technology innovation process and demonstrates the need to conceptualize that process. Farmers will not adopt a new technology until they are satisfied with the test. If research and extension cannot develop procedures for providing this satisfaction, then technology innovation must await the autonomous process to work through to completion.

5. Technology adaptation serves two purposes. It is the function by which a newly generated technology is modified to fit better in the farming system for which it is intended. It is also the function by which minor changes are made to fit the technology to a wider range of production systems and ecological conditions. Efficiency in the technology innovation process is increased as the technology serves a wider range of systems.

6. Technology Integration is that function of the process that integrates a new technology into current farming systems. New technology must be integrated along three dimensions.

a. One pertains directly to the system of production. Just as technology is a synthesis of many bits and pieces of knowledge and practices, a farming system is a synthesis of many technologies. In a system, the changing of one component (technology) often requires changes in other components. Integration is the function of fitting the new technology into the production system and making adjustments in the other components as appropriate. Some technologies are easy to integrate. Changing seed can be very easy but it is not always so. Introducing other technology can be more complicated. Finally there are some

innovations that are so effective that it becomes highly profitable to change other components of the system.
As with testing, farmers cannot adopt a new technology until they are able to integrate it into their production systems. If research and extension cannot help with this function, then again adoption must await the autonomous process, which moves at its own pace and its own direction.

b. A second dimension is integration with the input and product markets. If technology is embodied in a commodity, the commodity must be available at reasonable cost for the technology to be adopted. Integration may involve market action to make inputs available. If the product market is inadequate, farmers cannot integrate the technology into their systems of production.

c. The third dimension is integration with national policy. National policy often works through product and input markets and sets conditions the farmer must adapt to. These conditions affect the ways farmers can deal with new technology.

7. Technology dissemination involves farmers learning of the new technology, their being aware of its potential of its value, and their understanding of how it could fit it into their systems of farming. This learning, or spread of information, can be accomplished in a variety of ways--wars, commence, slave trading, social groupings and others, as well as by extension activities and salesmanship of farm supply firms.

8. Adoption-diffusion involves the decisions of producers to put the new technology into actual use. Individual farmers make the decision to adopt the new technology. As more and more farmers adopt it, it can be said to be diffused. It becomes an effective innovation when diffused among enough farmers to have a significant impact upon some segment of the population. In this function, farmers rely heavily on the experience and judgments of other farmers.

This conceptual distinction betwen "dissemination" and "adoption-diffusion" often will not be reflected in operations. Yet, if you can see the conceptual distinction, it will help you manage operations. Dissemination often involves the efforts and actions of non-producers, second parties who may or may not have any interest in whether a technology is accepted. Adoption and diffusion depend on producer decision and action, taken for the purpose of serving their own self interest. Professional advisers, such as extension agents can help with the decision.

Source: Appendix A " Project Handbook: Research and Extension," University of Florida, Farming Systems Support Project. 1985.

APPENDIX B

Research Organization Matrix

Subject Matter Research Units	Area-Specific Research Units				
	Area 1	Area 2	Area 3	Area 4	Area n
Cereals					
Legumes					
Livestock					
Soils					
Other					

This system of organization was developed and used effectively in Guatemala by ICTA. Each area-specific research unit is responsible for the integrity of the research program in its relevance to the most important farming system(s) of an area. Personnel must know and understand the farming system(s) and enough of the technology so that they can help adjust the subject matter research programs to that area.

At the same time the national (or system-wide) subject matter research program leaders are responsible for the subject matter integrity of the programs. Where the lines intersect, reconciliation must take place. Of course no one is completely happy, but under proper leadership from top management, total program intergrity can be maintained.

Reconciliation in ICTA takes place at annual meetings in which research results of the past year are reported and analyzed and research plans for the next year made. Top management may have to take an active role. If meetings can be held in the area, it may help.

The national subject matter programs can generate technology if national resources permit teams with this capacity. Those programs can also be manned with very small teams who depend on the international network for part of their technology if they are under more severe resource constraints.

Source: Research and Extension Project Handbook, FSSP, University of Florida, Gainesville, 1985.