REPORT OF EVALUATION TEAM ON THE

AGRICULTURE TECHNOLOGY DEVELOPMENT PROJECT
(Project No.525-0180)

SUBMITTED TO

THE U. S. AGENCY FOR INTERNATIONAL DEVELOPMENT/PANAMA

July 8, 1983

Implemented By

INTERNATIONAL AGRICULTURAL DEVELOPMENT SERVICE
Arlington, Virginia
(IQC-PDC-1406-I-16-1134-00)

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I. EXECUTIVE SUMMARY

1. The Evaluation

The evaluation reported here is intended as "a progress/process assessment at this juncture---to identify and correct any technical, administrative or procedural problems which have arisen and serve to impede effective project implementation". It will also "---review the status of IDIAP's own on-going, technology diffusion efforts, and how these efforts can be coordinated and/or integrated with those planned by Panama's Ministry of Agriculture Development (MIDA) under the new extension activity." (PIO/T No. 525-0187-3-3002).

2. Methodology used

The evaluation efforts were divided into four sub-groups and members of The Team were assigned specific information-gathering responsibilities along with staff members of IDIAP who were designated as counterpart evaluators.

During the course of the evaluation, it became apparent that there were such marked differences in the stage of development between the crops and the livestock activity that it would be more meaningful to treat them separately in this report.

3. The Project Evaluated

The purpose of the project on Agricultural Technology Development is to assist Panama to establish an agricultural research capability that will help small operators increase their land and labor productivity and ultimately their income and employment opportunities. Emphasis will be given to adapting production technology that has already been generated in other parts of the world to Panama conditions. The project is also designed to strengthen the flow of technical information from research to the diffusion agencies, and to strengthen the institutional capabilities of IDIAP for this purpose.

4. The Crops Research Program

Crops research is being conducted both on experiment stations and farmers's fields, with the major effort being made on farmers' fields. The relationship farmer technician is excellent, particularly in Caisan and Progreso. Some experiments on farmers' fields are continued for two or more seasons at the same site, but most are located at different sites each year.

Improved production technology has been generated for the maize common bean cropping system in Caisan, the potato potato system in Cerro Punta and for tomato production in Los Santos. New information has been produced about the nature and importance of the golden nematode problem in Cerro Punta, the value of liming soils with high contents of exchangeable aluminum, and the response of food grains to modifications in several production practices in the Progreso and Guarumal areas. In the latter two areas, tentative adjustments in technology for the rice sorghum and rice maize cropping systems are being validated on 0.5ha plantings with selected farmers. New varieties of pepper and pumpkin have been developed and are beginning to be used by farmers in the Los Santos area.

In addition to the more visible advances in the generation of appropriate technology, plant selection in Caisan has reduced plant height of the local maize by about 0.5m. Screening of sorghum varieties for resistance to anthracnose and stem rot, and onion varieties for adaptation to plantings during the rainy season have provided useful information but no solutions. Varietal trials have demonstrated the advantages of the open-pollinated maize variety, Across 7728, and the rice varieties, Costa Rica 5272 and IR-25, in certain areas of the country.

Some progress has been made in understanding and refining the research methodology that was proposed in the IDIAP/USAID project paper for the eight priority areas. This has occurred mainly in Caisan, Progreso and Guarumal where CATIE and CIMMYT participation has been most intensive. The use of zero tillage plus gramoxone with the maize beans cropping system has been extended to approximately 75% of the plantings in Caisan. Other production practices recommended for the system have been adopted to a lesser degree. In the Los Santos area, most of the 700 farmers, producing about 1,700ha of industrial tomatoes are using the improved variety developed by IDIAP. The extent of adoption of IDIAP technology in other priority areas is not too clear. Apparently many of the farmers who have cooperated in the field trials, particularly those conducted with food grains, have begun to use the improved practices.

Dissemination of information about the modified practices has occurred largely through farmer-IDIAP technician contacts. In great part, this has been due to the interaction between researcher and cooperating farmer during the course of carrying out the field trials. Also, field days have been conducted occasionally at validation plots, with cooperating farmer and technicians explaining to visitors the improved practices and expected benefits. MIDA extension personnel have not been involved in the transfer process.

Current yields of food grains in mechanized agriculture (Progreso, Sur de Sona, Alanje)-are good, with most farmers using modern technology. Improved technology produced by IDIAP represents refinements in agronomic practices and is expected to result in small to moderate increases in yield with little or no increase in cost. Yields of food grains in non-mechanized plantings are much lower, except in Caisan, and the use of modern technology is very limited.

In areas like Progreso and Guarumal, where tentative recommendations for the production of food grains have been generated, field trials should be continued at about the present intensity for one to three years until the validation plots demonstrate the economic superiority of the modified technology. In areas like Caisan, where the improved technology has been proven to be suitable, all or part of the research resources should be moved to a second location in the same priority area where technological needs are expected to be similar, but where site specific components like fertilizer use need local verification. Research on components like varietal improvement that require several years of selection may be continued in one or both areas.

Since on farm research should retain this quality of moving on to new locations as soon as a satisfactory technology has been developed, it seems unwise to construct permanent buildings at a given priority site. In fact, the construction of such facilities will almost certainly tie the area research team to a fixed location and thereby contribute to duplication of effort at that site and failure to respond adequately to farmer needs in the rest of the priority area.

Much of the technology on food grain production developed at Progreso and Guarumal should be appropriate for the farmers in Alanje and for other mechanized plantings on level to gently rolling lands in Chiriqui and Veraguas. Full use should be made of information generated in Progreso and Guarumal for planning and implementing field trials in Alanje and similar areas. In this way it should be possible to keep to a minimum the field studies needed in the latter areas.

Little research has been carried out up to now to develop improved technology for small, subsistence farmers. Since many of them use cropping systems that include rotation with native vegetation followed by the cut-slash-burn process, it is not clear to what extent research findings derived from the trials on mechanized plantings are applicable. If small, subsistence farmers constitute a part of the target population of IDIAP research, it will be necessary in the future to shift more resources to a study of their needs.

In carrying out experiments on farmers' fields, greater attention should be given to monitoring the trials during the growing season. Observations should be made regularly, every week to 10 days, on vegetative response to treatments and plant damage due to weeds, pests, diseases, drought, excess moisture, etc. The registering of field observations should be made by the researcher who will be interpreting the experimental data and planning follow-up trials. Although the regular collection of information on plant behavior during the growing season is being done by some investigators, this critical phase in the research process can be greatly improved in most areas. This critical aspect of research has been severely handicapped by restricted operating funds, but it can also be affected by lack of research discipline.

Fertilizer recommendations, made by the soil specialist of the Central Region and based on soil analysis, are used widely (about 5,000 per year) for crop production. As new information on fertilizer use is being generated each season in the area programs, it is important to formalize a procedure whereby these new findings become immediately available to the soil specialist that writes the recommendations.

5. The Livestock Research Program

In the livestock program there is good sense of purpose, dynamism and enthusiasm among those concerned with the program. The rate of progress would be good for, say, a one-year old program--which is about the time that most of the senior livestock program staff have been employed by IDIAP. A good size staff has been put together for the livestock program composed, of approximately fifty professionals, but no real "multidisciplinary teams" have been formed, as called for by the project paper. Although some of the senior staff have had solid administrative business experiences, they are new to research. Most of the rest of the staff are young and inexperienced in research. MIDA production specialists that were supposed to be incorporated into the IDIAP area teams, have not been assigned yet.

On the whole, IDIAP has fair physical facilities for conducting livestock research. It has plenty of land and cattle in its three experimental farms. In two of these there are also basic construction and equipment. Vehicles don't seen to be too scarce, but fuel and repairs are in short supply.

The livestock program so far is exclusively working with dual-purpose, beef/dairy cattle. There is a definite decision not to be concerned with poultry, but a little work on swine and goats is planned under the CATIE/ROCAP/IDIAP collaborative agreement. The two major thrusts of the livestock program are on pasture improvement, and on livestock management.

By overly-emphasizing a production systems orientation and on-farm trials, most of the true research content has been lost. That is, the design, data gathering and analysis of much of the "research" being carried out, does not permit the drawing of sound conclusions regarding the effects of the variables being dealt with. There are no well-developed, sound procedures for program formulation and data collection. Implementation of a conscious and systematic effort to design projects so that quantitative data can be obtained from them that permit comparisons, would result in a much more valuable research program. The scope of the present on-farm activities is too broad, in terms of travel distances and technological variables being tried-out. Given the current staff size and composition, transport and lodging facilities, and the ability of IDIAP to backstop field work with research at the experiment station, it would seem advisable to sharpen the focus and narrow the coverage of the on-farm trials. This should result in better data and sounder conclusions from fewer sites.

The major productivity targets in the livestock program are to: increase daily milk ouput per cow and lengthen the lactating period; improve calving rate; reduce mortality of calves; improve rate of gain of calves and steers; carry calves to heavier weight before marketing; improve quality of herds and the extraction rate. These targets are being addressed through pastute improvement and livestock management programs.

A reasonable amount of technological information has been accumulated by the livestock program:

Several grasses and legumes, including Brachiaria decumbens, Brachiaria humidicala, Andropogon gayanus, Digitaria swazilandensis, Pueraria phaseoloides, Hypherrhenia rufa, and others are at different levels of introduction, observation and testing at various locations. Some tentative observations and results are available, but much more documentation and validation are required before this technology can be recommended in packages of practices for farmer use.

- Experimental results show that faragua grass gives optimum response to low levels of N but little response to K.

- Pasture management studies show that rotational grazing of pastures gives best results when the rest period is 21-42 days duration.

- Feed reserves for the dry season can be supplied as silage, hay, or green chop, but the most appropriate species and the optimum form of utilization management have not yet been well defined.

- The use of herbicides combined with good grazing management as substitutes for the use of fire and the machete for weed control show promise, but specific recommendations cannot yet be made.

In addition to pasture improvement, other animal nutrition practices that are being demonstrated and tested include: grazing by milking cows in separate lots, balancing the diets with mixed forages and/or various supplements such as Melurea, feeding of salt and mineral mixes.

Calf production practices that are being demonstrated include: allowing longer nursing hours, keeping calves on good pasture while separated from the cow, rotational grazing on small paddocks with good grass, and the use nutritional supplements.

To increase milk production while maintaining resistance and adaptability, local cattle are being crossed with Holstein and Brown Swiss. The breed mix recommended by IDIAP is 1/2 Cebu and 1/2 Holstein on Brown Swiss.

Several specific recommendations are made regarding the livestock program:

- Place greater emphasis on, and strengthen the mechanism within IDIAP for planning, designing and evaluating the livestock program.

- Make better use of the few older, experienced researchers that IDIAP has, as well as of the senior foreign staff, for assisting the program directors in the program management.

- Make concerted efforts to incorporate MIDA production specialists into IDIAP's on-farm trials.

- Develop sound experiment station and on-farm research plans, procedures and techniques that allow observations and results to be adequately documented and compared.

- Concentrate on cattle and forages; keep breeding research to a minimum; keep the emphasis on nutrition, with special attention to testing the energy producing grasses, rather than spending much effort on native legumes; and continue testing and developing better livestock management practices, of a simple nature, for easy adoption by small farmers.

- Develop a continous, formal process of project and program evaluation, the main purposes of which would be to take full advantage of new information in formulating annual work plans and in selecting those results that are ready for diffusion.

- Step up the research trainning of staff. The over-emphasis on loose farm trials cum technology transfer is probably due largely to the weak research capabililty of the young IDIAP staff.

6. Inter-institutional Collaboration and Technical Assistance

IDIAP has enjoyed a considerable amount of inter-institutional collaboration and technical assistance over the past several years. This has been very effective in many of IDIAP's responsibilities in reducing duplication of effort within the country and of bringing to IDIAP much needed information and guidance in its programs of adapting technology to Panama production conditions.

Collaboration between IDIAP and MIDA/BDA was viewed as a cornerstone in the rapid identification, testing and diffusion of technology that could be adopted by farmers. This, however, has been the weakest part of IDIAP's interactions with national or international agencies. The major obstacles to close collaboration seem to be in the failure of top administration making this a clear and urgent policy in each agency and in the organizational structure which divides and dilutes interest and initiative. This situation is further aggravated when external funding agencies lend financial support to unchanged policies and to organizational structures that have proven to be unproductive in other Latin American countries.

Collaboration with the University of Panama has improved considerably in recent years. Several IDIAP research contracts have been let to the Faculty of Agronomy staff to study aspects of agriculture not covered in IDIAP's programs. Perhaps the most significant outcome in this effort is a climate for effectively utilizing the human and budgetary resources of each organization for the benefit of the Panamanian farmer.

IDIAP has established collaborative linkages with 7 other national institutions serving agriculture, all of which were intended to extend the mutual capabilities of the cooperating agencies.

Collaboration with CIMMYT has involved the interchange of scientists and maize and sorghum germplasm, as well as providing conferences and training of personnel. The results of this collaboration have been excellent. It has provided genetic materials for testing, it has brought farming practices to be studied, and it has provided excellent guidance from senior, experienced scientists.

Collaboration with CATIE is also of long standing and has produced excellent results, especially in the crops research activities. CATIE participated in the early diagnostic studies in several priority areas. They have located long term senior scientists in the field, working closely with IDIAP staff in both crops and livestock. Unfortunately, this collaboration may terminate before many of the validation tests in which they are involved have been completed.

Collaboration with PRECODEPA/CIP has provided technical assistance, germplasm and training for many years. This continues to be effectively utilized by IDIAP in its potato program. It is financed by a grant from the Swiss government.

Collaboration between IDIAP/CIAT has been effective in rice, but until recent months it has been very weak in yuca, beans and tropical pastures and forages. Recent understandings and new collaboration initiatives promise to overcome early weaknesses. IDIAP personnel have especially benefited from training programs in CIAT.

CIID has provided financial support for the livestock program but it has not been directly involved with technical staff.

Long-term and short-term technical assistance has been provided through the Cornell/Rutgers contract. Three of the 5 long-term scientists that were originally planned for this project have been assigned to Panama, including a general agronomist, specialist in tropical pastures and specialist in soils. Although the scope of work, responsibilities and duties of each of these technical assistants greatly surpasses that which might logically be expected from them, each has planned a program of work that will aid in the effective development of portions of IDIAP's research program. Their efforts in training local inexperienced staff in sound research planning, execution and interpretation will represent one of their most valuable contributions. Each needs to define his strategy for reaching his technical assistance goals during the next 18 months. This definition needs to be assisted by IDIAP/USAID decisions that enable the technical assistants to narrow their range of responsibilities to dimensions that are capable of being realized. The evaluation Team feels that these efforts should be strengthened by the addition of two additional long-term technical assistants--one in animal science and production and the other in technology transfer.

IDIAP has made extensive use of direct-hire contracts to supply short-or long-term technical assistance in areas where their technical or administrative staff has been weak. More than 40 people have been employed under this system, and to date it appears that most of them have been effectively utilized.

7. Research Priorities

The only serious question to be raised relative to research priorities lies not so much in the choice of commodities as in the relative emphasis among them. Livestock production makes a significant contribution to the total value of agricultural commodities in Panama. The total investment in research by IDIAP in the livestock area for 1983 is only slightly less than for crops research (B/.113,717 for livestock vs B/.150,523 for crops). However, the stage of development of livestock research is considerably behind that for crops. The crops research program has produced many results that are ready to be incorporated into farming systems programs. The livestock research program, however, is still largely in the exploratory stages and is in need of much stronger investment in obtaining aggressive leadership and direction.

It is recognized that research is an activity which requires considerable time to build a staff, to acquire the necessary facilities and to generate useful and reliable results. Therefore, recommendations regarding changes in priorities or in emphasis should only be considered as existing priorities are brought to a reasonable conclusion. In the case of IDIAP research priorities, it is recommended that the overall set of commodities being studied remain as at present. However, as opportunities arise, a shift toward stronger support to livestock research would seem to have promise of higher returns on investment.

8. Training and Staff Development

Training is the heart of institution building, and this fact is recognized in the project and by IDIAP management. They feel that they are pushing training abroad as hard as possible within the constraints imposed by English language deficiencies. The climate for retaining and using trainees efficiently seems quite good. The demand for more trained people is well documented. The absorptive capacity of IDIAP for more technical staff with better training seems to be limited, however, by the budgetary support from GOP. IDIAP has shown considerable ingenuity in finding ways to add staff on "soft" monies and to hold most of them in productive research positions pending the time when they can be moved onto firm budget rolls. They have been less successful in finding the necessary support for effective staff work in the field. Thus, while the training program has started slower than hoped and the number of trainees accommodated under the project is much less than expected, there is reason to give the current effort good marks and to encourage further investment in this activity at every opportunity.

The livestock staff needs to receive extra emphasis relative to the crops staff, both in short term and long term training efforts. It is not likely that they can greatly improve the effectiveness of their international collaboration without considerable extra effort in the training dimension.

It is recommended that the project find ways to increase the total investment in training of technical staff. This is true for both short term and long term training.

9 Construction of Physical Facilities

All construction sites were visited jointly by The Team architect and the IDIAP architect. Visits included sites where construction is underway as well as those projected but not yet initiated.

The regional design for Divisa and David offer little delight and less economy. They fix IDIAP into requiring air conditioning and interior lighting and really offer no alternative were energy to become prohibitively expensive, or were an air conditioning unit to require maintenance not locally available, or were the power source to go out. The buildings are not conceived as having to depend upon cross ventilation, natural light, or ceiling fans. Dead end corridors are used as return air plenums. Ten large compressors are the first items one sees turning into the administration building at Divisa.

If air conditioning is really required, then consider more air-tight windows, shading the walls, painting the roof white, shading all glass areas completely, shading the building with trees, insulating the exterior walls, increasing the insulation surrounding the ducts. If air conditioning is really not required, the consider most of the above and large exhaust fans, flow-through ventilation, ceilings at least 9-6" high so that ceiling fans may be installed.

It should be stressed that many of the problems encountered in the IDIAP architectural plans and projects in construction are more indicative of the level of the standards and accepted norms of the architectural and engineering profession and construction industry, than an indication of the competence and diligence of the IDIAP staff. It should be emphasized that the staff professionals seem keen to learn from their projects in construction and have persevered despite formidable bureaucratic and financial obstacles. The requirement of having to accept the lowest bid inevitably creates quality and performance difficulties.

A good many of the quality problems that IDIAP has been experiencing in construction can be traced to inadequacies of their plans. Little attention has been directed by the architects to building orientation, direction of land slope, site drainage, landscaping, or to the users' needs for cover from the hot sun, or staying out of the mud in a wet, poorly drained, area.

Introduce some Panamanian elements--interesting colors, textures, some interesting detail, some natural material for shading and divides and a landscape plan of useful plants.

The experience of building the sub-regional center is clear: IDIAP has largely received a good facsimile of their plans. The weaknesses of the built projects, could have been disclosed from a careful review of their plans. AID Panama should require earlier, periodic and timely reviews of their funded projects. Input at the end of a long and complicated project puts in jeopardy a considerable investment in engineering planning services.

To this end, a detailed review of the David and Divisa plans are included in this report in an attempt to help to eliminate the problems encountered in the construction of the sub-regional centers.

II. INTRODUCTION

A. Purpose of the Evaluation

The Project Paper for Project 525-0180 indicates that evaluation will be carried out on two levels. Annual evaluations will be made jointly by IDIAP and USAID/Panama and will focus primarily on the degree of efficiency in project implementation. A second type of evaluation will focus primarily on achievement of project goals and purposes. In particular it will focus on the results of the area-focused production systems research and dissemination activity.

The current evaluation is intermediate between the two levels called for in the Project Paper. The evaluation reported here is intended as "a progress/process assessment at this juncture---to identify and correct any technical, administrative or procedural problems which have arisen and serve to impede effective project implementation". It will also "---review the status of IDIAP's own on-going technology diffusion efforts and how these efforts can be coordinated and/or integrated with those planned by Panama's Ministry of Agriculture Development (MIDA) under the next extension activity." (PIO/T No.525-0187-3-3002).

B. Methodology Used in the Evaluation

The evaluation efforts were divided into four sub-groups and members of The Team were assigned specific information-gathering responsibilities along with staff members of IDIAP designated by The Director General. An itinerary of site visits was arranged with IDIAP for each sub-group. IDIAP took responsibility for arranging for the visits, providing transportation and making necessary reservations for accomodations outside of Panama City. The Team Leader came to Panama for a few days three weeks ahead of the Team arrival to make all the above arrangements and to give IDIAP time to schedule their staff participations. This proved to be very helpful and resulted in very close adherence to the planned schedule with minimum loss of time by The Team.

A draft outline of The Team report was also prepared prior to The Team arrival and was made available to AID/AGR and to IDIAP. This enabled both agencies to focus attention on the information which each expected to derive from the joint evaluation.

The Team itineraries are included in Appendix I

The four sub-groups formed by The Team were:

Group I	-	Livestock research, technology development and technology transfer.
Group II	-	Agricultural research, technology development and technology transfer.
Group III	-	Training.
Group IV	-	Construction.

C. Composition of The Team

USAID/Panama requested the International Agricultural Development Services (IADS) to assemble a Team of external evaluators for the above purpose. The Team consists of:

Dr. Jerome Mann	-	IADS-Animal Scientist
Dr. Reggie Laird	-	Graduate School-Chapingo, Mexico - Agronomist
Dr. Eduardo Venezian	-	Universidad Católica de Chile, Agricultural Economics
Mr. Ron Fridlind	-	Arquitectural Projects, Tucson, Ariz.
Dr. Jackson Rigney	-	N. C. State University-Agricultural Research Administration - Team Leader

In order for the evaluation to have maximum technical value to the project, IDIAP was invited to designate counterpart evaluators from its staff who would participate in the review and in preparation of the report. Those designated by Dr. Rodrigo Tarté, Director General of IDIAP, are:

Dr. Carlos Morán	-	Director of Livestock Research
Dr. Gaspar Silvera	-	Director, Agricultural Research
Ing. Rolando Sánchez Diez		Director of Techonology Transfer
Arq. José Isturain	-	Architect - IDIAP

III. THE PROJECT EVALUATED

A. Project Objectives

The purpose of the project on Agricultural Technology Development No. 525-0180) as outlined in the Project Paper is to assist Panama to establish an agricultural research capability that will help small operators increase their land and labor productivity and ultimately their income and employment opportunities. Emphasis will be given to adapting production technology that has already been generated in other parts of the world to Panama conditions.

In addition to the above primary objective, the project is designed to strengthen the flow of technical information from research to the diffusion agencies.

A significant aspect of the project is to strengthen the institutional capabilities of Panama's Applied Agricultural Research Institute (IDIAP) which has responsibility for the above tasks.

B. Project Components Evaluated

The PIO/T which authorized this evaluation specifically requested attention to the following:

1) Evaluate progress in carrying out the project's planned area-focused, production systems research program in eight selected geographic areas.

2) Assess the effectiveness of inter-institutional communication/collaboration between IDIAP and other local research organizations (e.g. the University of Panama's Faculty of Agronomy, MIDA, The National Agricultural Institute at Divisa) as well as regional organizations (e.g. ROCAP, CATIE, UNDP/FAO, etc).

3) Evaluate the extent and appropriateness of agriculture research carried out thus far and the degree of research dissemination and utilization by small-medium farmers.

4) Evaluate the criteria currently in use for setting research priorities, as well as the selection, utilization and over-all effectiveness of technical services provided under the contract.

5) Evaluate IDIAP's training program and over-all staff development.

6) Evaluate progress in construction of planned physical facilities (e.g. area research stations, laboratories, IDIAP headquarters building).

7) Evaluate the timeliness and effectiveness of equipment and other procurement programmed under the project.

8) Outline evaluation criteria to be used for any further progress reviews.

IV.- EVALUATION

Visits to the crops research activities were made by one group of evaluators and visits to the livestock research sites were made by a different group. It was initially planned to merge the observations of the two groups into a single set of comments that would be organized by priority areas. During the course of the evaluation, however, it became apparent that there were such marked differences in the stage of development between crops and livestock activity that it would be more meaningful to treat them separately in the report.

A. Progress and Extent of Usefulness of Research in Crop Production.

1. Observation on individual sites.

a) Caisan Area

Field experimentation in the Caisan area began in October, 1978. Based on information collected from a sample of farmers in the area, 16 experiments were established on farmers' fields at 5 sites to study the effects of herbicides, fertilizers and plant spacing on the production of beans (Phaseolus vulgaris). Beginning in March 1979, a similar set of experiments, expanded to include selection to reduce plant height, was initiated with maize. In 1980, studies were added to measure the usefulness of zero tillage. Later, experiments were added to compare introduced maize and bean varieties with local varieties.

Data are now available from five seasons of research on beans and four with maize. Field tests are presently underway with maize to continue the study of fertilizers, zero tillage, herbicides, chemical control of soil insects, varieties and selections to reduce plant height. Also, bean trials are being carried out to compare several varieties of red kidney beans for the Caisan area and to observe the tolerance of black bean varieties (for coastal plantings) to leaf rot (Rhizoctonia sp.). Validation trials are being conducted in which two improved options are being compared in large plots with the conventional practices of farmers.

The research program in the Caisan area is being carried out by one agronomic engineer and two agronomists. Technical backstopping is being provided by IDIAP staff at the regional and national levels, as well as CIMMYT specialists in farming systems and maize breeding and a CIAT specialist in bean production.

The most significant output of research is the finding that zero tillage, combined with the use of herbicides, is much less costly than mechanized land preparation plus weed control by hand or with chemicals, and that crop yields are equally as good or better. Also, zero tillage leaves more crop residue on the soil surface, thereby providing greater protection against erosion. Other research findings are: (1) crop response to fertilizers is small and does not pay the cost of the treatment; (2) traditional plant spacing can be improved by planting in the row and increasing plant density; (3) the local maize variety is too tall (lodging problems) but is still preferable to introduced varieties; and (4) introduced bean varieties have been identified that are superior to local varieties.

Zero tillage with the use of gramoxone at planting and 20 days later has been widely adopted in the Caisan area, perhaps in as much as 80% of the maize and beans plantings. Other recommended practices--reduced fertilizer use, planting higher densities in rows--have been adopted to a lesser degree than zero tillage. It is estimated that production costs up to and including planting have been reduced by 40% through the use of the recommended practices. Although no objective yield evaluations have been made for the Caisan areas, it is believed that yields have been increased perhaps by as much as 60% in the case of maize.

The dissemination of the improved technology has occurred largely through adoption first by the farmers that have cooperated in the field trials and subsequently by their neighbors. Although one MIDA extension agent is assigned to the Caisan area, there is little contact between him and IDIAP personnel and he has not been instrumental in the transfer of the new technology.

One of the stated objectives of the Caisan program is to increase the area planted each year to maize and beans. In order to do this, the research team believes that it will be necessary to improve the equipment presently available for mechanized planting with zero tillage. The team's effort to solve this problem, however, is limited by lack of technical expertise, and so far it has not been possible to arrange for assistance in machine design.

b) Cerro Punta, Bugaba District

Research on potato production was initiated at Cerro Punta, both on the experiment station and on farmers' fields, several years prior to the organization of IDIAP. Studies have been conducted on varietal evaluation, production of high-quality disease-free seed potatoes, control of nematodes, control of late blight, crop rotations, soil conservation and pest management. Some work has also been carried out with onions and other vegetable crops being produced in the area.

The major research effort at the present time is directed to the golden nematode problem: (1) screening of varieties for tolerance to the nematode, (2) biological control using parasitic fungi, and (3) identification of the species found in the local soils. In addition, a survey is being made of the level of nematode infestation of soils under different management systems. A nematode evaluation service is provided to farmers who are required by the public bank to have a soil analysis prior to receiving a loan.

Also, research is continuing with varietal evaluations and the control of late blight, root diseases, and polilla. Work on the production of virus-free seed potatoes continues with major attention being given to the variety, Granola. Validation plots have been established with farmers to demonstrate a modified planting procedure which avoids direct contact between potato seed and fertilizer and favors the drainage of water away from the seed.

Interest in solving the problems related to onion production during the rainy season continues. The major concern is to find an economically feasible way to dry the bulbs at harvest.

The research program at Cerro Punta is being carried out by one agronomic engineer and two agronomists. The research team receives technical support from IDIAP staff and CIP potato specialists. Research on the golden nematode is supported by a grant from the Swiss government. An agronomist on the Rutgers/Cornell team will be initiating research on the drying of onions.

The most significant progress in recent years is a product of the work on golden nematodes which has resulted in a better understanding of the: (1) nature and extent of soil infestations, (2) reductions in yields and (3) possibilities for reducing damage. However, a more economical technology for reducing the effects of nematodes (through varietal resistance, biological control, etc.) is still in the future.

Chemical control of late blight continues to be a very expensive practice. Although work has been underway for many years on producing locally the seed potatoes used by farmers, little progress has been made. Farmers continue to fertilizer very heavily with no research evidence that this practice can be made more economical. Soil erosion is at an alarming level with little attention being given to the problem.

The use of modern technology (improved seed, fertilizers, chemical control of diseases and insects) is general among potato farmers at Cerro Punta. This has been true for many years and has been influenced little so far by IDIAP research. There are no MIDA extension personnel working in the Cerro Punta area.

c) Progreso

Research on crop production in the Progreso area was initiated in 1979 with a farmer survey to obtain information on farmer circumstances, cropping systems, production practices, limiting factors, etc. Two cropping systems were found to be important in food grain pruduction: rice-maize and rice-sorghum. Rice is planted at the beginning of the rainy season (March-May) and is followed in October-November by maize or sorghum. The production practices given top priority in both systems were variety, fertilization, weed control and insect control.

Field experiments were begun during the second semester of 1980. Twelve trials were conducted with sorghum and two with maize. During 1981, sixteen field trials were carried out to study the four priority production practices for the rice-sorghum system and 20 for the rice-maize system. In 1982, a total of 40 trials were conducted with the two systems, including 5 validation plots. Approximately 87% of the field trials were harvested. All trials were carried out on farmers' fields.

Field research continues in 1983 at about the same intensity as in the previous two years. Forty-eight fields trials will be conducted at 30 sites. Approximately 40% of the trials in 1983 will be validation plots. These are 0.5ha plantings using the recommended technology; yields on validation plots are compared with the farmer's yield in the surrounding field.

A research program with plantain was begun in 1982. A farmer survey comprising 188 interviews was conducted to collect information on circumstances relevant to the production and marketing of plantains. The main problems identified were related to marketing, loss at harvest, labor shortage at peak periods, weeds, insects and fertilization. The last three problems are presently being studied in trials located with small farmers.

The research program in Progreso is being carried out by three agronomic engineers and two agronomists. In addition, approximately halftime of two resident technicians of CATIE is devoted to the work in Progreso as a part of the IDIAP-CATIE collaboration in farming systems research. Also, a specialist in plantain production, employed with USAID loan funds, resides at David and provides continous support in the plantain research.

The research on food grains has already generated considerable information. Although farmers use a complete fertilizer, something like 90-50-24, it has been found that cereal grains respond only to nitrogen; a tentative recommendation of 120 kg of nitrogen per hectarea is being made. This represents a significant reduction in production costs.

The rice variety, IR-25, has been found to be more resistant to blast disease in the Progreso area than the present varieties, CICA7 and CICA8. The improved weed control practice consists of two herbicide applications instead of one and a change in herbicide in accordance with the composition of the weed population. With respect to insect control, a soil application is not recommended because of cost and randomness of infestation, and folliage application is recommended only when the insect population surpasses a specified limit.

Research trials with food grains have been carried out with about 60 farmers during the 1980-1983 period. The farmer-investigator relationship in general has been very good, and many of these collaborators have already adjusted their production practices in accordance with research findings. There are no MIDA extension personnel involved in the transfer of the improved technology.

It is important to note that small grain yields of most farmers are quite high, perhaps 4 ton/ha or more in the case of rice. Also, most farmers are using modern inputs: tractors, fertilizers, improved seeds, herbicides, insecticides. The improved techonology of IDIAP is not the introduction of new practices but rather the refining of practices already being used. Consequently, the use of the improved technology will only result in small to moderate increases in yield, perhaps on the order of 0.5 to 1.0 ton/ha. However, the improved technology represents a saving for farmers presently using a complete fertilizer.

d) Alanje

A small agricultural research station was established at Alanje many years ago. During the 1970's rather extensive MIDA facilities were constructed at Alanje. Recently, an office building was constructed by IDIAP adjoining the MIDA facilities.

Crop production research was carried out at the Alanje experiment station in the past but was discontinued a few years back. During the past year a new research team has been formed consisting of two agronomic engineers, one agronomist and several experienced peones.

A survey has been conducted in the area to collect information on farmer circumstances, cropping systems, use of modern technology, average yields, and production constraints. Data are presently being analyzed and findings will be used to plan research activities. It is expected that priority will be given to developing improved technology for the production of rice, sorghum and maize.

e) Guarumal, Sur de Soná

The research program in Guarumal was initiated in 1980 with the collection of information from a sample of farmers to better understand their present circumstances, principal cropping systems, use of modern technology, average yields and main production constraints. Farmers' principal cropping systems are rice-sorghum and rice-maize with rice being grown during the first planting and sorghum and maize during the second (September-January). The production components that were assigned priority in the research program were weed control, fertilization, variety and insect control.

Field experimentation was begun in the second planting, 1980, with the installation of three exploratory sorghum trials and one maize trial. During 1981, thirteen field experiments were carried out to study the several components of the rice-sorghum cropping system and six with the rice-maize system. During 1982, nine trials were conducted with the rice-sorghum system and seven with the rice-maize system. two of the research plantings in 1982 were for the purpose of validating the superiority of the improved technology. Most of the maize and sorghum trials in 1982 were lost due to drought. All experiments were conducted on farmers' fields, mostly on land of asendados.

Field research continues in 1983 at about the same intensity as in 1982. Varietal evaluation, fertilization, and weed and insects control are being studied at a few locations. Nine 0.5ha validation plots with rice have been established. Eight validation trials with maize are programmed for the second planting.

The research team in the Guarumal area consists of three agronomic engineers and two agronomists. It receives technical support from IDIAP specialists, particularly in soils and entomology. Also, as in the case of Progreso, the research program on food grains in Guarumal benefits from the direct collaboration of two resident CATIE technicians as a part of the IDIAP/CATIE farming systems project.

A new research project was initiated this year in the Sur de Soná area to generate improved technology for the small, subsistence farmers that use the cut-slash-burn system on steeply sloping land. The collection of information from farmers, planning of trials, location of sites and installation of experiments, was made with the collaboration of the crop production specialists of the Sur de Veraguas Integrated Rural Development Project. Trials have been established with six farmers to study two rice varieties, two fertilizer treatments and two plant densities. The Rutgers/Cornell soils specialist participates directly in this project.

The tentative improved technological package for rice consists of: (1) the short-season variety, Costa Rica 5272; (2) a fertilizer recommendation that varies according to soil analysis. It includes the application of a complete fertilizer at planting plus a topdressing with urea. The recommended rate is usually less than what farmers are currently using. The application of lime is recommended for an occasional soil that contains more than one milliequivalent of exchangeable aluminum per 100 gms; (3) the aplication of two herbicides 8-12 days after planting plus a second application of one of them at 30 days, instead of a single application of one of the herbicides at 20 days (the farmers practice); and (4) control of a chinch bug at the beginning of flowering. Present information on maize production indicates that the open-pollinated variety, Across 7728, should be grown with a plant density of 50,000 per hectare. Preliminary results with zero tillage plus gramoxone have not been encouraging.

Field trials with food grains in the Guarumal area have been conducted largely with asendados. On reaching an agreement with the asentamiento leadership to establish a field trial, one asendado is named to work closely with the research team. It is expected that he will inform the other members of the asentamiento of research findings and the benefits to be expected from the improved technology. It is too soon to know how effective this transfer mechanism may be. There is minimal collaboration so far with the area crop specialists of the Sur de Veraguas Integrated Rural Development Project.

As was mentioned in describing the research program in Progreso, most food grain production in the Guarumal area is carried out on level to slightly rolling land where modern technology is currently being used: mechanization, improved varieties, chemical control of weeds and insects. Grain yields are moderately high, perhaps 4 ton/ha or more in the case of rice. The proposed modifications in production technology represent refinements of present practices rather than the introduction of something new. It is expected that increases in yield from the use of improved practices will be small, perhaps in the order of 0.5 - 1.0 ton/ha., with little or no increase in production costs.

f) Los Santos

The experiment station at Los Santos is one of the old research centers in Panama, predating by many years the organization of IDIAP. First priority of the research program over the years has been the development of technology suitable for industrial tomato production. A second priority for many years has been the generation of technology that will permit year-round production of onions; the main problem continues to be disease resistance during the first planting. Other areas of research include the development of: (1) pepper varieties tolerant to high tempertures and high humidity which will permit year-round production, (2) a more suitable pumpkin variety, and (3) sorghum varieties tolerant to anthracnose and stem rot.

Research on tomatoes, onions, pumpkins, pepper, sorghum, maize and rice is currently being carried out at the IDIAP station at Los Santos, two leased experimental fields, six and 21 km away from Los Santos, and on farmers' fields. The research team consists of five agronomic engineers, three with masters degrees, and one agronomist. The IDIAP regional plant pathologist also resides in the Los Santos area. Technical support is provided by other IDIAP regional technicians, particularly in soils. Greater CIMMYT collaboration can be expected in the future with the installation of storage facilities for maize seed and a small research program on high quality maize varieties.

A recent addition to the research effort in Los Santos is the IDIAP/CATIE project to develop and evaluate farming systems prototypes. The local team consists of three technicians and the project receives technical backstopping from non-resident CATIE staff. Current research is being carried out with 12 farmers and consists in the study of priority production components in six cropping systems.

Improved varieties have been developed for tomatoes, pepper and pumpkin. Other production practices and as fertilization, weed control, insect control have received less attention, and present recommendations draw heavily on the experience of local farmers and information from research in other parts of the country.

Tomatoes are grown under contract with a local processing plant. They are transplanted from November through the middle of January in accordance with a schedule specified in the contract. Approximately 700 farmers are involved in the production of tomatoes with an average of about 2.5ha per farmer. Most of these producers are currently using the new tomato variety developed at Los Santos. According to local technicians, this has enabled farmers to almost double their average yields.

The improved varieties of pepper and pumpkin have just recently been developed. There has been little or no adoption so far and the area that potentially may benefit from these new varieties is small.

The transfer of information on improved tomato varieties has occurred mainly through direct contact between researcher and farmer during the conduction of field trials on farmers' fields and the experimental stations. The MIDA extension people have not been significantly involved in the process.

It is well to point out that, although most of the farmers in the Los Santos area are small in terms of cultivated area, all of them are commercial producers. Most of them have access to irrigation, produce two crops a year, and frequently enjoy a moderate income level.

g) Rio Hato

The research station comprises a 35ha tract, belonging to the University of Panama, and a 15ha addition recently acquired by IDIAP. The research program at the station consists of work with rice, sorghum, maize, tropical fruits and yuca. No experiments are being conducted on farmers' fields.

Most research on rice is conducted during the rainy season. Studies presently underway include a yield test of advanced lines and a fertilizer trial with irrigated rice.

Most maize and sorghum trials are planted in September. Research consists mainly of: (1) selecting promising plants from segregating populations and (2) varietal evaluation for different purposes. In the case of sorghum, for example, the primary concern is to develop a high-yielding variety for mechanized plantings that is tolerant to anthracnose.

Work with tropical fruits includes the maintenance of a germplasm bank and varietal improvement of papaya. Research with yuca consists of varietal trials and the multiplication of introduced varieties.

h) Los Llanos de Coclé, Penonomé

A 42ha tract of land was acquired by IDIAP in 1980. About 1.5ha are used for research, the remainder for seed multiplication. Research presently underway with rice includes studies of the chemical control of nematodes, biological control of nematodes and the use of herbicides.

i) Divisa Soils Laboratory

The soil testing laboratory analyzes about 5,000 samples per year. About 30% of the samples come from the farms of small producers. The samples are channeled through MIDA extension. Most of them are taken in compliance with a requisite of the agricultural credit bank for loan approval. Routine analyses include soil reaction, color, texture, organic matter, available phosphorus, potassium, calcium and magnesium, exchangeable aluminum, and available levels of certain minor elements. Farmers are charged $5 per sample. Average time from the reception of a sample to the mailing of the recommendation is about one week.

Functioning of the Laboratory is handicapped at present by structural defects in the old building in which it is housed and some equipment which needs to be replaced. Present plans are to close down the laboratory for a few months while necessary repairs are being made. The laboratory is operated by a chemist and four assistants. Farmer recommendations are made by a soils specialist.

2. Useful Information Generated

As pointed out in the above description of project activities, improved production technology has been generated for the maize-common bean cropping system in Caisan, the potato-potato system in Cerro Punta and for tomato production in Los Santos. New information has been produced about the nature and importance of the golden nematode problem in Cerro Punta, the value of liming soils with high contents of exchangeable aluminum, and the response of food grains to modifications in several production practices in the Progreso and Guarumal areas. In the latter two areas, tentative adjustments in technology for the rice-sorghum and rice-maize cropping systems are being validated on 0.5ha plantings with selected farmers. New varieties of pepper and pumpkin have been developed and are beginning to be used by farmers in the Los Santos area.

Perhaps, it is worth repeating that the commercial houses that market agricultural inputs have been instrumental in providing information to farmers on modern technology. The role of IDIAP is to refine current practices so as to achieve greater productivity and profitability in the farming enterprise.

In addition to the more visible advances in the generation of appropriate technology, IDIAP technicians have progressed in other plant breeding research. Plant selection in Caisan to lower the height of the ear of the local maize variety has reduced plant height by about 0.5m. Screening of sorghum varieties for resistance to anthracnose and stem rot and onion varieties for adaptation to plantings during the rainy season have provided useful information but no solutions. Varietal trials have demonstrated the advantages of the open-pollinated maize variety, Across 7728, and the rice varieties, Costa Rica 5272 and IR-25, in certain areas of the country.

Finally, some progress has been made in understanding and refining the research methodology that was proposed in the IDIAP/USAID project paper for the eight priority areas. This has occurred mainly in Caisan, Progreso and Guarumal where CATIE and CIMMYT participation has been most extensive.

3. Dissemination and Utilization by Small Farmers.

One of the best examples of farmer utilization of improved technology generated by IDIAP is in the Caisan area. Apparently, the use of zero tillage plus gramoxone with the maize-beans cropping system has been extended to approximately 80% of the plantings. Other production practices recommended for the system have been adopted to a lesser degree.

A similar situation is found in the Los Santos area. Most of the 700 farmers producing about 1,700ha of industrial tomatoes are using the improved variety developed by IDIAP.

The extent of adoption of IDIAP technology in other priority areas is not too clear. Apparently many of the farmers who have cooperated in the field trials particularly those conducted with food grains (some 60 cooperators in Progreso), have begun to use the improved practices.

Dissemination of information about the modified practices has occurred largely through farmer-IDIAP technician contacts. In great part, this has been the interaction between researcher and cooperating farmer during the course of carrying out the field trials. Also, field days have been conducted occasionally at validation plots, with cooperating farmer and technicians explaining to visitors the improved practices and expected benefits. MIDA extension personnel have not been involved in the transfer process.

4. Overall Observations and Conclusions

Based on information gathered while visiting the priority areas in the Central and Western Regions, a few general observations can be made and conclusions drawn:

a. Crop research is being conducted both on experiment stations and farmers' fields; clearly, the major effort is being made on farmers' fields. The relationship farmer:technician is excellent, particularly in Caisan and Progreso. Some experiments on farmers' fields are continued for two or more seasons at the same site; most are located at different sites each year.

b. Improved technology is being transferred to farmers in several areas: Caisan, Cerro Punta, Los Santos. Research in these areas was begun prior to 1979. In other areas where research was initiated later-Progreso, Sur de Soná-tentative recommendations for food grains have been developed.

c. Adoption of improved technology part or all of the recommended package is high (80%) with the maize-bean cropping system in Caisan, potatoes in Cerro Punta, and tomatoes in Los Santos. Compared to farmers' technology, the recommended practices represent little or no increase in production costs. In Caisan, the improved technology results in savings for farmers.

d. Current yields of food grains in mechanized agriculture Progreso, Sur de Soná, Alanje are good, with most farmers using modern technology. Improved technology produced by IDIAP represents refinements in practices and is expected to result in small to moderate increases in yield with little or no increase in cost. Yields of food grains in non-mechanized plantings are much lower, except in Caisan, and the use of modern technology is very limited.

e) IDIAP collaboration with external agencies (CATIE, CIMMYT, CIAT,CIP, IDRC) is good. CATIE resident staff in Panama are fully integrated into the local research teams; personal relationships are excellent. The same seems to be true for Rutgers/Cornell personnel.

f) The IDIAP/MIDA linkage for facilitating the transfer of technology has not been established. There is limited interaction, particularly in Santiago, among staff of the two institutions through personal contacts and seminars. There seem to be no linkages at the farmer level.

g) The proposed research-cum-transfer methodology is being implemented most effectively where local programs are supported by CATIE and CIMMYT staff. There is general acceptance of the importance of planning research on the basis of information collected from farmers. A variety of ways are being used to collect such information, probably with some duplication of effort.

h) IDIAP and supporting staff are well-motivated, enthusiastic about their work and eager to show it to visitors. IDIAP staff is taking full advantage of the support it is receiving from external agencies. The enthusiasm of IDIAP staff and its capacity to use external assistance is due, in part, to the institutional backing which it receives: mobility, competitive salaries, travel expenses, short courses and advanced degree training, regional seminars, technical backstopping, etc.

i) Multidisciplinary team support to the area research teams has been minor so far. This is due to the large number of IDIAP personnel that is presently in training outside the country, and the lack of experience of newly-assigned staff. In Caisan, for example, greater use of appropriate mechanization can greatly increase the area in maize and beans, but adequate assistance in adapting farm machinery has not been forthcoming.

5. Recommendations

Based on field visits to IDIAP research programs in several provinces, conversations with staff and support personnel, and the review of research reports, a few recommendations are made with respect to possible adjustments in IDIAP crops research.

a. In the areas like Progreso and Guarumal, where tentative recommendations for the production of food grains have been generated, field trials should be continued at about the present itensity for one to three years until the validation plots demonstrate the economic superiority of the modified technology.

b. In areas like Caisan, where the improved technology has been proven to be suitable, move all or a part of the research resources to a second location in the same priority area where technological needs are expected to be similar, but where very site specific components like fertilizer use need local verification. Research on components like varietal improvement that require several years of selection may be continued in one or both areas.

c. The above recommendations derive from the concept that research on farmers' fields to adjust production technology to the needs of local producers should be a dynamic process. Research data should be analyzed and interpreted immediately following harvest, and the results used in planning the experiments for the next season. As soon as verification plots confirm that the modified practices are suitable, research resources should be shifted to new areas where questions about technology need to be answered. It is expected that the major returns from field trials on fertilizer use, insect control and weed control will be obtained in a period of three to five years. A longer period will be needed for some aspects of plant selection like the reduction of ear height in the local maize variety in Caisan.

d. Much of the technology on food grain production, developed at Progreso and Guarumal, should be appropriate for the farmers in Alanje and for other mechanized plantings on level to gently rooling lands in Chiriqui and Veraguas. Full use should be made of information generated in Progreso and Guarumal for planning and implementing field trials in Alanje and similar areas. In this way it should be possible to keep to a minimum the field studies needed in the latter areas.

e. Up to now, little research has been carried out to develop improved technology for small, subsistence farmers (work was initiated this year with six such farmers in Sur de Sona). Small farmers in Caisan, Cerro Punta and Los Santos, as well as the asendados in Guarumal, are largely market oriented in many of them have moderate levels of farm income. As many subsistence farmers use cropping systems that include rotation with native vegetation followed by the cut-slash-burn process, it is not clear to what extent research findings derived from trials on mechanized plantings are applicable. If small, subsistence farmers constitute a part of the target population of IDIAP research, it will be necessary in the future to shift more resources to a study of their needs.

f. The greatest apparent deficiency at present in the research-cum-technology transfer process is the almost total absence of a linkage between IDIAP area research teams and MIDA extension agents at the farm level. Conversation with IDIAP researchers revealed a general reluctance to search out their MIDA counterparts and take the initiative in establishing a working relationship. In the project paper, it is proposed that such a linkage be implemented at the validation stage of the research-transfer process. Preferably, the linkage should be established earlier so that MIDA personnel have the opportunity to participate directly with IDIAP researchers in planning, implementation and evaluation. This is unlikely to occur until there is a greater commitment at all levels in both organizations to seek an effective linkage.

g. Up to now, little use has been made of the field day for farmers as a means of disseminate improved production technology. Area research teams are currently establishing many validation plots, frequently together with component experiments. These should be used more fully for informing neighboring farmers of the studies being carried out and the research findings. IDIAP technicians and MIDA personnel should collaborate in holding the field days.

h. Fertilizer recommendations, made by the soil specialist of the Central Region and based on soil analysis, are used widely (about 5,000 per year) for crop production. As new information on fertilizer use is being generated each season in the area programs, it is important to formalize a procedure whereby these new findings become immediately available to the soil specialist that writes the recommendations.

i. In carrying out experiments on farmers' fields, greater attention should be given to monitoring the trials during the growing season. Observations should be made regularly, every week to 10 days, on vegetative response to treatments and plant damage due to weeds, pests, diseases, drought, excess moisture, etc. The registering of field observations should be made by the researcher who will be interpreting the experimental data and planning follow up trials. Although the regular collection of information on plant behavior during the growing season is being done by some investigators, this critical phase in the research process can be greatly improved in most areas.

B. Progress and extent of usefulness in livestock production

1. Observations on Individual Sites

In the following sub-sections a brief description of the types of activities observed at each site is presented. Not all field trials or experiments were looked at in each location, and only a sample is discussed here. The consistency, however, of the main features of the livestock program that emerge from these visits permits drawing some general observations and conclusions that are significant for the purposes of this evaluation.

(a) Gualaca

This experimental station is the oldest one in the country, having been originally setup under the Point IV Program (STICA) in the 1950's. During the 1960's an FAO program on pastures was located at this station. In a sense, Gualaca represents the birthplace of IDIAP, and is currently at the core of its livestock program. The farm covers 540 hectares, on which approximately 700 head of cattle are kept.

In general, the offices, laboratories and other farm buildings and facilities leave something to be desired for an efficient research operation; some parts, however, like the milking parlor seem to be quite adequate.

Research conducted at this station includes a few carefully designed and controlled fertilizer and grazing experiments; many trials on forages and livestock management which are not amenable to statistical testing; laboratory analyses; livestock breeding and improvement; and general upgrading of the grazing fields of the farm through introduction of better species. At the time of visit, land preparation was underway to establish a new systematic program for introduction and evaluation of forages.

All of the work in pastures, nutrition, breeding and livestock management is directed at primarily at dual-purpose cattle, but it also includes research on dairy and beef cattle. The main research project on dairy nutrition and management will be described in some detail since it illustrates some of the areas in which we feel IDIAP can improve its research methodology and approach. This project, since 1980, aims at: (1)establishing a "module", or management package for dairy production in the region, based on previous findings; (2) demonstrating this package to farmers; and (3) obtaining better yields of milk per unit land area.

The project involves 24 cows, one bull and their offspring grazing on 10 hectares of land. The breed is half blood Cebu and Holstein. The land is seeded to Brachiaria decumbens (8.5 hectares for grazing), king grass (1.0 hectare, for silage and soiling), and Digitaria swazilandensis (0.5 hectare for grazing by calves). Each of these grasses is fertilized with specific rates of N-P-K. The fields are divided in 12 paddocks; milking and dry cows graze in separate groups, each following a different rotational pattern of grazing-resting of paddocks. Feeding of cows is supplemented with molasses and urea "(melurea"), fishmeal and mineral salts.

A continous breeding system is followed by natural insemination (which involves periodically changing the bull, to maintain the 1/2 breed). All the standard health protection measures are applied. Milking is done by machine, twice daily. Calves are culled soon after birth and raised with milk substitutes, concentrates and grazing.

Records are kept of milk production, which show an average for the last two years of 6.9 lts/cow/day, for 222 milking days per year. That is, 1,532 lts/cow/year or 3,300 lts/hectare/year. This compares with the typical farmer production of 450-500 lts/cow/year.

The economic analysis of this package shows, however, that cash costs per liter are 22cents, and total costs per liter are 59cents. The sale price of milk is 29cents/lt.

The ongoing results under this "module" or technological package are to be compared with a previous experiment (1975-1980), in which the breed used was 3/4 holstein x 1/4 cebu, grazing on Brachiaria tanner and estrella africana (Cynodon spp.). Also, they are to be compared with "current practices" by farmers.

This project is conducted almost entirely as a demonstration of a complete technological package, but it misses the opportunity to collect further comparative data and to document the experience.

New knowledge that might arise from carrying out this project cannot be tested, or otherwise be scientifically supported so as to provide a solid basis for introducing changes in the variables composing the package. Furthermore, as a package (rather capital intensive and managerially complex) it appears to be economically unsound and hence not useful for farmer demonstration purposes. The same conceptual "research" problem is recurrent in much of the work being done on pastures and livestock by IDIAP. This is further discussed later on.

Another project observed was devoted to the study of different pasture associations, fertilization and grazing patterns. This is set up in a more rigorous, controlled fashion. It involves comparisons of faragua, vs faragua with 60Kg/Ha of N, vs a faragua/kudzu association. Three homogeneous lots of calves are used to graze rotationally each kind of pasture, divided in seven paddocks each. Measurements are taken monthly on weight gains and dry matter production. If properly conducted, this experiment can yield sound information on which to base alternative management recommendations.

A similar experiment looked at was concerned with studying alternatives for raising calves by grazing on Brachiaria decumbens, supplemented with melurea and salts. Homogeneous lots of calves are assigned to four 1-hectare paddocks and weight gain is controlled each month. Results are compared to other experiments conducted on different grasses.

The foregoing two types of experiments tend to require more time and resources to reach results, and sometimes may drag on at the experiment station. These risks, however, should not be overplayed to the extent of eliminating alltogether the more controlled experiments from IDIAP's research program. Such experiments (perhaps of a smaller size, with partial coverage, or for shorter terms) are essential to complement and backup the other forms of "research", or empirical trials on farmer fields being conducted by IDIAP.

The chemistry laboratory appears to be providing adequate support to the research staff and its head chemist is himself conducting some nutritional research. Analyses are made of animal tissues, grasses, silage, feeds, etc. Two specific research projects underway concerned measuring the digestibility rate of different forages, and cattle response to feeding of mineral salts including minor elements.

Two pieces of equipment provided under the AID loan, a chromatograph and an aminoacid analyzer, had recently been received and were being used.

This lab has accumulated a great deal of data on the chemical composition of different grass and legume species, since materials from field experiments are usually submitted to chemical analysis. However, these data have not been assembled or organized in a sort of "bank" for ready reference and retrieval; they remain in each project file and are thus practically of no use beyond their original objective. It would appear rather useful to collect and order these data for further reference, which can probably be done efficiently through the use of a computer.

Future research at Gualaca should be positively influenced by the collaborative work being initiated with Rutgers University under the AID grant, and with technical backstopping from CIAT. Plans under this collaboration call for (1) a systematic program for the introduction, evaluation and screening of forage germplasm with good potential under the various agroclimatic conditions of Panama; (2) development of seed production technology for selected promising species; (3) evaluation of methods for introducing legumes in established faragua pastures; (4) weed control methods in pastures with native legumes; and (5) agronomic and animal production evaluations for different forage species. While some of these activities have been present at Gualaca, they do not appear, to far, to form a well structured program, with clear objectives and research methodologies. The Rutgers University research support can be extremely important for improving these aspects of IDIAP's livestock research.

(b) Finca Chiriquí

This 250 hectare farm, adjoining the grounds of the Faculty of Agriculture of the Unversity of Panama, has been under IDIAP management for three years. It is in an area of very poor acid soils, and with high aluminum content. The IDIAP activity has centered on upgrading the farm, essentially by seeding 100 hectares to Brachiaria decumbens and Brachiaria humidicola and subdividing the area into several fields. These grasses were fertilized with 184 kg/Ha of 10-30-10 mix at seeding time, but no liming is used (reportedly because of the high cost of lime). Additional ammonium nitrate is applied twice yearly, for grass maintenance. Present fertilizer rates are much lower than previously recommended by IDIAP; this because they are trying to operate with low-cost technology.

Two of the grassed areas are being devoted to seed production, since lack of seed material is one fo the severest obstacles to increased use of these new grasses in Panama.

Approximately, 70 head of cattle are grazed on this farm, with melurea and mineral salts supplementation. This herd is a mixture of half-breeds Romosinuano x Cebu and South Devon x Cebu, which are dual-purpose animals. Earlier comparisons showed the SD x Cebu cross to be superior; hence the ongoing selection stresses the retention of these cattle. IDIAP researchers are also presently crossing them with a pure Ghir bull, which is a red. The purpose is to maintain the meat quality and good reddish color, and upgrade the milking potential (to 3.5 liters/day/cow). Subsequently, this crossbreed will be recommended to farmers.

So far no research is being conducted, in part because the farm lacks infrastructure (corrals, scale, etc.) In the future, data will be gathered on stocking rates, grazing capacity in the dry season, weight gains, milk production, etc. However, from the general description of these plans, it would appear that no clear-cut objectives and research layout have been established yet.

(c) Bugaba

Livestock production systems research on farmers' fields in the Western region is only being conducted in the Bugaba area, around Gariché. Currently, there seems to be collaborative work with only six small/medium farmers. This activity has been operated since 1979 under an agreement with CATIE, with financial support from BID & ROCAP. The IDIAP active participation has been facilitated by the AID loan. The drive, enthusiasm and good working relationships among project staff and farmers are highly commendable.

Two of the field projects were visited. These are the two "fincas de validación", in the terminology of the CATIE/IDIAP/BID project. (See their Informe Final, June, 1983). They aim at introducing and trying out certain agronomic and management techniques at the farm level, so as to increase production and farm income. Livestock in this area is of the dual-purpose type (Cebu crosses with Brown Swiss and Holstein, mainly); because of meat/milk price ratios, greater emphasis is being placed on milk production.

The essence of the improved technological package being tried on these farms includes: (1) Utilization of new grass and/or legume species on small areas of the farms, fertilization of these with low rates of nitrogen, and subdivision into paddocks to permit rotational grazing. Use of mineral salt is the only supplemental feeding done. (2) Change in handling of suckling calves, so that they graze while away from the cow, instead of being fully confined without feed. (3) Use of elementary sanitary practices for parasite and disease control, both in cows and calves.

The specific technological package differs between farms, according to the preferences and particular circumstances of each producer. Thus, in one case the grasses being used are Guinea, D. swazilandensis and Digitaria decumbens; while in the other the improved pasture includes a Kudzu/D. swazilandensis association. Also, weed control with herbicides is being utilized. The stocking rate and intensity of grazing are being varied according to the observed results on the pasture and on production. The project staff and the farmers keep fairly detailed records on milk and beef production, and on costs of operation.

As in other situations observed in Panama, it is clear that this project is really a case in technology transfer. To the extent that "control farms" not receiving IDIAP assistance are included in the project, one may say that there is also a research aspect, by comparing the "whole technological packages" versus the traditional technology. However, it is obvious that a many variables (agronomic, economic, human, extension inputs, etc.) are all confounded. Thus, this kind of research appears to be of limited value with regard to learning about specific agronomic, or livestock management factors affecting production in the area. Probably, with a larger number of farms in the project and with more complete and carefully designed data collection systems (as discussed in a later section) much more valuable information could be gained from this "on farm research". On the other hand, it is apparent that diffusion of the improved technology is taking place in the Bugaba area, as other farmers observe what is taking place in the "validation farms" and they reproduce parts of this technology on their own lands.

(d) Calabacito

The experimental farm at Calabacito is an area of very poor, acid soils high in Al content, in the Central Region . The farm is 537 hectares, mostly in native pasture and faragua grass. It appears to have been in a very run-down state when transferred to IDIAP a few years ago. The major emphasis of IDIAP's work has been in upgrading the farm and livestock herd, while simultaneously trying out the introduction of new grasses and other agronomic practices.

At present there are 60 hectares in fields with improved grasses: Andropogon gayanus, Brachiaria humidicola and Brachiaria decumbens. A few small parcels are seeded to Pangola, King grass, and D. swazilandensis. These grasses have been established with fertilizer applications. Calabacito has the only trial of liming done by IDIAP, on Kudzu/elephant grass association. The need to reduce weed infestation (chumico and matillo) has led to trying out alternative herbicides in open fields.

The cattle herd of 250 head is mainly a cross of Cebu x Brown Swiss. The present selection and breeding work is directed at raising the milk potential, for which crosses are being made with pure-bred and 3/4 blood Brown Swiss bulls.

The Andropogon and Brachiaria pastures are being grazed with selected groups of cattle, with the intention of comparing of the nutrition provided by these grasses. However, an appropriate experimental design--or at least inclusion of a rest group-is necessary before any meaninful observations can be made from such trial.

On the whole, the Calabacito farm appears to be at the initial stages of build-up of an experimental station Basic construction and equipment facilities need improvement, and the research program needs to be developed and managed more rigorously, with well-defined objectives and systematic data gathering and analysis procedures.

(e) Sur de Soná

IDIAP's livestock research in this area is all conducted on farmers' fields. Most trials concern the introduction of improved forage species, with associated grazing management practices. A few fertilizer experiments are also being conducted. The area is primarily for beef cattle production, although milking is of some importance too.

Eight farm locations where IDIAP has ongoing work were visited. These include medium-size livestock farms, and some "asentamientos".

IDIAP's research strategy in Soná is similar to that in other areas. Parts of farmers' fields are seeded to grasses such as Brachiaria humidicola, Digitaria swazilandensis, Brachiaria radicans (which is known as Tanner and is the most prevalent introduced grass in Soná) and Andropogon. These grasses are established with variable fertilizer applications and using different land preparation/seeding techniques, depending on local and farmer conditions. Rotational, or deferred grazing are followed in accordance with observed response to the intensity of grazing on different species.

On farms that milk cows, management of calves is being modified to allow these a longer suckling period, with grazing on small paddocks the rest of the day. Associated sanitary practices and salt supplementation are also applied. The objectives are to increase milk production and the production of meat from calves.

In all cases, the particular set of recommended practices is adjusted jointly by IDIAP staff and the farmer, depending on current "observed" results and the latter's preferences. It is to be stressed that, in general, few qualitative and quantitative data are systematically collected and recorded from these field trials.

Other fertilizer experiments of a complete factorial design are being conducted on farmers' fields, too. Two of these are to test different rates of N-P-K on Brachiaria humidicola and swazilandensis; another one is to test phosphorus, sulphur and molybdenum on legume pastures. From discussion with the researcher, it appears that the statistical designs, data collection and analysis of these trials need revision and improvements in order to obtain the most from these experiments.

Finally, in two locations limited grass introduction gardens have been established with the same species mentioned above, with the added objective of producing seed material.

In general, the kind of field work being done in Soná, as well as the orientation of the very dedicated IDIAP staff, suggest again that the emphasis is on technology transfer and assistance to small and medium farmers, rather than on research proper. Research, hopefully, will be a by-product that emerges from a loose trial and error process.

(f) Los Santos

This is a mixed farming area in which dairy and dual purpose cattle are important. IDIAP has a small central facility, with an adjoining field in which grasses for seed production are being established. The research activity follows the same pattern as in Soná, all trials being conducted on farmers' fields. However, fewer such trials are ongoing in this area.

Most projects are concerned with the introduction of various grass species. Two more interesting experiments were for testing N-P applications on Brachiaria humidicola, and P-S-Mb on a Faragua prairie containing native legumes. The first experiment generally showed bad adaptation of B.H. to drought conditions; but good response was found to low applications of N, and to P in interaction with N. The second experiment was not in very good shape. Both cases reinforce the observation that much information is being lost from these trials because of inadequate attention by the farmers and incomplete data gathering by the researchers. For instance in the P-S-Mb trial no analysis has been made of plant density/composition by plots after the initial measurement; only one cutting was weighed, with no follow through afterwards. Yet, some mild differences among plots were observable.

These shortcomings seem to be due not to neglect by the researchers, but simply to lack of experience and good research advice at the planning and execution stages of the field trials. It is not surprising that the IDIAP staff emphasize and excel at the on-farm technology package trials, because this kind of "research" is a very empirical exercise, not demanding in formal research training.

The visits at Los Santos included one to the farm of a large-scale dairy producer, which pointed to the fact that this type of producer seems to be technologically ahead of IDIAP. Also visited was an on-farm research project conducted by the Faculty of Agronomy, University of Panama. This included trials with a leguminous tree, lecaena, which seems a promising forage resource for the dry period. Aside from knowing what each other is doing, however, there is little research collaboration between IDIAP and the University.

2. Useful Information Generated

IDIAP's livestock program, in accordance with strategy laid out in the AID loan project, has been characterized by a near-total emphasis on assembling technological packages from pieces of information coming from many different sources. These include past research by IDIAP and other Panamanian institutions; current practices by the larger commercial farmers, technically supported by industries such as Nestlé, by banks, and by other government agencies; seed materials and test results from CIAT, CATIE and other foreign institutions; and the recommended practices by the chemical and pharmaceutical supply companies.

Thus, IDIAP's "research" role in livestock so far has been limited mostly to developing relatively simple combinations of the many possible factors forming a "technological package, such that these could be loosely adopted by local farmers, without drastically modifying the farmers' traditional technology. A minute part of IDIAP's livestock work has been science-based research, conducted at the experiment station, laboratory, or farmers' fields.

The on-farm production systems method of "research" requires, on the one hand, imaginative thinking and considerable knowledge and experience on the part of the research staff, so that the most relevant technological factors for each farming area are appropriately selected and organized for trial with farmers. On the other hand, it requires of the staff a very solid grounding in research concepts and methods, in order to be able to obtain new knowledge from these farm trials that has logical explanation, and that has some general validity beyond the particular farmer's field. These two conditions have imposed a heavy demand on a young institution like IDIAP, which ought to rely more on outside professional expertise at the early stages of its on-farm livestock research program.

Notwithstanding the difficulties and limitations of the program, there are several elements of technology that are being tried out by IDIAP at the farm level, which can eventually yield useful new knowledge and lead to sound recommendations to farmers. These technology components, or factors, have to be assessed in relation to the specific productivity targets IDIAP is aiming at, which are the following (restricted to cattle): (1) increase milk production per cow and per hectare, by increasing the daily milk output and lengthening the lactating period; (2) improve the calving rate; (3) reduce the mortality of calves; (4) improve the rate of weight gain by calves and steers; (5) permit the small cattleman to carry his calves to heavier weights before sending to market; and (6) generally improve the quality of herds and the "extraction" rate. Of course, different objectives take priority according to the type of livestock production in an area of the country.

The technological factors that IDIAP is manipulating in its on-farm trials, can be divided in two broad groups: those concerning pasture improvement, and those related to livestock management (nutrition, breeding and health).

(a) Pasture improvement

(1) Introduction of new grasses and legumes, identification of potentially superior native legumes, and testing of mixed-pastures.

Considerable work has been done by IDIAP on these aspects of range improvement and much has been learned about the adaptability of various species to Panama conditions. However, there does not seem to be firm, conclusive evidence on what forage species, where, how, when, etc should be used by farmers. Often contradictory opinions about a specific grass, for instance, were expressed by the researchers, the agronomic staff, and the collaborating farmers. Since there are no solid data and analyses to test performance, not much progress can be made beyond personal opinions. On the other hand, there are situations of rather widespread agreement (e.g., on the good adaptability, superior grazping quality of swaziland grass for calves), which give confidence that progress is being made.

(2) Grass seeding techniques

IDIAP has been trying several different ways of establishing grasses, varying according to species, location, farmer conditions, etc. Techniques include full land preparation with tractor and equipment, partial land preparation, use of herbicides prior to seeding, seeding with a stick ("chuzo"), tramping with cattle on mud ("jangueo"), using seed vs. vegetative materials, etc. Results are variable, since other factors are not kept at constantrates of fertilization, moisture, quality of seed material, etc. However, IDIAP staff feel that they can make fair recommendations for typical small farmer conditions.

(3) Determination of fertilizer nutrients, rates and forms of application.

Some IDIAP research results are widely accepted and recommended. For instance, that low N rates should be applied on faragua grass; that N-P-K mixtures with high phosphorus content are required for grass seedings; that K is not required in certain areas; etc. Thus, broad ball-park estimates of fertilizer needs are available; but much remains to be done to refine recommendations. On other nutrients, there is widespread opinion that many soils show deficiencies, but few firm, concrete results can be shown. Within the broad limits established by the fertilizer experiments, IDIAP is seeking to find the lowest acceptable rates of application, compatible with good forage production and maintenance. A notable omission is in the study of liming which should receive greater attention given the predominance of acid, Al-toxic soils in Panama.

(4) Rotational grazing and stocking rates.

Several trials, at the experiment station and on farms, have been run on the problem of determining optimum stocking rates and rest periods for different grasses and grass/legume associations. These studies have led to firm recommendations about the use of rotational grazing, with rest periods varying between 21-42 days depending on species, location, intensity of grazing, etc. One of the key variables of the farm production systems implemented, in fact, is the formation of several small fields ("mangas") in the newly seeded grass lots, to permit rapid rotation of grazing.

(5) Grass harvesting and/or grass reserves for the dry season.

The practices of ensiling, making hay ("paja"), or green chopping different grasses and legumes from deferred pastures are known and accepted practices in Panama. IDIAP has been concerned with determining which of these, and to what minimum extent, may be suitable for small farmers to do.

Many of the on-farm trials include one or more of these practices; the question is whether the observed results will permit drawing firm conclusions, since obviously the variability in results will be large.

(6) Weed control on pastures.

The rapid invasion of grasslands by weeds is a major problem in the tropics. The typical forms of control are by fire and machete. IDIAP researchers have been trying different herbicides, which combined with good grazing management and the traditional methods provide a wide range of workable alternatives. Few quantitative studies, however, have been made that could provide firm and objective recommendations on this topic.

(7) Insect control on pastures.

Little has been done on this subject, despite the fact that at least one pest ("salivers") causes considerable damage on some important grass species. Some observations are available, however, that suggest possible control measures. Intense grazing over a short key period of time seems a better alternative for small farmers, than use of spraying.

(b) Livestock Management

(1) Improvement of nutrition

IDIAP has devoted primary attention to this factor, witness the work going into pastures, which form the basis of cattle feeding. Thus, grazing better forage species in efficient ways becomes the key to the livestock management technology. In addition to the improvement of pastures, as such, this implies adopting practices like the following: rotational grazing; grazing by calves and milking cows in separate lots; keeping forage reserves for the drought periods; balancing the diet with mixed forages and/or various supplements, the principal of which is melurea; pre-feeding of salt and minerals mixes; occasional use of vitamins. In relation to calves: allow longer nursing hours; keep on good pasture while not with the cow; graze rotationally on small paddocks with good forage; supplement as other cattle in herd. IDIAP has developed rather firm ideas about these various practices and is implementing them at the farm level. Good current results suggests that a sound technological package is available in nutrition.

(2) Herd improvement through breeding and selection

IDIAP has reached the firm conclusion that the dual-purpose cattle should best be formed by 1/2 blood Cebu x European breeds, mainly Holstein and Brown Swiss. Increases in the European blood result in weaker, less productive cattle under most conditions in Panama. Exploratory research is underway or planned, to increase the milking potential through cross breeding with Cebu races such as Ghir and Sahiwal.

(3) Sanitary control

Although IDIAP has done little research on this, its technological packages for small farmers include the full range of health practices: spraying for external parasites, medication for internal parasites, vaccinations, disinfection of the navel of calves, clean water supply, etc.

(4) Farm buildings and equipment.

Within the concept of developing low-cost technologies for small farmers, there are a minimum of facilities that are required for better livestock management. These include simple sheds, corrals, water tanks, feedings bunks, etc. In these respects, IDIAP staff adopt known devices and techniques and incorporate then into the on-farm trials being conducted. Some practical knowledge may be gained from this, for further use by farmers.

3. Dissemination and utilization by small farmers

Given the short time spent by the evaluation team in the country, it was not possible to ascertain the degree to which the current technologies assembled by IDIAP are being adopted by small farmers. However, collaborating farmers in the project areas did report of neighbours copying certain practices and taking new grass materials. Besides, to the extent that many of the componentes of IDIAP's packages have been known and used in Panama for some time (e.q., use of certain grasses and livestock races introduced by "MIDA", the BDA, Nestle, private ranchers, etc.) it is obvious that such elements will be found on small farmers fields.

It should be stressed though that, as is discussed elsewhere in this report, given the limited linkage between IDIAP and the extension personnel of MIDA, the dissemination process will likely be slower than it need be. At a minimum, the MIDA area production specialists prescribed in the project paper should be effectively incorporated into the IDIAP multidisciplinary teams.

4. Overall Observations and Conclusions

An overall appraisal of IDIAP's livestock program at this point in time includes the following strong and weak points:

(a) The program is moving ahead. There is a good sense of purpose, dynamism and enthusiasm among those concerned with the program. Enough activities are being carried out and planned at the livestock experiment stations, as well as on farmer fields to indicate that a good base has been laid for further program development. Especially commendable is the interest and willingness of the IDIAP researchers to get out into the field and work with small farmers.

(b) The rate of progress would be good for, say, a one year old program--which is about the time that most of the senior livestock program staff have been employed by IDIAP. Since the AID project was initiated in 1979/80, it appears that the livestock program was very slow in getting underway. We have not had an opportunity to investigate the reasons for this, but, to the extent that the problems have been overcome, it may be advisable to consider adding time at the end of the loan period.

(c) The orientation of the program is perhaps too heavily weighted towards technology transfer activities designed to raise the image of IDIAP in the government's and public's views. While some of this is necessary for the long term effectiveness of the institution, care must be taken not to lose sight of the primary research function of IDIAP. The present strategy appears not to be paying enough attention to a careful definition of research objectives, priorities, design execution, etc., so as to come up with solid answers required to back up the technological recommendations and on-farm trials that IDIAP is putting out.

(d) A good size staff has been put together for the livestock program. There are approximately fifty professional staff, including engineer agronomos, veterinary doctors, chemists, agronomist technicians, and a few with masters degrees. No real "multidisciplinary teams" have been formed, as called for by the project paper, but this does not appear to be a significant problem at this stage. Perhaps a good agricultural statistician/economist would be the most valuable human resource they could add in the short run.

The staff is well distributed among the three administrative regions of IDIAP, in terms of being over the critical mass point at each region; also, a balanced combination of professional backgrounds has been achieved in the central and western regions, where most field work is being done.

Although some of the senior staff have had solid administrative and business experience, they are new to research. Most of the rest of the staff are young and inexperienced in research. There are only two foreign experts on the program and they have not been here long enough to make their impact felt.

Thus, despite good size composition, and distribution of proffesional personnel, the relative newness on IDIAP's staff, the scarcity of post-graduate trained people, and the limited research experience of most of the researchers represent important obstacles for rapid development of a sound research program. This is especially so in the case of livestock research, which is generally more complex to design, control, and analyze than crops research.

(e) It should be noted that the MIDA production specialists who were supposed to be incorporated into the IDIAP area teams, have not been assigned yet. This point is important for future development of the on-farm research and technology transfer, and is further discussed elsewhere in this report.

(f) On the whole, IDIAP has fair physical facilities for conducting livestock research. It has plenty of land and cattle in its three experimental farms; in two of these there are also basic construction and equipment. Vehicles don't seen to be too scarce.

Some deficiencies exist in office space and confort and this reduces work efficiency in laboratories, and germplasm bank seed storage and internal documentation/library services. Apparently, administrative procedures too are slow and bureaucratic--including those concerning disbursement of AID loan funds--which causes some ineficiency and frustration among the field staff. Recent government curtailment of IDIAP's budget has aggravated these problems at the present time.

The livestock program so far is exclusively working with cattle (dual-purpose, beef, and dairy). There is a definite decision not to be concerned with poultry, given the large scale and up-to-date technology characteristics of this business. A little work on hogs and goats is planned under the CATIE/ROCAP/IDIAP collaborative agreement for 1983, in the context of supplementary livestock enterprises that can use non-tradional feeds produced on small farms.

The two major thrusts of the livestock program are on pasture improvement, and on livestock management improvement (nutrition, breeding, health). Research is conducted both at the experiment stations and on farmers' fields. The nature of problems studied is broadly determined by the percieved needs of small and medium farmers. However, it is our impression that these are not well developed, sound procedures for program formulation.

This is an extremely important factor, given the characteristics of the livestock program staff noted earlier. A broader and better structured process of discussion and consultation among local and foreign staff, vertically and horizontally, would be highly advisable to sharpen program objectives, scope, research methodologies, evaluation of results, and re-planning.

(h) Specifically it is our observation that the livestock research program, by overly-emphasizing a production systems orientation and on-farm trials, has practically lost most of its true research content. That is, the design, data gathering and analysis of much of the "research" being carried out, at the experiment station and on farmers' fields, does not permit the drawing of sound conclusions regarding the effects of the several agronomic and animal variables being dealt with. Little progress can be made in this fashion, except in those exceptional cases in which the gains from a new technology might be so large and consistent, as to be self-evident.

(i) In fact, it may be said that the livestock research program at the present juncture is mainly a program of technology introduction and transfer, based on known information from a variety of sources. IDIAP's approach is a pragmatic, flexible, trial-and-error scheme, which is followed both at the experiment station and on farmers' fields. While this approach does provide a useful service and gives visibility and support for IDIAP, it unfortunately misses many opportunities for advancing practical research knowledge.

Without shifting away from the present on-farm production systems approach, implementation of a conscious and systematic effort to design projects so that quantitative data can be obtained from them would result in a truly valuable research program. This would be particularly so if research work at the experiment station were designed to investigate and test--under better controlled conditions--those problems and/or variables found to be relevant at the farm level.

(j) The scope of the present on-farm activities is probably too broad, in terms of geographic coverage (travel distances) and technological variables being tried-out. Given the current staff size and composition, transport and lodging facilities, and the ability of IDIAP to backstop field work with research at the experiment station, it would seem advisable to sharpen the focus and narrow the coverage of the on-farm trials. Part of the reason to suggest this stems from the fact that, despite the breadth of program noted, really few farmers are collaborating with IDIAP in each of the selected areas. Under these conditions, it may be better to concentrate activities and strengthen the research aspects (project lay out, data gathering, analysis, etc.) while still working with limited number of farmers in each area.

5. Recommendations

The observations and comments in the foregoing sections regarding the livestock program, lead to the following recommendations:

(a) Place greater emphasis on, and strengthen the mechanism within IDIAP for planning, designing and evaluating the livestock program. There is need for more formal staff probing, exchanging of ideas and information, peer reviews of proposed projects--all leading to building up of a sound, applied research program within the current general guidelines of IDIAP.

(b) Consider making better use of the few older, experienced researchers that IDIAP has, as well as of the senior foreign staff for assisting the program directors in the program management aspects indicated in (a).

(c) Seek a more even balance in the program, in terms of efforts devoted to on-farm trials cum technological transfer, and to actual pasture and livestock research, at the station and on-farms.

(d) Make concerted efforts to incorporate MIDA production specialists into IDIAP's on-farm trials. Make sure that appropriate mechanisms are developed to pass on the bulk of the technology transfer activity to the MIDA extension staff, which will be ultimately responsible for this task in the country.

(e) With respect to the research program proper, concentration on cattle and forages appears appropriate (with the exception noted in (f) but: (1) be careful to keep breeding research to a minimum, as the pay-off from it is likely to be nil under IDIAP conditions; (2) keep the emphasis on nutrition, with special attention on testing the energy producing grasses, rather than spending much effort on native legumes; and (3) continue testing and developing better livestock management practices, of a simple nature, for easy adoption by small farmers.

(f) Given the IDIAP/AID small farmer target, consider including some work on swine research. Feeding of hogs with non-traditional feeds that might be obtained as supplementary crops on small farms should be of primary concern.

(g) At the individual research project level, pay great attention to the design and methodology for execution of trials and/or experiments. IDIAP must insure that appropriate quantitative data can be, and actually are collected from its field trials. These data must be subjected to sound statistical analysis and results published in some form. They should ultimately be used to analyze the economic soundness of results, prior to issuing firm technological recommendations.

(h) A continous, formal process of project and program evaluation should be implemented. The main purposes of this would be (1) to build in the results and/or other new information gained into the annual work plans; and (2) select those results that are ready for diffusion, and document them in a manner that will soundly support IDIAP's recommendations.

(i) Consider sharpening the focus of the livestock program, particularly with respect to reducing the range of its on-farm activities. As only a few farmers are collaborating in each area, IDIAP might as well select them so as to maximize the efficiency of its staff, vehicle and other resource use. Also, to the extent that in some areas there are no small farmers available for collaboration, reconsider the appropriateness of engaging the collaboration of medium size absentee farmers.

(j) Step up the research training of staff. The overemphasis on loose farm trials cum technology transfer is probably due largely to the weak research capability of the young IDIAP staff. Some research training can be done on the job with assistance from the senior visiting scholars; some can be done with short-term courses such as those offered by CIAT; but there is no substitute for formal training in good graduate university programs.

(k) Proceed to build, remodel, or otherwise improve those physical facilities that are presently most limiting for efficient research performance. Several administrative procedures within IDIAP, as well as in reletion to the AID loan project seem to need revision too, to improve overall research productivity.

(l) IDIAP should strenghthen its research collaboration with the Faculty of Agriculture of the University of Panama. This would serve the double purpose of producing better research findings for the country, and turning out Ingenieros Agronomos that are better trained in research and who can therefore, be better qualified as future IDIAP employees.

(m) Similarly, IDIAP could expand its contacts with the international research centers. Besides CIAT, which is presently providing some assistance, ICRISAT and IITA may have materials, programs, or results useful to Panama because of the similarity in some agroclimatic conditions.

(n) Finally, in order to implement the foregoing items, consideration should be given to providing IDIAP with additional top-level, resident adviser for the livestock program. A senior research man, with a PHD in the livestock sciences and years of experience in research execution and administration seems to be a critically missing human input in IDIAP at present.

C. Effectiveness of Inter-institutional Communication and Technical Assistance.

The agricultural research strategy being employed by IDIAP and the limited experience of much of their staff requires that they make maximum use of available technology and technical assistance. The strategy states that the research program to be adopted is basically one of applied, as contrasted to basic research. Emphasis will be given to adopting production technology that has already been generated in other parts of the world to Panama conditions rather than creating new knowledge. Researchers from IDIAP will perform trials, tests, and evaluations on farms under the same basic conditions faced by the farmers.

For such a strategy to be successful, IDIAP personnel must not only be aware of the extensive agricultural technology available from both national and international institutions, but must also have the training and experience necessary to be able to identify and use that portion of the available technology that can be adopted and is useful in improving the Panamanian farmers' productivity and income. To take advantage of the training, technology and technical assistance available, close collaboration must be established with each institution and international center. Since the personality and modus operandi of each institution is different, an organized and institutionalized approach must be made to this collaboration.

1. Collaboration between IDIAP and other National Agricultural Organizations

As previously stated in the project strategy, agricultural research will emphasize the adaptation of production technology already generated in other national organizations or in the other parts of the world to local conditions rather than creating new knowledge through a program of basic research. The field-oriented effort requires close linkages with other national institutions and organizations that are involved in research, extension, credit and training. The long-term success of the IDIAP program will depend upon their ability to develop successful linekages and close collaboration with these national institutions to prevent duplication and to take advantage of the information, technology, training and capabilities available for the development and transfer of appropriate technology to the small and medium sized farmers in Panama.

1.1 Collaboration between IDIAP/MIDA/BDA

Increased agricultural production and farmer income requires the successful transfer of appropriate technology to the farmers' field. The technology must first be generated and validated and then disseminatd to farmers for incorporation into their production system. However, technology generation and transfer is not a one-way street. Technology that is acceptable and useful for the farmer must take into consideration the farmer's resources and interest, and is generally based on a modification and improvement of the farmer's traditional production system.

A program to generate appropriate technology and to successfully transfer and incorporate it into the small and medium farmers production system is extremely difficult under ideal conditions. The development of successful or methologies in which dissemination activities flow logically from the research/validation effort becomes even more complex and difficult when the major responsibilities for the two activities are divided between two institutions, as is the situation in Panama in which IDIAP has the responsibility for research/validation and MIDA has the responsibility for dissemination. The system is further complicated when the extension/credit responsibilities of BDA are included.

For the proposed strategy to be successful, close linkages must be developed and maintained between IDIAP/MIDA/BDA at both the personnel and institutional levels. Personnel of MIDA and BDA must be involved with the research teams from the begining so that they may participate in the planning and implementation of the research validation of new crop and livestock technologies. Direct participation in the activities of the research teams from their initiation will allow MIDA/BDA personnel to understand the problems of the farmers as well as the new and modified technologies necessary to overcome limitations and production constraints. MIDA/BDA personnel will develop along with the personnel of IDIAP. With this understanding and background MIDA/BDA personnel will be better trained and with a first-hand knowledge of the new technologies will be better able to interact with farmers for the successful ~~and~~ incorporation of appropriate technology into his production system.

Unfortunately, to date this IDIAP /MIDA/BDA linkage has not been developed. Occasional examples of successful collaboration are observed. These linkages are generally based on personal relationships and mutual respect between IDIAP/MIDA/BDA personnel. However, these examples of collaboration between IDIAP/MIDA/BDA personnel are much too rare to expect significant impact outside of their very limited zones of activity. If there is to be any hope of project success in the generation and transfer of appropriate technology that benefits the farmer and the country, an approach must be found to institutionalize this linkage.

The reasons for the inability of these three institutions to develop a rational and effective approach to collaboration are not readily apparent. Discussions with responsible personnel at many levels have provided some insights into the problem but have failed to pinpoint definitive reasons for the failure of these institutions to develop such collaboration.

Factors such as the following have been suggested as contributing to the problem:

a) The training and experience of MIDA personnel is not adequate to allow them to adapt and to contribute to the program.

b) MIDA personnel, because of their lower salaries, are not motivated or do not have the proper incentives that would encourage them to collaborate in an effective dissemination program.

c) Inadequate transportation reduces MIDA personnel's ability to participate.

d) IDIAP personnel are not interested in MIDA participation except at the final stages of extension.

e) MIDA personnel have little confidence in the technology recommended by IDIAP programs and, therefore, are reclutant to commit themselves to its dissemination.

f) Since MIDA personnel do not participate in the planning and development of the technologies, they feel little responsibility for their transfer to farmers.

g) IDIAP personnel feel little responsibility in helping to disseminate new technology to farmers other than those with whom they are collaborating in development/validation of technology.

h) IDIAP personnel feel that they should develop the technology and pass it on to MIDA for dissemination and that this is basically a one-way street.

Undoubtably at the lower levels of responsibility, these and many other factors contribute to prevent the collaboration of these institutions in a successful effort to generate and transfer appropriate technology to the farmers field. However, the evaluation team is united in their belief that successful collaboration will never develop until there is an organized and concerted effort to promote collaboration and a plan for accomplishing this task, and that this effort must be initiated, implemented and sustained at the highest levels of responsibility within these institutions. Persons of authority within these institutions must not only authorize and promote effective collaboration, but through their personal actions create a positive environment and phylosophy that will unite the institutions into an effective technology generation and transfer system as was envisioned in the project paper.

The recent initiative within MIDA to develop a separate Directorate of Technology Transfer and to strenghten its extension staff has received strong support from the local USAID office which is considering significant support for the project. New and improved agriultural technologies, to be of any benefit to the farmer and to the country, must be adopted by the farmer in order to improve his crop and livestock productivity and income. The extension effort and methodology required to optimize this transfer of techonology is under constant study by scientists and institutions working in the field of technology transfer. Experience in many areas of Latin America have emphasized the difficulty of effective technology transfer, and it has been pointed out that this effort becomes even more difficult when the agency responsible for technology transfer is separated from the agency responsible for technology generation and validation. The division of technology generation and technology transfer into two separate functions and especially the division of these functions between two separate agencies, from its inception places great stress and considerable doubt on the probable success of the extension activity.

In summary, the administrative separation of extension activities from the Agency that has responsibility for research and technology generation has been the organizational pattern for the many failures of technology transfer observed throughout Latin America. There is little reason to believe that the results of such a separation would be any different in Panama. Therefore it behooves external funding agencies to work closely with national government agencies in seeking alternative administrative and organizational patterns that have greater promise of success.

It is strongly recommended that the organization choosen for extension and technology transfer be one that will promote institutional collaboration and will prevent a sharp institutional separation of research and extension activities. A simpler, more efficient and less bureaucratic approach that unites these functions into a single effort is essential. The present plan to develop a complete and separate MIDA extension program and bureaucratic organization in Chiriqui is the beginning of an unfortunate pattern that may extend over the entire country and develop a separated system that will take years to build and even longer to modify once it is established.

An organizational system between MIDA and IDIAP must be found where personnel from both institutions work together daily as a team. It is recommended that these teams include IDIAP/MIDA personnel that are working on a specific problem or commodity within an area. For example a team on maize or milk/beef/pasture production could be formed. The team leader could be from IDIAP or MIDA depending upon the experience and capabilities of each member assigned to the team. It would be the responsibility of this team to identify the constraints to high productivity and income; select cooperating farmers; identify, adapt and/or generate the necessary technology for overcoming the constraints; validate this technology on farmers fields within the area; and develop demonstration and extension programs that effectively transfer this new or modified technology to large numbers of farmer's fields.

Once a valid and acceptable production package has been developed for the area and farmers have begun to adapt it into their farming system, a portion of the team can be moved to a new area to begin a similar program. A portion of the team from the MIDA extension staff will remain in the area to continue extension activities and to better refine the technology based on farmer problems, rate of adoption and success with the new technology.

At this point new MIDA extension staff would be added to the team when it was moved to a new area to carry out the same procedure. In this way research and extension staff would work together in the identification of production constraints and the planning and implementation of the technology transfer. All team members will benefit from the program from the beginning and will also feel responsible for all phases of the process. This rotational system will provide progressive training to MIDA & IDIAP personnel who would be absorbed into the system as it expands. As the program develops and more IDIAP and MIDA personnel are trained, these teams can be divided to form two, then four, etc.

1.2 Collaboration between IDIAP and the University of Panama.

The collaboration between the University of Panama and IDIAP seems to have taken a major step forward with the signing of a formal resolution by the University on November 24, 1982. This resolution expresses the need for close collaboration between the two institutions that will take advantage of the strengths of each and will reduce duplication. The two institutions will work together in the planning and implementation of specific programs and projects that are of mutual interest. Many new steps are being taken at the Director's level to stimulate effective collaboration. One of these efforts has resulted in IDIAP contracts with University professors to conduct specific research projects. Funds for these sub-contracts with university professors were supplied under the USAID contract. This contract research is in areas in which IDIAP's capabilities are limited and takes advantage of available in-country research expertise. These contracts will also help the university professors to conduct research that is relevant to the needs of the agricultural sector.

In past years since the establishment of IDIAP, collaborative efforts between these two institutions have left much to be desired, with each guarding jealously their independent right to conduct research of their own design and choice. Since the University of Panama has some excellent trained staff and some available facilities, they were in a position to continue the research work they have been engaged in for many years. On the other hand, with the information of IDIAP with a mandate to conduct agricultural research at a National level, some problems arose over priorities, duplication, funding, facilities, etc. Given the fact that IDIAP and the University of Panama seek to accomplish some of the same goals in research, training and technology transfer, many of the disagreement and conflicts that resulted in poor collaboration could have been and probably were, anticipated.

It now appears that many if not all of these conflicts have been resolved and there are general signs of positive collaboration. This new initiative for successful collaboration must be nurtured to stimulate continued effective collaboration, to take advantage of the resource of each and to prevent duplication.

1.3 Collaboration of IDIAP with other National institutions.

IDIAP has established collaboration linkages with many other national institutions. These include the following:

a) ENASEM - National Seed Corporation

b) INA - National Institute Corporation

c) PANAJURU - National Patrimony of Rural Youth

d) DINAS - National Directorate of Indigenous Affairs.

e) CALV - La Victoria Sugar Corporation

f) RENARE - National Directorate of Renewable Natural Resources

g) CONAC - National Federation of Campesino Settlements.

All are developed for specific purposes and have functioned at various times. Collaboration efforts depend on mutual interest and the ability of each institution to furnish resources that can be used to mutual advantage. IDIAP has supplied technical assistance for many, and in others, they have used them as bases from which to conduct specific research.

2. Collaboration with International Centers and International Organizations

IDIAP has developed a very extensive program of collaboration with many international centers and institutions. Although efforts have been made to develop effective collaboration in the areas of interest of IDIAP, effectiveness of this collaboration has varied from excellent to poor among the different institutions. Results have varied depending upon the level of support of the international agency and their method of operation. Where there has been continous technical support and some financial support from international institutions, collaborative efforts have, in general, been successful. Effectiveness has also depended very significantly on local interest, previous experience, the availability of the proper infrastructure, personnel, support and institutional priority placed on the collaborative effort.

Brief summaries of many of these collaborative efforts are presented in an attempt to provide a general overall evaluation of effectiveness.

2.1 Collaboration between IDIAP/CIMMYT.

While informal collaboration between IDIAP/CIMMYT began several years ago, a formal agreement of mutual collaboration to condut research on maize, wheat and economics was signed in March, 1982. To date the collaboration has concentrated on maize with some effort in sorghum. The collaborative work to be conducted was specified to be in the areas of plant improvement and production, methodologies of research with small farmers, documentation, and other aspects of research upon which IDIAP/CIMMYT might agree.

CIMMYT has provided frequent and continous technical assistance, short-term training of IDIAP personnel, genetic materials, information and support for local scientist to attend conferences and workshops, and has participated consistently in international and national trials on maize and sorghum in Panama. IDIAP has supplied land, laboratories, inputs, and local personnel to conduct research on maize and sorghum in Panama. Both institutions have shared and benefited from the research results and germ plasm identified, tested and developed under the program.

Collaborative efforts have included (1) a program of research on maize and sorghum for which CIMMYT has provided approximately $25,000 in direct and indirect support, (2) a program to develop appropriate technology for the small farmer, and (3) more recently, a program to test and promote quality protein maize in Panama to be conducted in Río Hato and Los Santos for which CIMMYT will provide approximately $80,000 in technical assistance and direct and indirect support.

There is ample evidence of the positive results of this collaboration which has been excellent. The interest and support from the IDIAP program and the excellent and frequent technical assistance supplied by CIMMYT have made this an efficient and effective collaborative effort. It points out the need and desirability to have excellent local counterparts upon which to build a program and the frequent and continous interaction and exchange with technical personnel of CIMMYT.

2.2. Collaboration between IDIAP/CATIE.

On April 9, 1979, the Minister of Agricultural Development of Panama and the Director of CATIE signed an agreement for collaboration on programs of research on agricultural production systems for small farmers with limited resources. Although the inter-institutional agreement was of a general nature, it included basically two projects; one for research on systems of production of crops for the small farmers with limited resources for which a budget estimated at $800,000 was proposed for a period of three and one-half years, and a second for applied research on milk production systems for the small farmer with limited resources, with financial support estimated to be approximately $400,000.

The fundamental objective of the Project is to increase the productivity, income and well being of farmers with limited resources, through the combined effort of IDIAP and CATIE in research, training and technical cooperation in agriculture and livestock production systems. The specific objectives include:

a) A characterization of the ecological and socio-economic aspects of the areas selected.

b) The identification of the existing production systems and the factors which limit production.

c) The development of research programs to improve the traditional small farmer production system.

d) The development of improved crop, livestock and mixed crops/livestock systems that optimize the use and conservation of the farmer's natural resources.

e) Study and development through research of appropriate channels for the proper and effective transfer of technology.

f) Strengthen the research capabilities of IDIAP technical personnel.

2.2.1 Applied Research on Milk Production Systems for Small Farmers with Limited Resources.

The collaboration of CATIE has played an important and very significant role in the development of this project. Resident staff from CATIE have become a part of the local research team to develop the project and have provided the technical leadership upon which the project has been developed as well as the day to day field support required for the implementation of the static and dynamic diagnosis of traditional small farmer milk and beef production. The presence of resident CATIE personnel have been essential for the successful completion of this effort to understand the dual- purpose milk production system of the small and medium farmer. Based on this initial collaborative effort, IDIAP/CATIE staff are extending these studies to other areas. Technical interaction at the field level has provided training for IDIAP staff and has indicated practical approaches upon which IDIAP staff can develop improved research programs on dual-purpose milk production. There is a need for both IDIAP and CATIE personnel to better document the results and effects of technical interventions on the small farmers' fields. Details of the results of this collaborative effort are available in the final report on the project presented on June 10, 1983. Collaboration is being continued with extensions of these projects and the development of new projects.

2.2.2 Research on Crop Production Systems for small Farmers of Limited Resources.

Collaboration between IDIAP/CATIE on a project to improve the crop production and farming practices of small farmers in two areas of Panama was begun in January, 1980 and will continue through late 1983. Efforts have concentrated on the production of rice in combination with maize and sorghum as second season crops. Work has also included the improved production of plantains with the complementary and alternate use of cacao and livestock. Varieties, insect control, soil fertility and weed control were identified as factors which most limit production. During the three plus years of the project, experiments on these factors have been conducted on the farmers fields and after two years of results on rice, maize and sorghum, validation studies were begun in early 1983.

Technology packages cannot be confirmed until completion of at least one complete cropping cycle in 1984. Therefore, should this excellent and productive collaborative effort be terminated as projected in 1983, the project and alternative packages with other crops and livestock will not be available.

This project represents some of the most effective collaboration with an international organization observed in IDIAP. The presence of resident CATIE staff as members of the IDIAP production and research teams as well as the significant financial support supplied by CATIE through the life of the project has contributed significantly to the overall effectiveness of the collaboration. This external assistance has been well received and complemented by IDIAP staff. It could well serve as a model for developing future international collaboration.

2.3 Collaboration between IDIAP/PRECODEPA/CIP

International collaboration for research on potatoes in IDIAP is being provided through PRECODEPA (Programa Regional Cooperativo de la Papa) and CIP. PRECODEPA is an organization of Central American and Caribbean countries interested in the production of potatoes. To prevent the dilution of scarce resources by each country, country members of PRECODEPA concentrate their research efforts on one phase or area of potato production. Problems being studied include seed production, viral diseases, storage, economics, industrialization and golden nematodes. Panama is a participating member of PRECODEPA and through this program is developing research on the golden nematode of potatoes within the National Potato Program of IDIAP. Results are shared between cooperating countries. These studies are financed through local institutional support and from a grant to PRECODEPA from the Swiss government.

CIP has provided technical assistance, germ plasm and training for many years. This collaboration continues to be effectively utilized by IDIAP who have provided local support, land, laboratories and technical personnel.

This collaboration has been well utilized by IDIAP and has contributed to a very effective potato program at Cerro Punta. The collaboration will continue to be strengthend in the coming years.

2.4 Collaboration between IDIAP/CIAT

Although the programs of CIAT; (yuca, beans, pastures and forages and rice) are all of interest to Panama, the collaboration between IDIAP/CIAT in some of these areas has been very weak or non-existent. The exception has been in the rice program where rice varieties, technical assistance and training have been provided through an effective program of collaboration. The use of CIAT varieties and short term training programs have strengthend the IDIAP program and played a significant role in the development and extension of locally productive varieties.

The bean program of IDIAP has obtained little assistance or support from CIAT because of the orientation of the CIAT Bean Program. CIAT's program is directed toward the breeding of bean varieties that are resistant to diseases. This has led them to focus on black seeded varieties which are not consumed or acceptable to the local population which has a preference for the larger red kidney type.

Although IDIAP personnel have received training in CIAT, these differences in orientation and program requirements have prevented the development of close, effective collaboration.

Only within the past month have collaboration efforts in yuca been initiated. A CIAT yuca specialist in collaboration with local IDIAP personnel have established research in Panama. These studies of local varieties and cultural practices are being carried out on farmers' fields.

The increased production of milk and beef from the cattle population of Panama depends very heavily on the development of sound, year-round pasture and forage production program that provides adequate nutrition. Although CIAT has an extensive Pasture and Forages Program, IDIAP has made only limited use of available technology and technical assistance. More recently several members of IDIAP's livestock program staff have received training in tropical pasture production in CIAT, and improved pasture species have recently been introduced. Since much of IDIAP's technical staff are new and have only limited experience, maximum collaboration with the pastures and forages program would significantly benefit IDIAP livestock program. New varieties, cultural practices, seed production technology and research methodologies and techniques could be obtained from a closer and more clear defined collaboration with the CIAT pastures and forages program.

In general, collaboration between CIAT and IDIAP has been weak. Given the similarity of many research interest of the two institutions, greater and more effective collaboration would be expected and is encouraged.

2.5 Financial Support to IDIAP from CIID.

Since February, 1978, CIID has made available approximately $801,500 Canadian dollars to support research and technology transfer in the area of milk and meat production. The principal objective of these projects has been to support IDIAP in its efforts to increase the production of milk and meat and their by-products, and to evaluate tropical pasture species in Panama.

The principal support in two phases has been dedicated to the development of feeding systems for dual-purpose cattle. Work under this project has included; the characterization of dual-purpose production systems in three areas of Panama, the generation of alternate technologies to increase the efficiency of utilization of available resources; the validation of improved production technologies, the training of technical staff and farmers; and in collaboration with farmers, the establishment of demonstration models to support the introduction of new production practices in the three selected zones.

Technical assistance for the projects has been supplied by CATIE, who has collaborated very closely with the technical staff of IDIAP. This financial support along with that from CATIE has made it possible for IDIAP to work on the fields of collaborating farmers. Much of the diagnostic work has been completed and work is continuing to validate and transfer the adapted technologies to the farmers.

Recently approved funds (March 28, 1983) amounting to $71.500 Canadian dollars will be used to evaluate tropical pasture species at the farm level, on the experiment station, and in the laboratory.

Funding was also provided to strengthen the institutional capacity in Panama to analyze and control national agricultural information.

3. Technical Assistance Provided Under the Project.

Technical assistance provided under the project have been basically of two types:

(a) Long-term and short-term technical assistance provided through the Cornell/Rutgers Contract.

(b) Long-term and short-term technical assitance obtained through direct-hire contract by IDIAP.

3.1 Technical Assistance Provided under the Cornell/Rutgers Contract.

Anticipating that IDIAP would not have adequate numbers of well-trained and experienced staff with which to carry out the initial stages of the area-focused research activity, provision was made for AID, though grant funds, to supply foreign professionals to provide the needed expertise for program implementation. A basic precept of the project was that all long-term foreign specialists would be participating line staff members of IDIAP's programs, fully integrated into the research and technology transfer activities, inter-disciplinary teams, and action committees.

The stragegy of the technical assistance was to use foreign specialists in areas where IDIAP was weak or where IDIAP senior staff were involved in long-term training. The original PIO/T called for five technical assistants as follows:

1. Specialist on Communication and Technology Transfer
2. Specialist in Soil Productivity
3. Specialist in Tropical Pasture Production
4. Specialist in General Agronomy (Agronomist)
5. Agricultural Economist

Three of the five foreign assistants originally defined in the PIO/T have been assigned to Panama; replacement of one team member during the course of the contract has been necessary. At present there is a General Agronomist, a Tropical Pastures Production Specialilst and a Soil Productivity Specialist. These specialist have performed well within the restrictions of time and local financial and institutional conditions. They are establishing effective programs in collaboration with IDIAP personnel.

Much valuable time has been spent in administrative matters and the development and organization of adequate infrastructure with which to carry out the assigned programs. Unfortunately, to date, many of the essential ingredients for normal function of these specialists and their counterparts are not in place. Transportation, laboratory equipment, inputs and other administrative factors continue to limit effective and efficient completion of their planned work. Many of these are being overcome, but at a much too slow rate given the limited time frame under which they are working as determined by the life of the project. It should be noted that local IDIAP staff face similar and, in many instances, more severe problems of transportation, inputs, delays, etc. IDIAP administration is aware of these problems, but although efforts have been made, seem unable to provide a rapid solution to the bureaucratic procedures required for input purchase, administration decisions, and infrastructure development. Most of these delays are related to internal problems and procedures of IDIAP that can be little influenced by the foreign technical assistants. Ways must be found to expedite administrative procedures and decisions that are slow and cumbersome. Experience has shown that this is the pattern generally observed in developing institutions in Latin America and if steps are not taken to remedy this problem, the situation gets even worse as the institution increases in size and complexity.

Although the scope of work, responsibilities and duties of each of these technical assistants greatly surpasses that which might logically be expected from them, each is attempting to plan an effective program of work that will aid in the development of an effective research, data collection, and analysis and technology transfer program and procedure within their area of responsibility. There is somewhat of a tendency to broaden their scope of work to too many projects and too many areas. This is in response to the tremendous need for senior leadership in both the agricultural and livestock programs and the institutional goals to cover eight priority areas of the country. The evaluation team feel strongly that to be most effective, the technical assistants must develop a sound strategy for their efforts that will prevent excessive dilution and will build a basic program upon which IDIAP personnel can be trained and upon which a sound future program can be built. This may require that they concentrate their efforts within specific regions, in order to lay the foundation of a successful program.

Their efforts and ability to train local staff in sound research planning, data collection and analysis, experimental procedures and techniques, and in program evaluation will represent one of their most rewarding contributions. The youth and inexperience of many of IDIAP's staff makes it essential that much effort be dedicated to their orientation and training.

Technical assitance in animal science and production represents a critical need of the institution. To be effective it must be supplied by a very senior animal scientist that has had years of experience in animal science production and research and that recognizes the problem and limitations of the small farmer in areas such those in Panama. This area is of special importance given the youth and inexperience of much of IDIAP's livestock staff. Although young, interested and energetic, they do not have the experience and basic skills needed to plan and implement effective research programs that document their results. These basic skills are essential if an effective applied research and technology transfer program in animal science is to be developed.

A second priority area is that of technology transfer. It is well recognized that standard systems of extension and technology transfer employed in some developed countries such as the United States, do not function in Latin America. Local conditions require special techniques that employ more on-farm demonstrations and farmer contact than employed in traditional extension programs. A senior person with extensive in-field experience in technology transfer programs in Latin America is needed. This person could be an agronomist, social scientist or animal scientist, but should have worked in programs such as ICTA in Guatemala where technology generation and transfer are integrated into a functional unit. The orientation of this specialist should be one of on-farm transfer as contrasted with that of extension methodology and communications. He should develop and lead technology generation and transfer teams that work directly with the farmers.

The team of technical assistants are aware of the complexity of their assignment and are attempting to develop individual strategies that will result in an effective program of work. All are concerned with the short time frame within which they are working. Each recognizes that approximately one year is required to get an effective program underway given local conditions and the present stage of institutional organization and development. Each needs to define their strategies for reaching their technical assistance goals during the next 18 months.

This definition of strategies should be complemented by a team, IDIAP and USAID decision of priority responsibilities of each team member. This is especially true in the case of the Crops Agronomist who is dividing his time between crops research and institutional building/administration.

The IDIAP program can benefit from additional long-term technical assistance. To be effective this must be supplied by senior, mature, experienced scientist who know how to develop programs and who have the ability to impart their knowledge and experience to young, energetic local staff. This type of senior assistance could be profitably employed throughout IDIAP were it available. However, two areas of special need were recognized; these include animal science and production and technology transfer.

3.2 Technical Assitance Supplied by USAID Funded IDIAP Direct-hire Contract

IDIAP has made extensive use of direct-hire contracts to supply short-or long-term technical assistance in areas where their technical and administratives staff have been weak. A list of the more than 40 people hired under this system is presented in appendix table IV. Although, the majority of these technical assistants have come from Panama, nine have been hired from other Latin American countries.

The rationale for these direct-hire contracts is that IDIAP has the flexibility to contract national or international specialists who can fill the gaps in programs where experienced personnel are not available or where experienced personnel are undergoing long-term training programs aborad. The need for this type of assitance is confirmed by the extensive use that has been made of this procedure. Both long-and short-term assignments have aided IDIAP in both their research and institutional building programs. To date most of these specialists appear to have been effectively utilized.

4. Appropriate Recognition of Funding Agencies

There is some concern among some AID administrators that appropriate recognition is not being given to USAID for their major contribution to IDIAP's overall Research and Institutional Development Program. Programs of lesser size and support have seemed to have received greater recognition and publicity than those supported by USAID.

It appears that the nature of the recognition is directly related to the visibility of the program and the apparent recognition received by the funding agency. For example, the fact that CATIE has had a long and continous involvement in the programs and has had several resident staff members directly involved in the work has contributed greatly to their recognition in IDIAP and in the areas of their work.

On the other hand, USAID support has, except for the technical assistance staff, been more of a general nature, supplying funds for overall institutional building. Funds have been supplied for vehicles and this support has been well recognized and appreciated by the IDIAP staff. Funding for long-term staff training is being spent, but lilttle recognition can be expected until those persons now being trained return to contribute to the programs. Only a few of the facilities and a small amount of equipment have been financed with AID funding. The building program has been slow and less efficient than was expected, but IDIAP is planning appropriate recognition of these facilities once they are completed. Appropriate plaques detailing USAID support have already been prepared for placement in sites of high visibility when the buildings are dedicated.

It is the Evaluation Team's opinion that USAID should not become overly concerned with the fact that they appear to not have received appropriate recognition for their substantive support to the program. It will continue to be recognized that the USAID support is essential for its effect on the development of IDIAP as a strong institution. It is also recognized that without this support, collaboration with programs such as those supported by CIAT, CIMMYT, CIP, CATIE, CIID, etc. could not function. That is, funding from USAID is aiding in the development of an institutional staff and infrastructure that makes it possible for IDIAP to take advantage of other technical and financial assistance such as that supplied by CIMMYT, CIAT, etc. It is the Team's opinion that adequate recognition will be forthcoming as facilities are completed, staff return from long-term training, and the long-term technical assistance specialists develop effective programs. It is possible that some more subtle areas of support will receive less recognition, but will be basic to the building and strengthening of IDIAP as an effective agricultural institution.

5. Observations and Conclusions

The success of IDIAP's technology generation and transferf program is predicated on its ability to take complete advantage of available technology and to utilize technical assistance effectively. As a new and developing institution IDIAP is under tremendous pressure to provide technology that can improve the productivity and income of the farmer and make Panama self-sufficient in most agricultural commodities. Therefore, IDIAP does not, and should not, have the luxury of developing a research program from its basic components. To produce results they must take complete advantage of existing technology, which is available from international centers, international institutions, other country programs. To take advantage of the available technology, close working relationships must be developed with international centers and technicians. To be effective, close personal relationship between IDIAP personnel and international centers staff must be developed.

It is the conclusion of the Evaluation Team that although IDIAP has made effective use of technology available for some commodities, they have been much less effective in their utilization of available technology in other areas. For example; maize, potato and rice germplasm and technology from CIAT, CIP, and CIMMYT have been well utililzed in IDIAP programs. On the other hand, yuca and pasture and forage germplasm and technology from CIAT have been poorly utilized. Other examples could be cited. If all IDIAP programs are to be successful under the proposed strategy of applied research, a more organized and aggressive effort must be made to identify and use technology from many national and international insritutions.

Technical assistance in areas of special interest or in areas of institutional weakness can be of tremendous value in the overall program development. Since IDIAP is a young organization with large numbers of young and inexperienced staff, technical assistance can be used to bridge the gap until more experience and better trained people return to provide program direction. However, to be effective this technical assistance must be of high quality. Senior and experienced scientists are needed to provide the leadership for the programs and to train the young IDIAP scientists. Some technical assistance is being supplied but more is needed. Of special importance is the need for technical assistance in animal production and technology transfer.

6. Recommendations

Based on the forgoing observations and conclusions, the following recommendations are made:

(a) IDIAP should develop a more organized and aggressive program for identifying and utilizing available technology from both national and international sources.

(b) IDIAP should seek to obtain additional senior technical assistance to provide leadership for their programs and training for their young and inexperienced staff. This need is especially critical in animal production and could be effectively utililzed in technology transfer.

D. Adequacy of Criteria for Setting Research Priorities.

One of the most difficult management problems that confront a director of research is the need to concentrate his scarce resources and efforts in a small enough set of activities to ensure success in a reasonable period of time. As research efforts demonstrate the capacity to resolve problems, the demand for allocation of similar efforts to other problems in other places becomes politically irresistable. Thus the use of well chosen criteria for the setting of priorities in the use of research resources becomes very important.

In the design of this project it was decided to concentrate efforts in the Central and Western Regions of the country and to choose a limited number of commodities to be studied in each. The basis for selecting commodities was to use those which were given top priority in Panama's five-year plan and in a more recent three-year plan.

Through extensive discussions within IDIAP and with officials in other agencies serving the agricultural sector it was decided to include nine priority crops, including rice, corn, sorghum, tomatoes, potatoes, onions, soybeans, edible beans (kidney beans and cow peas) and yuca. This list included all of the priority crops in the national Plan except for sugar cane and bananas.

Criteria for selecting priority livestock commodities were the same as those for crops'; namely, taking the National Plan as the guide and undertaking as many of those priority commodities as funds would permit. This resulted in selecting five livestock commodities, including beef, pork, milk, poultry and eggs.

After two and a half years of project implementation, the above commodity lists have changed very slightly. Work in soybeans was not initiated when it because apparent that a major investment in storage and processing would be required because there is no commercial production of this commodity at present. Work in livestock production has been limited to beef and milk, with major effort going into dual-purpose cattle.

The basis for choosing criteria for setting research priorities involves some combination of political, economic and technologic factors. The political factors require the research efforts to conform to those decisions made by government in establishing pricing levels, in setting import/export policies and in responding to public demand. These policies are subject to frequent change as Ministers change and as political movement within the country shifts. There is a little opportunity for the national research efforts to influence these factors or to avoid being influenced by them. Unfortunately, these are the factors which most frequently dominate the criteria for setting research priorities.

The economic factors are closely related to world market situations for specific commodities and to economic conditions within the country. Import substitution usually implies government subsidy, at least in the early stages. Production for export involves some form of taxation as a source of government revenue. The general food demands by the public are closely tied to their ability to purchase given commodities at prices within their reach.

The opportunity for a research program to affect the economic factors is much greater than in the case of political factors. The research program can make import substitution more feasible and it can make production for export more profitable. The research program can also affect the purchasing power of the rural segment of the population as well as reducing the cost of commodities demanded by the public. Therefore, the economic factors should be major candidates as criteria for setting research priorities.

The technologic factors involve a recognition of the state-of-the-art in world production in each commodity. In some crops and livestock commodities there has been great progress in development of production technology that has resulted in vastly increased production per acre and considerable reduction in the cost and/or the risk of production. In these commodities it should be possible to form some judgement about the upper limits of production or the lower limits of cost of production that could be expected from research. In such commodities there is every reason to believe that reaserch efforts within the country could quickly take advantage of these technological achievements and adapt them to local conditions. This would make them attractive candidates for the early research efforts within the country. On the other hand, there are commodities, such as dry beans, that have proven to be quite intractable to major technologic innovations. In such cases there is little to encourage the hope that marked success can be achieved here with the limited resources that can be brought to bear on the problem. If technolgic factors are to be used effectively as criteria for setting research priorities, there must be a reasonable acquaintance of what is happening in the rest of the world in this respect.

A review of the history of the development of this project provides little reason to question the initial criteria used in setting priorities for the research program of IDIAP. The political and economic factors were predominant in deciding which commodoties were to receive attention. In the intervening years, only a few factors have changed. Economic factors dictated the decision not to initiate work in soybeans in spite of a continuing shortage of edible oils. If anything is done along this line in future, it now appears likely that oil palm will be the crop to receive attention. However this crop falls in the same category as bananas and sugar cane in that it requires a considerable investment in infrastructure, and this will most likely come from large commercial ventures.

In the case of poultry the decisions are based on different factors. Poultry production is strongly influenced by large national and international interests. They have ready access to the best technology in the world, and it is easily transferred to local situations. There is little opportunity for small or medium sized farmers to enter this activity except through the large companies. Therefore there is little opportunity for IDIAP to make significant contribution in this area.

In the case of swine, the opportunities for making significant contribution to a technology that could affect production by small and medium farmers lie almost entirely in the area of finding under-utilized by-products that can be used as feed sources. The only major by product available in Panama is cull bananas, and it is being used reasonable effectively already. A major restriction in commercial swine production is the need to use a protein supplement in the ration. Under present circumstances this would have to be imported in Panama.

Therefore, the only serious question to be raised relative to research priorities lies no so much in the choice of commodities as in the relative emphasis among them. Livestock production makes a significant contribution to the total value of agricultural commodities in Panama. The total investment in research in this area for 1983 is only slightly less than for crops research (B. 113,717 for livestock vs 150,523 for crops). However, the stage of development of livestock research is considerably behind that for crops. The crops research program has produced many results that are ready to be incorporated into farming systems programs. The livestock research program, however, is still largely in the exploratory stages and is in need of much stronger investment in obtaining aggressive leadership and direction. Therefore in terms of potential returns on investment in research over the next five years, there is reason to expect higher returns from giving greater emphasis to research in the beef/milk area.

Reccomendations

It is recognized that research is an activity which requires considerable time to build a staff, to acquire the necessary facilities and to generate useful and reliable results. Therefore, recommendations regarding changes in priorities or in emphasis must be made with unusual care and study. In the case of IDIAP research priorities, it is recommended that the overall set of commodities being studied remain as at present. However, as opportunities arise, a shift toward stronger support to livestock research would seem to have promise of high returns on investment.

E. Trainning and Staff Development

In the project design it was recognized that in order to achieve the project purpose of enhacing IDIAP's capability to carry out agricultural research on a long-range, continuing basis, the following institutional development outputs are required:

a) An expanded research staff of sufficient size to carry out a large scale research program.

b) An adequately trained professional research staff capable of implementing an area-focused production systems research program. At the beginning of this project IDIAP had programmed an expansion of its professional and technical staff from 45 to 95. It also established institutional incentives to help assure a high degree of staff permanence and performance. Included among those incentives were comparatively high salary scales, provision for vehicle purchase, a family insurance plan, and opportunity for professional advancement.

The short term objectives of this project in the area of staff development were:

1) To provide IDIAP with technical personnel who are totally conversant with the technology accumulated in the regional and international research centers, such as CIMMYT, CIAT, CIP and CATIE.

2) To make maximum use of IDIAP's existing technical personnel by providing the opportunity to move into responsible research roles through improvement of their own technical capability.

3) To prepare IDIAP personnel to assume managerial roles in putting together all available technology, generating new technology, and testing appropriate production systems and practices for eight priority areas.

The above objectives were to be realized mainly by efficiently using the in-depth short course training offered by the International Centers.

The long term objectives of the project were to be realized through training to the M. S. level for 25 staff members and to the PhD. level for an additional 10 staff members.

Early in 1983 AID/Panama employed a team to make an assessment of the technical training needs in Panamanian agriculture over the next 10 years and to suggest how those needs might be met. In particular that study addressed "the general staff capabilities and training requirements of IDIAP and MIDA in relation to their technology development (research) and technology transfer (extension) projects". It also "assessed the current IDIAP/MIDA staff with respect to academic levels, language capabilities and special training needs, i.e., special degree programs, U.S. academic vs. Latin American institutions, preparatory courses, etc.".

In-as-much as the above study has just been released (May 9, 1983), the current report will confine its evaluation to the training provided under Project No.525-0180, but with one caveat. We do not concur in the judgement recorded in their report on pages 13-14 regarding the strengthening of The Directorate of Technology Transfer. It is our judgement that the training and development of Technology Transfer staff should proceed along the lines described in Project Paper No.525-0180. The major disagreement lies in whether the training of Technology Transfer staff should place stronger emphasis on the technical and technological aspects of the practices they attempt to disseminate, or whether their primary training emphasis should be in methodology of communication. Our collective experience in many other developing countries leads us to opt strongly for the former.

Observations

It has been noted in earlier sections of this report that the stage of development of technical staff is quite different in the crops and livestock areas. Therefore these groups are treated separately below.

Crops Research Staff

The crops research and management staff are quite up to date in their acquaintance with the research being conducted in the international centers and in various national programs of Latin American. There has been a remarkable improvement in the awareness and the understanding of relevant research that is going on outside of Panama. There has been a strong flow of communication with all of the relevant international organizations. There has been a productive level of participation in workshops, seminars and short courses offered by those organizations. There has been a useful and productive flow of visits to Panama by technical personnel from the international organizations. This has resulted in the efficient incorporation of outside research results into Panama's crops research program.

Funds from this project have contributed substantially to upgrading and informing of the technical staff in crops. Appendix Table II shows the short-term training that has been provided under this project to date for all of IDIAPS's activities. The rate of utilization of project funds for short term training seems quite acceptable.

The long-term training program got off to a slow start in 1980 but now it has picked up considerable momentum. Proficiency in english continues to be a problem. A total of 21 M.S. and 8 PHD candidates have been processed or are nominated for study abroad. Of these, 12 MS and 3 Phd candidates are funded by the project. The long term trainees funded by the project are shown in Appendix Table III.

The trainees listed in Appendix Table III will exhaust the project funds budgeted for this activity before they all return. This will actually involve little more than half the trainees contemplated in the project design.

Livestock Research Staff

The development of the livestock staff has started slower and has had lower project investment than the crops staff. Of the 24 short term trainee listed in Appendix Table II, only 3 are livestock specialists compared to 8 in crops. In the Team's visits with the livestock staff, there was evidence of this lower degree of training and experience, which manifested itself most prominently in an inadequate appreciation of the types of information that must be collected and systematically reviewed in their research efforts. There was much less evidence of useful inputs from or contacts with international centers than was the case with crops staff. As discussed in an earlier section, this is a reflection of the lower collaborative capacity on the part of the technical staff.

The long term training of livestock staff is receiving relatively more attention. Four of the fifteen trainees are from the livestock area. This number, however, will be far from satisfying IDIAP's needs in this area.

Conclusions

Training is the heart of institution building, and this fact is recognized in the project and by IDIAP management. They feel that they are pushing as hard as possible within the constraints imposed by english language deficiencies. At the time of the preparation of the project paper, the projected expansion of IDIAP technical staff from 45 to 95 seemed too optimistc, but today that number stands at approximately 150. The climate for retaining and using trainees efficiently seems quite good. The demands for more trained people is well documented in the study referred to above. The absorptive capacity of IDIAP for more technical staff with better training seems to be limited only by the budgetary support from GOP. IDIAP has shown considerable ingenuity in finding ways to add staff on "soft" monies and to hold most of them in productive research positions pending the time when they can be moved onto firm budget rolls.

Thus, while the training program has started slower than hoped, and the number of trainees accommodated under the project is less than expected, there is reason to give this effort good marks and to encourage further investment in this aspect of the program at every opportunity.

The livestock staff needs to receive extra emphasis both in short-term and long term training efforts. It is not likely that they can greatly improve the effectiveness of their international collaboration without considerable extra effort in the training dimension.

Recommendations

It is recommended that the project find ways to increase the total investment in training of technical staff. This is true for both short-term and long-terms training.

It is recommended that greater emphasis be given to training livestock staff relative to crop staff.

F. Construction of Physical Facilities

All construction sites were visited jointly by The Team architect and the IDIAP architect. Visits included sites where construction is underway as well as those projected but not yet initiated. Following are comments on the progress of construction and the adequacy of design for individual sites. Over all observations and recommendations for the project are given at the end of this chapter.

1. Individual Sites

Progreso

The Site:

The site located on the outskirts of Progreso, south of the town of 3,000 inhabitants on the west side of the street to Puerto Armuelles. The roughly rectangular site is 24.5 meters wide by about 50 meters deep and slopes slightly to the front of the site. The site is in a mixed residential and business area and had mature vegetation on it, some of which has been saved. To the north is IDIAP's existing rented quarters, a former store, to the south and west are residences. No municipal sewer or water services are available. Electrical power is from overhead lines at the street.

The Project:

This is a model sub-regional support facility comprising offices, vehicle storage, space for supplies and living quarters for a team working with small agricultural producers in this area. Presently there are 8 staff members - technicians, and 4 agronomos - one secretary and three vehicles. A single story office building of 5 meters is located parallel to the street at the front of the site. It has offices for 6 people each, separated by secretarial space and sanitary facilities. Perpendicular to it at the back is open covered parking for four vehicles and a storage building of 4 meters by 5 meters. A detached single story living quarters structure of 8 meters by 10.6 meters is located at the rear of the site. The living quarters are comprised of 2 dormitory rooms for 5 men each, with small open closets, relating to a hall bath, and one dormitory room which could accomodate 3 women and has an adjoining bath. The dormitory rooms are off a kitchen/eating/living room. There is some full height hall storage. A clothes washing area is located at the side of the building.

Building Approach:

The buildings utilize the conventional Panamanian building system of a light cast in place concrete frame with steel roof purlins and metal roofing, 4" concrete block infill walls and partitions, stuccoed inside and with the joints expressed outside, and glass louver windows. The floors are tinted exposed concrete in the front building and precast terazzo tile and base in the living quarters. In both buildings an inner ceiling of painted cellotex pressboard is applied to the bottom of the purlins over sleepers and follows the pitch of the roof. There is fluorescent lighting throughout. Cabinetry for the kitchen and clothes storage is shop made custom work. A 20 foot high 1,200 gallon water tank is supplied by a submersible pump in a 120' deep well. A thousand gallon septic system has a drainage field of 25 meters with two 4" perforated lines one meter apart.

Project Status:

The project has been accepted from the builder, Industrias San Juan, Panama City. The Project lacks the electrical meter, the submersible pump and water connections to the elevated tank. There were considerable problems with the builder using substandard materials in the foundations and in the blockwork. No landscaping is in yet nor is the driveway graded. The general level of cabinetry workmanship is low. The project lacks furniture and appliance. Despite its shortcomings, the Project is functional and is being gratefully accepted by the local team.

Plan Review: Progreso

Existing vegetation not shown on plans.

No provision for coffee preparation.

Water fountain not called out on plans.

No ceiling fans.

Lights could not be used installed as shown because ceiling slopes.

Not enough electrical outlets, none shown in secretarial space, only one in each dormitory room.

No telephone outlets called for.

No outside outlets for exterior use.

Switch locations for exterior lights poorly located.

Detail references not noted or filled in on plans.

No details or thought given to water supply or return pipes to upper water tank.

No ladder to upper water tank.

No exterior hose bibs to clean vehicles, mix chemicals, etc.

No notes on connection of metal roofing to purlins.

Cabinets poorly drawn, incorrectly call for 1/4" plywood faces.

No cabinet or drawer details.

Shelves shown as 1/2" plywood which is not thick enough unless faced with 1 x 2 minimum facing.

No possibility of locked storage for dormitory residents.

No door schedule.

No hardware schedule.

Critique:

This is a reasonable approach to tropical buildings in an isolated area. The linear one room deep offices have sufficient ventilation, good strong four foot overhangs on an sides and roofs of sufficient pitch. The main structure is fireproof and termite proof and the buildings are secure with bars from unauthorized entry. They are fully insect screened. If this case the offices are located very close to the street running in a north south direction. This orientation achieves excellent street identification but maximum solar heat gain from the low east and west sun, as well as receiving noise from vehicles passing by at 30 to 40 miles per hour. Due to the hard interior surfaces it is very hard to hear when a vehicles goes by.

There is no general secure storage for the office area. The windows are barred but the doors are of unprotected glass panels. The buildings are not air conditioned, correctly so, but they should have ceiling fans. The exposed raked masonry joints in the exterior walls are neither straight nor regular. This approach is asking too much of local masons accustomed to having their work stuccoed. The concrete frame structure is painted red with cream colored walls. As is the local custom, the lower one meter or so of wall should have been also painted red to conceal staining now occuring from water falling off the roofs. Sidewalks connecting all buildings should have been provided because of the clay soils and poor off site drainage. Surface runoff should be controlled by either gravel or earth forming by swales. A casual glance at the next door existing facility would have indicated that the storage area is undersized by at least a factor of three. Separation of seeds, herbicides and insecticides, and hand tools should be provided. No exterior electrical outlets or hose bibbs are provided for maintenance. Decorative grass is planned for the site. A better choice would be useful plants. In the living quarters securable clothing storage would have been desirable. There is a hardware conflict between the door knobs and the screen doors. A covered porch for sitting out should have been provided. This would also help shield the walls from solar heat gain. In the dormitory rooms the windows are held up off the floor 1.72 meters for privacy and to permit adjacent bunk beds. This severely limits ventilation. The women's room has only one window and should have two for cross ventilation. No provision has been made to darken the room. Ceiling fans should have been provided. A overall site fence would be desirable.

The Site:

The site is located approximately one kilometer south of the isolated community of 1,200 inhabitants of Plaza de Caisán. The site is in the shape of a right triangle with the short side of 40 meters pointing north towards the hypotenuse and with the long base side of 60 meters. Both of these sides face rarely used dirt roads. The hypotenuse faces a cultivated field. No utilities are available in this isolated area. The site has some vegetation and slopes gently to the west nearly a meter.

The Project:

This is another model sub-regional support facility of identical components of the Progreso installation. It is to replace a rented wood residences, used as an office and as a dormitory, on the other side of town. The team is presently comprised of two technicians, one assistant and they have one vehicle. They are working in small producers' farms. The office is oriented north-south along the short dimension of the site facing the dirt street for access. The living quarters are oriented to the other street. A small building for a diesel electrical generator is located to the east of the storage building.

Critique:

All comments as to the siting and construction approach as that of Progreso apply here due to the use of identical component plans, similarly oriented, but here there is a different juxtaposition. The small generator building provided here could be improved. The structure is similar to that of the main buildings---light cast in place concrete frame, concrete block infill walls, steel roofing and purlins, and a steel door.

Two inch thick styrofoam sound insulation is provided on an interior surfaces except the underside of the roof. No provision is made for ventilation needed by the diesel is mounted on the interior wall opposite the entrance, on the other side of the machinery. This location would make it inaccessible in an emergency situation. No exterior (or interior) outlets are provided for remote usage. No water is available for the equipment, nor is provision made for fuel storage or spare maintenance parts. The site would be difficult to fence due to the parking bays that face the street.

Project Status

The same contractor, Industrias San Juan of Panama City, is constructing this facility. They are four weeks behind the contractual completion date. The cabinetry and doors were made by the same sub-contractor in Panama City, but here are even more poorly installed. Drawers are mildewed and completely stuck in a closed position in the dormitory rooms.

Hanging bars are not straight. The kitchen base unit is not yet installed and the doors fit poorly. The window units uniformly do not fit in the wall openings, glass louvers are missing and there is no conformance with the plans as to location of translucent louvers and clear louvers. Screens are not yet installed or on the job. The shower in the women's bath is of two different color tiles and the floor does not slope to the drain, but to the other end. The electrical fixtures are not yet in nor are there any circuit breakers on the jobsite. In the office building there is cracking in the masonry below most windows, the ceiling has already sagged in the storage room, the sink is missing, and the painting needs touching up. The generator room lacks the steel door and frame. One quarter inch mesh galvanized hardware cloth is being installed over the styrofoam and is being stuccoed rather than the perforated aluminum surfacing called for in the plans. The stucco will render the sound insulation useless. Throughout the project the connection of the steel purlins to the concrete frame is by welding to projecting reinforcing bars instead of to angle clips as called for on the plans. The generator is not on the job. The well is half dug and stopped because of a cost dispute with the Ministry of Public Health, which is doing the work. The septic tank is in but not functioning. During rains there is supposedly water backing up from the drainage lines into the septic tank. A much more likely explanation is that surface water is accumulating from the fields to the north into the two foot depression around the septic tank. The drainage lines run against the slope and appear by eye not to have any slope but actually run uphill. No instrument was on the site to check the elevations at the inspection and distribution boxes. There is cracking in the concrete supports under the elevated tank. The Area Director, Miguel Acosta wants to move in the facility against the architect's advise.

Guarumal

The Site:

The site is located slightv north of the small town of Guarumal. The site is on the east side of the paved street with fields on the north and the east, Public Health Building is in construction to the south. The rectangular site of 40 meters by 60 meters has its long dimension to the paved street and slopes to the northeast corner 5 meters. No utilities are available in this area. The site was formerly cultivated and has no existing vegetation.

The Project:

This another model sub-regional support facility similar to Progreso and Caisán. The team is made up of three technicians, 6 assistants and 4 field laborers. They have two motorcycles, 2 hand tractor and 2 pickup trucks. They are presently housed in two rented wood residences about one half kilometer from this location. They are working in small producers's farms. The plan is identical to that of Caisán but with the long axis of the offices running east west and the storage area increased almost threefold and compartmented in a more reasonable way. The site is to be fenced.

Critique:

Similar comments apply here as in Caisán. Particularly critical here is site drainage, as the office building portion was excavated into the hill. Provisions for erosion control have already proven inadequate. The orientation is similarly problematical as in Caisán. The north arrow is incorrectly drawn on the site plan.

Project Status

The office, covered vehicle area, and storage area, water rank and generator building are completed. Due to bureaucratic foulup the living quarters are not yet under construction. The well, pump, piping to the elevated tank, and generator are not installed. This project appears somewhat more carefully built than the other two but similar flaws exist. The exposed masonry joints are not straight or regular. The metal roof panels are coming up from the roof purlins due to inadequate attachment. One of the pair of doors of the far storage room has been installed up side down. The upper throw bolt to the door jamb is missing on the other set of storage room doors. The exterior security bars on the windows were made from 3/8" reinforcing bars as a concession since the contractor provided louver windows with the integral 1/4" bars by mistake. The outer bars are inadequately secured to the building.

Calabacito

The Site:

The site is located approximately 15 kilometers northwest of MIDA's headquarters in Santiago. It is an isolated site used as pastorage of some 400 hectareas. There are four existing large well maintained storage buildings organized around a rectangular courtyard of 35 meters by 60 meters with an existing well in the center. No utilities are available.

The Project:

This in an addition of 55 square meters to an existing building, consisting of a conference room, an office, an office storage room, a toilet room, and a small addition to an existing bulk storage room to facilitate the connection to the existing building. A pump is to be installed in the existing well, an elevated water tank of 1,200 gallons built, a septic system installed and an electric generator facility constructed.

Critique and Project Status:

The plans for this project are not yet complete. A partial architectural set has been prepared but no electrical or plumbing design or drawings have been started. The structure is called out to be visually differentiated from the walls. This expression would not match the existing construction. It would be better to build the exterior walls in the same plane as the outer structure and stucco them to match the existing. This addition should be painted to match the existing construction. A north window in the conference room would assist air circulation. Ceramic tile would not be required in the bath on the walls. A good paint job would take care of sanitary needs for cleanliness.

Alanje and Santa Marta

At both of these former MIDA locations, small identical sub-regional support offices exist, built during the 1970's with Alliance for Progress assistance. These buildings are similar in concept but smaller than the current IDIAP sub-regional centers now being built. It is instructive to note the changes that have been made in them.

At Santa Marta, one of the two small offices is now a dormitory with two beds. Curtains were needed at the glass louvers to cut the light, and provide privacy. The other small office was made into a small laboratory. The rear storage room was increased in size. One of the double doors to the rear carport area was closed up with masonry for security reasons. A coffee area has been developed in the large office area. The rear carport is full of stakes and other miscellaneous equipment.

At Alanje one small office has been turned into a storeroom, which has been made to open off the other office with the door to the large space filled in. A coffee area with refrigerator has been developed. Another bath has been added at the back for the workmen. The carport area has been screened with cyclone fence for security.

Gualaca

The Site:

The site is 18 kilometers north of the Pan American Highway east of David. It is an isolated site of 400 hectareas with a large existing MIDA facility built in 1978 and including an animal nutritian laboratory staffed by seven IDIAP personnnel. All utilities are in place.

The Project:

This is a projected addition of 7.5 meters by 9.0 meters to the existing animal nutritian laboratory. The existing laboratory is well organized, and well maintained. This expansion is to be from national government funds but some additional fixed equipment will be request from AID loan funds. The addition consists of an annex to the existing main work space, a large store room, an office and clean equipment room.

Plan Review:

Cabinet details should be developed. All drawers should be on drawer guides. The exterior doors should have thresholds. The stoops should be larger and should slope outward to keep water out of the building.

Los Santos

The Site:

The site is located on the north outskirts of Los Santos. It is an experimental farm of about 10 hectareas with an existing building, recently partially remodeled, containing offices, covered vehicle parking, living quarters for a watchman, and storage facilities. This is an old MIDA installation and looks as if it could have been the model for the new sub-regional IDIAP buildings. Six technicians, two assistants, and fourteen field laborers use this as their support facility. One office has a small through-the-wall air conditioner. The site slopes gently to the north. There are many existing mature trees. To the west is a radio transmitting station and towers, to the south and east are residential zones, to the far north is the Rio Villa, which floods over about three hectareas from time to time. Municipal water and power serve the existing building.

The Project:

Proposed is a 11.5 meter by 19.1 meter building containing offices to replace the existing offices, new administration offices, conference room, office storage, secretarial space and toilet facilities. The project is similar in concept and construction to the sub-regional model, however, in this case the building is projected to be centrally air-conditioned, which involves a suspended acoustical ceiling. The building is proposed to be oriented with the long dimension (and entry) facing west.

Plan Review:

Apparently CIMMYT/IDIAP is planning a seed processing plant on this site. That plant shoud be located where the new building is projected. Prevailing breezes come out of the northeast, which will take the dust of the plant harmlessly out of the unmanned site of the radio transmitters. This location is also most convenient for truck access. The existing project should be oriented parallel to the existing building north of it, which will give a better solar orientation to it. Neglecting the advisability of central air conditioning discussed elsewhere, the following comments apply as a prima facie review of the construction documents.

Sheet No.1

There should be a comprehensive site development plan at scale 1:100 showing site drainage, site materials, site details, sidewalks, site utilities, air conditioning compressors, etc., to coordinate all site components.

The use of double doors in the entry and to the conference room should be questioned. If large items need to be brought into the conference room then an oversize regular door should be considered. Double doors present hardware problems, installation problems and maintenance problems. Untempered glass in doors present safety and potential security problems. A 1 x 3 facing should be added to the edge of the entry window ledge between the reception and the administration area for stability.

Sheet No.2.

Conference room windows not shown on front elevation nor properly located on right side elevation. Exposed, expressed masonry jointing should not be considered in light of its failure at Progreso, Caisán and Guarumal. Perhaps the best approach to the hall closet is to divide it into three divisions, instead of two, which would then permit the use of three separate single doors. This would save money on doors, eliminate hardware, fitting and maintenance problems. This would make the doors easier to lock if desired. The shelves of 1/2" plywood are inadequate without a 1 x 4 facing with the plywood let into it.

Are bars needed on the windows or will the site watchman be sufficient security?

Show a/c units, electrical installations in elevations. Show condensate piping.

Sheet No.3.

Question the use of wall tile in the bathrooms unless required by national codes. The joints are unsanitary and a well painted smooth wall is easier to maintain. Show tile facing to first step in detail 6/3 with the sidewalk coming up to it.

Sheet No.4.

Question that enough space exists above the suspended ceiling for duct clearance at the beams. Certainly lights and ducts together will not fit under concrete frame. Better to make the building higher.

Sheet No.5.

Question number of convenience outlets in the conference room. The telephone panel is not located in plan. Consider more telephone outlets in most rooms and the use of one inch conduit. Light switch at the storage room at the administration office is located behind the door swing. Best to move it to the other side.

Sheet No.6.

Air conditioning unit in the conference room is shown over column. Section A does not show projecting concrete beams which conflict with the ducts. Question the 12" x 8" branch off trunk line to baths. Better to extend and amplify the 14 x 6 duct in north office. It is hard to control the volume in a branch duct so close to the air handling unit. The top left hand office might be better fed off its neighbor's branch duct than to transition down so far. No splitter would be required and there might be less air noise and turbulance. Two inches duct insulation with reflective foil would be better if available. No outside makeup air intake shown at the air conditioning machine room.

Sheet No.7.

Provide vent through roof from the drain at the janitor's closet. Drainage field is excessive for this number of fixture units.

Divisa

The Site:

An irregular bow tie shaped site of about 175 meter frontage on the north side of the Pan American Highway at Divisa and 220 meter depth. A Guardia installation is to the east and MIDA cultivated fields are to the west and to the north. The site is cut into a front approximately 2/3 and a back 1/3 by an existing overhead IRHE high tension easement (not shown on the plans.) There is no existing vegetation on the site. The site slopes to the highway approximately 1/2 meter. The soil looks heavy and expansive. No soil tests have yet been taken. Municipal water and IRHE power are available at the front of the site along the highway.

The Project:

This is one of three regional administrative and technical ceters to be constructed. It is to serve the Veraguas, Herrera, and Los Santos areas and to replace facilities now located in MIDA owned buildings and rented facilities at Santiago.

The Plan:

Two rectangular single story buildings of approximately 20 meters by 40 meters, and two small greenhouses are proposed. The building to the east is to have professional, technical and administrative offices, a library and large conference room. The building to the west is to contain laboratories, with the two greenhouses to the northwest. The buildings are to be roughly parallel to the highway, with the main site entrance between them, and parking on both sides of them.

Building Approach:

They are to be single span steel frame structures with metal roofs and concrete block non hearing exterior walls and interior partitions. They are to be centrally air conditioned and have a suspended acoustical celling, glass louver windows, fluorescent lighting and custom cabinetry.

Plan Review:

The following commentary is based on 95% completed set of drawings provided by the IDIAP architect José Isturain. The review is intended only with an eye to eliminating field construction problems encountered in the sub-regional facilities, and calling attention to problems of drawing inconsistances, conflict and inadequate or poorly conceived detailing. At this point in the process it must be assumed that the interior spaces are properly sized and laid out to facilitate work flow. An overall critique of the approach is found elsewhere in this report.

Sheet No.1.

The overhead IRHE lines should be shown on the site plan. The septic system and drainage field would probably be better located closer to the front of site as where they are shown. They are uphill from the buildings. A comprehensive site plan showing all utilities and site improvements should be developed at a larger scale. The parking and location of the streets to the south of the laboratory is shown differently throughout the set. The five compressors facing the street at each end of the building might best be shielded with low walls. Instead of grass, a landscaping plan of useful plants should be developed. The one step difference to the office is dangerous and could be replaced by a sloping sidewalk. Site drainage should be indicated.

Sheet No.2.

A sink and counter should be shown in the cafeteria space. Finishes should be noted on the floor plan. The roof should be white for minimum solar heat gain. Mechanical and electrical equipment is not shown on the elevations. The raised stage in the conference room compromises its use. A window from the library checkout counter to the library might be useful.

Sheet No.3.

The stucco detail around the column shown in section H should not be revealed to the face of the building wall. The column might be better encased in concrete, then stuccoed. No details shown for the raised stage.

Sheet No.4.

The end parapet wall detail JJ is poorly conceived. The upper parapet is not properly supported. The flashing detail is very difficult to achieve. The gutter detail shows a projecting scupper not a downspout as shown other places. It is also inadequately sized. The gutter should show strap supports.

Sheet No.5.

The use of tile on the walls should be questioned. It is more sanitary to use epoxy or oil based paint.

Sheet No.6.

The use of fiberglass ducts should be questioned. The 3 1/2" insulation should be shown in the section.

Sheet No.7.

There are insufficient number of telephone outlets as well as convenience outlets. The lights are not coordinated with the ceiling diffusers and returns.

Sheet No.8.

The capacity of the tank and the size of the drainage field should be verified for the facility. If acids are used in the lab portion, some thought might be given to pretreatment and separation from domestic sewage for environmental reasons.

Sheet No.9.

A minimum of a 2" line shold serve the site, not 1". The drainage and septic system would be better located to the front of the site. Hose bibbs shouls be added to serve the site.

Sheet No.10.

The parking and street location is not in accordance with the site plan. Consideration should be given to installing a urinal in the men's room as there is plenty of room, and a privacy screen to the commode in both toilets. Double sinks would be better in each toilet. The use of tile on the walls should be questioned.

Sheet No.11.

The projection screens around the east and west windows are not detailed. The roof should be painted white. All mechanical and electrical equipment should be shown.

Sheet No.12.

There are dimension inconsistencies between this sheet and sheet No.10.

Sheet No.13

The whole column would be better encased in concrete in section BB.

Sheet No.14.

There are partition inconsistencies between this sheer and sheet No.10.

Sheet No.15, No.16, No.17, No.18 and No.19.

The cabinet elevations do not account for their being shop built offsite. They would be brought in sections to the jobsite, therefore shim space and spacers should be considered. All drawers should be on drawer guides, KV 1,300, or equal. All drawer fronts should be reinforced with let-in continous members.

Sheet No.20.

The lights are not coordinated with the mechanical diffusers and returns. The plan is different from sheet No.10. Verify electrical requirements for the refrigeration room.

Sheet No.21.

The pole lamps might be better located closer to the building.

Sheet No.22.

The door elevation is unique in the set. No door elevations have been provided.

Sheet No.23.

Laboratory and domestic waste might be best separated.

Sheet No.24.

The 36" x 36" supply ducts should be verified that they will fit in the space provided.

Sheet No.25.

A separate exhaust might be best provided for the chemical storage room. The air return system should be reviewed for cross contamination. No details are provided for the ducts, nor is equipment specified.

Sheet No.26.

Some thought should be given to closing the openings where the fiberglass meets the structure. There should be insect screen on the upper ventilator. The door should be detailed and its materials called out. The electrical installation should be drawn in the elevations and sections.

Soils Laboratory at Divisa

-Small existing soils lab belonging to MIDA but staffed by IDIAP.

-Built in 1948, brick load bearing walls.

-Building in run down condition, little maintenance.

-Problems stem from usual tropical sources:

1) Poor exterior drainage
2) Poor roof
3) Poor plumbing
4) Poor maintenance

Because of poor exterior drainage; some settlement of exterior walls, footings; floor slab has settled; separation of concrete block interior partitions and exterior walls.

Because of poor roof: cellotex ceiling stained and falling in.

Because of poor plumbing: drains eaten away by acid waste and dumping directly out on ground in back of building.

Because of poor maintenance: plaster not repaired or adequately protected by paint, structure is attacked by the bad drainage.

Poor use of interior space: disproportionate reception/secretarial to laboratory space.

Poor work flow due to bad floor plan.

Storeroom, air conditioned but not vented.

Inadequate electrical and out of date.

Rehabilitation, questionable, particularly if upper wood roof structure has been attacked by termites, which is probable.

Better to build a new building, particularly if existing laboratory would have to function during remodeling or be moved to another temporary location.

David

The Site:

The site is rectangular, approximately 90 meters wide and 185 meters deep located about 1/2 kilometer west of David fronting on the north side of the Pan American Highway. Formerly, under cultivation, the only vegetation is a large tree on the back of the site. A large privately owned agricultural commodity storage building is under construction on the east and gas station and bulk oil broker is to the west. Cultivated fields lie to the north. The site is fenced with barbed wire. It lies below the level of the road sloping approximately 1/2 meter to the front of site. An existing drainage channel has to be crossed to enter the site. The soil looks heavy and expansive; no soil tests have been taken. No municipal facilities extend to this point except electricity from overhead lines on the front of the site.

The Project:

This is one of three regional administrative and technical centers to be constructed. It is to serve the Chiriquí region, of which there are approximately 40 professional people, and 40 secretarial and administrative staff. A single story rectangular building of a similar plan and construction approach as that at Divisa is proposed for this site.

The building would incorporate professional, technical, and administration offices, library, laboratory space, and a large conference room. The building is to be fully air conditioned and be of a similar level of finish to the Divisa facility. The 18.4 meter by 37.65 meter building is to be oriented with the long dimensions parallel to the highway with the entrance street to the east. Future construction planned for this site is to include a vehicle storage and maintenance facility now located at a MIDA owned building on the other side of David.

Plan Review:

The following comments are based on a set of plans provided by IDIAP architect José Isturain and have been represented as being 95% complete. The plan is presumed to be functional and in accordance with the users' needs. Comments on the overall architectural concepts, on central air conditioning and other issues are made elsewhere. The focus of this review is: The coordination of architectural and engineering information, the highlighting of areas where information is lacking, and the identification of areas of potential functional, quality or construction problems.

Sheet No.1.

There should be a large scale omprehensive site plan with all utilities, site improvements, landscaping and drainage indicated. There is no provision for foot traffic between buildings. Future expansion of the building to the east is doubtful as all the five compressors are located there as well as a sewer line and other utility apparatus. If grades as indicated are to be believed then no stairs are required to enter the building. If furute expasion is being seroursly considered, it would be better to shift the building to the east and build to the west side. The cabinet sections anticipate built in place cabinetry. These cabinets would be shop built and should be so detailed. There should be large scale cabinet details showing finish and hardware. The sizes of support for countertops is inadequate. Drawers should be on drawer guides. The underside of countertops covered with plastic laminate should have backing sheets to resist warpage. Sinks should indicate anchorage. Fronts of shelves should be reinforced with let in continuos members.

Sheet No.2.

The roof should be white, not red, for maximum solar reflectivity. The flat 15% slope will not permit much of a view of the roofs in any event. The elevated stage in the conference room limits its use. No details for its construction are included in this set of plans.

Downspouts are not shown in the elevations, nor is the electrical service entrance nor air conditioning equipment. The air intake for unit UE 2 is not shown on the roof, nor is the air intake grill for the air conditioning room. The exhaust fan on the roof is not indicated.

Sheet No.3.

No details are shown for the elevated stage. Sheet size and anchorage should be called out on the section for the metal roofing.

Sheet No.4.

The end wall JJ detail creates a weak parapet wall. The flashing as shown is very difficult to achieve. The roof should project over the wall to shade it and cut heat infiltration into the building. No details are shown for the slab supporting the unit UE 2.

Sheet No.5.

The central drainage channel in the cabinetry is shown as galvanized, detail B, it probably should be of a more corrosion resistant material. The long under counter shelf in elevation 9 should have a 2 x 4 face support to strengthen it, as well as the counter above. Intermediate supports would be useful. The notes on cabinetry sheet one apply.

Sheet No.6.

The lights are not coordinated with the ceiling diffusers and returns. The drop slab under the unit UE 2 is not shown, and the light shown there will not fit. An overall comprehensive reflected ceiling plan should be developed. The tile on the walls in the bath should be questioned. It is better to paint the walls with oil based or epoxy based paints.

Sheet No.7.

The general use of fiberglass ducts should be questioned. They are subjected to internal erosion and the released fibers area heath hazard. On the other hand the use of fiberglass ducts for the exhaust fan should be considered as they are not subject to corrosion. The air intake for unit UE 2 is adjacent to a plumbing vent.

The plumbing vent should be moved. No return grills should be installed in the toilet room doors. Air conditioning condensing units are located in the way of expansion.

Sheet No.8.

The main service entrance location eliminates the window at that office. No electrical is shown to the water pump location.

Sheet No.9.

The drainage field runs uphill. It could be located to the front of the site. The downspouts are not called out in size and there are insufficient number for the runoff. The downspouts should be either run to the cañas or taken away from the building and used to water landscaping. The cañas at the entrances should have a cover over them for foot trafic. The cañas flanking the west end of the parking lot on the streetside should drain to the east. The entry line from the pump should be 1 1/2" minimum. More hosebibbs should be developed for site use. The cleanout in the library floor should be questioned. The sink in the janitor's closet is shown in two different locations. The water fountain is not shown in plan.

Sheet No.10.

The septic tank details will not be pertinent as the septic tank will be considerably lower than shown as the drainage to it is running uphill. The drainage field should be changed to the front of the site.

2. Observations and Conclusions

Architectural design addresses more than functional needs for shelter of activities--it should make a statement about the climate, about the site, about the culture, about the technology, about the aesthetic preferences of the owner, and about the owner's economic situation. Buildings do demonstrate care, craftsmanship, concern for detail, and interest in organization and order. They can instruct their users in ideological as well as cultural values. They can delight or anger the user at every encounter. They can make happy users or inefficient and frustrated prisioners. They can be good investments requiring a minimum of staff, energy and maintenace or they can deteriorate quickly and drain their owner's economic resources.

The regional designs for Dvisa and David offer little delight and less economy. They fix IDIAP into requiring air conditioning and interior lighting and really offer no alternative were energy to become prohibitively expensive, or were an air conditioning unit to require maintenance not locally available, or were the power source to go out. The buildings are not conceived as having to depend upon cross ventilation, natural light, or ceiling fans. Dead end corridors are used as return air polenums. Ten large compressors are the first items, one sees turning into the administration building at Divisa. Ideologically and practically these are statements to the public and to the users of these buildings.

It should be stressed that many of the problems encountered in the IDIAP architectural plans and projects in costruction are more indicative if the level of the standards and accepted norms of the architectural and engineering professions and construction industry, than an indication of the competence and diligence of the IDIAP staff. It should be emphasized that the staff professionals seem keen to learn from their projects in construction and have persevered despite formidable bureaucratic and financial obstacles. The requirement of having to accept the lowest bid enevitable creates quality and performance difficulties. In such a bidding situation, the importance of good construction plans and specifications cannot be under estimated. It should be noted that the engineering staff of AID Panama made many and important changes in their plan review for the sub-regional centers, and significantly improved these projects.

However a good many of the quality problems that IDIAP has been experiencing in that construction can be traced to inadequanies of their plans. Little attention has been directed by the architects to building orientation, direction of land slope, site drainage, landscaping, or to the users' needs for cover from the hot sun or staying out of the mud in a wet, poorly drained, area. An excellent example is the building cabinetry. The plans have no details of their construction, no tolerances or shims shown to facilitate their installation, no notes on finishes, materials are undersized and no hardware is called out. The cabinetry problems at Progreso, Caisán and Guarumal do not stem from hte remoteness of their sites or lack of local craftmanship. All the cabinetry for these projects were made in Panama City and installed by workers from Panama City. Similarly, careful review of the plans could have exposed many of the problems of attachment, hardware, electrical installation, septic, and exposed concrete block jointing.

Recommendations:

An enormous effort has been expended into the development of the regional plans for David and Divisa. In many respects it is too late to review the appropriateness of the architectural and engineering concepts of this projects. However, certain points should be brought out about one of the major elements and determinents of these designs---and that is central air conditioning.

If air conditioning is really required (as in laboratories with sensitive equipment) then consider more air tight (but operable) windows, consider shading the walls to cut heat infiltration, paint the roof white to reflect solar gain, shade all glass areas completely, shade the building with rees, consider insultaing the exterior walls, increase the insulation in the ceiling, and increase the insulation surrounding the ducts.

If air conditioning is really not required, then consider most of the abouve and large exhaust fans, flow through ventilation, make the ceiling at least 9-6" high so that ceiling fans may installed and provide shade and rain coverage and perhaps covered parking, so that people going from cars to the building, and from building to building, do not come to the buildiing overheated.

Introduce some Panamanian elements--interesting colors, textures, some interesting detail, some natural material shading devides--perhaps of bamboo--, and at the very least a landscape plan of useful plants--not decorative, no productive, and maintenance intensive lawn. Consider light ramadas covered with natural plant cover for parking and to create a pool of cooler, air around the building. Provide covered seating and tables outside for having lunch in good weather and for relief of being inside. Consider using roof runoff to irrigate landscaping. These buildings should offer a welcoming canopy to the visitor, make him feel at home and make a statement about the work and values of the staff of these facilities.

The experience of the sub-regional center is clear: IDIAP has largely received a good facsimilie of their plans. The weaknesses of the built projects, as this report has attempted ro demonstrate, could have been disclosed from a careful review of their plans. To better the project, improve the plans and the planning process. AID Panama should requiere earlier, periodic and timely reviews of thier funded projects. Input at the end of a long and complicated project puts in jeorpardy a considerable investment in engineering planing servises.

To this end, the detailed review of the David and Divisa plans included in this set is an attempt to help to eliminate the problems encountered in the construction of the sub-regional centers. This critique has been received by the IDIAP professionales in the spirit that it was given-to improve the projects for the use and delight of the Panamanian people.

G. Purchase of Vehicles, Equipment and Supplies.

A review of the purchase of vehicles, equipment and supplies purchased by IDIAP with USAID funding shows that a few items of equipment were purchased in 1980 and 1981. However, the bulk of the purchases were made in 1982 and early 1983.

Followings is a list of the general categories for which funds were expended.

Expenditures for Vehicles, Equipment and Supplies

Construction materials	20,695	
Farm machinery	132,038	16%
Farms tools and supplies	3,684	
Veterinary supplies	5,652	
Milking equipment	306	
Other farm supplies	553	
Research supplies	215	
Fertilizers	37,793	
Insecticides	5,496	
Lab. reagents	9,210	
Animal feeds and minerals	3,968	
Lab. equipment	118,985	15%
Communication equipment and supplies	22,780	
Office equipment	22,850	
Machine shop equipment	26,351	
Vehicles	367,064	45%
Computer equipment	4,900	
Publications	23,906	
Office supplies	3,364	
Total.....	810,503	

As can be seen from a review of this list, expenditures were made for all types of equipment and supplies required for the establishment and operation of the research areas. This included day to day supplies such as fertilizers, seeds, herbicides, feeds, drugs, etc., that are essential for normal research function. However, more than 76% of the total was expended for vehicles, farm machinery and laboratory equipment, with the largest portion (45%) being expended for vehicles. From the beginning of the project until April 1983 approximately $810,000 were spent.

Without this funding, IDIAP would not have been able to develop and sustain its area-focused research programs. Counterpart funding for other equipment and supplies has also been significant. This was supported by a budget increase in 1982, but has suffered somewhat during 1983. It should be noted that there is a multiplier effect associated with the vehicles, equipment and supplies purchased under this contract. The institutional infrastructive developed has served as a base upon which other collaborative programs have functioned.

Field staff have expressed much concern and disappointment over the timeliness of purchases and supplies. Many have indicated that requests for simple equipment essential for normal function of their programs have taken as much as six months to arrive, with many supplies arriving too late to be useful to the programs, especially in those programs which are seasonal in nature and must depend upon seasonal rainfall.

Although these delays are familiar to many national organizations, the system is excessively slow, cumbersome and bureaucratic. In IDIAP the process is complicated by a centralization of all approval and purchases in Panama. Initially the regional centers are required to submit a plan for the equipment and supplies they will require for the year. Following an analysis and review of the overall request, the regions are advised of the items that they will be allowed to purchase. Specific request for these items are sent to the central office for purchase. Approval for each request requires no less than 12 signatures.

The administration is well aware of these delays and is studying ways to make the process more efficient and less bureaucratic. From their initial review of this problem if appears that decentralization of the process will accelerate the purchase process. However, government regulations and controls will prevent a complete modification of the process.

Conclusions:

Purchases of equipment and supplies are slow and in some instances have prevented the normal function of research activities even to the point of causing the loss of some xperiments. IDIAP administration is aware of the delays resulting from a cumbersome and bureaucratic purchasing system. Purchasing with USAID funds are further delayed and complicated by the many U.S. Government formalities and procedures that must be followed. Ways to reduce the paperwork and to speed up authorization are being studied. Decentralization within IDIAP to allow regional centers to purchase directly will help to reduce the bureocratic process but will not reduce the formal processes required by law.

Recommendations:

- Initiate a system of yearly program and budgetary planning that will anticipate research needs.
- Streamline request and purchasing procedures that reduce to a minimum the bureaucratic process.
- Decentralize budgets and purchasing and allow regional centers to purchase directly instead of through the central Panama office.

H. Suggested Criteria to be Used in Subsequent Evaluations

The next general evaluation of the Agriculture Technology Development Project should observe two principal guidelines in collecting information and judging performance and accomplishments:

(1) The research focus of IDIAP as detailed in the original project paper. Highlights of the general organizational and operational philosophy are: a. the concentration of research resources in a few priority areas to work on selected crop and animal activities, b. the planning of research and technology transfer activities in terms of knowledge of farmer circumstances and improved technology generated in Panama and other countries, and c. the carrying out of research trials and validation plots mainly on farmers' fields.

(2) The recommendations made in the present project evaluation for improving the functioning of IDIAP. Two major concerns discussed in the report and expressed as recommendations are that: a. IDIAP should move more aggresively in establishing an effective linkage with MIDA extension in transfer of improved technology to target farmers. The integration of IDIAP and MIDA efforts is necessary at all institutional levels, particularly in activities in the priority areas where personnel of the two institutions should work together in the total research-transfer process; and (2) IDIAP research methodology should be strengthend, particularly in the animal production studies. Major deficiencies noted were the little importance given to replicated trials and the quantitative evaluation of the performance of forages in the animal science program, and the failure to record detailed observations on plant and animal response to treatments in most experimental studies of farmers' fields.

In the case of both the original project paper and the present evaluation report, emphasis was placed on the importance of short-term and degree training of IDIAP staff and the close collaboration between IDIAP and other national and international agricultural intitutions. Accelerated training of IDIAP staff is viewed as the single most important activity in overall strengthening of the institution. Close collaboration with other institutions is seen as an effective means of achieving greater operational efficiency and of assuring that the best available information on technology is utilized in planning and implementing research in priority areas. Both training and institutional collaboration should receive careful study in future project valuations.

APPENDIX I ITINERARIES OF TEAM VISITS

GROUP I.- Livestock/Pastures

Coordinator		-	Dr. Carlos Morán
Evaluators		-	Dr. Eduardo Venezian
			Dr. Jerome Maner
Tuesday	6/14	-	Leave Panama in the morning, visit Calabacito, continue to David.
Wednesday	6/15	-	Visit Bugaba, fincas of livestock producers. Seminar of CATIE/IDIAP/ and other agencies.
Thursday	6/16	-	Visit Finca Chiriquí, IDIAP Regional office; attend IDIAP monthly staff seminar.
Friday	6/17	-	Visit Gualaca.
Monday	6/20	-	Visitar Sur de Sona.
Tuesday	6/21	-	Visit Los Santos and meeting with the technical and research personnel of Central Region.

GROUP II.- Agriculture

Coordinator		-	Dr. Gaspar Silvera
Evaluators		-	Dr. Reggie Laird
		-	Dr. Jack Rigney
Tuesday	6/14	-	Visit Río Hato, Penonomé and Divisa, continue to David.
Wednesday	6/15	-	Visit Caisan
Thursday	6/16	-	Visit Cerro Punta and Alanje
Friday	6/17	-	Visit Progreso
Saturday	6/18	-	Meeting with technicians and researches of the western region.
Sunday	6/19	-	Santiago
Monday	6/20	-	Visit Guarumal
Tuesday	6/21	-	Visit Los Santos

GROUP III.- Training

Coordinators - Lic. Miguel Cuellar
Sandra Nelson

Evaluators - Dr. Jerome Maner
Dr. Jack Rigney

Work in Panama

GROUP IV.- Construction

Coordinator - Arq. Jose Esturain

Evaluator - Arq. Ron Fridlind

Tuesday 6/14 - Visit Divisa and Calabacito, continue to David.

Wednesday 6/15 - Visit Progreso and central region sites.

Thursday 6/16 - Visit Western Regional Center and Caisan.

Friday 6/17 - Guarumal

Saturday 6/18 - Los Santos, Panama

APPENDIX TABLE II - Adiestramiento a Corto Plazo Pagado por IDIAP

CONCEPTO		ACUMULADO AL 31 DE [illegible]	
NOMBRE	CURSO, SEMINARIO, GIRAS Y OTROS.	CONTRATADO B/.	GASTADO
TOTAL.....		61,833.00	58,339.40
Eric Candanedo	XII Reun. de Nematolog.	1,087.00	1,087.00
Mirnino Chávez	Curso/Prod. de soya	1,530.00	1,530.00
Caspar Silvera	Conf./Calidad de Frijol de soya.	1,390.00	1,390.00
Felipe González Func. de IDIAP	Curso/Prod. de maíz	5,250.00	5,250.00
	III Curso Intensivo de arroz.	3,750.00	3,750.00
Lineth de Lambolia.	Inv. para la Prod. de arroz con riego.	4,676.00	4,676.00
Carlos Ortega	XIII Cong. Internacional de Pastos.	720.00	720.00
Miguel Acosta Func. de IDIAP	Curso/Prod. de Frijol	2,975.00	2,975.00
	Sem. y Conf. dictados a personal tec. y Directivo.	3,000.00	3,000.00
José Isturain	Sem. Latinoamericano de Construcción.		
Orencio Fernández.	Seminario Taller de Virología.	350.00	350.00
Alejandro Ferrer.	XXII Reunión Anual de la Soc. Americana de Fitopatología.	800.00	800.00
César Velasco	Seminario y Congreso de Apicultura.	525.00	525.00
Ramón Vanegas	Seminario y Congreso de Apicultura.	784.00	784.00
Marcos Navarro Func. del Sector Agropec.	Curso de Inglés	784.00	784.00
	I Encuentro De Inv. Agropecuarias.	420.00	420.00
		11,931.00	11,931.00
Hermel López	XIV Cong. Int. de Planificación.	75.00	75.00
Kilmer Von CHong.	Curso de Inglés	145.00	145.00
José Isturain	Sem. de Admon. y Tecnología en Construc.	250.00	250.00
Func. IDIAP	Examen de Evaluación de Inglés.	300.00	300.00
Func. IDIAP	Sem. Taller de Eval. de Invest. en Area de Caisán.	1,957.30	1,957.30
Func. IDIAP	Curso de Transf. de Tecnología.	500.00	500.00
Func. IDIAP	Curso de Inglés.	12,240.00	12,240.00
Func. IDIAP	Curso /Métodos y Criterios de selec. y eval. de personal y Prog. de Inv. Técnicas de seguimiento.	6,494.00	3,994.00

APPENDIX TABLE III. - Adiestramientos a Largo Plazo Financiados por AID

NOMBRE	ESPECIALIDAD	LUGAR	AÑOS EN QUE SALEN LOS FUNCIONARIOS A CAPACITARSE				MONTO COMPROMETIDO	MONTO DESEMBOLSADO	SALDO NO CASTADO AL 31/6/81
			1980	1981	1982	1983			
ALEJANDRO DELGADO	Ma. Administración de Empresas Agropecuarias	Universidad Tecnológica de Monterrey - México	x				23,645.00	22,110.13	1,534.87
* MANUEL RUILOBA	Ph.D. Nutrición Animal	Universidad de Florida Gainville	x				71,020.60	56,242.94	14,777.66
PEDRO MIN	Ma. Fitomejorador	Brasil	x				5,270.00	2,309.88	2,960.12
ROBERTO QUIROZ		EE.UU.	x				7,102.20	6,980.32	121.88
ELIZABETH DE RUILOBA	Ma. Comunicación	Universidad de Florida Gainesville-EE.UU.		x			58,188.00	47,232.12	10,955.88
TOMASA VEGA		México	x				3,003.00	3,002.70	0.22
JORGE JONAS	Ph.D. Suelos	Universidad de Filipinas		x			16,000.00	6,114.12	9,885.88
EDILBERTO DE LEON	Ma. Estadística	Universidad de Chapingo México			x		23,875.00	12,548.90	11,326.10
MEDARDO PERALTA	Ma. Acuicultura	Universidad de Auburn, Alabama, EE.UU.			x		34,923.00	27,027.00	7,896.00
ALEXIS IGLESIAS *		México			x		635.00	630.55	4.45
* DOMICIANO HERRERA	Ma. Producción Animal	Universidad de Chapingo, México			x		23,965.00	12,383.21	11,581.79
ERIC CANDANEDO	Ph.D. Hematología	Universidad de Florida Gainesville, EE.UU.			x		46,104.00	20,794.00	25,310.00
* ROBERTO QUIROZ	Ma. Nutrición Animal y Toxicología	Universidad de Raleigh Carolina del Norte, EE.UU.			x		42,148.00	24,768.00	17,380.00
* SAID CABALLERO	Ma. Parasitología	Universidad Autónoma de México			x		24,000.00	3,492.95	20,507.05
MARCOS NAVARRO	Ma. Control de malezas	Lousiana State University Baton Rouge EE.UU.			x		50,600.00	17,226.33	33,373.67
SUSANA P. DE FERNANDEZ	Ma. Fitopatología Vegetal				x		40,172.00	16,960.38	23,211.62
ROMAN GORDON	Ma. Entomología					x	25,790.00	12,390.00	13,400.00
JOSE YAU	M.S.					x	34,600.00	3,200.00	31,400.00
TOTAL							$31,840.80	296,213.61	235,627.19

APPENDIX TABLE III (cont'd)

ADIESTRAMIENTOS PROGRAMADOS A LARGO PLAZO

Año: 1983

NOMBRE	MONTO COMPROMETIDO	MONTO DESEMBOLSADO	SALDO NO GASTADO AL 31/6/83
PEDRO GUERRA	34,600.00	-	34,600.00
KILPER VON CHONG	34,600.00	-	34,600.00
LINETH DE LANDOGLIA	34,600.00	-	34,600.00
LOURDES CHARLES	19,200.00	-	19,200.00
MANUEL DE GRACIA	19,200.00	-	19,200.00
ARNOLD MUÑOZ	19,200.00	-	19,200.00
MIGUEL SARMIENTO	19,200.00	-	19,200.00
TOMAS A. VASQUEZ	19,200.00	-	19,200.00
MIGUEL AVILA	50,600.00	-	50,600.00
ALFONSO SING	25,750.00	-	25,750.00
VIELKA CHANG YAU	20,200.00	-	20,200.00
BEYRA JAEN	20,200.00	-	20,200.00
HERMEL LOPEZ	20,200.00	-	20,200.00
TOTAL	336,750.00	-	336,750.00

APPENDIX TABLE IV - Asistencia Técnica Contratado por IDIAP

NOTA: EL CONTRATADO ES REAL (SE EXCLUYE LAS RESCISIONES DE CONTRATO)

CONCEPTO		ACUMULADO AL 31/5 83	
NOMBRE	ESPECIALIDAD	CONTRATADO B/.	GASTADO B/.
TOTAL		818.657	539.644
D. Chez	Viaje USA	1.937	1.937
T. Rodríguez	Arquitecta	9.000	9.000
A. Chizbara *	Asesor Préstamo	106.850	81.550
I. Arjona	Plan de Invest.	9.500	9.500
Tejada Mora	Sede IDIAP	7.500	7.500
C. Fuentes	Gestión Adm.	3.300	3.300
E. Espinosa	Agrónomo	34.175	34.175
L. De León	Computación	24.000	17.000
R. Sattler *	Banano y Plátano	33.000	22.500
L. López	Semillas	13.900	6.200
G. Ross	Diag. Socio Cultural	19.350	13.050
L. Ulloa *	Educ. Rural	19.350	13.050
M. Rodríguez	Nutrición Vegetal	7.650	7.650
E. Trentin *	Comunicación Agrícola	14.400	14.400
N. Moreno	Avícola y Porcino	25.750	16.650
T. Henríquez	Edafología	5.850	5.850
O. Fernández	Virología	24.600	15.200
I. Bruce	Entomología	18.900	12.600
A. Alvarado	Fitomejoramiento	27.800	11.000
H. Ruiz	Fitopatología	24.600	15.200
C. De La Victoria	Frutales	4.500	4.500
M. Rojas	Riego	20.475	13.125
L. Lasch	Toxicología	17.810	10.080
F. Garibaldo	Coord. Regional	23.400	14.300
J. Martini	Suelos y Cultivos	9.250	9.250
J. Aued	Diag. Districo	17.600	9.900
C. Guardia	Prod. Medios Visuales	4.200	4.200
J. Iturralde	Programa Construcción	14.700	8.500
R. Gabrielli *	Reducción Doc. Cient.	6.800	4.500
A. González	Financiación Proyectos	10.800	8.100
J. Espinosa	Análisis	19.500	9.000
A. Rubiano *	Plan Inv. Pecuaria	80.500	61.000
M. Caribaga *	Sociología	5.500	5.500
A. Cranges	Pol. de Inv. Pecuaria	9.750	9.750
N. Pineda *	Coop. Int. Prod. Básicos	1.730	1.730
K. Tzell	Viaje USA	2.400	2.400
AID/Rutgers	Contrato Univ. Rutgers	28.680	28.680
Técnicos Rutgers	Viajes	17.000	2.097
Técnicos Asist. Técnica	Viajes	25.000	5.220
M. Tejada	Invest. Social	5.950	1.050
J. Pinzón *	Control Plagas	49.600	
E. Esquivel	Fitopatología	9.150	
J. López	Edición Doc. Técnicos	6.750	450

APPENDIX V - LIST OF PEOPLE VISITED BY THE TEAM

Rodrigo Tarté, Director General, IDIAP

Gaspar Silvera, Director of Crops Research, IDIAP

Alfonso Alvarado, Sub-Director of Crops Research, IDIAP

Eziquel Espinoza

Jorge Jonas

José Román Araúz

Ismael Camargo

Delia Jiménez

Miguel Acosta

Rafael Satter

Washington Begarano

Phillip Shannon

Leonardo Marcelino

Rubén De Gracia

Eric Batista

Omar Chavarría, Director of Western Region, IDIAP

Rolando Sánchez Díez

Gabriel Von Linderman, Director of Central Region, IDIAP

German de León

Pedro Him

Ricardo Hernández

Eric Quirós

Santander Jaramillo

María Ruíz

Vasco Nuñez

Celia Sevilla

Thomas Scott - Cornell/Rutgers

Pedro Argel - "

Mark Gaskell - "

Dr. Carlos Morán - Director, Livestock Research

Ing. Julio Santamaria

Ing. Luis Felipe Ulloa

Daniel Batista

María Irene Arosemena

Noemí Tayloa

Alfonso Martínez

Juan Peralta

Rentao Bauera

Beningno Guerro

Olmedo Duque

Estebán Arosemena

Lucas Tason

Sandra Nelson - Head International Corporation