PD-AAS-747
43555

CLASSIFICATION

PROJECT EVALUATION SUMMARY (PES) – PART I

Report Symbol U-

1. PROJECT TITLE	2. PROJECT NUMBER	3. MISSION/AID/W OFFICE
Improved Water and Land Use in the Sierra (Plan MERIS)	527-0156	USAID/Peru

4. EVALUATION NUMBER (Enter the number maintained by the reporting unit e.g., Country or AID/W Administrative Code, Fiscal Year, Serial No. beginning with No. 1 each FY) 06-86

☐ REGULAR EVALUATION ☐ SPECIAL EVALUATION

5. KEY PROJECT IMPLEMENTATION DATES			6. ESTIMATED PROJECT FUNDING	7. PERIOD COVERED BY EVALUATION
A. First PRO-AG or Equivalent FY 76	B. Final Obligation Expected FY 76	C. Final Input Delivery FY 86	A. Total $ 21,000,000 B. U.S. $ 11,000,000	From (month/yr.) To (month/yr.) 9/85 Date of Evaluation Review

8. ACTION DECISIONS APPROVED BY MISSION OR AID/W OFFICE DIRECTOR

A. List decisions and/or unresolved issues; cite those items needing further study. (NOTE: Mission decisions which anticipate AID/W or regional office action should specify type of document, e.g., airgram, SPAR, PIO, which will present detailed request.)	B. NAME OF OFFICER RESPONSIBLE FOR ACTION	C. DATE ACTION TO BE COMPLETED
1. The Mission accepts the attached contractor's report. Comments on the quality of the contractor's report plus a summary are provided in Part II of this PES.		
2. This is a final evaluation report. The revised PACD is December 31, 1985. The contractor's report recommends that the San Marcos Pilot Project be extended for two or three months to insure adequate data analysis. Extending the PACD at this point is not possible, but the Mission is working on another arrangement with additional funds to provide adequate data analysis.		March 86
3. The Mission feels that the evaluation results are in general positive and plans to consider additional small and medium scale irrigation activities in the Sierra that are based on this evaluation and on the upcoming data analysis of the San Marcos Pilot Project.		

9. INVENTORY OF DOCUMENTS TO BE REVISED PER ABOVE DECISIONS

☐ Project Paper ☐ Implementation Plan e.g., CPI Network ☐ Other (Specify)
☐ Financial Plan ☐ PIO/T
☐ Logical Framework ☐ PIO/C ☐ Other (Specify)
☐ Project Agreement ☐ PIO/P

10. ALTERNATIVE DECISIONS ON FUTURE OF PROJECT

A. ☐ Continue Project Without Change
B. ☐ Change Project Design and/or ☐ Change Implementation Plan
C. ☐ Discontinue Project

11. PROJECT OFFICER AND HOST COUNTRY OR OTHER RANKING PARTICIPANTS AS APPROPRIATE (Names and Titles)

Raymond W. Waldron, USAID Project Manager

Raymond W. Waldron

12. Mission/AID/W Office Director Approval

Signature George A. Hill

Typed Name

Date 1/2/86

AID 1330-15 (3-78)

PROJECT EVALUATION SUMMARY - PART II

A. The Contractor's Report

The final evaluation was performed by the Institute of Development Anthropology through an IQC Work Order. See the attached "Article II - Objectives" and "Article III - Statement of Work" that defines their scope of work. This final evaluation was completed in two stages. First, an economist, anthropologist and irrigation engineer made a three-week visit to begin the data gathering process and design the evaluation methodology in February and March, 1985. In June, a rural sociologist was added to this team, and for a two-month period they gathered additional information, analyzed it and wrote the report.

B. Background

The Mission was in general satisfied with the contractor's work. Their final report was strong in its analysis of production, income, and employment effects. In this respect, the evaluation was perhaps unique in terms of hard data that was analyzed. Internal rates of return were calculated, and other project outputs were evaluated quantitatively. The final report was somewhat weak however in presenting the findings in a cogent and easily accessible manner. For example, Chapter 1 "Evaluation Goals, Methods and Findings" is an adequate executive summary, but the Mission would have preferred that the executive summary be more detailed. For this reason the following sections of this PES go into more detail than usual. The development impact of the project is covered in the different sections of the contractor's evaluation. The Mission would have preferred that this be a separate section. Also, the small-scale water management investment model and the lessons learned could have been more explicitly presented. The evaluation is useful to the Mission, and this information will enable future irrigation activities to be planned with a greater knowledge base.

The Project Loan Agreement was signed September 26, 1976 committing $21,000,000 ($11,000,000 Loan, $10,000,000 Peruvian Government contribution) to the project. The project purpose was: "to improve water and land use in the Sierra through (a) an increase in productive land area, (b) an increase in crop yields, (c) expansion of cropping alternatives, (d) an increase in the efficiency of water use, (e) a reduction in soil loss from erosion and (f) strengthening GOP technical capacity at the regional level".

The rationale for this small scale irrigation project was two-fold. First, there was an absolute need to increase food production as domestic agricultural production had not kept pace with population growth, which forced Peru to use scarce foreign exchange to import food. Secondly, there was social and regional development objectives. Income distribution was highly skewed, and most government investment had been in the coastal region. The consequence of this was a deterioration in the quality of life in the mountains or Sierra where most people live. This has led to out-migration

from the mountains and undesirable concentration in the capital city. Thus, there was a need for additional investment in the Sierra to reverse the deteriorating trend. An additional point is that per hectare irrigation costs in the Sierra were significantly less than in the coast. Although the production increase is also less, projects in the Sierra still show a favorable benefit-cost ratio.

C. End-of-Project Status

Project implementation resulted in carrying out 17 sub-projects - 9 in the department of Cajamarca and 8 in the department of Junin. In total, 11,261 families were counted as project beneficiaries. 5,455 hectares were newly irrigated as a result of the project, and irrigation was improved on another 7,988 hectares. Thus, productive land area was expanded or recuperated. Also, an increase in crop yields was realized. These increases were greater than the original projections in some cases. See Table 4.3: Yields for Major Crops in Six Selected Projects on page 53 of the contractor's report. In some sub-projects in the Junin area, the cropping mix was changed to higher value crops, thereby further increasing income available to project beneficiaries. The project purpose of increasing productive land area, increasing crop yeilds, expanding cropping alternatives and increasing the efficiency of water use were achieved. Some areas were reforested as a result of the project, and the regional Plan MERIS offices in Junin and Cajamarca have an improved engineering capability. Thus the project contributed to the achievement of these parts of the project purpose as well. These factors combined influenced positively the quality of life in the Sierra. Also, expansion and improvement of the irrigation network helped to reduce the risk of drought for project beneficiaries. Therefore, it is reasonable to assume that the project may have reduced out-migration from the Sierra in sub-project areas, but no hard data to this effect exists.

D. Implementing Institutions

Organizational problems have impeded timely implementation of project activities from the beginning. Organizationally Plan MERIS is managed through the Special Program for Small and Medium Scale Irrigation in the Ministry of Agriculture. Within the Ministry of Agriculture, moving the project from the General Directorate of Water to the General Executive Directorate and later creating the National Institute for the Expansion of the Agricultural Frontier (INAF) delayed project implementation. The special project approach was used to simplify project management because the administrative and budgetary process within the Ministry of Agriculture was too complex. The special project was to have its own budget direct from the treasury, its own organizational structure and separate contracting authority. Although this arrangement removed the project somewhat from the administrative problems involved in implementing any project through the Peruvian public sector, the administrative and accounting regulations that apply to public sector agencies slowed project implementation. For example, although the agreed upon counterpart budget was approved each year, amounts well below these levels

were disbursed, and implementation fell behind. For this reason, the construction period was in most cases much longer than anticipated.

The relationship of Plan MERIS to other institutions varied depending upon the particulars of the institution involved. One of the most important relationships was with the Banco Agrario who was in charge of implementing the credit component of the project. At first, the credit component moved extremely slowly. USAID's approval of changes in the bank's requirements to include loans for dairy operations and the bank's acceptance of certificates of possession instead of land titles did increase the lending rate. Still little credit reached the small land holder. This was due in part to his predilection against credit and was especially true for subsistence farmers who could not justify the cost of credit to produce goods that are not be sold. Also the bank's administrative cost for making loans to small farmers was similar to its cost for administering larger loans; thus there was little incentive for promoting loans to small farmers. In-kind loans have been recommended by project personnel and the evaluation team. In an attempt to find a solution to these problems, USAID and the project funded the services of a short- and long-term advisor. The agreed upon purpose was to design and implement a pilot activity within Plan MERIS that would facilitate the movement of credit to Plan MERIS beneficiaries. In spite of the problems in moving the credit, Plan MERIS personnel generally had good relationships with the Banco Agrario. They helped clients gather information to meet the loan requirements, and the bank appears to have trusted their opinions.

In general, the local Centers for Agricultural Research and Extension (CIPAs) provided less support than was needed. This was because during the project the Institute for Agricultural Research and Extension was relatively new and was concentrating on five national production programs and on rainfed agriculture in the Sierra. There was, however, successful collaboration between Plan MERIS and the extension office in Huancayo on a series of training courses.

At the end of the project, completed works will pass to the regional irrigation districts for management. There has been very little interaction between project personnel and the irrigation district in Junin. In Cajamarca, on the other hand, a collaborative relationship has developed. The irrigation districts are important because they establish water user fees.

The most important local institution involved in irrigation is the community irrigation committee. These committees have been in existence for some time and are organized along traditional lines. Although these committees are not efficiently managed, the failure of Plan MERIS to work with existing committees is causing some conflicts with users. These committees are responsible for collecting fees used to maintain the system. In general, however, they do not fulfill this collecting function and because of this future maintenance problems are projected. Some work with these committees should have been initiated earlier to establish an acceptable policy that can be implemented.

E. The Economic Evaluation

Detailed economic information was available so that internal rates of return (IRRs) could be recalculated. Two calculations based on different assumptions were made. First, it was assumed that crop yields, in sub-projects with land still to be irrigated, would continue to increase but at lower annual rates than experienced to date. IRRs based on this assumption ranged from 15 percent to 37.9 percent. Another calculation was made assuming that no additional production gains would be achieved. Naturally this lowered results with the IRRs ranging from 1.1 percent to 34.2 percent. It should be noted that four sub-projects still had IRRs over 12 percent.

Factors affecting the benefit-cost analysis included higher than expected construction costs and lower than expected yield increases. Construction costs are the major determinant of overall costs, and the previously mentioned delays in disbursing funds to the field is in part responsible for these cost increases. These costs on a per hectare basis ranged from a low of $308 to a high of $1070. Differences in site account for this variability in cost. Although these costs were almost double the original estimates, they compare favorably to similar projects implemented by other agencies whose per hectare costs were often in excess of $2000. See Table 4.1 page 49. Also these costs are considerably less than irrigation costs in the Coast where per hectare costs run as high as $15,000. This is consistent with the findings presented in the Report of the U.S. Presidential Agricultural Mission to Peru. The new Peruvian government, as well, is placing most of its emphasis on agriculture in the Sierra as opposed to the coast or jungle. This is due to social as well as economic reasons. Yield increases were less than expected primarily due to the previously mentioned failure of many farmers to use credit to purchase additional priced inputs such as fertilizers. In spite of these problems, however, the Plan MERIS project has yielded quite impressive economic results.

The economic achievements were accomplished despite a generally adverse economic climate. Inflation was rampant, and the relative price of inputs increased. For example, fertilizer subsidies were discontinued while subsidies continued for imported wheat and milk. In general, domestic terms of trade were disfavorable to agriculture.

Overall Plan MERIS has had a very favorable effect upon incomes of project beneficiaries. In 1984 the net increase in income per hectare ranged from a low $84 to a high of $594 for the different project sites. This same year the average increase in family income for the different project sites ranged from $137 to $986 per family. While this is encouraging, it should be remembered that because of unequal land distribution, farmers did not share uniformly in this benefit.

F. Irrigation Engineering

Generally the irrigation systems were found to be well designed given the site characteristics. Dimensions of the intakes, main canals and turnouts

were generally appropriate. Beneficiaries were becoming prepared to handle routine maintenance although there were no provisions for major maintenance yet.

Intake structure were generally well located, although in two cases (out of 8 total subprojects that were examined) problems existed because of stream movement. The effectiveness of one intake structure may be lowered because of sand deposits. Despite some danger from landslides and gross intrusion, the main canals were generally in good condition. Lateral canals and turnouts were not always as well maintained.

A general problem was the lack of flow measuring devices. Only two subprojects appeared to have adequate measuring devices. This is important to determine if there are losses once the water enters the network. Also measuring devices are needed for the equitable distribution of water to individual beneficiaries. Irrigation of individual parcels is usually done on a rotating basis; however, without measuring devices it is easy for someone closer to the intake structure to divert part of the water. It was observed that some areas were overwatered while other areas did not receive a sufficient amount.

An operation manual has been prepared. While generally adequate, it does not deal with drainage or training of personnel. It should be noted that no serious drainage problems were observed, although the potential exists. Farmers need to participate more in system operation and policy. They need to understand how the whole system works in order to operate and protect it. Training should emphasize the value of water, selection of the best irrigation method and individual responsibilities for total system operation.

Water supply in some cases is insufficient. In some instances, there is possible loss within the network. In the long run, however, a longer dry season and drought mean that less water will be available. Demand is a function of crops, soils, growing period, weather, water depth and irrigation method. Given supply limits, it is important to eliminate loss within the network, to control flows to individual beneficiaries and to base irrigation decisions on measurements of water depth.

In some instances it was observed that more water was entering farms than could be controlled. At times, the flooding method of irrigation was used on steep slopes, although project records reveal a decrease in use of this method. Records show that use of the furrowing method (more appropriate on steep slopes) had doubled as of 1982 while use of the flooding method decreased. Some of the larger farmers may use sprinkler irrigation in the future.

The overall watershed should not be neglected. Efforts to control erosion upstream will decrease system damage for landslides and sedimentation. Irrigation activities could conceivably create downstream drainage problems, and potential damage could occur from leaching of pesticides. Watershed planning should determine how much irrigation is possible within the

watershed. In one case, another irrigation project is being planned upstream from one of the Plan MERIS subprojects. There is probably only enough water available for one of these systems.

G. The San Marcos Pilot Project

For three weeks in March 1983, an A.I.D. team evaluated the project. Their report, A.I.D. Project Impact Evaluation Report No. 54, contained several recommendations which have been acted upon and have changed and extended the course of the project. The report concluded that in order to maximize subproject investments, INAF technicians and farmers should be trained in on-farm water management. Perhaps the key change in the project has been to increase the resources directed to on-farm water management. The San Marcos Pilot Project is the principal area where this approach has been emphasized. This site is the only place in Peru where project activities are concentrating on on-farm water management and agricultural development under irrigated systems.

The basis for USAID and INAF to support the San Marcos Pilot Project was established with an Addendum to Annex I of the Loan dated January 17, 1984 that extended the PACD to December 31, 1985. This activity addresses several difficult problems including the following,

1. Determining the amount of water to apply at specified times in order to meet plant needs,
2. Determining the correct package of technical inputs to attain maximum economic yields at a given site,
3. Introducing improved practices on small holdings where agricultural credit has not had an impact,
4. Specifying the organizational structure that can best pay operation and maintenance costs and manage the system and
5. Controlling irrigated water on steep slopes so as not to increase erosion.

USAID utilizing the S&T/AGR Water Management Synthesis II Project obtained a group of U.S. experts principally from Utah State and Cornell Universities to assist the project-funded Peruvian multidisciplinary team to carry out this scope of work and to disseminate information both to project beneficiaries and to project technical personnel. Although much technical information on how to improve water and land management exists, some site-specific research is lacking and is, therefore, being carried out. Activities appear to be proceeding reasonably well despite some administrative and logistical difficulties and some problems associated with Technical Assistance.

USAID expects that the benefits from these on-farm water management activities will be positive and consistent with project objectives. The pilot project has captured a broad range of support in a short-period of time. INAF is interested in replicating this approach in other areas. It is still too early, however, to assess the impact of this portion of the project as data on this cropping cycle are only now being analyzed. INAF senior staff, project

consultants and USAID are in agreement that the project is addressing some of the most important constraints to agricultural development in the Sierra and that the project's multidisciplinary team is reaching project beneficiaries. USAID is arranging to provide funding from additional sources to complete the analysis by March 1986.

H. Recommendations

The Mission supports the following recommendations from the contractor's report.

1. Support should continue for small and medium-sized irrigation projects because (a) an improved engineering capacity has been provided, (b) increases in production and productivity are occurring.

2. Continuing support should center on the following priorities areas:

   (a) irrigation activities with a strong agricultural development component as in the Pilot Project,
   (b) institution strengthening, especially in the realm of improved project administration and planning and the training of field personnel and
   (c) research and experimentation.

3. Organizational changes should place responsibility for the flow of funds on professional administrators. This should give agronomists and civil engineers more time to make substantive contributions to field activities. Administrative changes should focus on supporting and coordinating field activities including research and demonstration. Also, future activities should provide organizational support to the community irrigation committees so that they are prepared to fulfill their responsibilities for operation and maintenance of the system when the project is completed.

4. Flow measuring devices should be installed and personnel should be trained in their use.

5. Irrigation activities should be part of an overall watershed management plan.

6. Agricultural development activities should ideally precede construction and continue until the beneficiaries are capable of operating and maintaining the irrigation system. These activities should include research and experimentation in order to adapt to local conditions.

I. Lessons Learned

1. Irrigation projects should be implemented in an integrated package that includes the irrigation work, agricultural research and extension

and community organization work. Site specific applied research should continue in order to determine the most economically efficient package of technological inputs. This concept is being applied in the San Marcos Pilot Project with some success.

2. Results have revealed that small-scale irrigation activities in the Sierra have merited the investment. An improved engineering capacity for water management has been provided. Economic indicators including internal rates of return and family incomes of beneficiaries are positive including increases in income.

3. Much attention should be given to the administrative, financial and organizational aspects of the project. Although project designers and managers devoted much effort to this problem, delays in disbursement and cumbersome bureaucratic processes hindered the achievement of project goals. Although the Peruvian public sector continues to be difficult to deal with, professional administrators should be better able to handle financial and organizational matters than agronomists and civil engineers. If a simplier administrative mechanism could be found, more time could be devoted to the organizational problems of the beneficiaries and to field activities. The beneficiaries should participate in design and policy decisions to facilitate the transfer of the system to them. They should receive training in operation and maintenance.

4. Irrigation works should be planned as part of a watershed management plan. Upstream activities should protect the works and make the system operate more efficiently. It should consider possible negative downstream effects of installation of a new system. It should also determine the maximum number of hectares that can be irrigated in the watershed and their location. When seasonal water shortages are projected, the feasibility of small multi-purpose dams should be examined.

5. It should not be expected that standard credit programs will benefit the small subsistence farmer with holdings of less than one hectare. The feasibility of alternative credit programs such as in-kind lending should be explored.

6. Economic analysis should consider opportunity costs of labor and the differential return of irrigating different lands, such as more steeply sloped areas. More attention should be paid to the probability of using additional priced inputs and to probable construction times.

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Improved Water and Land Use in the Sierra

(Plan MERIS)

Final Evaluation

July 20, 1985

by

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1. EVALUATION GOALS, METHODS AND FINDINGS

The Improved Water and Land Use in the Sierra Project (Plan MERIS) was originally designed as a five-year effort to add to the area of productive land, increase crop yields and the efficiency of water use, expand the cropping alternatives available to producers, and reduce the rate of soil erosion in the Peruvian highlands though the construction of small and medium-sized irrigation projects in the departments of Junin and Cajamarca (see Appendix A-1). In 1985, however, the project is in its ninth year, and its impacts remain under discussion, despite extensions to compensate for delays in implementation and addition of $3.5 million to the original project budget of $21 million ($10 million GOP contribution and $11 million USAID/Peru loan funds) by USAID/Peru (USAID/P) to permit completion of the construction of irrigation works and to provide additional support for agricultural development activities.

Wilkinson et al (1984:vii) attribute the delays in implementation to three factors:

1) the transfer of responsibility for Plan MERIS within the government of Peru (GOP) at the time of project initiation, causing delays in staffing regional offices;

2) the slow completion of sub-project feasibility studies; and

3) GOP delays in approving the purchase of construction machinery, equipment and materials.

In addition to the delays in implementation, Wilkinson et al identify several other problem areas confronting Plan MERIS. For example, as of July 1983, only $100,000 of USAID's contribution of $1 million for credit to support agricultural investment by project beneficiaries had been disbursed, as had only $1.4 million of the combined USAID/P and GOP contribution for credit. Furthermore, the report found water management inadequate due to difficulties in enforcing water discipline, and it predicted that the subprojects in Plan MERIS would not generate enough revenue to provide more than manual labor for maintenance (pp. 5, 7-8). This prediction was in large part based upon the finding that farmers were not adopting new crop technology or double cropping practices for increased production.

1.1 Summary of Evaluation Findings

In general, the evaluation team was impressed with the energy and dedication of Plan MERIS field personnel whom we found to be achieving impressive results in bringing the irrigation works into operation and in helping farmers to take advantage of them. Achievments in this area are particularly noteworthy in light of administrative problems that have repestedly frustrated efforts to move equipment, building materials, and agricultural inputs to areas of subproject activity. In addition, Plan MERIS personnel have been harder hit by the current economic crisis than colleagues in other agencies of the Ministry of Agriculture. In this regard, we feel that the project's field staff deserves particular commendation for what they

have accomplished, and we emphasize that our critical comments are made within the context of a positive assessment of Plan MERIS.

1.1.1. Institutional analysis. Plan MERIS is a special project of the Proyecto Especial de Pequeñas y Medianas Irrigaciones (PEPMI), along with two other small and medium irrigation projects funded by the Federal Republic of Germany and the Inter-American Development Bank. When PEPMI was formed, during the Velasco administration, it was hoped that organizing small and medium irrigation efforts as special projects would free them from some of the constraints imposed by a highly centralized government bureaucracy. According to people whose involvement with the project dates from that period, the arrangement worked reasonably well at first. In the late 1970s, however, under the Morales Bermudez government, the project organization faltered as responsibility for PEPMI was shifted within the Ministry of Agriculture. Under the Belaunde administration, PEPMI was finally placed under the authority of the newly formed Instituto Nacional de Ampliacion de la Frontera Agricola (INAF). This stabilized PEPMI's position within the government, but it also introduced a new level of bureaucracy on top of PEPMI which shared in decisions about resource allocation and bound it more closely to the central government. Soon thereafter, the complexity of the original Plan MERIS project increased to include development activities in what had previously been a project primarly concerned with infrastructure building.

With the administrative changes described above and with the increased range of activities for which it is responsible, the special project structure of Plan MERIS became unable to allocate funds and other resources for efficient project execution. PEPMI projects continue to enjoy greater control over the management of their own funds after these have been disbursed by the Ministerio de Economia y Finanzas and international donor agencies than do line agencies of the Ministry of Agriculture. On the other hand, Plan MERIS has been less able than line agencies of the Ministry of Agriculture to protect the salaries of its employees during the current period of economic crisis. Plan MERIS salaries have declined more precipitously than those of colleagues elsewhere in the Ministry, and, as employees of a special project, they do not enjoy the same package of benefits given to their colleagues. These factors have been the cause of a high rate of personnel turnover and of a general demoralization of the Plan MERIS employees that remain, with adverse consequence for project performance.

We found that Plan MERIS field personnel have established effective working relationships with personnel in other government agencies, obtaining vegetable seeds from the Ministry of Health and trees for reforestation from the departmental offices of the Instituto Nacional de Forestacion. Sometimes these relationships are given official status by means of an agreement between the department office of Plan MERIS and the other agency, while in other cases they remain informal. However, in terms of what is actually accomplished in the irrigation subprojects, they clearly are the result of personal initiative on the part of Plan MERIS personnel.

1.1.2. Irrigation system design and management. The physical structures of the irrigation works are generally acceptable in terms of design and present condition. There are some areas which require immediate attention

to protect them from landslides, such as the section of the main canal of the Cotosh subproject between kilometers 10 and 11. Several structures also are in need of long-term corrective measures to insure their continuing serviceability, e.g. the intakes at Carahuanga (Cristo Rey) and Chingol which could be rendered useless by the meandering rivers.

The most pervasive problem is the lack of measuring devices at the intake works and along the lateral canals. Without these, efficient water management is impossible. This in turn means that it is technically impossible to control the water flow in order to maximize production impacts. The lack of measuring devices is indicative of a more general problem that needs to be resolved regarding what specifically is meant by "small and medium-sized" irrigation projects. Because the systems are supposed to be "low-cost", measuring devices were omitted as an economy measure, even though the amount they would add to the overall cost of the system is negligible. On the other hand, some of the intake works and canal systems are quite elaborate and will undoubtedly tax the ability of users and the local distritos de riego to maintain and operate them efficiently. Plan MERIS irrigation works need to be reviewed systematically in order to establish the kinds of design features that are appropriate for projects of this size.

The long-term potential of Plan MERIS depends upon establishing efficient water management practices. Knowledge in this area is lacking among many of the agricultural engineers working on Plan MERIS as well as among the beneficiaty population. The water management training program offered by plan piloto is badly needed, and some specific suggestions for what such a program should include are discussed in Chapter 3 of this report.

1.1.3. Economic impacts of Plan MERIS. Not all of the subprojects are alike in response to new or improved irrigation. They vary widely both in terms of the supplementary irrigation support required and the constraints that retard their development. However, while the Plan MERIS subprojects, do not fully reach the cost-benefit performance projected in the feasibility studies, their performance appears to be reasonably high.

Several factors are responsible for performance being less than expected. Slow implementation increased project costs, and diminished agricultural development efforts to increase production and productivity. Yield per hectare and cropping intensity response have been less than expected.

In addition, inadequate socioeconomic research led original projections to be overly optimistic. Projections regarding producer response to irrigation assumed an abundance of labor that simply does not exist in the subprojects. Factors such as off-farm employment and the relationship between irrigated and dryland agriculture in household production systems were not considered. Likewise, the initial projections assumed a relatively uniform response to irrigation by all producers, regardless of the size and tenure of holdings. These kinds of issues are being treated in a systematic way for the first time within Plan MERIS as part of the research effort being conducted by plan piloto.

A more favorable cost-benefit impact could be achieved in future small and medium-sized irrigation projects if agricultural development

activities were implemented sooner - either simultaneously or, better yet, prior to the initiation of construction. In addition, agricultural development personnel need to be prepared to deal explicitly with issues such as those noted above through appropriate orientation prior to entering the field, rather than being left to ad hoc judgements as happened in Plan MERIS.

Increased production and productivity could be encouraged by a more appropriate credit program. Even when small producers are desirous of obtaining loans --which many are not-- and the Banco Agrario is disposed to cooperate, the size of the loan that can be made without overly burdening the small farmer with debt will not substantially improve that person's situation. Furthermore, the administrative costs of such transactions are out of proportion to the size of the loans. The establishment of an input bank (at the irrigation comission or committee level) where farmers could borrow seed, fertilizers, and the like, and then repay the banks either in cash (at up-to-date prices) or in kind, would appear to be a practical way of circumventing the obstacles to providing small farmers with credit.

1.1.4. Potential contributions of Plan Piloto. Plan Piloto is gathering and analyzing data on a number of issues that have limited the successes enjoyed by Plan MERIS. These include the relationship between dryland and irrigated farming in household production systems, non-irrigation uses of system water, and the allocation of household resources among agricultural and off-farm productive activities. The project also can be expected to provide realistic budgets for small farmers and improved water management strategies based upon new technologies and techniques adapted to conditions in the Peruvian highlands.

Plan Piloto appears to be a good model for conducting multidisciplinary agricultural research and development activities on building and managing cost-effective small and medium-sized irrigation works in the highlands. This kind of teamwork would be a valuable improvement in future subprojects. Presently the tendency is for professionals from different disciplines working in agricultural development to concentrate on their specialities without reference to an overeaching program to guide their activities toward a common objective. Although there are no specific plans for this at the moment, developing a training program for the agricultural development personnel of future small and medium irrigation projects would be a valuable contribution.

Plan piloto has been hampered by the same administrative constraints that frustrate progress in the Plan MERIS subprojects. This has slowed data collection and analysis, so that the project may not achieve all of its objectives by the end of 1985, when USAID support is scheduled to terminate. A two or three month extension of the project for data analysis and report writing would greatly enhance the quality of the results obtained and facilitate its use in the planning and execution of future irrigati n projects.

1.2 Evaluation Goals

The present final evaluation of Plan MERIS discusses the achievements and problems of the project since 1983, when the Wilkinson team conducted its

evaluation. It also assesses the efficacy of the corrective measures adopted by USAID/P and Plan MERIS in response to the issues raised by Wilkinson et al. The final evaluation of Plan MERIS has six specific goals:

1) Assessing the institutional arrangements under which Plan MERIS has been conducted in order to determine their relevance in shaping the successes and failures of the project;

2) Determining the adequacy of the design and execution of the irrigation works constructed under the project and their appropriateness in terms of beneficiary capacity to manage and maintain them;

3) Judging the changes in beneficiary production systems due to introduction or improvement of irrigation facilities;

4) Estimating economic benefits and costs of representative sub-projects.

5) Assessing the prospects of the research conducted under Plan MERIS auspices at the San Marcos subproject (plan piloto) for research into management and irrigated agricultural development; and

6) Recommending how USAID/P might best structure future support of small and medium-sized irrigation in order to more effectively achieve agricultural development, and water and soil management objectives.

1.3 Evaluation Methods

The final evaluation of Plan MERIS was conducted in two stages. The initial stage involved a three-week visit in February-March by James Fitch (economist), Michael Painter (anthropologist), and Gustavo Sobrino (irrigation engineer) for the purposes of determining the data required to conduct an adequate evaluation and the availability of such data, and to design an appropriate evaluation methodology. In order to become more familiar with Plan MERIS operations at all levels, the team, with project officials, visited seven of the eight subprojects in Junin department. Interviews were also conducted with Plan MERIS personnel at the subproject, zonal, and national levels, with project beneficiaries and with relevant USAID officials in order to determine the most desirable means of proceeding with the evaluation. A description of the methods to be employed and a request for data on aspects of Plan MERIS and specific sampled subprojects to be sampled was left with USAID/P and Plan MERIS.

The second stage of the evaluation was conducted in June-July with some changes in the composition of the team. Because of a large number of questions about the role of institutional arrangements and project successes and failures, a fourth person, Kris Merschrod (rural sociologist), was added to the team to concentrate on this aspect of the evaluation. In addition, because of contracting difficulties that had caused the first stage of the evaluation to be delayed, Gustavo Sobrino was faced with conflicting commitments and had to withdraw from the evaluation. He was replaced by

Medardo Molina, who conducted the irrigation engineering aspects of the evaluation during the second stage.

An important feature of the evaluation has been the participation of an irrigation engineer from the outset. Jurriens et al (1984) have noted that many evaluations of irrigation projects do not include the participation of engineers. As a result, problems of water distribution and application are discussed strictly as management problems without reference to project design. As the evaluation progressed, the relationship between the design of the irrigation works constructed and the capacity of project personnel and beneficiaries proved to be a major question. This report is able to address the question from both an institutional and an engineering perspective, thanks to USAID/P foresight in including an irrigation engineer on the team.

The findings of the report are based on three types of data:

1) a review of project documents and relevant literature;
2) interviews with individuals involved in various aspects of project design and execution; and
3) on site observation and interviews at the irrigation subprojects.

The literature reviewed includes the pre-feasibility (diagnósticos) and feasibility studies of the Plan MERIS subprojects, the USAID Plan MERIS project paper and previous evaluations of the project, Plan MERIS monthly and annual reports from the beginning of the project to the present, and Huancayo and Cajamarca reports prepared in response to specific requests for information by our team. The team also reviewed documents from other USAID/P projects with components supporting the construction of small and medium-sized irrigation works in the highlands (eg. RDS 1983; Chetwynd et al 1985). Interviews were conducted with USAID officials involved in Plan MERIS and other relevant Mission activities, Plan MERIS personnel in the Lima, Huancayo, and Cajamarca offices, and in a number of subprojects, plus nearly 50 Plan MERIS beneficiaries. The team also visited GOP officials in agencies with which Plan MERIS is coordinating its activities (see Appendix 1).

In addition to making brief visits to seven of the eight Junin subprojects during its initial visit in February-March, the team selected six subprojects for more detailed examination. In Junín, these were the Apata, Sincos, and Cotosh subprojects, and in Cajamarca they were Carahuanga, Santa Rita, and Chingol. An opportunity arose to visit the Chupaca subproject when the team was invited to attend a Plan MERIS "field day" for professional personnel. In Cajamarca, the team also visited the San Marcos subproject, although the primary purpose of the visit was to learn about the activities of Plan MERIS' Plan Piloto. During the subproject visits the team received orientations from the Plan MERIS officials working there, conducted inspections of the irrigation works, and conducted interviews with beneficiaries.

1.4 The Context of Plan MERIS in Peruvian Agriculture

Plan MERIS originated in a period of growing crisis for Peruvian Agriculture and has matured as a project offering hope for recovery from that

crisis. Throughout the 20th century, and particularly since the establishment of its Ministry of Agriculture in 1943, the country has attempted to promote rapid industrialization by concentrating infrastucture in selected areas of the country, primarily in the coastal regions, and through the provision of cheap foodstuffs to consumers in those areas. In addition to encouraging industrial growth by providing the necessary infrastructure, the intention was also to draw a labor force from the largely rural population through the concentration of goods and services in targeted areas. Once established, the labor force's subsistence costs would be kept down by insuring its access to inexpensive foodstuffs, thus reducing upward pressures on wages (Thorp and Bertram 1978). The state relied heavily upon imported foodstuffs to satisfy growing urban food demands, to the detriment of domestic food production located primarily in the highland region of Peru (Gonzalez Vigil et al 1980).

By the 1950s, Peru's approach to development had evolved into a highly protectionist industrial import substitution model that provided little protection for agriculture, and created very unfavorable rural/urban terms of trade (Mann 1985). Domestic food production suffered particularly as credits and other state support were directed primarily to coastal enterprises producing industrial export crops. Several unfortunate results derived from this situation:

1) Due to the growing inequities in living standards and economic opportunities between areas targeted for development and their hinterlands, rural-urban migration reached alarming proportions. Public facilities and social services became increasingly overextended, and ever-larger amounts of food were imported in an attempt to satisfy the growing urban food demand.

2) Increasing difficulty in competing with imported foodstuffs in urban markets and declining labor availability due to the rural-urban exodus began to be manifested in declines in yields, land area under cultivation, and per capita food production.

3) As domestic food production stagnated and food imports increased, there came to be a growing disjuncture between the kinds of food consumed in the country's urban markets and what was being grown in the traditional highland food producing regions (Alvarez 1980).

Successive administrations tried to cope with the crisis engendered by these conditions in a number of ways. In response to the immediate political pressures generated by the rapidly expanding urban population, food imports were constantly being increased, and, by the 1960s, the state was subsidizing food imports to keep prices down. This type of response reached its logical conclusion early in the Velasco government, when strict price controls were placed on foods designated as staple items. The effects of such responses was to exacerbate the trends they were intended to counteract. Food prices were depressed, further reducing economic opportunities in the countryside and creating additional incentives to withdraw from agriculture as an income-generating activity. At the same time, existing inequities in the distribution of resources favoring urban areas increased, creating more pressures for people to abandon the countryside - a cycle of conditions in the

cities and in the rural areas which negatively affected each other was firmly established (Painter 1984).

During the 1970s, the state also responded to the agricultural crisis by increasing the area of cultivable land that was suitable for producing the foodstuffs being consumed in urban areas by undertaking ambitious irrigation projects in the coastal desert, and bringing areas of the high selva region under agricultural production. It also shifted the bulk of its agricultural credit support away from enterprises involved in industrial export crop production in favor of enterprises producing food for urban consumption. While these initiatives did result in absolute increases in food production, these did not keep pace with population growth; the dominant trend in per capita production continued to be downward (Alvarez 1980; Maletta and Foronda 1980).

Efforts to bring new areas of the coastal desert and high selva under production also proved to be more problematic than originally imagined. In the first place, investment costs in both areas are higher than projected and returns on the investment are not realized as quickly as originally hoped. Secondly, the high selva is subject to rapid environmental degradation when most conventional agricultural production practices are applied. Furthermore, while rice production has been successfully established in areas of the high selva, this has been accomplished with subsidies that include price supports amounting to an additional 46 dollars per metric ton plus paid transportation costs to the coast (see Keller et al 1984:18,29).

1.5 The Rationale for Small-scale Irrigation in the Highlands

In the context described above, providing support for small and medium-sized irrigation projects in the highlands has come to be regarded by many as an attractive means of helping Peru overcome its agricultural development problems. Costs appear to be low, and investment in productive infrastructure in the highlands offers the hope of reducing the rural-urban and regional inequities that fuel massive rates of migration.

However, there are also a number of factors that constrain the potential success of small and medium-sized irrigation projects in the highlands, and these need to be considered both in deciding whether or not to undertake such projects in the first place and in subsequent evaluations of performance. First, the problems of low production and productivity and a deteriorating resource base due to poor water and soil management are the consequence of the processes described in the preceding section rather than the cause. This means that regardless of how well a project might be designed and executed, what it can accomplish is limited by factors such as agricultural price policies and market conditions which shape producer responses to the opportunities provided by irrigated agriculture (Keller et al 1984: 3-4, 7-8; Mann 1985: 5-6). The fact that an irrigation project creates the potential for improving production, productivity, and resource management practices does not mean that producers will respond in the desired manner. Indeed, there is no particular reason to assume that improvements along these lines will be forthcoming if the appropriate incentives in the larger economy are not present.

Secondly, it also must be remembered that irrigation in the highlands is a production supplement. There are few arable areas where agriculture is not already being practiced and even fewer non-arable areas that could be brought into production with small or medium-sized irrigation works. As a result, while costs are lower than in high selva development or coastal irrigation projects, the production increments that can be expected from installing an irrigation system in the highlands also are more modest. In addition, projects in the highlands presuppose the need for more intensive agricultural development follow-up than in other regions of the country. This is because producers tend to be poorer than their counterparts in other regions, and as result, they are less able to adopt technologies and practices that will allow them to use a new irrigation system to its full potential. In addition, the task of implementing a production regimen that is profitable and practical is more difficult in the highlands than in other regions. In the first place, the chronic problems of frost and hail make adopting the sort of double-cropping system assumed in studies showing favorable cost-benefit ratios for small and medium-sized irrigation systems in the highlands both difficult and very risky in many areas. In addition, all highland agricultural development problems must somehow come to terms with the handicaps imposed upon the region by the policies described in section 1.3, above. These include a low level of infrastructure for transporting and processing agricultural products, unfavorable terms of trade with urban markets, and the fact that the products that many highland areas are best able to produce are not necessarily in great demand among urban consumers of agricultural products.

Thus, even though the costs of installing small and medium-sized irrigation systems in the highlands are less than the costs associated with irrigation in other areas, there are also constraints on their performance that are unique to the region. It is therefore necessary to examine critically the kinds of impacts that a project can be expected to have, both in establishing priorities for the conduct of new projects and for evaluating the performance of existing systems. One presumes that the major advantage conferred by supplementary irrigation systems such as those constructed under Plan MERIS is in improved timing and availability of water, leading in turn to greater production. Impacts may be of two types: those resulting from improved management of water and soil resources in areas already under irrigation, and those resulting from irrigating rainfed lands. The production increases manifest themselves in three ways:

1) Increased production per hectare;

2) Greater cropping intensity (obtaining two harvest per year from an area where only one was possible previously, for example); and

3) Changing cropping patterns to higher value crops than were being grown prior to the project.

The relative magnitude of these impacts varies from region to region, from one subproject of Plan MERIS to another, and among producers within a single subproject. Intervening variables that affect the specific yields include:

1) Climatic factors such as temperature variation or frost and hail, which absolutely limit the kinds of agricultural activities that may be conducted or elevate the risks associated with certain innovations beyond levels acceptable to producers;

2) The availability of complementary technology such as seed, chemical inputs, and machinery to facilitate the introduction of new crop varieties, or water and soil management techniques such as field levelling;

3) The quantity of water available at the intakes and at the fields;

4) Factors such as the opportunity cost of labor inputs to take advantage of irrigation facilities instead of engaging in off-farm activities, or the relationship between dryland and irrigated agriculture in a particular production system, or patterns of land tenure and stratification in a subproject area.

Mann (1985:8) notes that expanded agricultural output may be achieved through increased efficiency of existing productive resources, and through an absolute increase in the level of productive resources being utilized in the sector. Plan MERIS subprojects encourage improved resource use and increase the level of productive resources available to producers. However, all of these factors have constrained and shaped project success through their interaction with the institutional structures that organize the project, and with the design and management of the irrigation structures themselves.

2. ORIGINAL INSTITUTIONAL MODEL OF PLAN MERIS I

2.0 Introduction

A very detailed institutional history of Plan MERIS I (PMI) was included in the 1984 "Improved Water and Land Use in the Sierra" report (Wilkinson et al). This review will concentrate on the structure of the institution and its managerial implications in order to answer the evaluation questions, "Is this a useful model for future projects?", and "How did this model perform?"

In the mid-1970's, when AID began negotiating the 527-T-059 Loan with the GOP, it was found that the administrative structure of the Dirección General de Aguas (DGA) of the Ministry of Agriculture was too complex to easily carry out the development of the proposed small scale irrigation projects. The DGA had experience with the projects under the Linea Global I (a series of irrigation projects which included responsibility for agricultural development and the use of loan funds), but it was concluded by the Ministry that an administrative change was needed to facilitate the management of these types of projects because the administrative, accounting, and budgetary process was too complex. In order to do this a law was passed in 1976 which provided for Special Projects within the Ministry of Agriculture which would be directly under the executive office of the Minister of Agriculture. The Linea Global I was the first project to come under this Special Projects approach, and the PEPMI (Programa Especial para Pequeñas and Medianas Irrigaciones) was created to manage PMI, Linea Global I, and Plan MERIS II.

2.1 The Special Projects Approach

Special Projects within the Peruvian administrative structure are created by legislative law for the purpose of facilitating project implementation. Under this legislation a special project has:

1) its own budget within the administrating agency;
2) budgetary allotments directly from the treasury;
3) a specific beginning and end (as opposed to a general program of indefinite length);
4) its own organizational structure, and
5) contracting authority to fill its ranks with personnel hired on a yearly basis outside of the MAG's collective bargaining agreement.

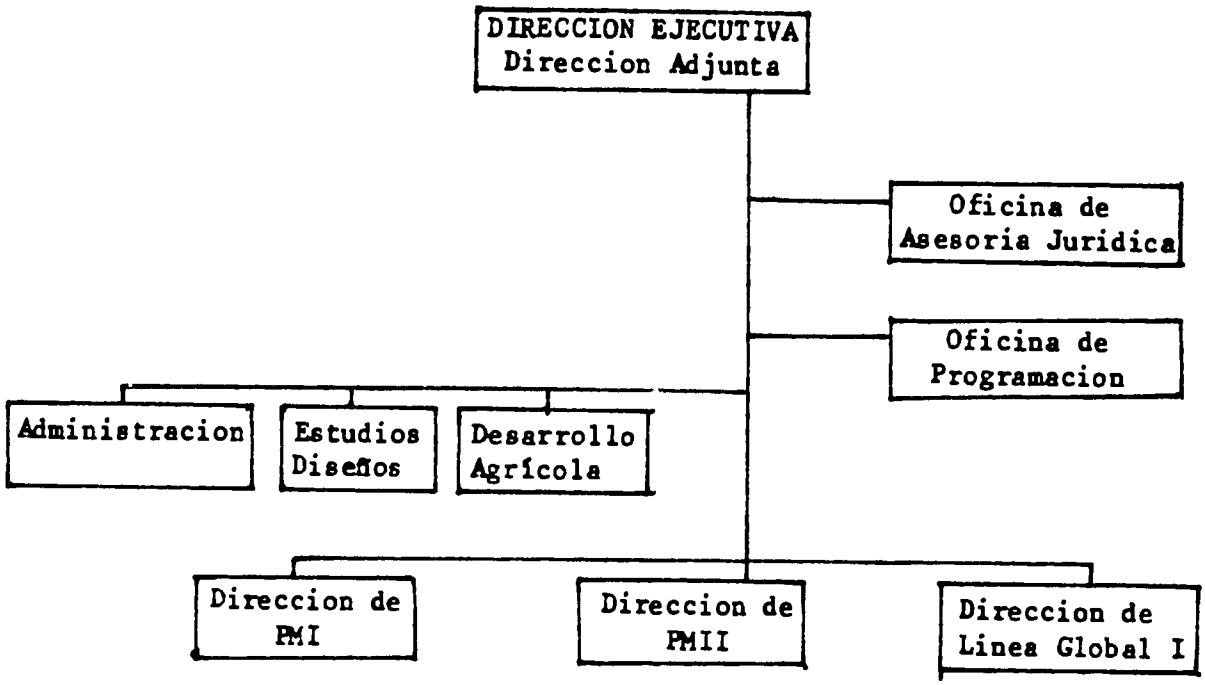
These provisions are intended to remove the Special Project from the general and fiscal administrative "constraints" of program- implementing government agencies.

2.1.1 Direct Allocation of Funds. By having a direct allocation of funds from the public treasury, and its own budget within the managing agency (The Dirección General de Aguas), the Special Project is theoretically assured of funding in isolation of the other programs of the managing agency. The importance of this approach is the independent flow of funds and accounting which otherwise would be managed by the more elaborate accounting office of a larger agency.

2.1.2 Direct Hire of Contract Personnel. The direct hire of contract personnel places project personnel under separate labor legislation which allows special salaries and conditions to attract and keep personnel suitable to the special conditions of the project. Personnel under this legislation is not part of the administrative agency's collective bargaining organization. Thus any labor. disputes which may arise between the administrating agency and the general employees should not interrupt the course of the implementation of the Special Project.

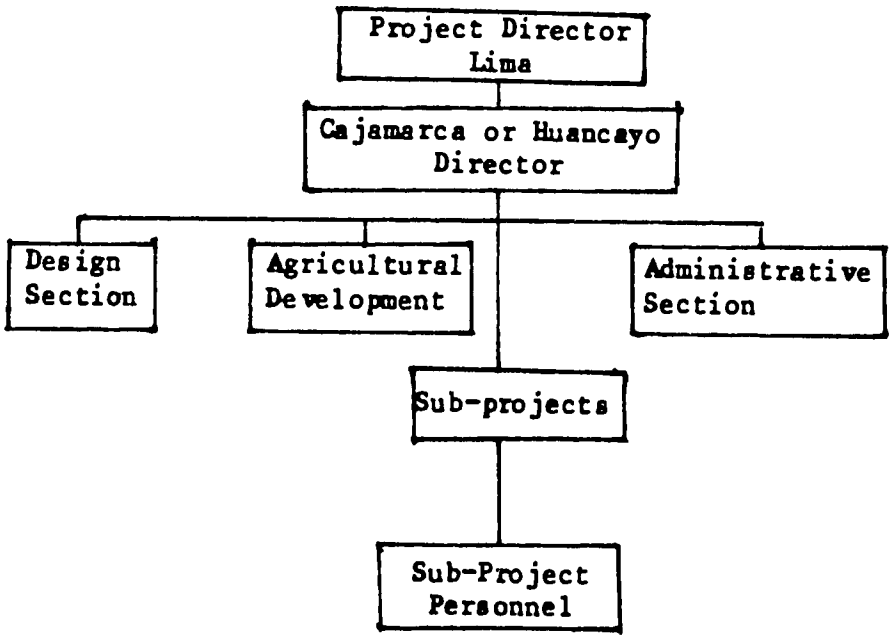
2.1.3 Organization Charts. Thus in 1976 PMI was established as a Special Project within what later became the PEPMI. Organization Chart 1 shows the position of PMI in the structure, and Organization Chart 2 shows the structure of PMI.

ORGANIZATION CHART 1: PEPMI



Note that PMI is currently one of three special projects under the PEPMI, and as the number of such projects increases the budgetary and managerial tasks of PEPMI also increases.

Organization Chart 2: Plan MERIS I



2.2 The Institutional Context

In spite of the implied flexibility of the Special Projects approach there are three main aspects of the institutional and fiscal context which effect the management and agility of project implementation:

1) the fiscal crisis and accompanying austerity laws;
2) the general administrative laws for public agencies, and
3) the basic accounting regulations for integrated government accounting (Normas Básicas del Sistema de Contabilidad Gubernamental Integrada) which are mandatory for all Peruvian government agencies.

It is to these three main aspects of the Peruvian context that we will turn in order to understand just how PMI fared during the implementation process.

2.2.1 Fiscal Independence. The fiscal independence which was to be assured by a direct budgtary commitment from the treasury was in question before the project began. In December 1976 there were a series of meetings and exchanges of memos between USAID/P and the DGA counterpart, because the Ministry of Economy and Finance (MEF), due to the "critical fiscal situation," continually attempted to reduce the initial counterpart budget allocation for PMI (USAID/P Memo of 7 DEC 76). Discussions were held with PEPMI on which line items could be reduced and agreed to push the MEF for a commitment of the initially agreed upon counterpart funds. The amount in dicussion was one half of the originally proposed allocation. The idea was to gain one half first and then have the second half disbursed later for the second half of the year. Thus, from the beginning, lobbying from outside of the organizational model was necessary for the fiscal wellbeing of PMI.

This "critical fiscal situation" continued throughout the life of the project and became worse. Thus, each year the pattern would be repeated: budget requests would be debated; amounts approved would not be disbursed; and PMI would not be able to implement on schedule because of fiscal constraints.

2.2.2 Adminstrative Independence. In 1979 a series of austerity laws were passed which froze the number of line positions in all GOP agencies. The Special Projects were not exempt from this law. Thus the contract personnel needed for the sub-projects of PMI could not be hired without specific authorization from the executive office of the MAG (Dirección General Ejecutiva).

One of the most important aspects of the Special Project from a personnel perspective was the contract conditions. The Special Project permitted the hiring of personnel at salaries above the level of similar Ministry of Agriculture (MAG) employees, but it also allowed for fewer fringe benefits. Among the contract employees this condition created a definite espirit de corps, plus a comparative financial advantage even though they could not depend upon long-term job tenure. Legislation in 1977 established a system of "Basic Salaries" and "supplements" for conditions and merits, which was encouraging to the employees. This legislation became a serious limit to

the main benefit of the contract employees - salaries - before the end of PMI, because while the other government employees realized adjustments for salaries because of inflation, the PMI personnel did not receive commensurate increases and their absolute purchasing power fell below that of similar employees in the Ministry of Agriculture. Their position as non-union employees made it impossible for them to collectively pressure PEPMI for salary benefits and their administrative superiors did not do it for them. The result is a loss of personnel and a feeling of dispair among those who remain. To illustrate this point the following figures were provided by PMI field personnel for a typical agronomist's case:

		Plan Meris I	MAG Alternative
1980	Monthly	s/185,000	s/ 145,000
	Year end bonus	s/ 50,000	s/ 145,000
1985	Monthly	s/ 1,165,000	s/ 1,800,000
	Bonus	100,000	s/ 1,800,000

Thus, in five years a PMI agronomist went from having a 20.4% advantage over a MAG agronomist to where the MAG agronomist has a 66% advantage over the PMI agronomist. It may be that these figures were exaggerated by the field personnel, but it is their perception of the situation and is part of the reason for their low levels of morale.

During the course of the project the other personnel matter which changed was, as mentioned above, the limit on the hiring of contract line personnel. The administrative result of this austerity legislation was two-fold:

1) Needed technical personnel was hired as "workers" on a daily basis at worker's wages. Agronomists, anthropologists, secretaries, etc. agreed to these terms with the hope that a line position and commensurate salaries would be approved. In some cases this came to pass as positions opened.

2) Because hiring, contract or worker, is restricted by the austerity legislation all positions to be filled can require approval at the executive level of PMI. The planned administrative independence of the Special Project office for hiring has been lost and considerable pressure to hire personnel proposed by higher level MAG executives has become common. This extends not only to the hiring of managerial level personnel in the regional offices but also to the level of secretaries, drivers, and workers.

This second condition has resulted in inexperienced personnel having to be trained for jobs and this delays implementation. It also has resulted in people from other areas of the country arriving unprepared for the local climate; they do not stay long. On the local administrative side, frustration is experienced when they propose locally available and suitably skilled candidates for approval, but they are rejected in favor of appointees from above. The result of this process is the opposite of one of the stated project goals -- the creation of local employment.

Another aspect of the employment pattern is that some employees at all levels are not from the region and their families are left behind. Because of the fiscal crisis in the country, employees are desperate for jobs and take positions far from their families. This implies greater living and travel expenses for the employees. Some employees visit their families only a few times a year. This, too, adds to the low level of morale of the personnel.

In summary, from a personnel perspective, the well intended Special Project approach proved to be quite dependent upon MAG and the GOP fiscal process from the beginning. The root of the problem may be the fiscal crisis, yet the fact remains that the public administrative laws, general accounting proceedures, and the austerity laws apply to all entities of government agencies. The application of these regulations leads to greater centralization of decisionmaking and negates the intended Special Project benefits. In spite of the optimistic concept of an independent budget allotment from the Treasury to provide counterpart funds, the liquidity crisis of the GOP has dominated.

2.2.3 The General Accounting Problem. It is not necessary to attempt an audit of the accounting of the project to identify the cause of the slow flow of funds to and within the project. As mentioned above, USAID/P identified, in 1976, the fact that counterpart funding could be a problem. In the initial discussions about the possibility of using FAR (Fixed Amount Reimbursements) it was concluded that budgetary constraints meant that PEPMI could not finance the start-up project costs while waiting for reimbursements (this applied to USAID financed inputs). It was pointed out that,"It is critical to avoid any cash-flow problems which would threaten loss of momentum in implementation."

A great deal of attention was paid to the details of accounting and reporting between PEPMI and USAID/P, Section 3.02(a)1. - iv "Sistema de Contabilidad del Plan MERIS" of the Loan Contract describes the procedures -- independent books for the project, a sub-account in the public treasury, etc. But just as the General Accounting proceedures of USAID must be used on the USAID side of the loan agreement, so too must the GOP accounting procedures be followed in the management of the funds. As a USAID/P memo noted in 1976, there will be a complete set of subsidiary accounts for the USAID loan which will be "inserted in the existing MinAg accounts..." It was also stated that, "we wonder if whether this system will be able to provide timely the data we need..." This last observation has proven to be the case -- timely data is often difficult to obtain.

It should be pointed out that PEPMI, too, has complained of the slow flow of funds from USAID/P in response to their rendering of accounts. Both agencies show records "proving" either their speed of response or the counterpart's slowness of response. The roots of the problem are many: in spite of meetings to clarify definitions of USAID/P reimburseable costs, inappropriate claims have been made -- communication has not been satisfactory. The three major problems are: 1) number of personnel which must handle the paper, 2) the inter-line and inter-account transfers in an attempt to cope with the counterpart liquidity crisis, and 3) andministrative procedures.

In the case of problem 1, too many people have to approve bills, and the fact appears to be that papers go from desk to desk and office to office. It is not that any particular office delays the flow; it is a matter of human nature that adds time to the process. A given item is purchased, the messenger or driver who is given the receipt puts it on a clip board, later that day or the next it is passed to a clerk; the clerk holds it for a while or a day; it is then entered into a file and recorded; the regional administrator must approve it and enter it into a sub-project account; these are approved by the regional director, but his secretary may hold the papers for a while; at the end of the month they may be passed to Lima via a driver where the papers start the process which takes them to USAID/P; and in USAID/P the process continues. If, along the way, a person reviewing a given receipt finds it to be "wrong", then a decision has to be made back down the line. All of these steps take time. The result is that the liquidity crisis is exacerbated.

Problem 2, temporary, inter-line and inter-account transfers, stems from coping with the liquidity problem as well as the accounting structure. Because of the treasury's tendency to disburse only part of the counterpart funds for a given budget, the regional offices have to "make do" with what they receive. The temporary transfers begin with the priorities which have to be established at the regional office because funds are disbursed by area and then by project. For example, a check for the PMI Agricultural Development area is issued from the Banco de la Nación account. On the check the amounts for each project are listed, but the check is deposited as Agricultural Development. Given priorities of the moment the funds are used on any of the projects and may even be "loaned" to the construction account or be used for studies for new projects. Typically the first priority is to meet salaries. If the money has not been used for expenses for which it was originally allocated then receipts cannot be presented for reimbursements. An undetermined amount of time may pass before funding is allocated for expenses previously covered and thus become reimbursable. It should all "come out in the wash", but it takes time, and this contributes to the inefficiencies. The same procedure applies to loan funds from international agencies. When counterpart funds are short, loan funds are used to meet expenses. Earlier in 1985 PEPMI had to borrow from the IDB-funded Linea Global project to cover USAID/P PMI expenses. The only way to overcome this type of problem is by having adequate advances to cover expenses between disbursments. Of course, accurate budget planning is assumed. It is suggested that advances cover at least 2.5 months' expenses.

In this process of "making do with less than needed", the material side of the project suffers, materials for construction are delayed, per diem and gasoline are not allocated, and inputs for demonstration plots are not available. The result is that the salaries paid are not with the necessary complements for implementation and the efficiency of labor is greatly reduced. Aside from the obvious delays in meeting program goals, there is the less obvious return on investment which directly effects the benefit/cost and internal rate of return because agricultural development does not begin, nor water flow, until after the planned dates.

Problem 3, administrative procedures, has its basis in the legally required process of doing business as an agency of the GOP. The example which

illustrates this best is the renting of a compressor to replace the original one, which was inoperative. To rent one in Huancayo for the tunnel work at Cotosh the bidding process and advertising plus actual contracting took approximately six months. This process should have been avoided as in the case of the tractor needed in Cajamarca to supplement the tractor lent to the Pilot Project at San Marcos. In this later case, it was rented from SINAME, a state agency, without licitation because the rental rates were established by law. In the future, an alternative to the bidding process should be found because the paper work cannot be handled locally and must pass through the Lima offices. The Special Project model does not provide for relief from these regulations.

Another type of procedural problem is illustrated by the purchases of cement for the construction project. The cement is purchased periodically in large quantities and an order for the quantity is issued. Then PEPMI can draw upon the quantity until it is all removed. Payment is made periodically as the cement is used, but only when the last of the order is removed, and not before, the receipt is given to the regional office. It may take a few months to withdraw all of the cement for a given order, but because the receipt is not provided until all is withdrawn the regional office cannot provide the paperwork for reimbursment. These types of problems could have been avoided if project personnel had throught through the implications of each type of transaction and planned accordingly. In this case, the terms of the contract with the supplier could have included smaller lots and final receipts for each shippment.

2.3 Plan MERIS Linkages to Other Institutions

The initial design of PMI required institutional linkages between the project and state agencies as well as community organizations. Both sets of linkages were necessary to obtain non-project financed resources -- technical assistance, trees for forestation, food for work -- and to attain project objectives -- community participation, training, termination of the project by turning the irrigation works over to the irrigation district for management, etc. The degree of success varied by region (Cajamarca and Huancayo) and by institution. The following description is provided to illustrate the nature and success of these linkages so that future projects can be planned with this experience in mind. In general the PMI experience indicates that although these linkages were planned, a very particularistic pattern of implementation resulted because of personalities and events beyond the control of PMI and not necessarily because of the formal agreements between PMI and collaborating agencies. The same fiscal constraints noted in the implementation of PMI also applied to the collaborating agencies.

2.3.1 Banco Agrario. One of the key components of the PMI project was USAID/P funded credit for on-farm irrigation works, structures, and animals. The institution which managed the agricultural credit fund was the Banco Agrario. It was assumed that the Bank would provide loans for agricultural inputs as its normal course of business. The general performance of the bank in placing loans did not meet expectations in timeliness nor amount. This lack of success can be attributed to: 1) farmer attitudes, 2) USAID/P and Banco Agrario policy, and 3) project timeframe.

Farmer attitudes -- reluctant to request or accept bank loans -- should have been identified in the project design stage. Even if they had been identified it would have been difficult to assess the degree of resistance on the part of participating farmers until actually tested. Basically highland farmers do not trust credit relationships. While there may not be much precedent for the fear that the bank would take the lands of the farmer in the case of loan arrears or default, it is the firm belief of the farmers that they could lose their land. The production and credit personnel of PMI found that very few farmers were willing to take out loans. In one sub-project, of 17 farmers who were interested in credit, the bank approved 9, but only 2 of those 9 actually accepted the loan. The other 7 decided, for "family reasons", that they did not need the credit. From what the credit personnel said it appears that some farmers went ahead with the credit application just to be polite to the credit personnel. The pressures against borrowing seem to be great, and in one extreme case the children of a farmer who planned to accept credit actually brought a lawyer to bear upon him because they thought that he was going to waste their inheritance.

It is important to note that part of the attitudinal complex is the farmers' calculus of the probability and amount of return for the borrowed investment. The calculation of risk is affected by previous experience and the amount of effort required to obtain the loan. If the holding of the farmer is small, and the farm is used for subsistance agriculture (all or most of the produce is consumed on the farm), then the marginal return on effort will be too small. Obtaining titles or certificates of possession is an example of a time-consuming expense which the majority of small holders had to bear in order to obtain loans.

Traditional credit or borrowing practices vary between Cajamarca and Junin. Farmers in the Cajamarca area have a custom of sharecropping to obtain working capital for inputs. Thus one may borrow in exchange for a share of the harvest. In this way crop failure does not result in the loss of land, just a smaller harvest. For those farmers who have animals their custom is to sell an animal to obtain the working capital for planting. In this form of saving (an animal) inflationary pressures are cushioned.

In Junin the more typical form of sharecropping is for the use of the land rather than for inputs. That is, the owner of the land lets it out to the sharecropper for a given number of cropping seasons. The same calculus relating to farm size and return on investment holds as in Cajamarca, but when the farmer is not the landowner the question of titles is a formidable barrier to obtaining a loan. Also, with specific regard to the USAID/P loan fund, a short-term tenant would not be willing to make an infrastructure or land improvement loan.

The credit plan was for the Banco Agrario to provide credit for agricultural inputs, but for the small farmer and his correspondingly small loan, the bank had to invest as much in reviewing the loan application as for a larger loan. This is a common complaint about small-farmer loans.

Some of the larger farmers successfully applied for loans. Their calculus for investments in cattle and related infrastucture is based upon a

commercial agricultural perspective (most of the production is for the market and not for household consumption). The larger farmers had experience with the bank and had titles for the land.

The timeframe was an additional problem with the loan fund, as loans were available before the sub-project infrastructure was complete, and the program ended too soon to be useful on infrastructure improvement projects. It is possible that if the agricultural development aspects of the projects had been started before or during the construction phase, then the PMI personnel and the farmers would have been able to complete the paperwork and prepare the bank contracts before the loan period expired.

Part of the timeliness problem is linked to the loan regulations and the work that the credit personnel had to do to prepare the loans for approval. Specifically, land titles, certificates of possession, irrigation receipts and other documents required to make loan applications took up to three months to obtain. When the farmers did not have titles or certificates the Plan Meris I personnel helped them obtain these documents from the agrarian reform agency. This meant that land had to be measured and certificates of agreement obtained from each of the neighbors. In the areas with absentee owners this part of the certification process became impossible. Again, these efforts show the dedication of the PMI personnel; but, it also indicates limited initial understanding of the economic conditions and needs of the farmers, which could have been identified from the beginning of the project had an appropriate farming systems methodology been used.

The case of the changing relationship between PMI and the Banco Agrario illustrates an important factor in determining how loans were disbursed. During the first part of the loan period the agricultural development personnel of PMI in Huancayo promoted credit, but the regulations at the Huancayo branch of the Bank were strictly enforced and poorly understood. For example, PMI personnel mention a USAID/P minimum farm size requirement of 1 Hectare; but, this was never a requirement. The credit personnel completed forms for the applicants and did the footwork to obtain land titles required by the Bank. The PMI personnel were providing a service for the Bank and for the farmer in their effort to move the credit. But they were constantly frustrated by the regulations and the apparent disinterest on the part of the bank. An important change came just prior to the end of the USAID/P loan period.

The important event was the change of the Banco Agrario from a branch bank to a regional bank. Along with this change, the bank removed the old director, and personnel were promoted upward. The agricultural development personnel of PMI in Huancayo described this change as one which meant that their old contacts were now in decision-making positions and that these contacts trusted the judgement of the PMI personnel to approve loans. Also, about this time, the requirement for titles was changed to certificates of possession, which made it easier to fulfill the requirements for a loan. After this change another loan officer was transfered to the bank and his arrival caused a short delay in loan approval because he needed to review the procedures, but the PMI personnel were able to gain his confidence quickly.

The importance of this case is that it shows the importance of personal contacts between PMI personnel and a collaborating institution for the relative success of a project component.

2.3.2 INIPA/CIPA and CESPAC. The relationship between PMI and the regional agricultural investigation offices (CIPA) was to have been the source of appropriate cropping and animal husbandry technology for the agricultural development component of PMI. In Huancayo collaboration between the two institutions was strongly developed through personal contacts as per the Banco Agrario. In Cajamarca the development was not so strong. In Huancayo CIPA and PMI personnel developed a series of training workshops in which PMI personnel trained CIPA personnel and vis a versa. These training sessions took place at field days and with the use of CESPAC (Centro de Servicios de Pedagogía Audiovisual para la Capacitación) materials at the regional office. CIPA was not the strong institution that it should have been to give the needed support to PMI because it is a relatively new organization and is underfunded. The CESPAC relationship was established by the Agricultural Development Department of PMI, in Lima, and was a strong training source for both Cajamarca and Huancayo. It did not, however, have irrigation training. These materials were procured later from Utah State University. Fortunately, the CESPAC agreement provided for audiovisual equipment because the Plan Piloto did not have the projection equipment in time to use the irrigation training materials which they had prepared. The CESPAC connection made the use of these materials possible.

In Huancayo, the Instituto San Juan, part of the La Molina agricultural school, collaborated with the PMI team on demonstrations. The Universidad Nacional del Centro also provided courses to train PMI personnel. The University in Cajamarca assisted PMI in that area as well. Both universities were considered in the PMI plan to do soil testing, but because of financial constraints on the part of PMI very little soil testing was actually done. This is lamentable because without the soil testing some of the comparison/demonstrations were not meaningful.

2.3.3 IVITA -- FONGOL. In the field of veterinary medicine and artificial insemination IVITA (Institute for Veterinary Studies) and FONGOL (Foundation of Dairymen) were important linkages for Junin and Cajamarca respectively. While relations with the FONGOL already existed, in Huancayo the linkage was developed with the INVITA because of personal contacts. In both areas these linkages supported the development of PMI personnel in the promotion of animal husbandry and in the development of artificial insemination services. Both organizations helped maintain supplies and equipment so that the PMI could reach farmers which the organizations did not cover.

2.3.4 Ministry of Health and ONAA. In the construction stages of PMI projects the National Food Organization (ONAA) provided food for the community labor component of some of the projects. This support was not altogether successful because in most cases the food did not come at the time of work but lagged a few weeks. Nevertheless, farmers and their families did receive food from this program and it did support the local labor component. It is impossible to say to what degree the success of the construction depended upon this service.

Ministry of Health personnel have collaborated with the agricultural development personnel of PMI by providing seeds and inputs for home gardens. The PMI personnel have been providing the technical assistance to groups of women that the Ministry of Health and PMI personnel have organized. This is a small part of the overall impact of PMI, but is yet another area of development activity of PMI in collaboration with other agencies.

2.3.5 ATA/CLASS/CID Technical Assistance. The initial phase of the technical assistance was reported in Wilkinson et al (1984). This assistance was completed by the time our review was conducted. According to Wilkinson et al the technical assistance was aimed at water use research, study preparation, construction planning, and irrigation extension.

The problems identified by the previous review team were repeated in part with the second technical assistance project, Plan Piloto, e.g., a project leader without the necessary language skills. However, the employment of Peruvians on the Plan Piloto technical assistance team did overcome the earlier problem of expatriates settling-in.

It is difficult to assess the impact of this first technical assistance effort on PMI. Wilkinson et al state that "farmers did continue to participate in field day demonstrations begun by the research-extensionist...", but this review team found that the demonstration plots were inappropriately designed and not well thought out. Aside from this observation on the technical assistance, the Wilkinson team said that it was not possible for them to determine the impact of the first technical assistance. The CID pilot project at San Marcos in Cajamarca is the second technical assistance effort.

2.3.6 Plan Piloto. The CID plan piloto in San Marcos, for the development of appropriate extension and irrigation methods, has provided a considerable amount of training in the use of irrigation methods for PMI personnel. The orginal plan was that this plan piloto would provide training for PMI personnel of both areas, but, because of communication and transportation constraints, the impact has been greater on the Cajamarca office. The Pilot Project began in October of 1984, and only began irrigation demonstrations in mid-1985.

The Plan Piloto was planned as a research and support project for PMI. In the specific case of Cajamarca the immediate impact upon PMI agricultural development has been negative -- not by design but because of poor logistic support for the plan piloto. The supplies and equipment for the plan piloto did not arrive as planned, and in order to begin work plan piloto personnel borrowed equipment (tractor, trucks, etc.) from the Cajamarca PMI office. This caused PMI demonstration plots not to be planted. In addition, personnel from other sub-projects in the region were transferred to complete the plan piloto team. Some of the best PMI personnel were transfered in this way during late 1984 and 1985. Plan MERIS/Lima did not replace many of these people and the result at several projects was that the agricultural development component of the project was greatly reduced.

2.3.7 Irrigation Districts. Part of the Special Project concept was that it would have a definite time span and at the end of that time the completed sub-projects would be transfered to the regional irrigation district for management. Two distinct forms of relationships developed in the two regions:

1) In Junin, the relationship which evolved was that the irrigation district took no immediate interest in the sub-projects. Where irrigation systems did exist the irrigation district appears to have given up control to PMI. Irrigation district personnel said that their main concern was to monitor water quality because of runoff from the mines. These projects could be described as "turnkey" operations, that is, once the sub-projec is completed the district and PMI will enter into a transition agreement. During this transition the district will review the works of the project and the personnel such as the canal supervisor. If the works are acceptable, then the sub-project will be taken over by the district and the personnel may be accepted for continuing employment by the irrigation district.

2) In the case of Cajamarca the relationship between the district and PMI is collaborative, at least for the two projects located adjacent to the town of Cajamarca itself, and should lead to smoother transitions of sub-projects to the district. The district maintains an active, supportive interest in the systems. For example, when PMI personnel have difficulties with the participants in the control or use of the system, the district has supported the personnel by pressing charges to discipline the user who is violating the schedules or maintenance practices. This collaborative relationship between the Cajamarca district and PMI personnel is quite appropriate and should be encouraged in Junin It is probable that the difference can be traced to budgetary differences between Cajmarca and Huancayo, district policy concerns, and attitudinal differences on the part of both Plan MERIS and District leaders.

2.3.8 Community Irrigation Committees. The most important local institutional link between PMI and the community should have been with the community irrigation committees. This linkage should have been developed during the initial survey of the project sites and built upon through all stages of the project. In both Cajamarca and Junin the attitude of Plan MERIS personnel seems to be that the existing community committees had to be restructured even though these committees may represent generations of control and maintenance experience. Even the areas where new lands are being incorporated, many of the farmers are members of existing irrigation committees and are familiar with irrigation control and maintenance organization.

While it is true that the formal organization of the committees -- rotation of officers, titles employed, records kept -- does not fit the form that the irrigation district recommends, it would have been easier if Plan MERIS personnel had respected the existing committees and had built upon them. In a few cases they ignored existing irrigation organizations and in the process have created conflicts between old users and new users (Huayuri Huach in Sincos' canal "B", Sector 5). In the case of Apata, the proposed new committees do not include users with a special canal relationship. They will

be in conflict with the new commission because they are left out (La Pampa and San Lorenzo). In the case of Cotosh there is a more general problem which illustrates the poor appreciation of the importance of the committees and their integration into the commissions. The Cotosh sub-project is limited to the left bank of the river, but the right bank also has existing committees (some of the farmers have parcels on both sides of the river) with claims to the river. Part of an extended plan in Cotosh would irrigate beyond the present area using the main canal, but to do this successfully a dam would be built upstream from both the new and the older takeoffs which supply the right bank of the river. When water is released from the dam during the critical dry season, those committees on the right bank of the river would, undoubtedly, try to use the released water and would be in conflict with the committees on the left bank in the new area.

Another concern is the establishment and collection of water user fees. This is the domain of the irrigation districts, but it is also the right and responsibility of the committees and commissions to implement. It is the source of revenue that should support the commissions and the systems. The PMI personnel, in the role as promotors and organizers of the user groups, should encourage the users to tackle the fee questions directly in order to prepare for the future maintenance of the systems. Among farmers there was concern about the user rates, but neither the irrigation district nor PMI personnel could present policy. This question should be addressed as soon as possible so that the agricultural development personnel of PMI can begin to prepare these commissions for their own self-support.

These organizational problems illustrate a conceptual problem with the promotion and development of the sub-projects at three levels:

1) the committee level to manage each sector;
2) the commission level (made up of representatives from each sector committee to make system-wide decisions); and
3) the watershed level which, although beyond the scope of the sub-projects, is not beyond the scope of the impact and managerial concerns of the sub-projects.

The organizational perspective of these sub-projects has been to treat them somewhat in isolation rather than in relation to existing resource use and social orgánization. This is more notable in the case of Junin than in the case of Cajamarca. The close working relationship betwen the Cajamarca irrigation district and the PMI personnel probably explains part of this differenece. For future sub-projects these types of problems can be avoided if the Agricultural Development and Engineering components are developed simultaneously by multidisciplinary teams with a social and natural resources systems perspective which begins with an analysis of the existing systems.

2.4 CORDEs as an Alternative Approach to PEPMI

When reviewing the institutional structure of PEPMI the evaluation team was asked to consider the CORDES' structure as a possible alternative

counterpart organizational form. The information used for this analysis is based upon a recent USAID/P final evaluation (Chetwynd et al. 1985).

The CORDEs (Departmental Development Corporations) approach to development is based on the idea of decentralized government and the coordinated management of regional development in Peru. Two CORDEs were established in 1982 -- one in Cajamarca and one in Junin. The question of the suitablity of CORDEs to carry out development projects of the PMI type is quite sound. The regional planning perspective of the CORDEs is that rural development can be induced by strengthening the rural to urban linkages around poles of development. This would certainly add to the PMI focus on just the irrigation system; and, if correctly used and implemented, would coordinate the development of irrigation infrastructure while tying it into the marketing channels not developed in the PMI approach even though called for in the original project papers. The CORDEs approach also calls for the support of transformation industries to add value to the agricultural product.

The main barriers to the implementation of the CORDEs are similar to those of the Special Project approach of Plan MERIS -- Fiscal and Administrative. The USAID/P coordinated final evaluation of the CORDEs under the Integrated Rural Development project offers the following summary:

> "The current Peruvian budgetary and administrative process is antithetical to decentralization. Despite promising new legislation on empowerment to municipalities, budgetary and administrative processes seem calculated to enhance control at the center and frustrate local initiative, planning and development." (Chetwynd et al. 1985:iv).

The Hammergren Annex to the report on the Institutional Development of the CORDEs (Chetwynd et at 1985: Annex B) provides greater detail on the same theme -- the lack of independence. It is important to point out that, in addition to Ministry of Finance approval, the budgets for the CORDEs must be approved by Council of Ministers, the National Congress, and the Assemblies of Mayors. These additional legislative processes over the PEPMI Special Project approach make the CORDE approach even less attractive.

The same evaluation describes how the CORDEs have done exceptionally well with very dedicated and very well trained personnel; just as this PMI evaluation team has described the Plan MERIS field personnel. The accomplishments of both projects are considerable, and the problems experienced in both projects are similar. The CORDEs experienced greater frustration with the credit component than did the PMI personnel, but the root of the problem was the general administrative structure and the budgetary constraints. The CORDEs, just like the PMI special project, are an attempt to decentralize a highly centralized economic and political system at a time when the financial resources are limited and come from the central government.

Any project management which must depend upon and administer itself from Public Treasury funding, or use public accounting procedures will suffer the same frustration and limits to implementation. The conceptual framework or "approach" is secondary to this overarching context.

The degree of decentalization will also depend upon the new government's interest in decentalization and its willingness to give up control to the CORDEs. If the CORDEs can generate local funds and not depend upon the central government, then they may be able to carry out such projects with greater facility than the PEPMI. If this comes to pass then the integrated rural development approach of the CORDEs will be an addition to the PEPMI sub-project centered perspective.

2.5 Summary

We have compared the Special Project implementation with the expected features of the Special Project approach. The expected benefits of the approach have not been realized. It is impossible to describe what the differences might have been had the PMI project been handled within the MAG as a program. The important contextual observations are that both the fiscal constraints and the accounting questions were considered by the USAID/P personnel, and efforts were made to compensate for them; however, it was optimistic to believe that the Special Project approach would isolate PMI from the context of Peruvian administration and finances.

To have avoided the accounting delays USAID/P and the Peruvian treasury should have provided an advance equivalent of 2.5 months' expenses. USAID/P could have constantly applied pressure to the Peruvian treasury for timely and complete budgetary approval and disbursment of counterpart committed funds, as it tried to do for the first disbursment. These efforts, had they been successful, would have avoided the need for account juggling and the accompanying paperwork lag.

For its part, the DGE and the PMI/Lima directorship should have been more aggressive in pressing for timely and complete treasury disbursement. The field teams and regional offices made heroic efforts, but they were not supported by the central office with salary supplements nor technical assistance. With managerial assistance from the central office some of the paperwork could have been eliminated and expedited so that the burden of the liquidity crisis could have been lighter. On the other hand, it would have been impossible for USAID/P to have done anything about the fiscal crisis and the accompanying austerity laws which brought about the personnel problems described above.

Management at all levels of PEPMI consists of personnel not trained as managers. Only the "administrators" are educated in enterprise administration. These administrators are "off to the side" on both Organization Charts I and II. Their purpose is to handle the paperwork, but they do not manage and plan the project *per se*. The managerial staff consists of professionals trained in the technical aspects of agricultural production, but they do not have the managerial training which should go with the positions of responsibility and authority that they occupy.

For future projects, as it is difficult to envision an end to the fiscal crisis in the immediate future, it is only realistic to extend the timeframe for project implementation and completion while providing at least 2.5 months' advance on the project budget. One must also lower the

expectations of counterpart funding capability and not expect that counterpart fiscal commitments, no matter how modest, will be easily met. There are simply too many demands from domestic programs and other international counterparts for the limited national resources. The technical assistance component of future projects should include managerial training and advise for directors at all levels. It is not realistic to assume that professional managers will take over these rôles, but the technical personnel which is assigned to these positions of responsibility and authority could be prepared on the job.

3. IRRIGATION ENGINEERING

3.1 The Irrigation System

This chapter deals with the engineering component of the evaluation. Two main aspects are presented:

1) engineering considerations about the location, design, present condition, operation and maintenance, and risks of failure due to natural phenomena or to missmanagement of the irrigation network, including the intake structures, conveyance and distribution systems; and

2) water management considerations which include water availability and distribution, methods of irrigation, and farmer participation as factors that affect the optimum use of water. Six subprojects of the 17 have been selected to evaluate the soundness and viability of the irrigation system.

3.1.1 Components of the System. In general, we found the design and execution of the irrigation works to be adequate. Specific comments on the structures evaluated are noted below:

(a) Intakes. Table 3.1. shows, the location, design flow, design conditions and risks to the normal operation of water intakes. In general, all intake structures look well designed. However, 3 out of the 8 intakes visited have suffered from shifting of the main water courses; and important works are needed to redirect the river toward the intake structure as originally designed.

(b) Main Canals. Table 3.2. show the characteristics of the main canals of the six subprojects. Most of these canals are lined. The design conditions are adequate except in Cotosh where the cross section has been kept unchanged along its 11.105 Km. although in its last part the flowrate has been considerably reduced. The ratio length of canal/irrigated area is a variable whose value can help to assess the relative costs of maintenance in the sub-projects. The higher the ratio, the higher the cost per Ha. According to this the best subproject appears to be Apata (4.43 m/Ha.) followed by Chingol (10.10 m/Ha.) and Carahuanga (11.23 m/Ha.). On the other hand Sincos, Cotosh and Santa Rita have the highest values (18.18, 20.95 and 20.34 m/Ha. respectively). The average ratio would be 14.32 m/Ha.

Risk of landslides over the Cotosh canal exists from Km. 10 to the tunnel. The problem will be serious during the rainy season. A similar problem exists in Huasahuasi.

(c) The Distribution System. The water conveyed by the main canals is delivered to the farms by a series of secondary, and tertiary canals where the water is diverted by turnouts of different sizes. The available information about length of secondary and tertiary canals and number of turnouts in each subproject is not complete. Table 3.3 shows the available information about secondary canals. The best length/area ratio is found in Cotosh (5.1. m/Ha.) while the highest is in Apata (28.4 m/Ha.). The 3 subprojects in Cajamarca have very similar ratios.

Table 3.1 Characteristics of the Intake Structures

Project Area	Subproject Name	Location	Design Flow m^3/s	Comments
Junin	Apata	Left bank Rio Seco	0.800	Good location: good design for good operation. Risk of deposits from stream (pebbles, coarse sand)
	Sincos Huychac	Spring, on right bank Rio Mantaro	0.260	Good design. Risk of flooding and deposit from Rio Mantaro. No flow measuring device.
	Tierra Blanca	Spring	0.340	Good design. No flow measuring device.
	Cotosh	Left bank Rio Palcamayo	1.000	Good design.
Cajamarca	Carahuanga Carahuanga	Right bank rio Chonta	0.150	Risk of detachment of unconsolidated and vertical right bank. No measuring device.
	Cristo Rey	Right bank, Rio Chonta	0.500	Shifting of stream has isolated this intake from main water course. Need of defense works on river.
	Santa Rita	Left bank Rio Chonta	0.450	Good location, good design Risk of erosion on right bank.
	Chingol	Left bank Rio Condebamba	1.100	Shift of stream is a problem. Risk of sediment deposit.

Table 3.2. Characteristics of Main Canals

Project Area	Subproject Name (Irrigated Area)	Main Canal Name	Design Flow m3/sec	Length Km	Comments.
JUNIN	Apata (650 Has.)	A	0.400	2.400	Expansion joints, and lining of side walls risk being raised by grass intrusion (kikuyo) some seepage observed.
		B	0.400	0.440	
	(Total sub-project			2.880)	
	Sincos (460 Has.)	A	0.260	2.225	Expansion joints and linings risk being raised by grass intrusion (kikuyo).
		B	0.340	6.462	
	(Total sub-project			8,687)	
	Cotosh (530 Ha.)	Cotosh	1.000	11,105	Danger of landslides over the canal from Km. 10.0 on during the rainy season.
CAJAMARCA	Carahuanga (970 Has.)	Cara-huanga	0.150	7,300	Danger of landslides on both sides. Needs constant surveillance & maintenance work.
		Cristo Rey	0.500	5,972	Frequent breakages, and opening of unauthorized farm diversions.
	(Total sub-project			13,272)	
	Santa Rita (617 Has.)	Santa Rita	0.450 0.250	12,540	See page losses. Breakages unauthorized farm diversions.
	Chingol (1,460 Has.)	Chingol	1.000 to 0.500	14,140	Risk of mud slides from two narrow valleys.

Table 3.3. Distribution of Secondary Canals (Laterals)

Project Area	Subproject Name (Irrigated Area)	Number of Sec. Canals	Total Length of Sec. Canals Km.	Ratio Length/Area m/Ha
JUNIN	Apata (650 Has.)	4	18.390	28.3
	Sincos (460 Has.)	18	5.700	12.4
	Cotosh (530 Has.)	7	2.720	5.1
CAJAMARCA	Carahuanga (970 Has.)	9	17.430	18.0
	Santa Rita (617 Has.	2	10.850	17.6
	Chingol (1.460 Has.)	11	22.445	15.4

(d) Flow Measuring Devices. The six subprojects do not have flow measuring devices, except for a Parshall flume at the intakes in Cotosh and Apata, which are not being utilized. In Apata, it was mentioned that a triangular weir was being used to measure the flow of water delivered to the farms.

(e) Other On-farm Structures. Non existent. Only rustic turnouts to distribute water into the farms.

3.1.2 Design Considerations. The irrigation networks and their different components seem to have been designed according to the topographic, geologic, and soil characteristics of the project areas; and level of distribution desired. In addition, all the hydraulic structures visited appear to be in good working condition. However, some observations follow regarding size, and water use, slopes and location.

(a) Size of the Structures and Water Use. The dimensions of the intakes, main canals, turnouts and other structures seem appropriate for the flowrate to the point where water leaves the secondary canal for field level distribution. However, it should be pointed out that the system designs did not consider patterns of field level water use by farmers themselves. Future system designs should be based upon on-farm water use and new areas to be irrigated. It should also consider future improvements of systems layouts in the event of change in cropping patterns and farming practices.

(b) Slopes. No observation except to point out that the lateral canal "J" in Chingol has such a high slope that the flow is super critical, and, as such, has very high and very erosive velocity.

(c) Location. The intakes in two subprojects have been left beyond the reach of the main water course because of the meandering character of the rivers or because of heavy scouring of an unstable river bed. Costly river training works will be necessary to make the intakes fully operational.

3.1.3 Operation and Maintenance Considerations. Beneficiaries are generally becoming prepared to handle routine maintenance and repairs. Preparations for dealing with relatively large or costly repairs have not been made.

(a) Operation of the Irrigation System. A Manual de Operaciones that has been prepared by PEPMI describes the characteristics and functions of the hydraulic structures related to the diversion, conveyance, measurement, control and distribution of the water for irrigation. However, two basic requirements for an efficient operation are not considered:

(i) well maintained irrigation and drainage works.
(ii) trained personnel familiar with the system operation and procedures.

(b) Operational Technical Data. Other basic technical data related to the operation, such as canal velocities, discharges of turnouts, losses in the feeder canals, farm ditches and other farm losses, have not been

considered. Additional information from hydrometeorological stations may provide data necessary for the efficient operation of the system. The following operational procedures should be designed and periodically updated to cover the entire range of integrated activities:

(i) Planning for schemes of water application in accordance with cropping patterns.

(ii) Reporting the status of the water situation in the field (daily, weekly, etc. depending on the crops) and assessing water requirements according to the various stages of plant growth.

(iii) Collecting and processing climatological and hydraulic data within the project area.

(iv) Planning, allotting, regulating, and delivering water by main canal, lateral, sub-lateral down to the farm ditches according to farm requirements.

(v) Disposing of excess water and evaluating flood water.

(vi) Emergency measures during droughts or in the event of flood damages.

(c) Maintenance. The irrigation system looks unevenly maintained. In general, the intakes and main canals seem adequately maintained. But the laterals, turnouts, sublaterals and farm ditches show poor maintenance or no maintenace at all. However, PEPMI has prepared a detailed "Manual de Mantenimiento de la Infraestrucutura de Riego, Drenaje y Vias de Acceso", which includes the procedures to maintain the intake, main canals, laterals gates and other works. Table 3.4 includes a bar diagram illustrating the scheduling of maintenance activities.

The activities described in the "Manual," include mainly routine maintenance but satisfactory implementation calls for an appropriate system of inspection. The following elements should also be considered:

(i) annual repairs, carried out after the irrigation season is over, based on a preliminary list of repairs which is prepared, evaluated and prioritized.

(ii) emergency repairs that require prompt action. Priorities must be pre-determined for the various types of emergency repairs.

(iii) minor improvement works that are always necessary because newly completed projects are seldom perfect. Inadequacies will come to light and additional works may have to be carried out to improve the operational efficiency. For example, location of farm turnouts.

Table 3.4 Simplified Example of a Bar Diagram of Maintenance Activities for Carahuanga Subproject

Group of Activities	Month of the Year											
	J	A	S	O	N	D	J	F	M	A	M	J
. Preparation of Budget												
Inventory												
Field												
Office	—											
Approval of budget		—					—					
. Maintenance works												
Intake, cleaning, repairs										—		
Distrib. system - cleaning, repairs										—		
Structures, cleaning, repairs										—		
Greasing of gates											—	
Painting	—		—		—					—		
Service roads												

3.1.4 Drainage System. During the visits to the six subprojects no serious drainage problems were observed except localized spots due mainly to seepage from the main canals and poor irrigation techniques. As the use of water will increase (double cropping) and as long as poor water control to the field continues, it will be necessary to keep a watchful eye on the lower parts of the project area to detect possible drainage problems. This will be necessary in Sincos where salt deposits have been observed. As an illustration, Table 3.5 shows the drainage works done in Cajamarca. Because of the importance of adequate drainage to maintaining production and productivity, particular attention should be given to maintenance of drainage systems.

3.2 Water Management. Fig. 3.1 illustrates the influence of a good management on the water requirements of an irrigation system. Because water is such a valuable resource every effort should be made to improve the management level of an irrigation project to optimize its use.

Good water management should be understood as an integrated process of intake, conveyance, regulation, measurement, distribution, application and use of water to farms, and drainage of excess water from farms. Attention should be given to the application of the proper amounts at the right time for the purpose of increasing crop production and water economy. It should also include economic, social, institutional and other aspects which are relevant to the successful implementation of the project. There is much to be done to reach an acceptable level of water management in these projects. The following considerations are relevant.

3.2.1 Water supply and demand. Several factors appear to cause the amount of water supplied by the systems to be less than expected. At the same time poor management makes water demands by users greater than they should be.

(a) Water supply. Even though all the feasibility studies claim that there is enough water to satisfy the demand, the following findings show a different situation:

(i) Serious shortages in several sub-proyects have been reported, (Apata, Santa Rita, Cotosh) particularly during the dry season. It is our impression that this may be due to higher water losses in the network than first estimated.

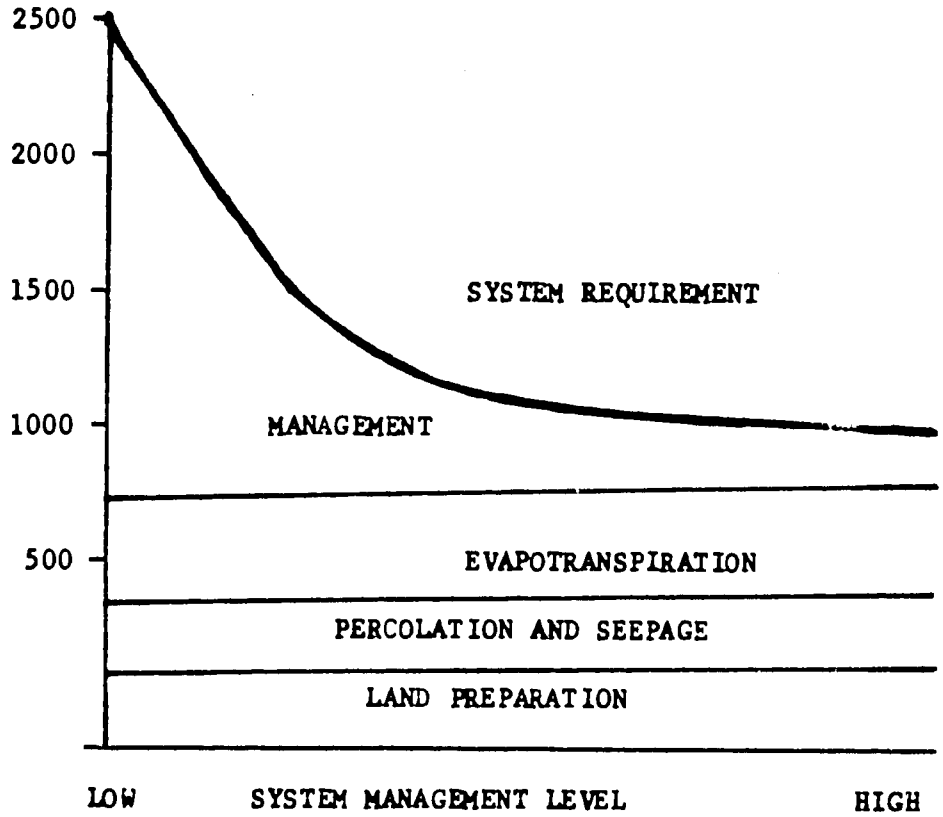
(ii) There is actually insufficient water volume being delivered to some farmers. Ungaged structures do not permit measurements and control, therefore farmers near the intake can divert the water to the detriment of the farmer at the other end of the system.

(iii) Even though the determination of the water supply has been based at a 75% duration, droughts should be expected in the region, and therefore, over the long term there will be less available water than originally calculated.

Table 3.5. Drainage Works Cajamarca, 1984

Sub Project Name	Total Irrigated Area (Ha.)	Area gained by Drainage (Ha.)	Improvement of drainage network (Km.)
Santa Rita	617	50.7	18.7
Carahuanga	970	30.0	13.5
Namora	222	18.0	0.6
San Marcos	390	39.2	---
Carrizal-La Grama	682	34.9	6.9
Cholocal	655	76.0	2.0
Tabacal-Amarcucho	522	23.2	2.2
Chingol	1,460	87.9	9.7
TOTALS	5,518	359.9	53.6

Figure 3.1. System Water Requirement As A Function of Management Level



Source: G. Levine, "The Water Environment and Crop Production," Paper presented at Cornell Workshop on Some Emerging Issues Accompanying Recent Breakthroughts in Food Production, Cornell University, March 30 to April 3, 1970.

In conclusion, it is probable that the volume of water available to the farmer, particularly during the dry seasons will be less than the demand.

(b) Demand for Water. The water requirement depends on many factors, such as type of soil, crops growing period, methods of irrigation, time of the application, and weather conditions. These factors were not always considered in the feasibility studies. For this reason a good relationship between the water applied and that required cannot be expected.

Table 3.6. is an example of the monthly water depth applied to some crops in Apata and Sincos. During February the depths for lima beans, potatoes, vegetables and wheat were 9.9, 8.1, 1.9, and 27.9 cms., respectively. The differences are remarkable. Note also that in March (Apata), the vegetables were irrigated 4 times to accumulate 1.6 cm. while wheat was irrigated one time and 32.3 cm. applied. This data, if correct, shows poor water management.

3.2.2 Water Disbribution. Because of the lack of measuring devices and poor knowledge about water management little control is exercised over water distribution and delivery.

(a) Control of Volume Delivered to the Farm. Except for Apata, where the water delivered to the farm is measured by a portable triangular weir, there is an absolute lack of knowledge and control on the amount of water being delivered to the farmer. This is reflected mainly as an uneven distribution of water which creates resentment among farmers because very frequently the farmer with more economic power or the farmer at the head of the system diverts all that he wants preventing the user at the other end of the network sometimes, from getting any water.

(b) Control of Volume Being Conveyed by Laterals and Main Canals. The absence of flow measurement devices on the irrigation network prevents Plan MERIS personnel from knowing the volume of water that is being used in the system as a whole. Thus, it is not possible to plan and control the water being distributed among the users.

(c) The Rotation System. Most subprojects have a weekly distribution system as shown in Table 3.7. This is a rotational system by laterals and requires rigorous control and regulation of distribution, particularly to meet a drought situation. In these projects, this will be possible only when flow measurement devices are installed.

In Santa Rita, on the other hand, the farmer has the right to water only every 15 days; missing a turn means having to wait 15 more days for the water.

(d) Distribution by Laterals. Table 3.8 shows the water distribution in the Chingol network by laterals. Considering the discharge as a function of the area served - depth of water conveyed in mm/day, - a lack of consistency is observed. This can be explained considering the interconnections that exist among laterals.

Table 3.6 Monthly Water Depth Applied by Irrigation and Frequency for Selected Crops: Huancayo (Plan MERIS, 1985)

Sub Proj.	Crop	Depth(cm) Freq/month	Month of the Year												Total Year
			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	
Sincos	Lima beans	Depth(cm)			4.7	8.4	9.9	10.9	8.7						42.5
		frequency			1	1	1	1	1						5
	Potato	Depth(cm)	4.5	5.8	14.7	15.6	8.1								48.9
		frequency	1	1	1	1	1								5
Apata	Vegt.	Depth(cm)					1.9	1.6	15.3	30.9	25.2	11.4			86.3
		frequency					1	4	4	4	1	1			15
	Wheat	Depth(cm)			3.7	16.0	27.2	32.3	90.8	9.4					99.4
		frequency			1	1	1	1	1	1					6
	Peas	Depth(cm)	25.8	9.3							6.7	16.2	32.2	35.6	125.8
		frequency	2	1							2	2	2	2	11
			Rainy Season							Dry Season					

Table 3.7 Chingol Water Use Rotation, by Laterals

Day	Improved Area		New Area	
	Lateral	Starting Time	Lateral	Starting Time
Monday	A	6 a.m.	H	6 a.m.
Tuesday	B	6 a.m.	I	6 a.m.
Wednesday	C	6 a.m.	J	6 a.m.
Thursday	D	6 a.m.	K	6 p.m.
Friday	E	6 a.m.	K	
Saturday	F	6 a.m.	K	
Sunday	G	6 a.m.	K	

Note: Farmers using lateral A to J alternate weekly irrigation using water either at night or day.

Table 3.8 Chingol: Operation by Laterals ("Manual de Operaciones", PEPMI, Cajamarca, 1983)

Lateral Name	Length Km.	Discharge Lt./Sec.	Irrigated Area Has.	Number of Farms	Depth of Water conveyed in mm/da
A	4.000	300	824.42	36	3.14
B	0.250	200	20.40	5	84.70
C	0.600	200	3.00	3	576.00
D	0.600	200	25.13	13	68.76
E	0.800	200	53.52	24	32.28
F	0.900	200	8.45	4	204.50
G	4.150	300	115.94	4	22.36
H	2.100	200	34.60	5	49.94
I	1.750	200	61.39	9	28.15
J	1.900	200	55.62	4	31.07
K	4.000	300	197.60	7	13.12
			1,400.04	114	

3.2.3 Methods of Irrigation. It is important that methods of irrigation be selected to fit individual land features in an irrigated area. The adoption of a given method should not be based, necessarily, on the common practices in the community. The method selected should conserve the soil as well as the water. Observing the irrigation in the areas visited, several defficiencies were noted:

(a) Excessive water applied at one point while not enough water applied to another one.

(b) More water entering the farm than could be controlled.

(c) Irrigation by furrows along the maximum slope of the terrain.

(d) Flooding method applied on steep slopes.

As a consequence there is loss of water and soils; water is applied unevenly; and areas with drainage problems may appear.

It is emphasized that proper irrigation methods must consider the slope, the crop to be irrigated, the water supply, the permeability of the soil, and its holding capacity. The water should be applied wisely to assure sufficient amount to satisfy the needs of the plant but not enough to cause waste and damage as such is the case in the subprojects.

Table 3.9 shows the evolution of three irrigation methods in 3 Junin subprojects. If the data has been gathered by the same method from year to year, the following observations can be made:

1) With the completion of construction in 1982 the irrigation area doubled for furrow and basin methods while being reduced for the flooding method.

2) Considering that newly incorporated lands tend to be steeper the use of furrow methods represents a good irrigation practice, and the flooding method an inappropriate method.

3) The decline in flooding, overall is a positive trend.

4) The impact of the projects at these sites is manifest by position change in methods and area under irrigation. It should be noted that aside from the radical change from 1982 there is not a clear trend except for increasing basin area in Apata which may be explained by area incorporation or change in cropping such as row crops to pasture.

Table 3.9 Evolution of different methods of irrigation (Has.)

Irrigation Method	Sub-Projects	1980	1981	1982	1983	1984	1985
Furrow	Sincos	-	154	169	369	395	390
	Apata	190	192	172	519	650	450
	Cotosh	-	-	275	674	625	509
	Total			616	1562	1670	1349
	% in Furrows			62.25	79.9	79.4	74.
Basin	Sincos	-	43	72	117	43	90
	Apata	-	-	26	115	210	240
	Cotosh	-	-	-	45	20	15
	Total			98	217	273	345
	% in Basin			9.9	14.2	13.0	19.
Controlled flooding	Sincos	-	-	-	-	-	-
	Apata	40	143	143	95	96	70
	Cotosh	-	-	130	21	65	56
	Total			273	116	161	126
	% in Controlled flooding			27.6	5.9	7.6	6
Total for 3 methods	(Has)			987	1955	2104	1820
	(%)			100.0	100.0	100.0	100.0

The topography of the subproject areas require furrow irrigation, except in some lowlands where basin irrigation may be better and it is probable that research efforts should be in this direction. Concerning sprinkler irrigation, it may be that some large farmers with high commercial income would be able to invest in such a system and, also, provide the technical expertise. The experiment to be carried out in the plan piloto may not be applicable in the Sierra, because its design may be difficult to replicate by the small farmer who makes up more than 80% of the landholders in the 17 subprojects.

3.2.4. Farmers' participation. Success of an irrigation project ultimately depends on the conscious involvement of the farmers in the operation, maintenance and use of the system. Fortunately for the project, most farmers are genuinely interested in their irrigation system and will participate in whatever activity is required from them by the technical personnel to improve its performance. In relation to this subject we have observed:

(a) Participation in the operation of the system is relatively low. Farmers have no control over the amounts of water being delivered to the different parts of the system. Eventually, though, they should be taught how the whole system works to enable them to understand it and protect it. The Commission and Committee members should be trained in these aspects.

(b) The farmers provide the manpower required for most of the maintenance works in the system. Two or three times a year the main canals are cleaned of sediments and minor repairs are made by all the farmers served by each main canal. In the same way are the laterals maintained. The tertiary canals and individual turnouts are maintained only by those farmers who use them.

(c) In all subprojects a rotational distribution of water use has been established by the users committee and commission. But the actual assignment of water to each farmer is done, at their request, through a "papeleta de riego" issued by Plan MERIS in Junin and the Distrito de Riego in Cajamarca.

3.2.5. Education and training for water management. The importance of good water management has to be recognized by government officials who should initiate action to bring about better and faster results from irrigation projects. But, improved water management requires education and training. This should be done at all levels of water management such as the professional, the technical and the field level. Most of the knowledge to be transmitted should be acquired through the development of practices and techniques adapted to local conditions. In view of this the following guidelines would be useful for training programs and methods of training (FAO 1971):

(a) the contents and nature of such education and training should be of immediate use and application.
(b) the training should be designed to put personnel on the job with the minimum of initial training.

(c) training should be adapted to local conditions.

In the subprojects' present condition, immediate attention should be given to the farmers for training and education on:

(a) the real value of water as an irreplaceble natural resource;

(b) the importance of respecting the rights of each other;

(c) the importance of sharing the responsibility for the conservation of the system, the water and the soil; and

(d) the best method of irrigation according to the terrain, the soil, and the crop.

3.2.6 Watershed Management. The watershed should be considered as the social and economic unit for development programs and conservation of water and soil, forests and related resources. It is known that management practices applied at one point, and water control structures built at another, affect the economy at yet another point. Therefore, the management of the subprojects should adopt measures to protect the watershed upstream and to monitor the effects of the irrigation system downstream.

(a) Watershed Protection. The benefits for the project areas from watershed protection are multiple. For instance land treatment measures such as terraces, rotation, pasture improvement, range management, contour furrowing and tree planting, protect the soil from sheet and gully erosion, retard runoff, conserve moisture and increase yields. Watershed protection also helps to reduce damage from floods and sediments and tends to stabilize the streamflows. Almost all of these measures are being applied more or less intensively in the project areas, but they should systematically be extended to the areas upstream. This is particularly important for areas such as Cotosh, Huasahuasi, and Carahuanga where the viability of the canals depends mostly on good watershed management.

On the other hand, it has been observed that upstream from the Carahuanga and Santa Rita intakes, another diversion has already begun. This may be a plausible idea, but, in-depth studies should be done to assure that the water supply of Rio Chonta is enough to satisfy the requirements of both existing projects during the dry season first. Then the use of any excess may be considered. Our present impression is that to proceed with the construction works before conducting these studies would be a serious mistake with undesirable political, social and economic implications.

(b) The Downstream Area. The soils in this area are likely to be affected by drainage and salinity problems. Pollution produced by leaching down of pesticides and fertilizers may also affect its wildlife and general environment. Therefore a responsible management will be aware of these problems and constantly monitor the soil, water, and general environment to present the deterioration of their quality.

4. ECONOMIC EVALUATION OF PLAN MERIS PROJECTS

4.0 Introduction

The Government of Peru, with U.S. foreign assistance, is investing in irrigation improvement and expansion facilities designed to increase the production capacity of farmers in the highland. It is intended that the cost of the investment be recovered indirectly in the form of future increases in farmer incomes as well as through increased food products which will be available to farmers and the public at large, and which, in some cases, will lead to reduced food imports.

In Peru a distinction must be drawn between irrigation and land reclamation projects which have been carried out in coastal and high jungle zones and those of the highlands. High jungle projects involve extensive land clearing and costly roads into remote, sparsely populated areas. Many of the high jungle development areas have proven to be subject to rapid environmental degradation once they are cleared, and farming practices, normally developed for other circumstances, have been applied. Projects in the coast, such as Majes, and Olmos, involve the reclamation of relatively large expanses of sandy desert soils which are then irrigated with water obtained by building expensive dams, reservoirs, and conveyance facilities. Costs of coastal projects have often run as high as $15,000 per hectare.

In contrast, sierra projects appear to be relativly inexpensive. For example, it was originally estimated that Plan MERIS projects would cost about $700 per hectare. But sierra projects differ from other projects in several important ways. Typically, land included in sierra projects is already under cultivation, either with old irrigation systems or rainfed cropping procedures. (See Appendix Table A-1) In fact, irrigation in the sierra is typically supplementary in nature, meaning that it is used when rainfall fails and during the lower rainfall months of the year. Therefore, the impacts of irrigation in the sierra are only incremental in nature, and benefits may be considerably lower than in coastal projects. Thus, a critical issue in sierra projects, as in all irrigation and reclamation projects, is to determine whether or not the benefits justify the costs.

In his cost-efficiency evaluation of the Corporaciones Departamentales de Desarrollo (CORDEs) in Junin and Cajamarca, Cornejo (1985) compares the costs associated with small and medium-sized irrigation projects executed by different agencies. The sample includes one Plan MERIS subproject in Cajamarca (Santa Rita) and two from Junin (Yanacancha and La Huaycha), plus ten projects executed by the PRODERINs (which was replaced by the CORDEs), CORDECAJ, and Cooperacion Popular. Overall, when the projects are ranked according to cost per hectare or cost per beneficiary, those executed by Plan MERIS are found near the center of the list. The only exception to this is the Yanacancha subproject, which is the most expensive of all the projects sampled in terms of cost per beneficiary family. This is due to its high-attitude location, where agricultural production is largely limited to livestock, and the consequent low population density (See Table 4.1.)

Table 4.1. Small and Medium-Sized Irrigation Projects Executed by Different Agencies (Size and Cost per kilometer, per Hectare, and per Family) (Cost shown in 000's of constant Soles as of December 1984)

Project	Institution	Project Km.	Goal Ha.	Beneficiary Families	Total Unit Cost Per Km.	Per Ha.	Per Fam.
Canal Coshapampa (reservoir)	PRODERIN	-	-	400	-	-	575
Canal Atunmayo (diversion works)	CORDECAJ	0.2	200	160	-	-	557
Canal Orcoruro Matara	COOPOP	6.0	200	30	27,577	827	5,515
Canal Collpa Huacataz	PRODERIN	6.0	243	70	-	1,647	5,718
Canal Procon-La Ramada	COOPOP	11.6	60	30	9,350	1,808	3,615
Irrigacion La Mejorada	PRODERIN	-	340	1.050	-	1,835	594
Irrig. Yanamarca-Concho	PRODERIN	-	100	431	-	1,868	433
Irrig. Santa Rita	Plan MERIS	12.54	618	976	110,710	2,246	1,422
Irrg. La Huaycha	Plan MERIS	-	540	620	-	2,319	2,020
Irrig. Heroinas Toledo	PRODERIN	-	60	424	-	3,737	529
Mejoramiento Canal Andabollan (bocatoma)	PRODERIN	0.338	140	297	-	4,622	2,179
Canal Huacaruro San Juan	PRODERIN	15.5	150	813	-	6,102	1,126

Source: Cornejo 1985

It also should be noted that Plan MERIS projects tend to be larger than those executed by other agencies. When Plan MERIS projects are compared with those in the sample that are of comparable size, they are superior in their cost per hectare performance, and comparable in terms of cost per beneficiary family.

Unfortunately, because of different approaches to calculating project costs, we cannot use our figures to expand the comparison to the rest of the Plan MERIS subprojects. However, on the basis of the evidence presented by Cornejo, it would be difficult to argue that other agencies are significantly more efficient in conducting small and medium-sized irrigation projects than is Plan MERIS.

Benefit cost B/C analysis is a procedure frequently employed for economic evaluation of land reclamation and irrigation projects. B/C analysis was originally conducted as a part of the feasibility studies for Plan Meris projects. Six of the 17 Plan Meris projects were selected for B/C analysis as part of this project evaluation. As Table 4.2 indicates, the original studies showed very favorable rates of return on investment. In practice, performance has not been as favorable as anticipated. This chapter is an analysis of how the projects were planned and implemented, how this relates to actual economic performance. Measures which are likely to lead to improved performance in the future are presented.

4.1 Organization and Implementation of Plan MERIS Projects and Relation to Ecomomic Performance

Plan MERIS projects were organized by related components. The first were studies to prepare detailed engineering plans and designs, and estimates of costs and benefits, to develop or improve the irrigation system for a proposed project area.

Based on these studies projects are ranked and selected for implementation. Plan MERIS is unique among Peruvian government entities because it carries out the construction itself, utilizing its own equipment and engineers, rather than contracting to private companies or the Ministry of Public Works. A series of complementary agricultural development activities were undertaken beginning midway through the construction phase. This included agricultural engineering, production and credit support, communication and social promotion, and enterprise development.

In support of the construction and development activities, there have also been technical assistance activities (supported mainly by the foreign funding component) which, since 1984, have been renewed in the form of the plan piloto research and extension program organized with the support of Utah State University. Technical assistance has also included domestic and foreign training of Plan MERIS staff.

Table 4.2. Rates of Return and Construction Periods for Six Project: Projected vs Actual

Project	Internal Rate of Return (%)		Contruction Period (months)	
	Projected	Actual	Planned	Actual
Apata	29%	38%	15	22
Cotosh	26%	-	18	30
Sincos	47%	18%	12	13
Carahuanga	41%	-	17	32
Chingol	41%	15%	18	46
Santa Rita	34%	22%	17	28

Source: Projected measures were taken from the original feasibility studies for each project. Actual measures were estimated by the evaluation team based on project reports and on information provided by Plan MERIS field staff.

4.1.1 The Initial Studies. The feasibility studies conducted for each project were quite detailed. They provide more information and entail much more planning than is usually encountered for projects of their size. They represent a fairly high degree of uniformity with respect to types of engineering and socio-economic data collected, as well as in the calculations, engineering designs, and benefit-cost analysis which were produced. The benefit-cost analyses follow uniform guidelines which were formally specified in a project publication produced in September 1978 by Jose M. Hernandez which follow well known World Bank procedures laid down by Gittinger.

While the studies did collect substantial amounts of data, some important elements were missing. Alternative activities, demands and opportunity costs of farm labor were not considered. For example, the fact that farmers in the projects often have lands which they cultivate in rainfed areas outside the project boundaries was not considered. Nor was the practice, prevalent in some areas, of non-farm work in mines and nearby commercial activities. The implicit assumption seems to have been that project farmers had surplus labor which they would devote to expanded irrigation production. Evaluation team discussions with farmers disclosed that labor scarcity is a significant factor in such projects as Sincos and Chingol. It was also noted that in the construction process Plan MERIS normally had to bring in labor from outside the project villages, since local labor supplies were not adequate for construction needs.

The benefit-cost studies were based on questionable cost data and assumptions as to ultimate project impacts. Construction times were under-estimated, (Table 4.2). As will be shown below, construction costs were also underestimated. For production costs, it was assumed that farmers would use relatively modern techniques requiring substantial inputs of fertilizer and chemicals. In reality, most farmers appear to have continued practices which require relatively few "modern" inputs and which require less cash investment. Yield increments of 50 to over 100 percent were often assumed whereas actual yield increases were much less than that amount (See Table 4.3.). While increases of this level may at times be possible, when converting from rainfed to irrigated cropping, a considerable proportion of lands in the Plan MERIS project, was already under irrigation and was only being improved. Furthermore, such high yield increases normally imply use of complementary inputs (Mann, 1979).

Underestimates of construction costs and overestimates of production increases led to overly optimistic B/C estimates. Table 4.2. shows that internal rates of return of 30 percent or more were generally expected, based on the initial studies.

Table 4.3 Yields for Major Crops in Six Selected Projects
Planned vs Realized

Project	Crop	Estimated Yields before Proj.	Planned Yield at Time of consoli-dation*	Achieved 1983	Achieved 1984
		... metric tons per hectare			
Apata	Potatoes	8.5	16	8.7	13.8
	Maize	2	10.8	5.4	7
	Wheat	1.5	3	3.2	2.5
	Barley	1.6	2.5	3.3	2.0
	Fava beans	3.4	7	4.6	7.5
Cotosh **	Potatoes	16.5	23	-	15
	Maize	3	7	-	6
	Wheat	2.0	2.8	-	1.5
	Barley	2.1	2.8	-	4
Sincos	Potatoes	9.6	15	8.9	8.7
	Maize	2	3	4.7	4.8
	Wheat	1.6	3	2.1	2.0
	Barley	1.9	2.5	2.1	2.0
	Fava beans	9.5	6	4.8	4.0
Carahuanga	Potatoes	8	13	9.8	9.9
	Maize, grain	1.2	2.3	2.8	1.8
	Barley	1.3	2.5	1.4	1.5
Chingol	Potatoes	8	15	11	12
	Maize, grain	1	4	2.2	2.3
	Yuca	7	14	11.5	11
Santa Rita	Potatoes	9	13	9.6	9.5
	Maize, grain	1.2	2.3	2.8	1.8
	Barley	1.3	2.0	1.4	1.4

Source: Feasibility studies and project reports.

* Year of "consolidation" is the year in which project was expected to be complete and full yield impacts realized. Except for Cotosh, all of the selected subprojects would now have reached consolidation according to original plans.

** 1984 was first year of production under Cotosh project.

The feasibility studies failed to diagnose some important socio-economic problems. One of these was farmer inexperience with credit and general reluctance to accept bank loans. Another was the land distribution factor. Virtually all of the studies measured size and distribution of holdings. Appendix A-2 shows the land and income distribution, taken mainly from feasibility studies, of six subprojects. In general, holdings for all 17 Plan MERIS projects average just over one Ha. However, at least 85 percent of all project farmers have less than 1 hectare. But the distribution of land varies from very equitable (Sincos and Apata) to fairly inequitable (Santa Rita). What was not recognized, however, was that such small farmers are subsistence oriented and often find it difficult to use credit and obtain purchased inputs. No strategy was developed for dealing with these problems.

The process by which projects were finally selected for implementation is not entirely clear. While benefit-cost studies were conducted for each project, the final ranking of projects consisted of a set of ten criteria which included overall size of project (smaller being better), execution time and construction costs, but which did not include the benefit-cost measures which had been so painstakingly developed.

4.1.2 Construction. Most Plan Meris projects are constructed in remote areas where poor roads complicate the entry of machinery and materials. Communication with project administrative offices is time-consuming. The evaluation team was impressed that project staff has persevered in overcoming many of the difficulties. From the construction of the 17 projects Plan Meris engineers have accumulated valuable experience and expertise which should be extremely valuable in future projects.

Construction of the projects took more time than planned. For the six projects shown in Table 4.2, construction delays averaged more than a year. Projects in Cajamarca suffered more delays than those in Junin. Projects which are relatively more distant from the regional offices in the departmental capitals experienced more delays than projects which are more easily reached from those offices. Chingol, which is about 6 hours' distant from the Cajamarca office, had a much longer delay than Carahuanga and Santa Rita, which are very close to the same office, and Cotosh (more than 3 hours from Huancayo) suffered a longer delay than Sincos and Apata (less than an hour away).

Aside from logistic difficulties attendant to long distances and poor roads, Plan MERIS staff attribute most of the construction delays to funding and procuring materials. Such delays added to cost overruns because a certain amount of construction costs -- especially engineering and administrative staff salaries, and equipment costs -- tend to be directly proportional to the length of construction period.

4.1.3 Agricultural development. Agricultural development activities are intended to complement the construction process and to insure that farmers are able to take full advantage of the new irrigation systems as they are completed.

The agricultural engineering staff is in charge of seeing that obras menores (tertiary canals, takeouts, gates, small bridges, etc.) are completed and that necessary farmer efforts (field leveling and construction or rearrangement of field ditches) are properly oriented and expedited. Since the agricultural development program normally started mid-way during the construction period, there were problems in coordinating this work with the construction effort. The main construction effort is usually completed before the minor works, and this often leaves the agricultural engineers with tasks which are burdensome to accomplish without the support of heavy equipment and vehicles.

Much of the labor which is required for the obras menores — particularly for installing minor canals and field ditches — is provided by project farmers. Normally, this has been organized under the direction of project technical staff, through the traditional system of faenas (community work days). In varying degrees this work has been compensated for with payments of rations from the World Food Program. In 1982, for example, such food was used as compensation for 32,229 days of labor in all Plan Meris projects. This amounted to 56.4 tons of food having an estimated value of $24,240.

One important task of the project staff is to convince farmers of the need to level their fields so that water can be conveniently and efficiently applied. Often there is also a need to install new field ditches and drains in order to take full advantage of the improved water supply system. Smaller fields--and typically the fields of smaller farmers--tend to lie on the upper edges of the project areas and thus tend to require more leveling and ditch work than do the larger fields which lie nearer the center of the project areas and principal canals.

Despite the encouragement of the owners by project staff, many of the smaller fields have yet to be fully leveled and incorporated into the new water system. Considering the relatively high proportion of small farmers and small fields in Plan MERIS projects, this is often a real problem and may help to explain why increases in yields and cropping intensity have often been slower than planned (see Tables 4.3 and 4.4). Although it is clear that farmers with smaller plots are often reluctant to give up the land required to install new field ditches, all of the reasons for their reluctance or inability to participate more fully in the new systems are not understood. They should be studied so that more effective incorporation of small fields can be realized in the future.

The production and credit component of agricultural development entails demonstration of improved techniques, dissemination of information about new crop varieties and improved inputs, and assisting farmers in obtaining loans for farm improvements (such as leveling), livestock purchases, and for purchase of production inputs.

The original program budget contained $1 million in AID funds to be used for land leveling, farm buildings, equipment and other capital

Table 4.4. Changes in Cropping Intensity* in Six Projects

Project	Cropping Intensity before Proj.	Planned Intensity in feasibility studies	Intensity Achieved	
			1983	1984
Apata	1.0	1.30	1.12	1.47
Cotosh	1.15	1.25	1.48	1.33
Sincos	1.0	1.36	1.17	1.13
Carahuanga	1.0	1.04	1.01	1.01
Chingol	.44	1.39	1.07	0.62
Santa Rita	1.0	1.21	1.11	0.98

* Here, cropping intensity is defined as the total number of hectares of crops grown during the year, divided by the total hectares in the project area.

improvements. Both production credit and capitalization loans were also provided under Peruvian Government counterpart funds. Loan funds were disbursed through the Peruvian Agricultural Bank (BAP). Plan MERIS agricultural development staff assumed considerable responsiblity for assisting farmers make loan applications and for helping the BAP in monitoring the loans. Interest rates were very favorable to project farmers -- initially running at less than 40 percent per year in periods when Peru's annual rate of inflation was climbing to over 100 percent.

As early as 1981, when most projects were receiving their first agricultural development efforts, it was recognized that credit program disbursements were going slowly (USAID 1981). A number of problems were identified. BAP loan procedures required that farmers have title to their lands, and many small farmers did not have formal titles. Plan MERIS personnel assisted numerous farmers in obtaining certificates of posession to satisfy the bank. They intensified their efforts in helping to prepare loan papers.

The rate of loan disbursement continued to be slow. During 1981-83 only 68 capitalization loans were made to the eight Plan MERIS projects in Junin department, and a total of 80 loans for capitalization and production were made to farmers in the nine Cajamarca department projects. Apparently, less than two percent of the more than 11,000 farmers in the two areas participated in the loan program. Of the 37 loans made during this period in Chupacca, the largest Junin project, only 9 percent went for land leveling. Discussions with Plan MERIS field staff support the conclusion that the vast majority of the loans were made to farmers with two or more hectares of land.

USAID/P and GOP participation in the loan program was terminated at the end of 1983. During the five years which these programs had been available to Plan MERIS farmers, some $503,000 in US funds had been disbursed, plus an estimated $1.5 million equivalent in counterpart funds.

IFAD (International Fund for Agricultural Development) loan funds were made available to Plan MERIS farmers in 1984. In that year, a total of 162 loans with an estimated value of $204,000 were disbursed. While this level of credit movement was apparently somewhat higher than that which had been obtained previously, it is still not very high, it represents less than two percent farmer participation, and discussions with project staff and bankers did not indicate that the program has been successful at reaching more small farmers.

Discussions with farmers, project staff, and bank officials convinced the evaluation team that it is unrealistic to expect a formal loan program, such as that administered through BAP, to be effective at reaching the small farmers who constitute the vast majority of Plan Meris participants. Despite real effort on the part of bankers and project field staff to bring more small farmers into the loan program, this has not been accomplished. Given the extremely volatile prices and inflation which prevail in rural markets, neither bankers nor farmers have any assurance for the repayment of loans.

Small farmers indicated, and bankers affirmed, that they had often turned down loans that had been approved at the bank. There is inadequate knowledge on the part of bankers about small farmers actual operating costs. Most small farmers did not even apply for loans even though several of those queried indicated that they would use more purchased fertilizer and other inputs if money were available. Lacking experience with formal credit -- or with any credit at all, in many cases -- small farmers are reluctant to take the risk which credit represents. Despite efforts to work with small farmers, bankers affirmed that the cost of doing business with them is high and that there is no real incentive to do so. The administrative cost for Plan Meris staff when helping farmers to apply for loans has been high, too.

The rationale for the projects' success (and the basis for economic viability) is closely tied to the concept of increasing the use of fertilizers, chemicals, and improved seeds -- along with the improved water availability and control. But farmers are slow to adopt these inputs. Agricultural development staff have clearly tried to promote the use of new inputs. Yet, while there is evidence that some of the larger farmers have increased their use of these inputs, field interviews provided little indication that small farmers have altered their production practices very much. This appears to be another reason why yields have not increased as much as anticipated.

When considering the problem of how to increase the use of improved farm inputs, particularly among smaller farmers, the evaluation team could find little reason to expect much improvement in the performance of the type of formal credit program which has been used thus far. This is not to say that the use of bank credit should be abandoned. Rather, it appears that an additional program is needed to support small farmers when trying new inputs and gaining initial credit experience.

Plan MERIS staff members in both field offices believe that a system of in-kind input loans, which they refer to as a banco de insumos (input bank), could be effective. We agree that this approach should be tried. With such a system, inputs would be loaned directly to farmers who would be required to pay it back, in-kind, when their crop is harvested. Such a program could initially be administered by agricultural development staff members, but ultimately, it could be managed by comites de regantes or other village organizations.

One of the important functions of Plan MERIS agricultural development teams is to work with the water users organizations. Traditionally, these organizations have operated and maintained small irrigation systems. It is the users groups, in the long run, which must perform the vital management function for the water systems. While the process varies from community to community, user organizations are typically responsible for organizing periodic group work days to clean, repair, and even construct canals. They appoint or hire tomeros and/or vigilantes de agua to operate the canals and see to the distribution of water. If these functions are not properly conducted there is little point in building new systems because canals will deteriorate and water distribution will be inefficient.

Such groups cannot count on the support and guidance of the distritos de riego (the government's official irrigation water management bodies) because these have limited personnel and budgets. Thus, if the users' groups do not function well by the time that Plan MERIS support is terminated, the ongoing operation and maintenance of the water systems will suffer (See Jurriens et al:1984).

The development of water committees is clearly time consuming. For this reason, in particular, it would have been preferable to begin the agricultural development program even before the beginning of the construction work rather than mid-way during the construction period. During this early start it would be important to establish a clear system of collecting water tariffs. As it is, water tariffs are not being collected in many of the sub-projects, and agricultural development staff are only now discussing them with farmers. It is a subject of great uncertainty for most farmers. Many recognize that they may ultimately have to pay for the water, but they have no idea how much. In fact, it appears that the tariffs will have to be increased above those which the distritos de riego have collected at other systems.

Peruvian water law specifies that tariffs should be collected and that 90 percent of what is collected should be returned to the commissions for operation and maintenance. In a few cases, such as Carahuanga, this system is actually functioning, but in most projects it has never been put into effect. Once it is established, users groups have a means of obtaining the funds they need to keep the the new facilities operating properly and in good condition. Without such a system, the new irrigation facilities are bound to deteriorate. Thus, the sooner that the water tariff system can be established, the sooner the Plan Meris agricultural development staff can leave the systems in the hands of the users groups.

Starting earlier with the agricultural development program in each project should also serve to expedite the processes of production support, extension, and training of farmers. It is evident that project staff members, after several years work, are arriving at a clear understanding of the agroclimatic conditions, farming systems, and marketing situation in each zone. Only after two or three seasons are they able to effectively assimilate all the information they need to begin to help farmers work out the altered production practices, cropping patterns, and water management practices required to take advantage of the new water system. If the agricultural development program is not begun until mid-way through the construction period, then this learning and extension process cannot be completed, until after construction is completed.

4.1.4 Program Administration and Technical Support. Each project is supported by three levels of support: 1) field office in Huancayo or Cajamarca, 2) Plan MERIS office in Lima, 3) staff support from PEPMI. Specifics of the institutional relationships are discussed in Chapter 2.

From an economic perspective of the projects, good administrative support is important to insure that materials procured will arrive at the project sites when they are needed for construction and agricultural engineering activities. The distance factor and communications difficulties

obviously make this process difficult. The various fiscal and administrative constraints discussed in Chapter 2 also pose serious obstacles. To the extent that material support for the projects is delayed, the entire construction process, and the production increases which depend upon the new facilities, are similarly set back.

Administrative rules specify the reporting procedures for the projects. Each project is required to make a monthly construction and agricultural development report (latest areas planted and crop yields, credit activity, demonstrations conducted, and so forth). These reports are quite detailed and contain valuable information -- information which was often of use to the evaluation team, when writing this report. Nevertheless, the amount of information required on a monthly basis entails many hours for the project teams to assemble; some report formats are not very explicit or well designed; and the information is normally filed without being analyzed in Lima. The project monitoring and managment process would be greatly enhanced if some reports were eliminated and others were redesigned. Field staff would also benefit from technical guidance on such matters as measuring yields and estimating milk production.

Ideally the number of reports should be reduced to four -- one for each of the two harvests and one for each planting season. The timing and rythmn of work for agriculture is unique and should not have to fit an urban office routine.

Technical guidance appears to be missing for the agricultural development teams in experimentation, trials and demonstration. They also need help in deciding how much emphasis should be placed on each and in how to interperet the results. Some simple experiements are probably required, in order to clarify factors which pertain to the specific conditions of a given project site. Normally, however, one would not expect the limited technical staff of projects such as Plan Meris to develop experiments. Time would probably be better spent on conducting well designed trials and demonstrations of techniques which have been proven elsewhere.

In general, it was noted that most of the demonstration work was related to fertilizer and seed varieties and that very little was related to improved field level irrigation practices. It is expected that results from the applied irrigation research at Plan Piloto in San Marcos will serve to identify improved irrigation techniques that are suitable for demonstration.

4.1.5 Technical assistance. Based on the original program agreement and timetable, technical assistance was provided jointly through the Consortium for International Development and two Peruvian consulting companies, ATA and CLASS. The CID part of the program, which began in early 1978 and terminated in April, 1980, provided assistance to Plan MERIS and the DGE in planning, applied irrigation research, and extension techniques. The ATA/CLASS component provided assistence in such areas as irrigation and drainage engineering, agricultural economics, soils, and rural development planning.

The CID assistance proved to be particularly useful in applied irrigation research. ATA/CLASS participated in at least 10 of the feasibilility studies (USAID, 1981). Unfortunately, the technical assistence program was completed in 1980, when construction had not begun on several of the projects, and before agricultural development started on most of them. Technical assistence was not resumed until the latter part of 1984, when the plan piloto program at San Marcos was formulated under the guidance of Utah State University. Thus, technical assistance, particularly in the area of applied irrigation research, was not available to the project from mid-1980 until late 1984. Better support for the agricultural development teams during this critical period could have facilitated their work in helping farmers to develop improved water management and cropping procedures.

4.2 Effects of Government Policy and General Economic Conditions

A number of conditions which prevail in the national economy appear to have affected project performance. During the past ten years the economy has experienced hyperinflation which has recently reached 150 percent per year. Inflation has not been uniform. Since 1983 the prices of imported and manufactured goods, including agricultural inputs, have increased more rapidly than the prices of most agricultural products. In other words, the domestic terms of trade have been shifting against agriculture, and this, in addition to the high levels of risk associated with inflation, has reduced farmers' incentives to increase production.

Within the general context created by hyperinflation, a number of agricultural policy factors have influenced producer decisions independedently of project-level agricultural development efforts by Plan MERIS. For example, the state policy of subsid' ing fertilizers during the 1975-79 period greatly reduced their costs to farmers. The average fertilizer subsidy in 1977 was 31 percent but was as high as 82 percent for of some imported fertilizers. When the subsidey policy was discontinued in 1979, the resulting price increase was accentuated by the high inflation rate. As a result, producers substantially reduced fertilizer use in the early 1980's (Orden et al 1982).

State food import policies are another factor that impinges upon Plan MERIS efforts to increase production and productivity in project areas. While subsidy levels vary from year to year, the state has continued to subsidize wheat and milk product imports throughout the 1980's. This has had the effect of reducing wheat to the status of a subsistence crop in project areas, even though it can be grown well under irrigation. Milk import subsidies limit project success in increasing milk production in Cajamarca, where Perulac, the principal buyer, prefers buying milk powder and fat that have been imported under the subsidy program rather than purchasing fresh milk from local producers. In the face of these obstacles at the level of national policy, the success that can be expected for even the best agricultural development component of a project such as Plan MERIS may be reduced.

4.3 Benefit Cost Analysis of Selected Plan MERIS Projects.

Of six projects selected for close detailed analysis by the evaluation team, it was possible to conduct B/C analysis on four, Chingol and

Santa Rita in Cajamarca Department, and Apata and Sincos in Junin Department. A subsequent B/C analysis was carried out for the other two Cotosh and Carahuanga. (See tables 4.11 and 4.12 respectively).

4.3.1 Analysis of Actual Project Development Costs. At the time of the original program agreement in 1976, the plan was to construct 27 different sub-projects encompassing 27,900 hectares. Dividing the entire program budget (USAID/P and GOP) of $18.5 million (not including credit program funds) by this area indicates an expected average development cost of $662 per hectare. In practice, only 17 sub-projects encompassing 13,443 hectares have been developed. This brings the average cost per hectare up to $1,374 per hectare, which is more than double what was originally planned. Average costs can be misleading, however, since local conditions as well as construction and agricultural development requirements vary according to location.

Plan MERIS staff in Lima provided a detailed analysis of actual development costs for the six selected sub-projects. Yearly summaries of these are shown in these are shown in Appendix Table A-3. To avoid problems associated with high inflation rates of the Peruvian Sol, amounts have been converted to current dollars of each year. These costs are further summarized in Table 4.5, which also includes the cost of foods which were distributed to compensate farmers for work which they performed. Overall, costs varied from a low of $665 per ha. for Carahuanga to a high of $1725 per ha. for Cotosh.

Construction costs are the main determinant of overall costs. These varied from a low of $308 for Carahuanga to $1,070 per hectare for Cotosh. Carahuanga is a case in which the construction of simple river diversion works and lining existing canals were the main requirements. The project is located adjacent to the town of Cajamarca, which provided easy access and simple logistic support. Cotosh, on the other hand, required not only diversion works, but the construction of new canals high on a steep hillside, where access was difficult. A short tunnel for the main canal was also required. These factors obviously increased the costs greatly.

Agricultural development costs ranged from $109 to $271 per hectare, with the latter figure being reported for Sincos, which is quite close to the town of Huancayo. In general, lower agricultural development costs were reported for the projects in Cajamarca. Costs of administration--those incurred in providing administrative and technical support from both Lima and the regional offices--varied from $68 to $271 per hectare. They tended to be higher for the Junin Department projects and are proportional to construction costs.

4.3.2 Operation and Maintenance Costs. The future operation and maintenance of the projects will be instrumental to insuring their sustained productivity. As noted above, the distritos de riego do not have the personnel or funding to insure that this is done, and the main responsibility will have to be assumed by the users organizations with funds collected through the water tariffs. Project staff estimates of operation and maintenance for 1985 ranged between $2 and $10 per hectare for personnel (tomeros and, in some cases, guardians), repair materials and replacement parts, and transportation (a motorcycle). These costs seem low and probably

reflect the fact that the projects are still new and have yet to experience the maintenance costs that will occur in the future. These costs range from two to ten times the water tariffs which are currently being collected in some project areas (S/. 6,500, or approximately $1 per ha.).

4.3.3 Measurement of Production Impacts. A number of sources of information were used to estimate crop output and production costs. The initial sub-project feasibility studies were taken as the main source of information for areas cropped and yields prior to project implementation. Monthly and annual reports made by the agricultural development staff of each project provided the main source of information on areas cropped and yields for the years after the start of the projects. Project staff members were questioned as to the methods used in collecting this data. Yield estimates

Table 4.5 Summary of Construction and Development Costs Per Hectare for Six Sub-Projects

Item	Cara-huanga	Chingol	Santa Rita	Apata	Cotosh	Sincos
Feasibility Studies	115	107	145	180	46	356
Construction	308	742	433	858	1070	523
Equipment	47	122	67	130	110	79
Ag. Development	109	127	229	324	183	271
Administration	68	271	125	135	291	178
Tech. Assistance		92	27	6		1
Food for work	19	49	33	27	27	27
Total per ha.	666	1510	1059	1660	1727	1435

Source: Appendix A-3

are made based on weighed samples in farmers' fields. Milk producers were interviewed periodically for the average daily milk output per animal. Annual censuses of livestock population were conducted for most projects.

While the sampling procedures for crop yields are not as systematic as would be prefered, crop yield and area data were deemed to be fairly reliable. In general, procedures for estimating livestock and meat production were far less reliable, and thus, the B/C findings for projects such as Santa Rita and Carahuanga, which have large dairy components, are viewed with less confidence than results for the other projects which are devoted mostly to crop production.

In general, measurable project production impacts resulted from:

(1) increases in area cropped under improved irrigation, rather than under the old irrigation system or under rainfed production (see Table 4.2 and Appendix Table A-1);

(2) increases in yields (for examples of main crops, see Table 4.3), and;

(3) changes in crop mix from lower to higher valued crops.

In Chingol, for example, potatoes and yucca accounted for 7 percent of the crop mix before the project, compared to 12 percent after the project. In Santa Rita, vegetable crops accounted for 4 percent of the total cropped area before the project and 10 percent after. In both cases, the relative (but not absolute) amount of area devoted to cereals and legumes declined with the advent of the project.

Obtaining prices and changes in production costs proved to be more difficult to obtain. It has been the general practice in the feasibility studies, and in reporting ongoing production statistics, to use cost budgets of BAP. Based on evaluation team field interviews with farmers, it was felt that these budgets were generally inadequate as indicators of costs for most of the small farmers in the project areas. This was confirmed by referring to some actual production budgets being collected for farmers in the plan piloto project. By comparison to bank budgets for Cajamarca department, the field data indicated that small farmers were using at least 50 percent more hand labor and animal plowing hours than was allowed for in the bank budgets, while virtually none of the chemicals and fertilizers figured by the bank were being applied. In general, farmer budget costs were higher than those estimated by the bank, when (family) labor was valued at the market wage. On the other hand, the farmers' actual cash outlays appeared to be much less than anticipated by the bank. As previously noted, few if any of the small farmers were able to utilize bank credit.

In the original feasibility studies, it was estimated that farmers would double or even triple their per hectare costs of operation in the course of making the transition to improved production under irrigation. Field interviews with farmers showed almost no indication that this had happened, particularly in the case of small farmers. It was clear, of course, that

farmers are now devoting more time (labor hours) to irrigation in many cases. For certain crops, fertilizer use has probably increased, particularly in Junin department and also to some extent in Cajamarca.

In view of the preceding, a number of procedures were used to estimate production costs for the benefit-cost analysis. To estimate costs of production, BAP budgets were modified to reflect more labor use and less use of fertilizers and chemicals. These were then increased, depending upon team field observations for different crops, by a total of 5 to 15 percent over a five year period for Cajamarca projects and by 7 to 10 percent for Junin area projects. Costs were first estimated in Soles for the 1984-85 crop season and then converted to U.S. dollars.

Product prices for the same period were taken first from bank budgets, where available, but these were then modified in some cases to reflect actual prices reported for the different project areas in monthly reports. Prices cited by farmers themselves for some items such as milk were used in a few cases.

4.3.4 Limits to Analysis. In benefit-cost analysis it is common to use "shadow prices" which attempt to correct for distortions in product and input prices and which try to measure the true opportunity cost of labor. While, as discussed in Section 4.2, there is ample reason to expect price distortions in the case of sierra agriculture, the information required to measure these distortions is not readily available. Therefore, the analysis conducted here did not use shadow pricing and may be limited as a result.

4.3.5 Benefit-Cost Findings. Estimates of actual benefit-cost performance are shown in Tables 4.6 through 4.11. Reference to feasibility study projections may also be seen by comparison to Table 4.2. While the actual rates of return are lower (in three of the four cases) than what was originally projected, they are still all well above 12 percent; quite acceptable by most investment standards. Benefit cost ratios were calculated using a 12 percent rate of discount. All four sub-projects have positive benefit-cost ratios.

In performing the benefit cost analyses, it was initially assumed that increases in crop yields, area under irrigation (for projects in which additional area still remains to be incorporated), and cropping intensity, would continue to increase during 1985-1990, but at somewhat lower annual rates than those experienced to date. Based on observations of the evaluation team, this seemed to be a reasonable assumption.

It is also useful to ask what would happen to the overall economic outcome if only the gains attained thus far are achieved. Thus, for an alternate calculation it was assumed that production and cost impacts would stabilize after 1985. The alternate internal rates of return, based on this assumption, are also shown in Tables 4.6 - 4.11. A comparison of results is shown in Table 4.12. Naturally, rates of return are lower for the case in which no additional gains are realized after 1985. Nevertheless, four of the projects would still have rates of return of greater than 12 percent. Only Sincos (11.1 %) and Chingol (9.9%) fall below this rate.

4.3.6 Comparison of Performance with Similar Projects. A legitimate question arising from the encouraging rates of return estimated here is to what degree other small and medium-sized irrigation projects in the highlands can be expected to perform similarly. An indication that our findings may not be atypical is found in the ex-post evaluation of the Linea Global I project conducted by the Inter-American Development Bank (IDB, 1981). The Bank conducted B/C analysis of four of the twelve sub-projects which had been developed starting in the early 1970's, two of which were coastal projects and two of which were in the highlands. The highland subprojects analyzed were Asillo (located in Puno department) and Huanta (located in Ayacucho department).

The Bank evaluation calculated internal rates of return of between 26.7 and 35.7 percent in the case of Asillo and between 5.4 and 11.9 percent in the case of Huanta (Table 4.13). Their lower rates were obtained under the assumption that production increases would stabilize in 1985, and the higher rates were based on stabilization in 1990.

Table 4.7 Benefit Cost Analysis for Santa Rita

BENEFIT-COST ANALYSIS
SANTA RITA

	YEAR 0	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990-2007
DEVELOPMENT COSTS:	.....						thousands of U.S. dollars				.....				
Studies		0	0	18	72	0	0	0	0	0					
Construction		0	0	5	150	76	34	2	0	0					
Equipment		0	0	0	10	21	10	0	0	0					
Ag. Development		0	0	1	17	19	45	18	20	20					
Administration		0	0	4	46	16	10	0	0	0					
Tech. Assistance		0	0	4	13	0	0	0	0	0					
Operation and maint.											2	2	2	2	2
Food for work					1	1	3	14	2						
Sub total		0	0	32	308	132	99	20	20	20	2	2	2	2	2
FARMER ACTIVITIES:															
Added Prod.Value					-14	11	108	90	134	135	147	156	164	172	180
Added Prod. Cost					-34	-33	-2	10	0	1	3	5	5	7	9
TOTAL CASH FLOW		0	0	-32	-288	-88	11	59	114	114	142	150	157	163	170
ALTERNATE CASH FLOW		0	0	-32	-288	-88	11	59	114	114	114	114	114	114	114

INTERNAL RATE OF RETURN 22.0 % BENEFIT COST (12%) 1.87
ALTERNATE I.R.R. 18.8 %

Table 4.8 Benefit Cost Analysis for Apata

BENEFIT-COST ANALYSIS APATA	YEAR 0	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990-2007
	thousands of U.S. dollars														
DEVELOPMENT COSTS:															
Studies				4	91	21									
Construction					69	372	96	21							
Equipment					5	53	26								
Ag. Development						81	20	39	36	36					
Administration					4	52	18	14							
Tech. Assistance					1	3					5.4	5.6	5.9	6.2	6.5
Operation and maint.															
Food for work					1	1	2	12	4						
Sub total		0	0	4	171	583	162	85	40	36	5	6	6	6	7
FARMER ACTIVITIES:															
Added Prod.Value						41	11	366	714	637	700	755	809	837	858
Added Prod. Cost						6	-26	93	149	136	143	151	159	163	167
TOTAL CASH FLOW				-4	-171	-548	-125	188	525	465	551	598	644	668	684
ALTERNATE CASH FLOW				-4	-171	-548	-125	188	525	465	465	465	465	465	465
INTERNAL RATE OF RETURN		37.9 %		BENEFIT COST (12%)		2.50									
ALTERNATE I.R.R.		34.2 %													

Table 4.9 Benefit Cost Analysis for Sincos

BENEFIT-COST ANALYSIS

SINCOS	YEAR 0	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990-2007
DEVELOPMENT COSTS:	thousands of U.S. dollars														
Studies					4	159									
Construction						46	192	3							
Equipment						12	24								
Ag. Development							27	28	35	35					
Administration						14	67	2							
Tech. Assistance						1									
Operation and maint.											4.4	4.7	4.9	5.1	5.4
Food for work					1	0	1	11	3						
Sub total		0	0	0	5	232	311	44	38	35	4	5	5	5	5
FARMER ACTIVITIES:															
Added Prod.Value						-273	-3	124	178	102	204	232	258	280	309
Added Prod. Cost						-126	4	40	62	37	63	65	68	69	71
TOTAL CASH FLOW		0	0	0	-5	-380	-318	40	78	30	137	163	185	207	232
ALTERNATE CASH FLOW		0	0	0	-5	-380	-318	40	78	30	30	30	30	30	30
INTERNAL RATE OF RETURN		17.9 %		BENEFIT COST (12%)		1.46									
ALTERNATE I.R.R.		1.1 %													

Tale 4.10 Benefit-cost Analysis for Carahuanga

BENEFIT-COST ANALYSIS CARAHUNGA	YEAR 0	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990-2007
DEVELOPMENT COSTS:							thousands of U.S. dollars								
Studies				17	94										
Construction					39	131	125	3							
Equipment					9	18	18								
Ag. Development					15	19	28	18	13	13					
Administration					1	23	41	1							
Tech. Assistance															
Operation and maint.											2	2	2	2	3
Food for work						1	2	4	11						
Sub total				17	158	192	214	26	24	13	2	2	2	2	3
FARMER ACTIVITIES:															
Added Prod. Value						34	82	224	271	267	280	290	300	308	317
Added Prod. Cost						-1	25	40	43	46	49	51	54	56	59
TOTAL CASH FLOW		0	0	-17	-158	-157	-157	159	204	208	229	236	243	249	256
ALTERNATIVE CASH FLOW		0	0	-17	-158	-157	-157	158	204	208	208	208	208	208	208
INTERNAL RATE OF RETURN		31.6%		BENEFIT COST	(12%)	2.08									
ALTERNATIVE I.R.R.		29.6%													

Table 4.11 Benefit-cost Analysis for Cotosh

BENEFIT-COST ANALYSIS COTOSH	YEAR 0	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990-2007
DEVELOPMENT COSTS:							thousands of U.S. dollars								
Studies				18	2	3	2								
Construction							70	301	196						
Equipment							12	23	23						
Ag. Development							23	12	31	31					
Administration							7	64	83						
Tech. Assistance															
Operation and maint.											5.7	6.0	6.3	6.6	7.0
Food for work							1	9	3						
Sub total				18	2	3	115	409	336	31	6	6	6	7	7
FARMER ACTIVITIES:															
Added Prod. Value								95	421	334	368	424	480	547	597
Added Prod. Cost						-		74	106	76	84	92	100	110	119
TOTAL CASH FLOW				-18	-2	-3	-115	392	-21	227	278	326	373	431	471
ALTERNATIVE CASH FLOW				-18	-2	-3	-115	392	-21	227	227	227	227	227	227
INTERNAL RATE OF RETURN		37.5%	BENEFIT COST	(12%)	2.17										
ALTERNATIVE I.R.R.		28.6%													

Table 4.12 Rates of Return Based on Alternate Assumptions about Future Production Increases

Project	Internal Rate of Return (%)	
	Assuming Continued Increases 1985-1990	Assuming No Increase After 1985
Chingol	15.0	9.9
Santa Rita	22.0	18.8
Apata	37.9	34.2
Sincos	17.9	1.1
Carahuanga	31.3	29.6
Cotosh	37.5	28.6

Table 4.13 Internal Rates of Return for Highland Irrigation Projects Conducted Under Linea Global I.

Project	Assumed Year of Stabilization	I.R.R (percent)
Asillo	1985	31.1 - 35.7
	1990	26.7 - 29.9
Huanta	1985	6.2 - 11.7
	1990	5.4 - 9.9

Source: (IDB 1981:47)

4.4 Estimated Impacts on Individual Farmers.

Based on the benefit cost analysis it is possible to make some rough estimates of the impacts of the projects on individual farmers' incomes. This may be done by dividing the net production benefits by the land area and number of families in each of the project areas in order to estimate the average net return per hectare and per family.. This was done for the 1984 crop year, the last year for which actual project data was available, and for 1990, based on the assumption of continued increases in production until that time. Results of the calculations are shown in Table 4.14.

The estimated changes in annual incomes are quite impressive. For 1990, the net increases per hectare range from $279 for Santa Rita to $1063 for Apata. On a per family basis, however, they range from $176 for Santa Rita to $2168 for Chingol. The differences reflect, of course, the differences in average size of holding for the different projects. For example, average land holding sizes in Chingol are quite large (5.8 ha.) compared to Santa Rita (0.6 ha.).

While benefits of this magnitude are quite encouraging, it is necessary to recall that land is never equal in its distribution and that not all families in the projects will share benefits equally. In Chingol, 70 percent of the families have less than 5 ha. of land and thus would probably receive less than average incomes. In Santa Rita, more than 75 percent have holdings which are less than average in size. Furthermore, we must recall that it is those farmers with smaller fields that have not been incorporated as effectively into the projects as the larger farmers. Proportionally speaking, their benefits would be even less because of this.

Earlier, the importance of collecting water tariffs was discussed. This would provide a means of funding continued operation and maintenance of the projects. With the levels of benefits shown in Table 4.11, it seems reasonable to expect that water charges of as much as $10 per hectare could be supported from the net benefits generated by the projects. Cash may be a problem for the very small farmers--those with less than half a hectare, for example--since they are often subsistence oriented and may have little actual cash income. This provides all the more reason to begin working on the problem of collecting water tariffs early in the project development process.

Table 4.14 Average Changes in Annual Income Per Hectare and Per Family Compared to Situation before Project

	Net Increase in Income Per Hectare	
	1984	Projected 1990
	.....dollars.....	
Chingol	84	371
Santa Rita	217	279
Apata	869	1063
Sincos	252	517
Carahuanga	235	266
Cotosh	594	901

	Net Increase in Income Per Family	
	1984	Projected 1990
	.....dollars.....	
Chingol	488	2168
Santa Rita	137	176
Apata	986	1206
Sincos	504	1035
Carahuanga	358	406
Cotosh	252	382

4.5 Conclusions

The implementation of Plan MERIS projects has not always gone according to plan, and difficulties have been encountered along the way which have had their effect on ultimate economic performance. While performance has not lived up to original projections in most cases, it appears to be surpassing expectations in some cases. A number of important lessons can be learned from experience to date.

Initial plans were overly optimistic in certain regards. Planned construction periods were probably not long enough, particularly in more remote areas where access was difficult, and for projects which entailed construction of difficult tunnels and high canals. Nevertheless, inadequate administrative support and difficulties in procuring materials produced unnecessary delays which contributed to time overruns. Time delays in construction inevitably increase costs, to the detriment of economic performance.

Plans were clearly too optimistic in terms of yield increases and levels of cropping intensity which were anticipated. It is probably unrealistic to expect yield increases of more than 100 percent from sierra projects, unless increased use of complementary inputs--more fertilizer and improved seed varieties--can be assured.

Increased use of complementary inputs, as envisioned in original plans, has not been forthcoming in most cases, and particularly not in the case of the smaller farmers which constitute the majority of project participants. In part, this can be attributed to beginning agricultural development activities too late in the project development process, and to a credit program which does not work for small farmers.

It is recommended that input banks that would make in-kind loans of fertilizers and seeds to project farmers be established to see if this could overcome the credit bottleneck. In-kind lending would seem to be a logical means of overcoming small farmers' reluctance to participate in formal loan programs and for them to gain needed experience with the loan concept.

The agricultural development activities in the projects were not initiated until mid-way during the construction period. This was too late in several regards. It did not permit the development teams to learn local agroclimatic conditions and to develop their system of farm demonstrations and farmer training in time to have an early impact on farmer practices. Above all, the agricultural development teams have not had enough time to work with local irrigation committees and thus to prepare them to work with the distritos de riego to insure adequate project operation and maintenance.

An earlier start should also have been made on establishing a working system of collecting water tariffs from project users. Only in this way will funding for future operation and maintenance of the projects be generated and the satisfactory future economic performance of the projects be assured. The levels of benefits generated by the project seem quite adequate to support the up to $10 per hectare in annual O & M costs that will be needed.

Overall development costs of the projects have averaged about $1375 per hectare, which is more than double what was originally anticipated. While this has undoubtedly contributed to the somewhat lower than expected performance of some projects, performance, as measured by the internal rate of return on investment, appears to have been good for those projects on which it was possible to make a benefit-cost analysis.

Nevertheless, economic performance does vary substantially from project to project. This should provide valuable lessons for future project selection and administration. For example, the project with lowest economic performance of those analyzed was Sincos, which had an internal rate of return estimated to lie between 1 and 18 percent. Sincos has problems with labor scarcity and absentee land ownership which have contributed to levels of land use which have been much lower than anticipated. These problems should have been more carefully diagnosed in advance.

In general, Plan Meris I projects appear to be achieving good levels of economic performance. In the future, through more careful selection of projects and through improved administrative support, it should be possible to bring about economies in construction and development costs. By advancing the start of the agricultural development phase, production increases should come sooner and be somewhat larger in magnitude. In this way it should be possible to attain even better economic rates of return.

5. PLAN PILOTO

5.0 Introduction

In response to recommendations in Wilkinson et al (1984), Plan MERIS and USAID/P contracted with the Water Management Synthesis II (WMS II) project to conduct research and training activities intended "to improve water and land use in the watershed of the Mantaro River and bordering areas, the watershed of the Crisnejas, Condebamba, Cajamarca and Jequetepeque watershed" (WSM II 1984:i). Work on the project, commonly referred to as the "Plan Piloto", is being conducted by a technical assistance team from Utah State, Cornell University, and a team of Peruvian counterparts.

The USAID/P implementation plan for the project was approved in early March 1984, and the final plan of work, prepared by the WSM II technical assistance team in collaboration with the Peruvian counterparts, was completed in late October of the same year. The scheduled completion date is December 31, 1985. Therefore, it is important to bear in mind that our comments in no way attempt to assess the results of Plan Piloto, because it is still primarily involved in data gahtering. Data analysis has only recently begun in some of the project's areas of activity and it has yet to begin in others. Our assessment simply attempts to illuminate three areas:

a) the degree to which the administrative difficulties that have afflicted other areas of Plan MERIS activity have also affected Plan Piloto, and the effect that this has had on its ability to conduct its planned activities;

b) the degree to which the areas of activity defined for Plan Piloto address issues that we find to be problematic in our assessment of Plan MERIS agricultural development activities; and

c) ways in which the knowledge and experience being gained under plan piloto may be most fruitfully applied to future efforts in the area of small and medium irrigation projects.

5.1 Activities Conducted

Plan Piloto begins with a premise that is a major conclusion of the present evaluation: that the ability to adequately manage water and soil under a regimen of irrigated agriculture is lacking among Plan MERIS beneficiaries and technical personnel alike. The technology required to correct this deficiency is regarded as available; but, the cost of introducing it into the Peruvian highlands needs to be evaluated in the context of poor smallholders trying to earn a living in a macroeconomic environment that generally does not provide incentives for increased production and productivity. Plan Piloto estimates that 80 percent of the total knowledge required to introduce correct water and soil management practices is presently available from previous research, while the remaining 20 percent must be obtained through site-specific research (WSM II 1984:1).

Plan Piloto is conducting research in water management techniques, and the interactions between cultivars, water, soil, and fertilizers. In addition, it has a strong anthropological component which is conducting research on land tenure and property rights, household productive strategies and income sources, local institutional capacity for water management, and marketing and credit arrangements among producers. The project is conducting extension demonstration on the use of both new and locally accepted techniques for improving the management of water resources, and it is conducting a course on water management using video modules developed at Utah State University. At present, formal training is directed primarily at Plan MERIS professionals participating in the water management course. Efforts are also directed toward farmers participating directly in plan piloto by working with project personnel to improve their farming methods. Ultimately, the goal of these activities is to "... provide and test a model for use throughout the irrigated regions of the Sierra...that will address the major water and land use problems" (WSM II 1984:2-3).

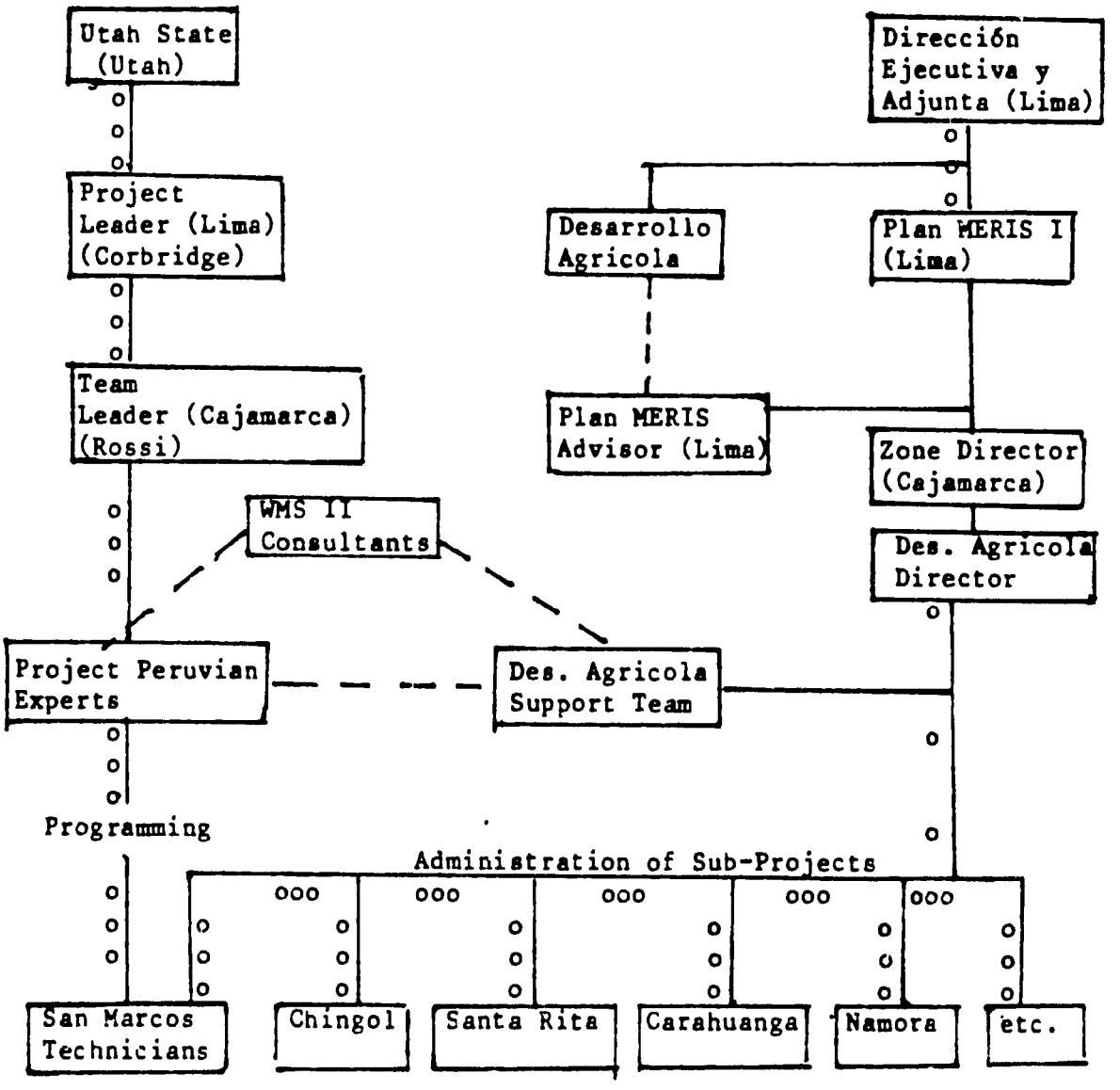
The activities described above are being conducted in the San Marcos subproject of the Plan MERIS Cajamarca zonal office. WSM II decided to concentrate activities in one subproject rather than overtax the material resources and personnel available. In order to compensate for the experience and knowledge lost by not working in more than one setting, smaller "satellite" activities in other subprojects were included in the project workplan. Within the context of these considerations, San Marcos was selected as the site for Plan Piloto because it is far enough from the city of Cajamarca that the agricultural picture is not complicated by the large numbers of people who go there daily to work as wage laborers.

5.2 Organization and Difficulties

Since the outset of Plan MERIS the combination of a highly centralized bureaucratic organization and chronic problems of disbursing funds in a timely manner have inhibited the effectiveness of Plan MERIS as a whole. These factors also have taken their toll on the Plan Piloto. Vehicles ordered for the project have not arrived, forcing the team to abandon most of the satellite activities it had planned to conduct outside of San Marcos. Likewise, equipment to test the practicality of introducing low pressure aspersion irrigation systems to steeply sloping areas of the highlands has not arrived. The team was in San Marcos between five and six months before it was able to secure the basic office equipment alloted to it in the project budget.

The institutional structure of this project, and its location in the PEPMI structure is, in part, responsible for some of the organizational difficulties experienced. The other major aspect was the selection of personnel. Organization Chart 3 shows the planned structure of the Plan Piloto.

Organization Chart 3: PLAN MERIS I Plan Piloto



------ Lines of Communication
_____ Lines of Command
_ooo__ Funding route

What is not clearly shown is the fact that the two funding sources were not coordinated from one office. Funding came directly from the Utah/Lima office to Dr. Corbridge and to the Project Peruvian Experts in the field. Counterpart funding came from the PEPMI/Lima office via the Cajamarca zone office for the San Marcos Pilot Project technicians, personnel, travel expenses, irrigation works, etc.

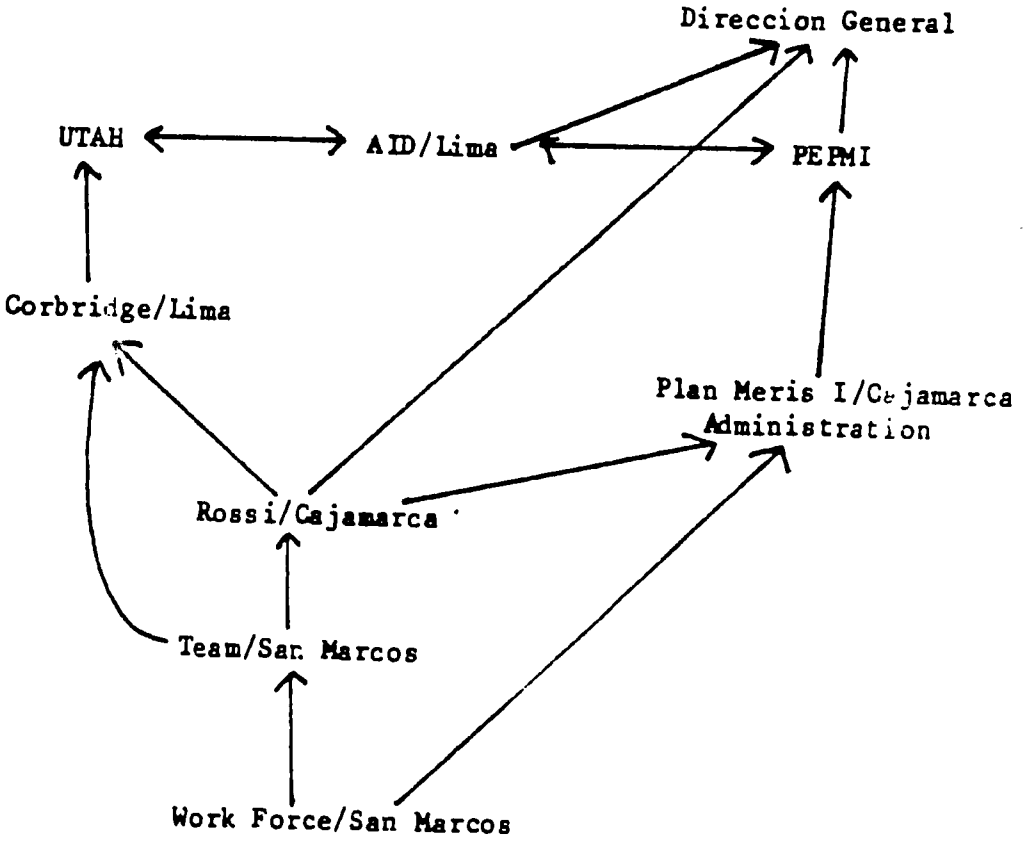
When funding or the processing of orders for material became a problem from the counterpart side it was important that pressure be brought to bear. But Dr. Corbridge was not a forceful enough personality, and he could not express the demands in Spanish to support the counterpart side of the project. Ing. Rossi was, however, a forceful personality and was able to pressure the Cajamarca regional office to provide support. The Cajamarca office of PEPMI seems to have supported the plan piloto fully with supplies, although its funding ability was very limited by disbursements from Lima. It must be recalled that the Plan Piloto was based upon Peruvian loan funds and Peruvian treasury funding within the PEPMI. During part of the project the funding was taken from the agricultural development components of other sub-projects for the Plan Piloto. One area of debate which illustrates the dual funding control is the approval and accounting for project per diem. Utah thought it appropriate to use its accounting system for per diem; Plan MERIS wanted to control the funds through its rules of accounting. In the end the funds have not been readily available because neither side would give in to the other.

The lines of command did not follow the organizational chart either. One of the responsibilities that Corbridge had was the coordination of the agricultural economic and anthropological work at San Marcos, and his other responsibilities (advisor on credit to the Banco Agrario and general project director) were in Lima. Rossi, as team leader was also in charge of the team which included the agricultural economist and the anthropologist. Again, the organizational structure of the project did not lend itself to unity and control. Policy came by a fairly straight route (UTAH-Corbridge-Rossi-Team), and even though Rossi depended upon Utah/Lima for his salary, his differences of opinion were debated around Dr. Corbridge to Utah and around the project into PEPMI and the Ministry of Agriculture. It should be recalled that support for Ing. Rossi's being given the position came from above PEPMI. This, reflected the "end run" on assignments observed in other cases in the PEPMI structure, in which lower level employees were assigned to regional offices "over the head" of the zone officer. In this way authority was subverted. When differences in opinion arose between the Ing. Rossi and Dr. Corbridge it was difficult for the latter to exercise the control that he should have, and the organization did not have a suitable decision-making body which could have decided, quickly, just what course of action was to be taken. The pilot project coordinators in Utah were too far removed. Yet, as seen in the trips of principals and meetings held to resolve differences, from Utah they attempted to manage the project. Therefore, because of Ing. Rossi's personal prestige and contacts within the Ministry of Agriculture he was able to gain audience beyond the lines of the project organization, and unity on the team suffered.

The place of USAID/P in the resolution of conflict added an additional dimension to the organizational chart. The project office of USAID/P tried to mediate by discussing the matter with Utah, PEPMI, and the personnel (Corbridge and Rossi) involved. This created another audience. One can appreciate USAID/P interest in limiting tension between the host country agencies and itself (as well as its obvious interest in insuring the goals of the project).

In retrospect, the personnel selection for the key administrative positions on the pilot project were poorly chosen - probably because of haste, and probably because of the debate between counterpart agencies as to the candidates and their qualifications. The administrative lines of the project were too dispersed geographically, and the funding not coordinated. There were too many "audiences" before whom differences of opinion could be discussed. The result was that control was dispersed and not possible. Inspite of this organizational disorder the field team accomplished an admirable amount of work and has begun a course of research that is needed, but has, lamentably, no future organizational home or financial support (Organization Chart 4).

Organization Chart 4: PLAN MERIS I PILOT PROJECT "AUDIENCES"



The evaluation team observed that many Plan MERIS officials are less than enthusiastic about the existence of the plan piloto. This is because the project was established with funds that had not been disbursed under the credit program sponsored by USAID/P through Plan MERIS. Those who are not happy with plan piloto seem to regard it as a USAID/P imposed activity that draws funds from their budget. There also seems to be sensitivity regarding the fact that the project was established in response to perceived problems in the Plan MERIS agricultural development program, so that some individuals regard plan piloto as a criticism of them as professionals. For their part, some plan piloto officials interpret the difficulties that they have experienced in obtaining budgeted resources to be the result of Plan MERIS' lack of enthusiasm for the project.

5.3 Current Status

It would be a serious error to discount plan piloto's potential contribution to improved water and soil management in the highlands on the basis of these administrative difficulties. The plan piloto technical team in San Marcos has proven to be very resourceful in securing the materials it needs for its work. Because of this, plan piloto has shown impressive progress despite the difficulties described above.

In the Huayllapampa area, research on the responses of crops to different levels of water and fertilizer is proceeding, despite difficulties in obtaining seed potatoes for the experiment. Certified seed potatoes that were ordered from the CIP experiment station near Huancayo arrived spoiled, and had to be replaced with certified seed from SAIS Atahualpa, in Cajamarca. The San Marcos team has also undertaken an effort to monitor fluctuations in ground-water levels in Huayllapampa. Groundwater in low lying areas has caused some fields to be taken out of production altogether and the San Marcos team is studying this as an independent initiative to help farmers bring the area back into production.

Training efforts with Plan MERIS technical personnel also are advancing. Bimonthly seminars on water management utilizing the videocassette modules prepared by Utah State University have been well received by the agricultural engineers and technicians. Here too, the San Marcos team has demonstrated considerable initiative. For example, noting that the Utah State modules tend to focus on the engineering aspects of water management, the team has drawn upon its experience to incorporate treatment of social and economic issues into the seminars. It also has invited specialists from other institutions, such as the soil conservation program at the University of Cajamarca, to give presentations on their work. During one period in which the videocassettes arrived without the accompanying teacher's guides, the team prepared its own supplementary materials in order to go ahead with the seminars. For the last two months, however, the seminars have had to be postponed because the Betamax machine being rented (from CESPAC) to show the video modules had to be returned to Lima for servicing and has not yet been returned.

Most of the planned satellite activities in subprojects other than San Marcos have had to be abandoned because vehicles ordered for plan piloto

have not arrived. However, anthropological research is currently underway and extension activities will soon be initiated in the Santa Rita subproject. The anthropological research promises to yield particularly interesting results, as a large number of farmers there rely on wage labor in Cajamarca for their primary source of income while agriculture supplements the buying power of their wages by providing food. Similar situations exist among smallholders throughout the highlands (c.f. Brush 1977; Figueroa 1982; Painter 1984), and were apparent in the subprojects of Sincos, La Huaycha, and Apata in Junin. The roles of different economic activities for household subsistence are an important factor shaping producers responses to irrigation.

In La Huaylla, where the principal water management experiments and demonstrations are being conducted, the plan piloto team has succeeded in preparing the designated area for the project despite numerous delays in equipment deliveries. The work has included removing stone fences separating the small plots of individual producers and replacing them with small cement markers to facilitate mechanized cultivation and the installation of contour furrows, stone removal, filling in a large gully that divided the area, and the removal of brush from a large area that had not been cultivated for a number of years. The sprinkler equipment ordered for the experiment has not yet arrived, forcing the team to rapidly develop and install an improvised system (earthen ditches lined with stones and eucalyptus planks) so that the farmers whose land is being used for the project do not miss the early-July planting period. This system carries water from the La Huaylla canal down a 14 percent slope into contour furrows in the fields. To install the system in time for the planting season, plan piloto had to employ over 60 laborers. In addition, plan piloto borrowed a tractor from the Plan MERIS office in Cajamarca to complete the work. In the meantime, construction on the large holding tank continues in the hope that the sprinkler equipment will arrive and can be tested during the next planting season--in November-December.

5.4 Relevance of Plan Piloto Activities for Improving Plan MERIS Performance

Plan Piloto can be expected to provide information on a number of topics relevant to improving the performance of Plan MERIS agricultural development activities.

These include:

a) the relationship between dryland and irrigated farming;

b) the ways in which small farmers use the water made available for irrigation for other purposes, such as drinking, bathing, and washing cloths, and the implications of these uses for irrigation management;

c) realistic farm budgets for small holders, showing production costs in cash and kind and the revenues earned;

d) household strategies for allocating resources among agriculture and other economic activities, and

e) new and improved water management practices and the constraints upon their adoption by project beneficiaries with different sizes of farms.

A particularly valuable contribution of the plan piloto could come from applying the experience gained in conducting multidisciplinary, problem-oriented research and extension. We observed that Plan MERIS officials in the zonal offices and at the subproject level are aware that the problems they confront cross-cut their disciplinary specialties. However, they do not have a clear idea of how to resolve them. The Plan Piloto team is working together well as a team. They indicated that they could prepare a manual on multidisplinary teamwork focusing upon the research and extension problems associated with small and medium-sized irrigation projects. This would be a valuable product. During our visit, the plan piloto team stated that, producing such a manual will not be possible within the present time frame. It would, however, be a possibility should the project be extended to permit additional data analysis and writing.

In assessing the relevance of plan piloto to Plan MERIS as a whole, it is important to remember that its main components involve basic experimentation and research on problems related to water management. The training it is providing to Plan MERIS personnel may find immediate application, but no institutional mechanism for direct support to subprojects on a more broadly defined and continuing basis has been contemplated. The form that such support might take will in part depend upon the results of the research and experimentation currently being conducted.

Nevertheless, one can perceive immediate and concrete applications for the lessons learned through the experience with plan piloto. The most obvious is the continuation of water management training for Plan MERIS personnel. Based upon the knowledge gained, however, the topics covered could be expanded to include multidisciplinary field methods, extension techniques for producers with different size landholdings, and institution-building for organizing water user organizations.

The plan piloto team also could serve as a core group to help conduct and coordinate the feasibility studies for future small and medium-sized irrigation projects. In particular, the team has acquired experience in pulling together the construction and agricultural components of future studies and strengthening the socioeconomic analysis. As has been discussed, one of the reasons that the production response of the present Plan MERIS projects is less than was projected is that producers did not increase yields or cropping intensity as quickly as had been anticipated. This, in turn, was due to socioeconomic analysis that did not consider several important factors such as the relationship between rainfed and irrigated cultivation, or differential response of producers to irrigation according to the size of their holding or the land tenure arrangement under which they were operating. Furthermore, the socioeconomic analysis that was conducted was not evaluated in light of projected construction costs and timetables. Based upon the lessons it is learning in San Marcos, the plan piloto team should be able to anticipate many of the variables that influence producer response to irrigation and help focus data gathering and analysis for future feasibility studies accordingly. On this basis it should then be possible to coordinate

the agricultural development and construction components of projects so that producer response to the opportunities provided by the new facilities is more rapid and, hence, improve the cost/benefit performance of the subprojects.

5.5 Conclusion

Although its progress has been hampered by administrative difficulties that are quite serious, the plan piloto has been proceeding with the activities projected in its workplan. The results promise to be invaluable to the successful execution of future small and medium-sized irrigation projects in the Peruvian highlands. The administrative difficulties derive from three sources:

a) the inability to disburse funds and secure equipment and materials in a timely manner, which has its origins in the Lima office of Plan MERIS and afflicts the project as a whole;

b) the failure to provide plan piloto with strong leadership, and

c) a dual administrative structure which did not facilitate the management of funds or conflict.

Given the importance of the work being conducted by plan piloto and the delays it has experienced, we feel that, at minimum, the project should be extended from two to three months beyond the present December 31, 1985, completion date. This will permit a complete analysis and write-up of the data being collected. Ideally, a means should be found to continue the research and training activities on a permanent basis. Because of administrative difficulties, and because research and training activities inherently proceed at a different rythmn than the execution of projects, we feel that any long-term continuation of plan piloto activities should be accompanied by a reorganization of the project so that it does not depend upon Plan MERIS for funds or leadership. Continuing the project as a separate entity responsible to PEPMI or to INAF would facilitate its contribution to all of the small and medium irrigation projects and might increase its control over its own activities.

For the final six months of the project, the project will need leadership to support the efforts of the field team. If they can be assured of supplies and labor from counterpart funds, plus ample transportation funds for Plan MERIS I personnel, then they should be able to complete the research, analyze the information, and offer ideas and suggestions for the continuation of this much needed research. Furthermore, given the necessary transportation funds, Plan MERIS I personnel should be able to receive the planned training in extension and irrigation techniques.

The present debate between Plan MERIS and Utah State University about the candidates for the team and project leader is lamentable. But it reflects the bifurcated organizational structure, and unless the parties involved can find one person to unify the command and funding, or two people who can work together, then the final results of the project will be in jeopardy.

This late in the project it will be difficult to find a person who has not been attached to PEPMI or Plan MERIS and at the same time be able to accomplish the difficult task of meeting the budgetary demands from counterpart funds. The field team appears to have the solidarity, interest and knowledge to be able to carry out the planned work without a "team leader" in residence, but they must have administrative support.

6. CONCLUSIONS AND RECOMMENDATIONS

6.0 General Findings

Despite delays in the execution of construction projects, the initial confusion over the relative importance and timing of construction and agricultural development activities, and beneficiary production responses that have been slower than expected, Plan MERIS has made improvements in the production potential of the areas in which its subprojects are located. Also, producers are increasing yields, cultivating higher value crops, and devoting more land to double-cropping. The project is making long-term contributions to agricultural output in the highlands through increased efficiency of land and water resource use and through increases in the absolute amount of land and water available to producers.

Initial delays in execution and lack of project definition were the result of changes in the institutions responsible for Plan MERIS. Once Plan MERIS found a stable institutional home, it was plagued by administrative difficulties which revolved around the inability of the Lima office to secure and process receipts from its zonal offices and to manage effectively the flow of funds from USAID/P and the GOP. Plan MERIS has not had administrators capable of dealing effectively with the complex code of rules and norms governing the administration of public agencies. These constraints, combined with Peru's fiscal crisis, limited administrative options. Also, the central administration has not been able to coordinate project activities effectively in order that resources arrive in a timely way to zonal offices and individual subprojects.

Increased production responses as beneficiaries have been lower than expected, in part, because the agricultural development component was slow in getting started, and, in part, because the production responses projected in the prefeasibility and feasibility studies were overly optimistic. Although more attention was paid to conducting adequate studies by Plan MERIS than is frequently the case in similar projects elsewhere, a number of critical factors in shaping production response were neglected; for example, microclimatic variation within the subprojects, labor availability among project beneficiaries, size of holding, and land tenure. Had these factors been considered it would have been possible to coordinate agricultural development and construction activities so that production impacts began sooner, and internal rates of return would have been even more favorable.

The administrative shortcomings, and initial lack of attention to agricultural development activities, have been partially offset by an exceptionally high level of dedication and perserverance in the face of adversity by the Plan MERIS staff in the zonal offices and individual subprojects. Despite declines in salaries and inadequate material support, they are showing progress in increasing production and productivity. The field staff has shown exceptional initiative in establishing contacts with other institutions to obtain resources such as trees for reforestation and seeds for vegetable production.

The individual initiatives have not been sufficient to overcome the late start of efforts to organize the irrigation committees and establish --more formal-- linkages with the respective distritos de riego where the subprojects are located. Many of the irrigation committees have very limited participation and only a few are currently organizing users to clean and maintain the irrigation works without substantial direction from Plan MERIS. None of the committees have begun to consider the level of users fees they need to charge, beyond the minimum required by law, in order to maintain and repair the system. In a number of cases, even this minimal amount was not being charged. Field staff also are in need of training in water management and greater conceptual support from their superiors in conducting research and demonstration activities. Knowledge of irrigation management is deficient both from the point of view of organizing an equitable distribution of water among users, and with regard to how to apply an optimal amount of water to farms. Although demonstration and research are accorded great importance, activities tend to be conducted on an ad hoc basis by subproject staff without reference to extension practices and overall goals.

6.1 General Recommendations

Based upon our observations, we feel that USAID/P support for small and medium-sized irrigation projects should continue for the following reasons:

a) Plan MERIS has provided a much-improved engineering capacity to manage soil and water resources and thus to achieve increases in agricultural production and productivity in its subproject areas; and

b) although production and productivity impacts are lower than projected at the outset of the project, improvements in these areas are occuring and the prospects for long-term improvements appear good.

The above mentioned support could appropriately come in three areas:

a) continued support for irrigation projects, but with a stronger and better-planned agricultural development component than has characterized Plan MERIS;

b) institutional support to PEPMI focusing upon professionalizing administration in order to alleviate the problems experienced in funds disbursement, thus freeing the agricultural and civil engineering staff to focus on substantive issues on their areas of expertise; and

c) support for research and experimentation activities focusing on the soil and water management problems of small and medium-sized irrigation projects in the highlands.

In our opinion, all three of these areas are worthy of support and would yield positive long-term benefits for agricultural development in the highlands. If no other source of international support appears to be forthcoming for the execution of irrigation projects, we would recommend that USAID/P give priority support in this area. However, if project execution can continue without, or at a substantially reduced level of USAID/P support, we

feel that institutional strengthening, research, training, and experimentation are the areas that should receive funding priority.

6.2 Institutional

6.2.1 Project Organization. The administrative difficulties experienced by Plan MERIS have their origins in the complexity of the norms governing the administration of public agencies (made even more complicated by the scarcity of GOP resources), and the inability of the Lima office to efficiently secure receipts for expenditures from zonal offices and present them to USAID/P and the GOP in order to insure a stable flow of funds. While little can be done at the project level to simplify administrative procedures or alleviate national fiscal constraints, the ability of Plan MERIS to function more efficiently within these constraints can be enhanced through reorganization to place responsibility for the flow of funds more directly in the hands of professional administrators. This would also free the agronomists and civil engineers currently administering the project to make more substantive contributions to field activities. Until the administrative organization within Plan MERIS is improved, the difficulties with cash flow and poor activity coordination will continue, and the improved ability to bring together people and resources that is supposed to characterize special projects will not be realized.

The original Plan MERIS design depended upon the establishment of too many external linkages for agricultural development activities to be implemented efficiently. Good personal contacts and a high level of initiative by Plan MERIS staff in the zonal offices and subprojects partially compensated for what the formal agreements could not. However, personal relationships were necessarily established on an ad hoc basis as opportunities arose, and the coordination of agricultural development activities to move together toward overall project goals was lost.

6.2.2. Conduct of Field Activities. Because Plan MERIS tends to lurch from one administrative crisis to another, agricultural development and engineering professionals in the Lima office are not able to provide field staff with the substantive support they need to conduct activities in a coordinated manner. Contacts between Lima and the zonal offices are centered around bureaucratic matters. The solution to this problem lies in the administrative reorganization in Section 6.2.1. above.

One of the results of the lack of substantive support from the Lima office is that field personnel are frequently left to their own devices in carrying out demonstration activities. At the field level there is confusion about the relationship between research and demonstration.

6.2.3 Beneficiary Organization. The organization of functioning comites de regantes capable of operation and maintenance activities and assessing water user fees to finance maintenance and repair of the system is critical to the long-term success of Plan MERIS. At the present time, very few comites de regantes are ready to assume these responsibilities because organizational efforts by Plan MERIS began late, and because the project personnel conducting these efforts frequently do not have sufficient knowledge

of water management to adequately train the beneficiary organizations. In addition, the linkages between the comites de regantes and the distritos de riego are frequently weak. These problems can be alleviated in future projects by beginning organizational activities sooner and training field personnel in appropriate water management practices, and organizational skills.

6.3 System Design and Water Management

6.3.1 System Design. In general the Plan MERIS subprojects have been adequately designed and executed, although in specific cases there is need for immediate corrective measures to protect areas from being damaged or destroyed by landslides. In some cases, inadequate attention was given to how upstream projected irrigation works would affect Plan MERIS subprojects, or how the Plan MERIS subprojects might affect downstream populations.

The most serious design flaw found throughout the Plan MERIS subprojects has been the failure to install flow measurement devices. These devices are inexpensive and easy to learn to use. Without them, it is impossible to monitor water flow to insure equitable distribution among users or to adjust water applications in order to achieve optimal production impacts. The installation of measuring devices, and training in their use is strongly recommended.

6.3.2 Water Management. Although the basic system is adequate for distributing the available water resources, the actual distribution remains problematic. Because of inability to control the amount of water delivered to a particular area due to the absence of measuring devices, and poor discipline among water users with regard to limiting their consumption to the time periods allotted to them, there are chronic shortages of water at the tail end of the systems and cases of inequitable distribution throughout. When adequate water allotments are available, lack of knowledge about farm-level water applications leads to over-irrigation, negatively affecting crop yields and causing water loss and soil erosion.

The solution to the water management problem is three-fold:

a) the installation of measuring devices to provide the technical capacity to measure and fine-tune water flow levels at different points in the systems;

b) the training of Plan MERIS agricultural development personnel in water management techniques at the irrigation system and field levels, and

c) a more intensive effort to organize comites de regantes at the beginning of construction activities to provide them with the technical knowledge to operate and maintain the system as well as the capacity to discipline of their members.

6.4 Socioeconomic

6.4.1 Production Response. While more time has been needed to complete construction, construction costs have been much higher than planned,

and production increases have been more modest than projections in the feasibility studies considered, adequate irrigation works have been constructed. The production potential of subproject areas has been enhanced, and increases in production and productivity have been achieved.

While economic performance has not been quite as high was predicted in most cases, benefit-cost analysis of selected sub-projects indicates that performance is nevertheless quite encouraging. Internal rates of return above 20 percent were measured in five out of six cases analyzed.

The feasibility studies overestimated yield impacts because they failed to consider differential producer responses based upon microclimatic variation within subprojects, size of landholdings, land tenure arrangements, and labor availability at the family level. As a result they incorrectly assumed a rapid and uniform rate of adoption of double-cropping, new input packages, and improved cultivation techniques. Strengthening the capacity of Plan MERIS to gather and analyze data on these topics will enable future feasibility studies to learn from the present experience and make more realistic projections.

6.4.2 Technical Assistance. Plan MERIS technical assistance was poorly timed to overcome the construction and agricultural development problems that were encountered. The CID/ATA/CLASS support program began and ended too early to address many of the specific obstacles encountered as work progressed. Plan piloto has begun too late to help current subprojects improve their performance at the time when such help was most needed.

6.4.3 Agricultural Development. Agricultural development activities were too late in coming to accelerate production response greatly. Ideally, agricultural development should precede construction and continue until after beneficiaries are capable of operating and maintaining the irrigation system themselves. This would allow project personnel more time to adapt their work to local conditions, and it would accelerate production response.

6.5 Plan Piloto

Plan Piloto generally addressing the major problems that have been encountered in Plan MERIS, and the results of its research and experimentation should permit substantial improvements to be made in the performance of future projects. Plan piloto began too late for current projects, and only the training component of its design is intended to have an immediate impact. The same administrative difficulties that have affected Plan MERIS have also affected plan piloto. This is compounded by a serious lack of leaderhip within plan piloto and has limited the field activities described in the project work plan. However, perserverance and resourcefulness by the staff in San Marcos have enabled the project to make considerable progress in spite of these problems.

Because of the delays experienced, plan piloto should be extended two or three months to insure adequate data analysis. We feel that a continuing research and experimentation component to provide technical support to future

small and medium sized irrigation projects would be an asset. It should be organized to support project needs on the one hand, while enjoying enough autonomy to carry out activities without being continually forced to improvise research and experimentation because of administrative problems in Plan MERIS or PEPMI.

APPENDIX 1

Persons Contacted

USAID

1) David Bathrick
2) Robert Burke
3) Paul Dillon
4) David Flood
5) David Hess
6) Robert Kent
7) Alfredo Larrabure
8) Fred Mann
9) Johannes Oosterkamp
10) Mario Quiroga
11) John Sanbrailo
12) Raymond Waldron
13) Richard Whelden

Plan MERIS/Lima

1) Eduardo Armas
2) Elizabeth de Dalf
3) Hugo Galvez
4) Julio Guerra
5) Simon Lau
6) Eduardo Linares
7) Mery Mandujano
8) Abraham Maravi
9) Jorge Mieses
10) Rolando Osorio
11) Wilfredo Sarmiento
12) Carlos Torres
13) Oscar Vigo

Plan MERIS/Huancayo

1) Felipe Ceclen Chunga
2) Eudolio Cordova Estrada
3) Ciro Delzo
4) Hugo Josusi
5) Juan Jurado
6) Guillermo Malpartida
7) Angel Rojas
8) Jaime Piòas
9) Luis Valdivieso
10) Arturo Valencia Huaman
11) Gladys Velasco
12) Cesar Paitan

13) Elio Sucualaya

Plan MERIS/Cajamarca

1) Walter Abanto
2) Jose Cabrera Obando
3) Antonio Diaz
4) Adrian Echeandia
5) Celso Espinoza
6) Javier Farfan
7) Pedro Mejia
8) Juana Paz
9) Arnulfo Romero
10) Mauro Vega Salazar
11) Ligia Villanueva Pastor

Plan Piloto

1) Luis Barrios
2) Larry Bond
3) Ivan Corbridge
4) Rodolfo Flores
5) Barbara Lynch
6) Carlos Nonone
7) Renato Rossi
8) R. Kern Stutler
9) Carlos Villanueva
10) Luis Villaran

Others

1) Raul Andrade, Oficina Estadistica de la Region Agraria XVI, Ministerio de Agricultura, Huancayo.
2) Hector Martinez, Universidad Nacional Mayor de San Marcos
3) Antonio Mosquiera, Jefe de Seccion Tecnica, Banco Agrario
4) Augusto Pezo Paredes, Administrador Banco Agrario del Peru, Huancayo
5) Carlos Pomareda, Instituto Nacional de Investigaciôn y Promocion Agraria
6) Orlando Schettini, Administrador, Banco Agrario del Peru, Huancayo
7) Abilio Tovar, Jefe del Distrito de Riego, Valle del Mantaro

A-1. GENERAL DESCRIPTION OF PLAN MERIS PROJECTS

Project Name	Number of Families	Irrigation Area (Ha.) Newly Incorp.	Improved	Total	Irrigable in 1984	Percent Irrigated 1984	Construction Period Comple-tion	Total Months
Santa Rita	976	167	450	617	595	96%	July 82	28
Carahuanga	636	120	850	970	970	100%	Dec. 82	28
Namora	220	121	101	222	222	100%	July 82	36
Carrizal La Grama	294	250	432	682	578	85%	May 85	54
Cholocal	162	283	372	655	380	58%	Apr. 85	53
San Marcos	277	130	260	390	311	80%	Dec. 85	42
Tabacal-Amarcucho	138	363	159	522	467	89%	Apr. 85	53
Chingol	250	807	653	1,460	1,142	78%	Nov. 82	46
Granja Porcon	60	66	124	190	N.A.	--	Nov. 82	17
Sub Total Department Cajamarca	3,013	1,253	4,455	5,708	4,855	85%		
Yanacancha	350	697	3	700	487	70%	Jun. 82	21
Apata	573	548	102	650	504	78%	July 82	22
Chiccho	350	428	256	684	684	100%	Nov. 79	26
La Huaycha	620	354	186	540	537	13%	Feb. 80	13
Chupaca	4,285	1,785	1,966	3,751	3,465	92%	Oct. 82	38
Sincos	230	200	260	460	445	97%	Oct. 82	13
Cotosh	1,250	190	340	530	490	92%	Dec. 84	30
Huasahuasi	590	-	420	420	367	87%	Dec. 85	55
Sub Total Department Junin	8,248	4,202	3,533	7,735	6,979	90%		
	=====	=====	=====	=====	=====	======		
TOTAL 17 Projects	11,261	5,455	7,988	13,443	11,834	80%		

Average holding size: Cajamarca, 1.89 Ha./family
Junin, 0.93 Has./family
All 17 projects, 1.19 Ha./family

A-2 LAND DISTRIBUTION 1,2 PATTERNS AND INCOME DISTRIBUTION IN SELECTED PROJECTS

Project Name	0-0.5 Ha.		0.5-1 Ha.		1-3 Has.		3-5 Has.		5-10 Has.		- 10 Has.			
	% Fam.	% Area	% Fam.	% Area	% Fam.	% Area	% Fam.	% Area	% Fam.	% Area	% Fam.	% Area	X	ID**
Apata*	44.22	12.28	31.35	27.55	15.33	17.67	5.78	14.17	4.95	17.10	2.48	11.23	2.31	36.25
Income[3]													9,065	21.0
Cotosh	88.44	39.58	7.54	17.21	1.61	6.59	1.28	11;29	1.12	22.25	--	--	.31	49.47
Income												Not available		
Sincos	47.8	14.8	29.6	24.8	10.8	20.0	5.7	14.5	3.9	14.3	2.2	11.6	2.0	37.8
Income													12,533	21.00
Carahuanga*	63.36	9.7	12.11	5.62	18.55	20.61	1.89	4.63	.79	3.55	3.3	55.91	1.77	62.25
Income													5,768	39.4
Chingol*	-	-	-	-	56.64	7.7	13.27	4.7	24.78	60.14	5.31	27.46	11.12	57.51
Income													11,018	48.4
Sta. Rita	76.29	16.72	13.96	9.78	5.59	9.51	2.42	6.6	.95	8.47	1.79	48.93	.72	63.26
Income													3,840	28.81

1. Padron de Catastro Rural y Diagnostico Social 1980 (Huancayo)
2. Padron de Usos Agricola Catastro Rural 1976 (Cajamarca)
3. Encuesta Socio Agronomica 1977 (s/. por mes)

* These figures include the Area and families in coops.

**The index of dissimilarity, (ID) is a coefficient of distribution with a range of 0 to almost 100. It is the percent of land which would have to be redistributed in order to have equality (MERSCHROD, 1981).

APPENDIX TABLE A-3. PROJECT DEVELOPMENT COSTS, 1977-1985

PROJECT DEVELOPMENT COSTS
PROJECT: CARAMUANGA AREA: 970 ha.

Item	1977	1978	1979	1980	1981	1982	1983	1984	1985	TOTAL	PER HA
	thousands of Dollars										Dollars
Studies			17	94						111	115
Construction				39	131	125	3			299	308
Equipment				9	16	18				46	47
Ag. Development				15	19	28	19	13	13	106	109
Administration				1	23	41	1			66	68
Tech. Assistance										0	0
	0	0	17	158	191	212	23	13	13	627	646

PROJECT DEVELOPMENT COSTS
PROJECT: CHINGOL AREA: 1,460 ha.

Item	1977	1978	1979	1980	1981	1982	1983	1984	1985	TOTAL	PER HA
	thousands of Dollars										Dollars
Studies	73	84								157	108
Construction			367	450	163	105	3			1,083	742
Equipment			45	45	45	45				180	123
Ag. Development			30	69	13	26	20	14	14	185	127
Administration	33	24	96	125	49	67	2			395	271
Tech. Assistance		- 7	90	35	2					134	92
	106	115	623	723	271	243	25	14	14	2,134	1,462

PROJECT DEVELOPMENT COSTS
PROJECT: SANTA RITA AREA: 617 ha.

Item	1977	1978	1979	1980	1981	1982	1983	1984	1985	TOTAL	PER HA
	thousands of Dollars										Dollars
Studies			18	72						90	146
Construction			5	150	76	34	2			267	433
Equipment				10	21	10				41	66
Ag. Development			1	17	19	45	18	20	20	140	227
Administration			4	46	16	10	1			77	125
Tech. Assistance			4	13						17	28
	0	0	32	308	132	99	21	20	20	632	1,024

APPENDIX TABLE A-3. PROJECT DEVELOPMENT COSTS, 1977-1985....page 2

PROJECT DEVELOPMENT COSTS
PROJECT: APATA AREA: 450 ha.

Item	1977	1978	1979	1980	1981	1982	1983	1984	1985	TOTAL	PER HA
	thousands of Dollars										Dollars
Studies			4	91	21					116	178
Construction				69	372	96	21			558	858
Equipment				5	53	26				84	127
Ag. Development					81	20	38	36	36	211	325
Administration				4	52	18	14			88	135
Tech. Assistance				1	3					4	6
	0	0	4	170	582	160	73	36	36	1,061	1,632

PROJECT DEVELOPMENT COSTS
PROJECT: COTOSH AREA: 530 ha.

Item	1977	1978	1979	1980	1981	1982	1983	1984	1985	TOTAL	PER HA
	thousands of Dollars										Dollars
Studies			18	2	3	2				25	47
Construction						70	301	176		547	1,070
Equipment						12	23	23		58	109
Ag. Development						23	12	31	31	97	183
Administration						7	64	83		154	291
Tech. Assistance										0	0
	0	0	18	2	3	114	400	333	31	901	1,700

PROJECT DEVELOPMENT COSTS
PROJECT: SINCOS AREA: 440 ha.

Item	1977	1978	1979	1980	1981	1982	1983	1984	1985	TOTAL	PER HA
	thousands of Dollars										Dollars
Studies				4	159					163	354
Construction					46	192	2			241	524
Equipment					12	24				36	78
Ag. Development						27	23	35	35	125	272
Administration					14	67	2			83	180
Tech. Assistance					1					1	2
	0	0	0	4	232	310	27	35	35	649	1,411

REFERENCES CITED

Alvarez, Elena
1980 1969-1977. Politica Agraria y Estancamiento de la Agricultura. Lima: Instituto de Estudios Peruanos.

Brush, Stephen B.
1977 The Myth of the Idle Peasant. In Peasant Livelihood. James Dow and Rhoda Halperin, eds. New York: St. Martin's Press.

Cornejo, Wilbert
1985 Corporacion Departamental de Desarrollo. Junin-Cajamarca. Informe Costo-Eficiencia. Lima: Rural Development Services, USAID/P (mimeo.).

Chetwynd, Eric Jr., John Hatch, Linn Hammergren, Ronald Johnson, Dennis Rondinelli, and Patricia Salinas
1985 Integrated Regional Development. Final Evaluation. Lima: USAID/P (mimeo.)

FAO - United Nations
1971 Integrated Farm Water Management, Irrigation and Drainage Paper No. 10, Rome.

Gonzalez Vigil, Fernando, Carlos Parodi Zeballos, and Fabrian Tume Torres
1980 Alimentos y Transnacionales: Los Complejos Sectoriales del Trigo y Avicola en el Peru, Lima: DESCO.

Hernandez, Jose M.
1978 Metodologia para la Evaluacion Economica de Proyectos de Riego, Ministerio de Agricultura/Division General Ejecutiva/Plan MERIS, September 1978.

Jurriens, R., A.F. Bottral, and Others
1984 Evaluation of Irrigation Design: A Debate. Irrigation Management Network (April). London: Overseas Development Institute.

IDB
1981 Ex-Post Evaluation of Small and Medium-Irrigation Projects. Peru. 277/SF-PE. Washington, D.C.: Inter-American Development Bank. Operations Evaluation Office, Office of the Controller. (mimeo).

Keller, Jack, Bryant Smith, Percy Aittken, Allen LeBaron, Ray Meyer, Michael Walter, and James Wolf
1984 Peru: Irrigation Development Options and Investment Strategies for the 1980s. Water Management Synthesis II Project. WMS Report 14. Logan, Utah: Utah State University, Agricultural and Irrigation Engineering.

Maletta, Hector and Jesus Foronda
1980 La Acumulacion de Capital en la Agricultura Peruana. Lima: Centro de Investigacion de la Universidad del Pacifico.

Mann, Fred
1985 Policy Agenda for Agriculture. Lima: USAID/Peru (mimeo.).

Mann, Fred
1979 Relative Benefits of Irrigation Investment in the Sierra as compared to the Coast, memorandum to John B. O'Donnell.

Merschrod, Kris
1981 The Dissimilarity Index as a Measure Inequality, Quality and Quantity, Vol. 15.

Painter, Michael
1984 Changing Relationships of Production and Rural Underdevelopment. Journal of Anthropological Research 40: 271-292.

Painter, Michael
1984 The Political Economy of Food Production in Peru. Studies in Comparative International Development 19:34-52.

Plan MERIS
1978 Priorizacion de Sub-Proyectos de los Valles de Mantaro y Tarma.

RDS
1983 Proyecto de Desarrollo Regional Integrado. Evaluacion de Impacto. Proderin Cajamarca y Proderin Junin. Lima: USAID/Peru-RDS (mimeo.).

Thorp, Rosemary and Geoffrey Bertram
1978 Peru 1890-1977: Growth and Policy in an Open Economy. New York: Columbia University Press.

USAID/Peru
1981 Regular Evaluation of Project No. 527-T-059, Improved Water and Land Use in the Sierra, May, 1981.

U.S. Presidential Agricultural Mission to Peru
1982 Report of the U.S. Presidential Agricultural Mission to Peru.

Wilkinson, John L., Cressida McKean, Raymond E. Meyer, Barbara S. Nunberg, Caroline E. Weil, and Hector Martinez
1984 Peru: Improved Water and Land Use un the Sierra. A.I.D. Project Impact Evaluation No. 54. Washington, DC: U.S. Agency for International Development.

GLOSSARY OF ACRONYMS

BAP - Banco Agrario del Peru/Peruvian Agricultural Bank

CESPAC - Centro de Servicios de Pedagogia Audiovisual para la Capacitaciôn/Center for Pedagogic Services for Training

CIPA - Centro de Investigacion y Promocion Agraria/Center for Agricultural Research and Extension. Departmental Office of INIPA

CORDE - Corporacion Departamental de Desarrollo/Department Development Corporation

DGA - Direccion General de Aguas/General Directorate of Water. Agency of the Ministry of Agriculture

DGE - Direccion General Ejecutiva/General Executive Directorate. Ministry of Agriculture agency charged with executing Plan MERIS prior to the establishment of INAF

FONGAL - Fomento Nacional de Ganado Lacteo/National Milk Cattle Development; a semi-autonomous state-sponsored producers' cooperative

GOP - Government of Peru

INAF - Instituto Nacional de Ampliacion de la Frontera Agricola/National Institute for Expansion of the Agricultural Frontier. Institute established within the Ministry of Agriculture by the Belaunde government, with administrative responsibility for PEPMI.

INIPA - Instituto Nacional de Investigacion y Promocion Agropecuaria/ National Institute of Agricultural Research and Extension

MAG - Ministry of Agriculture

PEPMI - Proyecto Especial de Pequeñas y Medianas Irrigaciones/Special Project for Small and Medium-Sized Irrigation Projects. Executing agency of Plan MERIS

USAID/P - United States Agency for International Development/Peru