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FINAL EVALUATION OF
IRRIGATION DEVELOPMENT PROJECT
PRORIEGO
PROJECT NO. 522-0268

SEPTEMBER, 1993

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CONDUCTED BY AGRO ENGINEERING, INC.

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EXECUTIVE SUMMARY

The PRORIEGO project was approved in 1986 with the goal of enhancing the earning potential of Honduran farmers. The purpose of the Project was to "improve farmer productivity and production by providing irrigation technology and on-farm technical assistance". The principal components included the design and construction of irrigation systems, provision of assistance in on-farm water management, strengthening the Government of Honduras (GOH) capability in irrigation by promoting institutional changes, increasing the capacity of the private sector to develop irrigated crop production, and supplying credit for irrigation development and production.

The strategy for implementing those components was to establish and develop Honduran capabilities in design services, credit for irrigation projects, construction services, and production extension assistance in three regions of the country (later increased to four regions). This, in turn, was to increase demand for irrigation in Honduras.

The project also called for the GOH to develop a national water law and national irrigation and drainage plans. GOH was to establish a secure land tenure for farms of less than 5 hectares so that viable irrigation could be established, and was also to establish a system for the use of initial reflows generated from loans to continue support activities in the rural sectors.

After a mid-term evaluation in 1989, the Project agreement and some strategies were modified. The Project budget was amended to allocate funding for subsistence farmer construction and operation. The Project was to provide funding for additional technical support. It was to provide technical support for promoting approval of a National Water Law, and to finalize the National Irrigation Plan. The Project was to provide monitoring to ensure high-quality irrigation design. Credit and land tenure mechanisms were to be established to increase the number of beneficiaries.

The purpose of the evaluation is to provide an assessment of the overall performance of the PRORIEGO project in terms of achieving purpose and goals. It evaluates sustainability of accomplishments. It identifies key lessons learned through the execution of the Project. The evaluation addresses the impact which the Project has had on irrigation development in Honduras. Specific issues addressed in the evaluation, as per the Statement of Work, centered on privatization of irrigation support services, credit, production and productivity, and gender considerations.

The methodology used in the evaluation consisted of reviewing and analyzing Project design documents, progress reports, technical assistance, and relevant Project information. Interviews were

conducted with PRORIEGO and USAID staff and with the long-term advisor. Interviews and field visits were also conducted with Project personnel and beneficiaries (farmers, water users associations). Interviews and surveys were conducted with private industry representatives (designers, construction companies, etc.)

The PRORIEGO Project provided assistance for the construction of irrigation systems on 5,255 ha. PRORIEGO financed the construction of 3,518 hectares. Assistance was provided for the rehabilitation of the three irrigation districts in the Comayagua Valley. Production and productivity were increased as a result of the Project, as new and efficient systems were installed on land not previously irrigated. Most of this development was for production of export crops. Export earnings from PRORIEGO projects are expected to be four to five percent of the Honduran total, with a reduction in unemployment of 1.5 percent. Indirect benefits are expected to exceed direct benefits by more than five times.

The PRORIEGO Project provided extensive training in irrigation project design and construction supervision. Most of these services have been privatized. Technical assistance on PRORIEGO projects by a highly qualified expatriate engineer and expatriate consultants continued through the life of the Project.

There has been a substantial increase in the capacity to construct irrigation projects, drill wells, and supply irrigation equipment. The demand for irrigation equipment (especially sprinkler and drip irrigation) has increased substantially, with one supplier reporting a tenfold demand from 1987 to 1993. The only shortage of irrigation construction equipment is in surface irrigation, where land leveling equipment appropriate for irrigation systems is scarce.

The management of the irrigation districts in the Comayagua Valley has been turned over to water users associations. With some additional training, the directors of the water users associations will be able to fully maintain and manage the districts as soon as these are rehabilitated and when the districts are equipped for routine maintenance operations.

Private banks are financing new irrigation development, and loan repayment is excellent. Private financing of irrigation development has been greatly facilitated for larger landholders who own title to their land. However, subsistence farmers without land titles do not have access to credit for irrigation development. Since 1991, reflows from Project credit have been used for financing new projects. Bank credit from private banks for periods exceeding two years will be very limited unless some form of subsidies or incentives can be arranged. Credit for longer periods is needed for well construction and the establishment of fruit crops. Currently available financing will be adequate to finance only a fraction of the new irrigation required for future needs.

Limited assistance was provided for on-farm water management. Crop yields are low relative to potential yields. Field observations and interviews indicate little knowledge about appropriate water management. Principal reasons for lower-than-potential yields are poor on-farm water and fertilizer management and, in some instances, inadequate drainage of excessive irrigation or rainfall or proximity of poor quality groundwater to the surface.

A large part of new irrigation developments use wells for a water supply. However, the extent of groundwater resources which can be developed is not known.

A National Water Law has been proposed and has been awaiting enactment by the Congress for several months. Political interests may prevent this from becoming a reality. A National Irrigation Plan has yet to be adopted. Land tenure mechanisms which will allow subsistence farmers to have title to land that they farm have not been developed.

A number of women received loans for irrigation development. However, the number of women who participated in Project financing is low because few women are landowners or farm decision makers. Although a number of women are landowners, men are the principal farm decision makers.

The major conclusions reached in the evaluation of PRORIEGO are:

1. A highly significant impact of PRORIEGO has been an increased awareness of the benefits of irrigation within the farming population, the banking community, government entities, and other sectors due to the success of PRORIEGO projects. As a result, farmers and bankers are more willing to invest in irrigation. PRORIEGO projects on over 5,000 hectares not only increase export earnings and reduce unemployment, but they provide highly visible examples of success.
2. An institutional capacity was developed for designing and constructing quality on-farm irrigation systems. However, the sustainability will depend on future demand created through development of irrigated agriculture.
3. The privatization of three irrigation districts in the Comayagua Valley is succeeding. Private irrigation support services (irrigation design, construction supplies) have expanded significantly because of PRORIEGO, and are capable of fulfilling the current demand for irrigation development in Honduras.
4. Credit availability for irrigation development has increased. However, available financing for new projects from reflows, normal bank credit, and private sources is adequate for only a fraction of the required development.

5. Yields of some crops are low due to on-farm water and fertilizer management and, in some cases, to poor drainage.
6. The benefits of PRORIEGO did not reach a significant number of subsistence farmers except possibly through better water supply in the Comayagua irrigation districts. Major obstacles are a lack of clear titles and water rights for small farmers. Land tenure mechanisms to provide clear titles and a National Water Law to assure water rights are essential to address these issues.
7. Women have had equal access to Project services, and a number have received loans for irrigation development.
8. Extensive groundwater and surface water development for irrigation is not possible without a good country-wide natural resource inventory. The sustainability of the progress seen under PRORIEGO may be shortlived if water resources are over-exploited.
9. An institutional capacity for interagency coordination and multipurpose water resource planning and development is lacking.

Primary recommendations which are necessary to sustain and accelerate irrigation development are:

1. The competence of the private sector in irrigation design and construction should be sustained and strengthened. To accomplish this, GOH should develop irrigation training programs in the various universities or at other training institutions, such as CEDA and the Pan American School at Zamorano.
2. Irrigation districts should be assisted in obtaining required equipment for operation and maintenance so that privatization can be completed.
3. To achieve sustainability of the PRORIEGO achievements, irrigation should be promoted and financed. The GOH should make every possible effort to find new sources of financing for irrigation development.
4. Continued technical assistance is recommended for on-farm water and fertilizer management. A training program which will reach farmers in the field is necessary to assure efficiency, productivity, and sustainability of new irrigation systems.
5. Efforts are recommended for the granting of clear titles for small irrigated farms and for enactment and implementation of a water law which will grant and protect water rights.

6. GOH should assign priority to a country-wide natural resources inventory, with emphasis on groundwater and surface water.
7. A system for interagency cooperation in multipurpose water resource planning and development is essential for development of irrigation resources, along with other needs of the country, and should be considered as priority by GOH.

A key lesson learned is that rapid awareness of the benefits of irrigation can be brought about through an extensive irrigation project such as PRORIEGO. Another key lesson is that good capability in irrigation design and construction can be developed in a relatively short time through formal training programs (mostly short-term) and extensive hands-on experience such as occurred in PRORIEGO. Privatization of irrigation design, construction, and supply industries can be promoted through an extensive project such as PRORIEGO. Another lesson learned is that credit cannot be made available through the private banking system if farmers do not have titles to their land.

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CHAPTER I

PROJECT DESCRIPTION, PURPOSE, AND GOAL

The needs for increased irrigation development in Honduras have been recognized for considerable time. Ffolkes (1980) recommended an increase in irrigated area of 200,000 ha by the year 2003. This goal was considered desirable to meet the needs of the rapidly increasing population, for the provision of food and fiber to meet domestic needs, and to provide foreign earnings.

During the late 1970's and early 1980's, several important irrigation developments were under consideration. These included Quimistan, 3612 ha; Nacaome, 6000 ha; Rehabilitation of Flores Project, 2140 ha; and the first phase of the Choluteca Project. These were proposed as intensive irrigation developments. An extensive project was needed to create a recognition of the potential benefits from irrigation, to train a cadre of engineers in the principles of irrigation design, and to provide training in on-farm water management and the elements of crop production. The Irrigation Development Project (PRORIEGO) was born in response to these needs.

The Project Agreement, signed September 29, 1986, initially provided a total of \$32.98 million for the purpose of improving farmer productivity through irrigation and improving agricultural practices through technical assistance. The amount actually made available was \$27.77 million. Improved productivity and income at the farm level was considered necessary in order to create a demand for increased irrigation development. It was recognized that institutional improvements and increased technical competence were needed for a major increase in the rate of irrigation development.

The PRORIEGO Project goal of enhancing the earning potential of Honduran farmers was to be realized through four principal components. These components were as follows:

1. Design and construction of projects for farmers and entrepreneurs.
2. Provision of on-farm water management technical assistance.
3. Strengthening the institutional capacity to plan and execute irrigation investments on a country-wide basis.
4. Credit for infrastructure and production.

The strategy for achieving the desired results was to provide irrigation design services, credit, construction supervision, and production technical assistance, which would result in model or demonstration irrigation systems in three regions of the country. The agreement called for GOH to:

- a. develop the legal and institutional framework through enactment of a National Water Law to ensure long-term water rights;
- b. develop a National Irrigation and Drainage Plan to coordinate activities on a country-wide basis;
- c. establish secure land tenure for farm units of less than five hectares on which financially viable irrigation could be established;
- d. establish a system for use of initial reflows from loans to support activities in the rural sector.

By Project completion date on 9/30/93, the physical and economic viability of irrigation was to have been proven. By this date, banks, design and construction firms would be willing and capable of continuing irrigation activities, and GOH would be institutionally capable of providing normative and planning services.

Designs of irrigation projects were made by Honduran engineers or companies. Until June 30, 1991, the designs were financed from project funds. Due to small farm sizes and administrative problems, many failed to qualify for loans. This resulted in the completion of many designs that were not constructed. As of this data, 169 designs had been completed, with construction on 62 projects. Plans and designs were reviewed by a competent expatriate engineer, and this process provided training for Honduran engineers.

Technical assistance was programmed for the preparation or updating of a National Water Law and a National Irrigation and Drainage Plan. It was anticipated that enactment of a National Water Law would create an Institute of Hydraulic Resources (IHRH), with a mandate to collect, process, evaluate, and store data on the land and water resources of Honduras. IHRH could then adjudicate rights to water use and plan and prioritize the land and water resources development for Honduras. Technical assistance was also provided for training in on-farm water management, preparation of design and training guides, and other Project-related activities.

Credit was proposed for financing approximately 271 irrigation loans on a total of about 6,000 ha. Some improvements in land tenure conditions for small farms were anticipated to be part of the loan. Despite a good level of effort, this was not implemented.

The original project proposed:

1. Constructing or rehabilitating approximately 600 irrigation systems, servicing 3,000 farm families, with approximately 18,000 beneficiaries.
2. Providing irrigation facilities for 6,000 to 7,000 ha.

3. Providing technical assistance to farmers to adopt new cropping patterns and modern agricultural inputs.
4. Providing credit for irrigation infrastructure and production costs.
5. Constructing drainage works as needed.

USAID and GOH were to decide jointly on the reflows from repayments of Project loans.

After the mid-term evaluation was completed in 1989, the strategies were modified as follows:

1. Add funding for continuing the Winrock International technical assistance contract.
2. Provide technical support for promoting approval of the National Water Law.
3. Provide technical assistance to finalize the National Irrigation Plan.
4. Provide monitoring to ensure high quality irrigation design.
5. Establish credit and land tenure mechanisms to increase the number of beneficiaries.

CHAPTER II

IMPACT AND ACHIEVEMENTS

By September, 1993, feasibility studies had been completed on 6,784 hectares, and construction was accomplished for 5,255 hectares, or 83 percent of the modified goal. However, the success of the PRORIEGO-financed developments had promoted construction financed by other sources on a very significant area.

A review of the farm budget estimates indicated an average labor requirement of 177 person-days of labor per hectare per year. For 5,255 hectares, this is equivalent to more than 900,000 person-days, or full-time employment for about 4,000 persons. Total off-farm labor generated was several times more than on-farm labor.

The PRORIEGO Project financed considerable technical assistance and training. Monitoring was provided that resulted in high-quality irrigation designs. The impact of the training and monitoring is that now irrigation systems are well designed and constructed. The sustainability of this achievement will depend on the demand for new irrigation development so that professionals may maintain their skills. It will also depend on GOH developing and maintaining irrigation training programs within the country.

PRORIEGO provided technical support for promoting approval of a proposed National Water Law. A proposed 10-year irrigation development plan was prepared for consideration by GOH. The impact of these accomplishments depends upon the enactment and implementation of the National Water Law and the 10-year irrigation plan. Except for establishing land tenure mechanisms and opening up credit for subsistence farmers, the modified goals were accomplished.

Credit for construction and production was provided. However, subsistence farmers do not have access to credit due to land tenure problems, as well as other problems, such as their inability to break into export markets due to size, knowledge of the marketing system, etc.

Credit for irrigation investment is now more available due to the positive experience of bankers with PRORIEGO projects. Since 1991, reflows from credit repayments have been used for financing new projects. However, reflows are inadequate for maintaining a satisfactory rate of development. Without an adequate source of new funding, the institutional capacity created can be expected to decline.

Agriculture generates about three-quarters of the country's export earnings and provides employment for nearly half of the work force. However, a major problem is over-dependency on exports of bananas and coffee. Seventy-five percent of the area in the projects was

for production for export. Nineteen percent was for non-traditional crops including melons and squash. The impact of the Project has been significant in terms of increased exports, increased employment, and increased production of some crops for local consumption. It is estimated that production for export from the developed area will contribute four or five percent of future export taxes collected by the GOH. The projected reduction in numbers unemployed is between one and one-and-a-half percent.

On-farm water management technical assistance provided was much less than desirable, with insufficient emphasis placed on learning by doing. With few exceptions, farmers and professionals alike have little knowledge of irrigation scheduling and the importance of good land leveling. Excessive irrigations, non-uniform crops, and little use of moisture monitoring techniques are the general observations. There is little recognition of the interactions of water and fertilizer. For some farms, drainage systems should have been included in the project design. The impact of the project will be much further reaching, with training of both professionals and farmers in on-farm water and fertility management.

Partial rehabilitation of the three irrigation districts in the Comayagua Valley was financed by PL 480 funds. The PRORIEGO Project furnished technical assistance and training in crop production on about 3,000 hectares in these districts, which serve about 1,000 water users. Assistance was also provided in the organization of water users associations for the management of these districts.

Notwithstanding the small farm sizes, the lack of clear titles, and the absence of water rights, these water users associations appear to be sustainable. The primary achievement of the WUAS has been that they can now assure the farmers in the district of a supply of water for irrigation on a regular basis with disciplined delivery. The impact of this is significant, as all district farmers, including small farmers and those at the tail end of canals, are assured of water for growing a crop. It allows farmers to grow some crops in the dry season and to access water during dry spells during the wet season. The District Directors have expressed a willingness and desire to assume full responsibility for operation and maintenance activities when the districts have been rehabilitated and supplied with the equipment required for maintenance.

Sufficient information for calculation of indirect benefits was not available. However, based on the evaluators' experience, indirect benefits from irrigation are probably at least five times direct benefits. In 1992, the average hectare in banana production required the equivalent of \$5,687 in goods and services, and produced \$948 in export taxes. The permanent labor force was reported at 1.09 persons per hectare. The indirect benefits from

the PRORIEGO Project are, and will continue to be, several times the direct benefits.

A primary impact of the Project has been that attitudes toward irrigation have changed. With hardly any exceptions, borrowers are repaying their loans. Both banks and farmers are realizing that investment in agriculture can be profitable. The capabilities of the private sector to design, construct, and operate irrigation systems have increased dramatically through PRORIEGO. There is much satisfaction with the PRORIEGO Project, and there is reason to believe that benefits can be sustainable. Sustainability of achievements will depend in large measure on the demand for irrigation which, in turn, is dependent on the availability of continuing financing and on the future policies of the GOK. Enactment of a National Water Law and implementation of a long-term irrigation and drainage plan is critical to achieving sustainability.

CHAPTER III

PURPOSE AND METHODOLOGY

The purpose of this evaluation is to provide the USAID/Honduras mission and the Government of Honduras (GOH) with an assessment of the overall performance of the Irrigation Development (PRORIEGO) Project (522-0269). The report indicates how Project strategies and components contributed to the Project's goals and purpose. It provides a summary of the impacts and sustainability of achievements and recommendations for improving the sustainability and advancement of irrigated agriculture in Honduras.

The evaluation was accomplished by reference to the Project documents, consultants' reports, and progress reports. Visits were made to the four regional offices, farms, and the irrigation districts. Farmers, professionals, Project designers, bankers, Project officials, directors of the water users associations, and irrigation suppliers were interviewed.

The information obtained was evaluated based upon the experience of the evaluation team in Honduras and in other developing countries. Background information and much support and assistance was provided by the Direccion General de Recursos Hidricos (DGRH). Use was also made of reports and studies prepared under an AID-financed project during the 1970's. References are included at the end of this evaluation, and documents provided by DGRH are in Annex 1. A list of persons contacted is presented as Annex 2.

The analysis consisted of an assessment of the overall achievements and impact of the Project and its sustainability.

However, the evaluators were asked to specifically address the following areas:

1. Privatization: What are the private sector capabilities for delivering irrigation design and construction services in a sustainable manner to the agricultural community? What is the feasibility of water users associations to independently manage and operate the districts, and what additional support or actions are required for them to do so?
2. Project credit and private commercial banks: To what extent are banks participating in the financing of irrigated agriculture now in comparison to when the Project was initiated? Are banks willing to continue the financing after the Project terminates?
3. Production and productivity: How much has the Project contributed to agricultural productivity, production, and exports? What have been the indirect benefits of the Project?

4. Gender considerations: Did women in the Project have the same access to PRORIEGO services as men? If not, what were the constraints?
5. Lessons learned: What are the major constraints to further irrigation development in Honduras? How was Project performance facilitated or impeded by economic, social, and political factors? What was the Project's overall impact, and did it achieve its stated objectives?

The evaluation report presents its findings. Based on these findings, it presents a set of conclusions and recommendations. Key lessons learned are presented in a summary.

CHAPTER IV

FINDINGS

Privatization Capabilities of Private Sector in Design, Construction, and Supply

The PRORIEGO Project promoted privatization of design and construction of farm-level irrigation systems. During the seven-year life of the Project, PRORIEGO provided training by conducting in-country workshops, seminars, and short courses. A number of professionals in the Project attended short courses and long-term training in countries outside of Honduras. Several professionals were trained at the Masters level in irrigation, economics, and in specialties related to irrigated agriculture. A summary of personnel trained and the type of training received is included in Annex 3. Many of the personnel trained by PRORIEGO are now in private practice.

The field experience obtained through collecting field data for design, the design itself (with technical advice from consultants), the quality control on the installation, and the observations of installed systems have all been an important part of the experience. Design studies reviewed by the consultants are thorough and professional. They cover the different aspects of the design process well. Farmers are very satisfied with the service provided by these professionals who are now in the private sector.

The PRORIEGO Project qualified or certified eight engineers and ten companies as qualified designers of on-farm irrigation systems. In the San Pedro Sula area alone, there are now at least eight professionals designing and providing construction services for irrigation systems. Six of the eight professionals were trained by PRORIEGO. Several independent designers are working out of the Tegucigalpa and Comayagua areas. Some of the professionals who are independent private contractors in either design or construction are able to make a living doing irrigation design and/or construction. Others have had to resort to non-irrigation activities to survive. However, that some are able to survive is quite encouraging, considering the infant stage of irrigation development in the country.

The professionals who have gone into private business have little or no capital with which to buy computers, surveying equipment, drafting equipment, etc. Most of them have managed to acquire some sort of transportation, but they have to resort to subcontracting, equipment loans, and other means to get their work done. Credit lines from banks for purchasing basic equipment are hard to obtain because of the unproven nature of the consulting business and the lack of collateral. The lack of basic equipment, such as flow measuring devices, results in designers having to use data which at

times may be faulty if it was obtained by well drillers or others who may not be well trained.

Primary design and reference manuals which the designers rely on are the Design Norms and Standards, which were developed for and by PRORIEGO. Some designers indicated that distribution of these standards had been less than desired. Other materials have been obtained from short courses and other training programs which they have attended. While these materials are generally adequate for most designs, a number of other references should be available, either in the designers offices or in a central library accessible to all.

The economists and agronomists who performed the soils inventories and analyses and the economic feasibility analyses for PRORIEGO are well trained. They have not incorporated themselves into the private companies as well as the engineers have.

There are other professionals who have significant training and experience outside of PRORIEGO. Some of them have had an opportunity to enhance their capabilities by working on the PRORIEGO Project under the Project's technical supervision. The majority of the professionals who are now engaged in irrigation design in Honduras have had extensive training through PRORIEGO, with the exception of two or three designers who work with Standard Fruit or other large private farms.

Traditionally, there have been two main irrigation suppliers in Honduras. These are NOVATEC and POLYTUBO, both of which handle the plastic irrigation pipe made in Honduras. They also handle other types of irrigation equipment, but their inventory is limited. Interviews with these two irrigation supply companies indicate the Project has motivated them to have larger inventories, obligated them to have more technical irrigation personnel on their staff, and has required them to carry new modern equipment for sales because of the demand created by the Project. For projects of more than two to five hectares, all but the irrigation pipe and fittings have to be imported. Imported materials generally require up to six weeks to arrive after the order is made. Some commonly needed spare or repair parts, such as for pipe fittings and sprinkler heads, are available in some cases. However, farmers indicate that they often do not find the spare parts that they need.

Three other irrigation suppliers are RIEGOS DE HONDURAS, AGUASISTEMAS, and RHINEHART. RHINEHART is an established supplier of equipment. In the last year, they have set up an irrigation section which sells Rainbird products. They are vigorously promoting their irrigation equipment through trade shows and short courses for potential customers. AGUASISTEMAS is a recent arrival on the scene. These suppliers do not manufacture pipe, but they are able to access plastic pipe from NOVATEC, POLYTUBO, or from Costa Rica or the U. S. Other equipment is obtained from

distributors in other countries, primarily from the U. S. and Israel. One distributor, NOVATEC, has a design section of three professionals (an agricultural engineer, a civil engineer, and an agronomist). The manager of NOVATEC indicates that prior to 1987, the company designed and constructed only two to three systems per year, and now they are designing, supplying equipment to, or constructing as many as 50 irrigation projects per year. He attributes the increased demand for irrigation equipment to PRORIEGO activities in recent years.

Basic farm equipment dealers do not carry ditchers and other equipment useful for constructing, managing, and maintaining irrigation systems on the farm.

Land leveling equipment is in short supply. Land leveling equipment used specifically for agriculture is found in Choluteca with two individuals. Both have laser leveling equipment. Other land leveling activities, such as for construction of level basins for rice irrigation in Comayagua, are performed by earthmovers, caterpillars, and land graders used in other construction industries. For installation of pressurized irrigation systems, the trenching for installation of pipelines is done with backhoes, rather than with trenchers as in the U. S. However, this is a very adequate means, and backhoes are very commonly available in other parts of the construction industry.

As much of the new water supplies for irrigation are coming from wells, it is important to know whether there is adequate well drilling capacity in the private sector. There are a number of well drilling rigs in the country at this time besides those owned by DGRH. Some of the better equipped drilling companies are INVERSIONES DIRECTAS, SERTE, HIDROSISTEMAS, and HONTEX. Interviews with PRORIEGO staff in San Pedro Sula would indicate that at least ten well drilling rigs operate in that part of the country at certain times. Cable Tool, air rotary, and reverse rotary rigs are all available for different well construction requirements. All of those interviewed indicated that the number of well construction rigs was sufficient to meet current demand. Very few persons have formal training in design of wells or in groundwater studies.

An adequate supply of pumps is indispensable for a country with a large number of irrigation wells. A large number of foreign pump manufacturers are represented by Honduran companies such as BOMOFESA, MASTEC, ACEYCO, ERASA, CEMCOL, and RIEGOS TECNICOS. End suction centrifugal pumps for pumping from rivers, canals, and reservoirs are commonly available. Submersible pumps are commonly available in sizes to six inches. At least in the case of BOMOFESA, the company can assemble pumps for different flow and head requirements. They are also able to replace impellers and service pumps in general. They are able to conduct good, basic designs for commonly encountered conditions. Given time of up to six weeks, these suppliers are able to come up with most pumps

which would be specified. Availability of pumps is not a limitation to irrigation development. However, few repair parts are stocked except for a few models. This should be considered in the design and purchase of pumps. Deep well turbine pumps with column pipe and shafting are not generally available except with a special order from abroad. These pumps should be considered in design, as they are much less affected by sand wear, and electrical problems are much more easily fixed.

Privatization: Irrigation Districts and Water Users Associations

PRORIEGO promoted and assisted in the privatization of irrigation districts by water users associations. Farmers are organized and have developed workable rules and regulations for the administration, operation, and maintenance of the districts. They have taken over much of the maintenance of the secondary and tertiary canal systems. These canals are cleaned and maintained at least four times during the year on a formal basis, and at other times as necessary. Although the cleaning is with traditional equipment, such as shovels, hoes, picks, machetes, and other simple devices, this system works very effectively. It is much less expensive than using machinery, as the farmers contribute their labor. Available monetary resources from water assessments can then be used for materials and machinery expenses where needed. The water users associations have been able to increase the collection of water charges significantly each year of the last three. The funds come back to the district for use in maintenance and operation according to the association's priorities. The water users associations are able and willing to impose sanctions on users who do not pay their water charges, who do not do their share of the maintenance, or who would steal water or in other ways infringe on the rights of other members.

There is already much of the discipline within the district which is necessary for the control of irrigation water and elimination of conflicts. One of the key factors has been the installation of good headgates at each of the primary and secondary canal turnouts. A total of 118 headgates have been installed in Flores district since 1990. This, along with other rehabilitation activities, has made possible the controlled distribution of water. The canalero, or ditch rider, has been responsible for the equitable distribution of water, as he assures that water distribution is in accordance with the association's by-laws.

Fine tuning of the system will be possible when rehabilitation activities are completed and when the water users associations obtain more experience in operation and management. Training of water users on aspects of good farm water management, along with training of the district's officers and operations personnel, will also help them to improve the system to make water available in tune with crop needs. It is also critical that the availability of

water be improved during winter months when rainfall fails to meet crop water requirements.

Water assessments are currently at a maximum rate of ten lempiras per hectare per irrigation, including the water charge and maintenance fees. This is only 1/3 of the water assessment necessary to pay the full cost of management, operation, and maintenance within the district. The thirty lempiras per hectare per irrigation will include ownership of equipment by the districts and all costs of operation such as salaries, fuel, repair parts, etc. To manage the resources, the districts will need technical assistance. Personnel will need to be trained in accountability, operation, and maintenance of equipment, etc. A rate increase from ten to thirty lempiras is significant. Considering that an average of 9.8 irrigations are given per year, this corresponds to 294 lempiras per hectare. On a rice crop, this would represent less than four percent of the market value of the crop, with a yield of 100 quintals per hectare and a market value of 60 lempiras per quintal. The fraction is much lower for export crops. The cost of water would still be much lower than for a farmer who has to develop his own water source and pay for the cost of pumping. Farmers with wells often pay in excess of 100 lempiras per hectare in energy costs alone, and over 1,000 lempiras per hectare in the amortized cost of a well with pumping plant and accessories.

The rehabilitation of the Comayagua Valley projects is about forty percent complete. Equipment for maintenance is in short supply.

DGRH does not have funds for completing the rehabilitation of the Selguapa and San Sebastian projects now but may be able to obtain the necessary funding over a period of the next two to three years. The directors indicated that, with completed rehabilitation and availability of maintenance equipment, they would be willing to assume full operation and maintenance responsibilities within a period of two years.

Project Credit and Private Commercial Banks

PRORIEGO developed mechanisms to assist and encourage banks to finance irrigation activity. The credit financed by the project has constructed 3,518 ha of irrigated land. Approximately 60% of all the projects were of 20 ha or greater, and 25% were less than 10 ha. The majority of individuals who received credit through the Project were medium to large size land owners and/or entrepreneurs who had easy or open lines of credit with banks. The subsistence or small scale farmer with less than five ha was mostly excluded from Project credit because of land title and/or loan guarantee obstacles in the loan contract.

Three bank officials were interviewed. Two of them considered irrigated agriculture to be high risk, but fundamental to the economic growth of Honduras. For that reason, they recommend that

interest rates for irrigation infrastructure be subsidized and that loans be for longer periods than those available through the banks. Production of some fruit crops offers good returns on investment and creates high demands for labor. However, the period prior to self sustained economic production may be several years. There appears little possibility of financing these developments through the current banking system.

Since 1991, the repayments of PRORIEGO loans are being used to finance new loans. At present, the Central Bank has required an increase in bank reserves. Consequently, the banks have very little money to loan and interest rates have been increased. However, bankers have indicated that, due to the favorable experience with PRORIEGO loans, they are willing to continue financing irrigation when funds are available. One banker stated that 60% of PRORIEGO borrowers are entrepreneurs who have open lines of credit.

Production and Productivity

Annex 4 provides a summary of areas and yields of the crops produced. These data are from the PRORIEGO regional offices. These data on crop yields appears to be very general to the contractor, since crop yields were exactly the same on all the projects. There was no detailed study of crop yields from any of the projects. Interviews with farmers indicated a wide variation in yields. The yield per hectare reported for bananas is 57% above the national average yields. Yields of cantaloupe, water melon, onions, and tomatoes are considered to be much below the potential with advanced technology. Table 1 compares these yields with good yields in tropical areas, as indicated in FAO Irrigation and Drainage Paper No. 33. These comparative values are considered to be on the low end because of improved crop production in the last 15 years, as average crop yields worldwide have increased slightly more than one percent per year.

Although yields of most crops can be significantly improved, the consultants' reports and interviews with farmers indicate a good level of profit from the crops grown except in cases of unusual losses due to pests, floods, etc.

Table 1

CROP	PRORIEGO AVERAGE YIELDS (TON/HA)	FAO GOOD CROP YIELDS, TROPICAL REGION (TON/HA)*
Banana	53.1	40.0-60
Maize (grain)	4.1	6.0-8
Onion	18.9	35.0-45
Rice	5.6	6.0-8
Sorghum	4.5	3.5-5
Sugarcane	86.0	110.0-150
Tobacco	4.2	2.0-2.5
Tomato	48.8	45.0-65
Water melon	18.2	25.0-35

*FAO Irrigation and Drainage Paper No. 33, Table No. 1, p. 5, 1979.

Average production and employment figures from the 1992 report, Agricultural Sector-Honduras, were used to estimate Project benefits from the 1,942.8 ha of banana production financed by Project funds. Export taxes are estimated at \$1.1 million, or 3% of the total export income for Honduras. About 2.1 thousand permanent jobs were created, with a reduction of about 1% in the number of persons unemployed. Future annual export earnings from the crops financed by the Project will be four or five percent of the total, with a reduction of about 1.5% in numbers unemployed. These are direct benefits. Indirect benefits are estimated to exceed direct benefits by more than five times. This multiplier is indicated by the large amount of harvest labor required for the export crops and annual requirements for goods and services, equivalent to \$5,687 per hectare for banana production.

On-farm water management continues to be a major production limitation on yields and operating costs. One of the contractors assisted in evaluating the Project's water management practices on a farm level in 1992, and has since seen no steps taken nor improvements made in training farmers. Irrigation timing and depth of application are not definable practices on most of the projects. The practice of "getting the ground wet" is most common at the farm level. Some of the owners of PRORIEGO projects are not directly involved in the agricultural production of the crop and, therefore, provide little, if any, incentive for the farm manager to operate efficiently in irrigation management. Others do not have the proper training or experience to manage irrigation systems for optimum yields.

Gender Considerations

Culturally, the agricultural field is dominated by men. This is directly reflected in how male entrepreneurs and large land owners invest capital in their area. Women are more involved in agriculture at the subsistence level, and the Project did not reach this group of individuals. This was not due to gender, but because of constraints (previously mentioned) in obtaining credit.

There is probably little difference in access to Project credit due to gender, although women involvement was minimal because of cultural influences. The bankers interviewed indicated that women are usually more reliable than men, but men are more aggressive and active in agriculture. If all other considerations were equal, there would be little or no favoritism due to gender. Twenty-three women have benefitted directly from PRORIEGO loans.

Irrigation canals and wells serve several needs in addition to irrigation. They provide water for bathing and culinary purposes and reduce the needs for carrying water, particularly during the dry season. These indirect benefits of the Project influence women to some extent in their daily lives.

There are relatively few female professionals in engineering and irrigation sciences relative to the number of men. Two women have been selected for long-term training grants, and four were selected for short-term training at Utah State University. Considering the number of women selected for training abroad, there is evidence of efforts made by PRORIEGO to include women. However, attendance at in-country training courses was essentially all male, and the evaluation did not find evidence of participation by women in the administration and management of the irrigation districts.

Land Tenure and Water Rights

The Project Agreement includes special covenants relative to land tenure and water rights. The average farm size in Honduras is 11.2 hectares. Forty-two percent of agricultural land is in pasture. The average irrigated farm size is small. Few small farms have clear titles, and there are no private rights to water. The typical small farm has little or no access to credit. Without collateral, few organizations or individuals will finance agricultural operations.

The strategy of granting land titles required the participation of INA, and little progress was made in implementing the strategy of granting land titles. Various activities by USAID-sponsored projects and DGRH over a period of nearly 20 years have failed to produce a procedure for the granting of water rights.

CHAPTER V

CONCLUSIONS

Privatization

An institutional capacity for designing and constructing quality on-farm irrigation systems was developed from the limited initial capabilities. The institution's capacity was developed through long- and short-term training programs outside of Honduras, through short-term training in-country, and through extensive hands-on experience in design and construction supervision on PRORIEGO projects. Review, inspection, standards, and supervision were provided in order to provide quality control. The capabilities of the irrigation supply and construction industry are adequate to meet the current demand for irrigation services. This capacity is sustainable only if sufficient funding is obtained from private and/or institutional sources to maintain and increase the demand for irrigation in the country.

Private design companies are facing obstacles in obtaining financing to acquire basic equipment such as computers and flow measuring devices required for designing quality projects. They have the technical expertise, but not the equipment. Credit for these new private companies during start-up is essential.

The privatization of the operation and management of the three irrigation districts in the Comayagua Valley is proceeding well. If privatization is to be completed, the Project's rehabilitation needs to be completed, equipment needs to be made available to the district, and personnel have to be trained.

Project Credit and Private Commercial Banks

The Project was successful in providing credit for irrigation development through private banks using PRORIEGO funding. The success of these projects created an awareness of the profitability of irrigated agriculture. It also demonstrated to the banks the value of good irrigation design and economic analysis in irrigation development.

The procedure for the use of project financing reflows has been in operation since 1991. Significant additional development is being financed by entrepreneurs. Subject to the availability of funds, the banks have a desire to continue to finance irrigation. However, the rate of development that can be financed from these sources is only a fraction of that necessary to keep pace with the rapidly increasing population. Funds are required for this access to credit and economic success will be enhanced if a successful strategy can be found for giving titles and water rights to the small farms. Some form of land consolidation or block management

of irrigation and farming operations could be considered to enhance the efficiency and profitability of irrigation.

Production and Productivity

The areas brought under irrigation have added significantly to the ability of Honduras to produce crops during the dry season for export. During the wet season, the new irrigation systems provide irrigation during dry spells. However, the positive examples on PRORIEGO projects has motivated farmers to construct systems outside of PRORIEGO. For example, in Comayagua, the area recently developed for irrigation is more than double that which PRORIEGO designed and constructed. Production resulting from the Project lands will provide an annual increase in export tax income of 4% or 5%, and will directly decrease the numbers unemployed by about 1.5%. Indirect benefits are estimated to be about five times the direct Project benefits. Yields of some crops are much below the potential with advanced technology. A major factor is the inadequate emphasis on on-farm water and fertilizer management.

Gender Considerations

If the Project had a gender bias, it may have been in favor of women. Women with comparable qualifications had equal or better access to Project activities and/or benefits than did men. However, involvement of women in the Project is less than that of men for cultural reasons. For example, men make the majority of the decisions at the farm level. This is particularly true on larger farms.

Other Considerations

Particularly for small farms, the lack of water rights and the limited access to land titles are major obstacles to farm productivity. This is particularly pertinent to the future success of the irrigation districts and the twenty irrigation cooperatives. Most private irrigation development is from wells. This requires medium-term financing. Development could be enhanced by a good groundwater resource inventory. An inventory of surface and groundwater resources is essential for the implementation of a National Irrigation Plan and for administration of a National Water Law.

Interagency coordination and a procedure for multipurpose development planning should be given priority by the GOH. Rural electricity is needed in the areas of good potential for groundwater development.

The actual funds that are available for irrigation development are only a fraction of those necessary for financing agricultural development to feed the rapidly growing population. Some form of consolidating lands, possibly with management practices in

irrigation blocks and/or farm operations, could be evaluated to improve efficiencies, sustainability, and profitability of irrigation.

CHAPTER VI

RECOMMENDATIONS

Privatization

The competence of the private sector in irrigation design and construction should be maintained, expanded, and improved. Continued monitoring of quality by an expatriate engineer is recommended. The GOH should actively search for expanded funding for development and subsidies provided for engineers and others wishing to establish themselves as private consultants in irrigation development. GOH should encourage the establishment of training programs at universities and other Honduran training institutions to ensure that new, well-trained professionals enter the irrigated sector periodically. GOH should continue to provide training and support for the irrigation districts to allow them to be privatized completely. This should include assistance in financing the acquisition of the equipment needed for operation and maintenance.

Project Credit and Private Banks

Reflows will be most inadequate for financing Honduran needs for irrigation development. The GOH should make every possible attempt to obtain a source or sources of funding at a level adequate for the development of at least 6,000 hectares of new lands for irrigation per year. Credit accessibility by small and subsistence farmers must be improved if these are to share in the benefits of irrigation. Land tenure issues must be resolved so that farmers acquire titles to land they farm. This will make credit much more accessible.

Production and Productivity

Production and productivity can be greatly enhanced through on-farm water and fertilizer management. This will require extensive training of professionals, technicians, and farmers. GOH should expand the current efforts at CEDA and should train personnel to provide on-farm assistance. A local source of soil and plant chemical analysis should be developed. It is recommended that technical assistance in on-farm water management be subsidized initially, and that subsidies be phased out so as to provide these services entirely in the private sector. Services should also include other aspects of assistance that relate directly to crop yields and production.

Gender Considerations

There are few women directly involved professionally in agriculture. Due to agrarian reform activities, there was a large increase in the number of women landowners. However, these

ownerships are usually managed by husbands or sons. GOH should encourage the involvement of women as directors in the districts, as professionals in irrigation design and management, and as agricultural producers.

Other General Recommendations

It is strongly recommended that the GOH give priority to the granting of clear land titles whenever feasible on small irrigated farms. Continued efforts are recommended for obtaining approval and implementation of a National Water Law and implementation of a National Irrigation Plan. Efforts to create an institutional capacity for a country-wide inventory of groundwater and surface water resources are strongly recommended. This has prior importance, as this knowledge is essential for administration of a water law. The need is urgent, and action should not be delayed. These activities should be promoted independently of promotion of a National Water Law. Full-time long-term technical assistance is recommended in connection with both groundwater and surface water hydrology.

Provision for a good, readily accessible natural resources inventory is also strongly recommended. This is essential prior to the development of a National Irrigation Plan.

It is recommended that the GOH establish some form of coordination relative to multipurpose planning for the use of the water resources.

CHAPTER VII

LESSONS LEARNED

The private sector demonstrated an expanding ability to provide quality designs and construction for on-farm irrigation systems. The key to developing this capability was the long- and short-term training, as well as the experience in designing and constructing irrigation systems provided through PRORIEGO. This capability has the potential for supporting a much larger future activity in privatized irrigation development. The welfare of the rural poor depends to a large degree upon the productivity of the land, the economic growth of the area, and the demands for labor. The PRORIEGO Project has demonstrated that privatized irrigation can provide many opportunities and benefits for the rural poor.

Access to credit is essential for irrigation development. A key to opening credit avenues has been the success of well-designed irrigation projects which have resulted economically and financially viable. These presently use reflows as the source of funding. The PRORIEGO Project financing, plus that available from the regular banking system and private sources, produced substantial benefits to the economy. However, the level of financing currently available is only a fraction of that required to meet the increasing needs for the production of food and fiber and export earnings, and it does not reach subsistence farmers or small farmers. Farmers without titles to their land were not able to qualify for financing of irrigation systems. A GOH strategy for giving priority to the granting of titles for small irrigated farms will improve credit, permit land consolidation, and permit block management through leasing and other arrangements.

On-farm water management and, in general, good farm management are essential for achieving good production and efficiency in irrigated agriculture. Yields are significantly below their potential in Project areas, and water management problems are obvious. Future projects need to provide technical assistance in on-farm water management and general farm management from the outset. This could be accomplished through private organizations or consulting groups whose services eventually would be paid by the irrigators. Initially, such services might have to be subsidized.

The extensive character of PRORIEGO over several regions of the country and the success of the irrigation projects to date has created highly visible examples of the potential benefits of irrigation. Bankers, farmers, irrigation suppliers, and government have all seen the potential benefits from irrigation development. PRORIEGO can serve as a model in other countries where the benefits of irrigation are yet to be realized.

CHAPTER VIII

OTHER CONSIDERATIONS FOR IRRIGATION DEVELOPMENT IN HONDURAS

Macro-economic studies indicate that a total of six to ten thousand hectares of new irrigated production per year will be required to meet the needs of a rapidly growing population and produce import earnings for capital growth and to repay the national debt. The GOH must now aggressively seek new funding for an expanded irrigation development program in the private sector.

Production can be increased by placing more land under irrigation. It can also be increased by improving yields. The yields reported for most crops are lower than those typical from good management. There is a potential for doubling yields of some crops. Several factors contribute to this. For some farms, poor drainage is a limiting factor. However, the principal limitation to yields is related to on-farm water and fertilizer management. The yields obtained are adequate for satisfactory economic returns but, with good management, the productivity can be significantly improved. Increased emphasis is needed on the production of high-value, labor-intensive fruits and vegetables for export.

The twenty irrigation cooperatives with land titles held by INA (Instituto Nacional de Reforma Agraria) are essentially non-productive. The four cooperatives financed by the Government of Japan are not used for irrigated production. The facilities are excellent. The lands appear to be very good for the production of fruit crops for export. These cooperatives should be privatized and brought to a high level of productivity.

Efforts over the past twenty years with the objective of obtaining a National Water Law have not yet produced many results. Good inventories of groundwater and surface water are essential for irrigation planning and administering water rights.

The extent of irrigation from wells in the Comayagua Valley has far exceeded that previously thought possible. This development, and benefits possible from similar developments in other areas, clearly indicates the urgency of obtaining a good inventory of the groundwater resources. This development from wells and the possible benefits from production for export clearly indicate the desirability of medium-term financing at favorable interest rates.

The planning, administering, and developing of irrigation and other uses of water resources would be greatly facilitated if a good country-wide inventory of natural resources could be completed. Priority needs to be assigned to documenting the groundwater and surface water resources. This material should be readily available in one location. Little data are available on the resources of the eastern one-third of Honduras. The resources for agricultural development of this area need to be evaluated.

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ANNEX 2. PERSONS CONTACTED

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 Director-Flores District
 Flores District
 President Flores District
 Regional Director DGRH Comayagua
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 Secretary Selguapa District
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 Private Engineer
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Politubo - Irrigation Supplier
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PRORIEGO SPS District

ANNEX 3. TRAINING AND CONSULTANCIES

Short Courses Abroad for Professionals

Design:

Irrigation systems	Sprinkler irrigation
Pumps and wells	Surface irrigation
Irrigation evaluation at farm level	Small scale irrigation projects

Water Management:

On-farm water management	Irrigation scheduling
Field trips - water management at farm level	Efficient water use

Water Districts/Farmer Organizations/Extension:

Field trip to water district	Irrigation extension
Organization of irrigating farmers	

Institutional:

- Teaching, programming, and organizing farm extension institutes
- Political planning and strategies for irrigated agriculture
- Water laws
- Irrigation canal regulations

Industrialization and Business:

- Industrialization of farm cooperatives
- Agri-industrial promotion
- Administrative planning and strategies in financial companies
- Upper level management

Soil Conservation:

- Field trip on soil conservation
- Soil and water conservation management

Others:

- Meteorology instrumentation
- Operation, management, and administration of irrigation systems
- Irrigation, drainage
- Modeling watershed hydrology
- Roles of women
- Integrated management of hydrologic resources

In-Country Training for Professionals

Design:

- Surface irrigation
- Drip and microsprinkler irrigation
- Land leveling and topographical maps
- Sprinkler irrigation
- Pumps
- Selecting economic tube diameters for pressurized systems
- Flow measuring devices
- Furrow irrigation
- Small scale irrigation projects
- Inlet structures

IWM:

- Irrigation water management
- Evaluation of irrigation systems
- Technological package in water management
- Measurement of moisture

Irrigation Fundamentals:

- Logic sequence in irrigation development
- Irrigation methods
- Irrigation system operation
- Topographic mapping
- Irrigation perspective in Honduras

Extension Services:

- Methodology for promoting the projects to clients
- Extension methods in irrigation
- Farmer participation
- Administration of human resources for executives
- Human relations

Crop Management:

- Technical guides for cultivation of maize and rice with irrigation
- Soybean and its acceptance in the national market

Business:

- Credit seminar
- Computer and software use
- Personnel administration
- Modernizing the financial system
- Privatization of PRORIEGO services
- Effective writing
- Training of secretaries
- Editing of reports in decision making
- Administration of agricultural farms

Others:

- Operation and maintenance of irrigation systems
- Agrometeorology
- General water laws of project
- Cost estimates and quality control of irrigation construction

In-Country Training for Farmers

- Irrigation water management
- Irrigation fundamentals
- Cultivation of rice, tomato, and onion with irrigation
- Administration of agricultural farm

Formal Training Through PRORIEGO, 1988-1993

<u>Type of Training</u>	<u>Number of Courses</u>	<u>Number of Participants</u>
Professional level	41	83
Short courses abroad		
Short courses, seminars, and workshops in-country	69	1057
Long-term training at Masters level		9
Farmer level		
Short courses and seminars	13	202

Training at CEDA and PRORIEGO's Contribution

The PRORIEGO Project trained nine professionals at the M.S. level. Five of these are now assigned as trainers at the Agricultural Development Training Center (CEDA). CEDA is located in the Comayagua Valley. Construction and some operational funding was furnished by the Government of Japan.

CEDA offers twenty to twenty-five courses per year. The following courses were given in the first trimester of 1993:

1. Basic training for a period of five days in the cultivation of various irrigated crops for a total of 162 farmers.
2. Medium-level training in tractor maintenance for 40 mechanics. The courses were for 11 days.
3. Medium-level training for 56 agronomos and extensionistas in irrigation and crop production for periods of two weeks.
4. Training of 15 canaleros for a period of two weeks.
5. Advanced courses in irrigation technology for periods of two to three weeks for a total of 74 Ingenieros Agronomos, Ingenieros Agricolas, or Ingenieros Civiles.

From 1990 until the end of the PRORIEGO Project, CEDA has provided 72 courses with approximately 1,075 participants. A wide variety of grains, fruits, and vegetables are grown on 50 ha of irrigated lands. The facilities are very good. The staff is well trained in irrigation technology. It seems desirable that the staff become more involved in applied irrigation research and in extension-type activities throughout the Valley. More emphasis is needed on crop production methods.

CEDA has good laboratories for physical properties of soils and provides results at very reasonable prices. Facilities are lacking for soil fertility analyses. Chemical soil analyses, combined with response from pot tests and records of fertilization practices and

Annex 3, Cont.

resultant yields throughout the Valley, could be used to develop CEDA into a very useful extension-type training center serving the entire Valley.

Summary of Consultancies from 1987 to 1992

<u>Topic</u>	<u>Length of Consultancy (weeks)</u>
Evaluation of Water Law Project	6
Credit	4
Restructuring the PRORIEGO Project	14
Design standards and norms	17
Status of the National Irrigation Plan	6
Analysis of the Water Law Formulation process	4
Design and arrangement of office facilities	1
Technical analysis of very small irrigation projects	13
Support on diagnostic analysis of DGRH	8
Design and supervision of construction projects	2
Administrative processes for PRORIEGO	13
Training in the use of video equipment	6
Technical assistance in use of computers	80
Support to the Department of Hydrology and Climatology	26
Support to DGRH in environmental issues	4
Use of computers for administrative purposes	4
Technical aspects of the Water Law Project	6
Technical aspects of the Water Law Project	14
Technical Assistance in Crop Production	38
Technical assistance and supervision on irrigation projects	12
Evaluation of the need for computers	6
Agricultural marketing	6
Redesign of PRORIEGO administrative system	9
Development of work plan - 1989	3
Design and construction norms for small scale irrigation	26
Water Law	3

Annex 3, Cont.

Institutional analysis of DGRH	14
Organizational development and structure of DGRH	6
Organizational development and structure of Dept. of Natural Resources	5

Consultancies from 1987-1992, Cont.

Irrigation drainage reconnaissance and feasibility studies	3
Privatization of irrigation districts	2
Technical assistance to DGRH on hydrology and climatology	3
Technical assistance to DGRH on hydrology and climatology	2
Water management	3
Project evaluation	9
Environmental impact of PRORIEGO	4
The Water Law	2
Farm water management	11
Farm water management	4
Support to Dept. of Hydrology and Climatology	4

IRRIGATION DEVELOPMENT PROJECT
 PRODUCTION SITUATION TO SEPTEMBER, 1993 - FIRST CYCLE
 BETWEEN 1988-1993

NO.	CROP	AREA HA.	DESTINATION	AVERAGE YIELDS MT/HA	PRODUCTION MT
CHOLUTECA (SOUTH REGION)					
1	MELON	328.00	EXPORT	13.66	4,547.00
2	WATERMELON	12.00	EXPORT	18.22	218.64
3	PASTURE GRASS (ESTRELLA)	4.61	LOCAL	72.00 (1)	331.92
4	SUGAR CANE	36.70	LOCAL	(2)	
	TOTAL	381.31			
COMAYAGUA (CENTRAL REGION)					
5	TOMATO	91.60	LOCAL	50.00	4,580.00
6	APPLES (ANA)	5.00	LOCAL	3.80	19.00
7	PASTURE (KING GRASS)	2.00	LOCAL	114.00 (1)	228.00
8	RICE	90.79	LOCAL	7.46	677.00
9	CORN FOR GRAIN	51.87	LOCAL	4.10	213.00
10	SQUASH	47.38	EXPORT	10.50	497.00
11	TOBACCO	104.00	LOCAL	2.00	208.00
12	ONIONS	1.46	LOCAL	21.23	31.00
13	GINGER	7.00	EXPORT		
14	IDLE LAND	92.50			
	TOTAL	493.60			
SAN PEDRO SULA (NORTH REGION)					
15	BANANA	2,309.00	EXPORT	53.80	124,224.20
16	RICE	286.00	LOCAL	5.00	1,430.00
17	PLANTAIN	216.00	EXPORT	22.70	4,903.20
			LOCAL	2.80	604.80
18	GRAPEFRUIT	132.00	EXPORT	(3)	
19	CACAO	28.00	EXPORT	1.60	211.20
	TOTAL	2,971.00			
FRANCISCO MORAZAN (CENTRAL REGION)					
20	CORN (SEED)	96.00	LOCAL	3.50	336.00
21	TOMATO	29.10	LOCAL	37.50	1,091.25
22	ONIONS	6.10	LOCAL	18.30	111.63
23	SWEET PEPPERS	6.10	LOCAL	9.20	56.12
24	TOBACCO (BURLEY)	39.00	LOCAL	2.20	85.80
25	PASSION FRUIT	27.00	LOCAL	18.00	486.00
26	SQUASH	14.20	EXPORT	11.25	159.75
27	SORGHUM	16.40	LOCAL	4.50	73.80
28	SORGHUM (FORAGE)	14.00	LOCAL	46.00	644.00
29	SUGAR CANE	37.00	LOCAL	86.00	3,182.00
30	IDLE LAND	18.85			
	TOTAL	303.75			
	GRAND TOTAL	4,149.66			

- (1) YIELD OF PASTURE ESTRELLA IS 6 MT/CUTTING, AND FOR KING GRASS IS 19 MT/CUTTING
 (2) PLANTED A NEW CROP IN THE MONTH OF MAY - HARVEST WILL BE IN THE FOLLOWING YEAR
 (3) PLANTED A NEW CROP IN NOVEMBER OF 1992, AND FIRST HARVEST WILL BE IN NOVEMBER OF 1995

AREA AND PRODUCTION OF CROPS

IRRIGATION DEVELOPMENT PROJECT (PRORIEGO)
 PRODUCTION SITUATION UNTIL SEPTEMBER, 1993 - FIRST CYCLE
 BETWEEN 1988 AND 1993

NO.	CROP	AREA HA.	TYPE	AVERAGE YIELD (MT/HA)	PRODUCTION, MT (METRIC TONS)
1	MELON	328.00	EXPORT	13.86	4,547.00
2	WATERMELON	12.00	EXPORT	18.22	218.64
3	PASTURE GRASS (ESTRELLA)	4.61	LOCAL	72.00	331.92
4	PASTURE GRASS (KING)	2.00	LOCAL	114.00	228.00
5	SUGAR CANE	73.70	LOCAL	86.00	6,338.20
6	TOMATOES	120.70	LOCAL	48.81	5,891.25
7	APPLES (ANA)	5.00	LOCAL	3.80	19.00
8	RICE	376.79	LOCAL	5.59	2,107.26
9	CORN FOR GRAIN	51.87	LOCAL	4.10	212.67
10	SQUASH	61.58	EXPORT	10.67	657.24
11	TOBACCO	143.00	LOCAL	4.20	600.60
12	ONIONS	7.56	LOCAL	18.87	142.63
13	GINGER	7.00	EXPORT		
14	BANANAS	2,309.00	EXPORT	53.80	124,224.20
15	PLANTAIN	216.00	EXPORT	22.70	4,903.20
16			LOCAL	2.80	604.80
17	GRAPEFRUIT	132.00	EXPORT	(1)	
18	CACAO	28.00	EXPORT	1.60	12.10
19	CORN - SEED	96.00	LOCAL	3.50	336.00
20	SWEET PEPPERS	6.10	LOCAL	9.20	56.12
21	PASSION FRUIT	27.00	LOCAL	18.00	486.00
22	SORGHUM	16.40	LOCAL	4.50	73.80
23	SORGHUM (FORAGE)	14.00	LOCAL	46.00	644.00
24	IDLE LAND	111.35			
TOTAL		4,149.66			

(1) PLANTED A NEW CROP IN THE MONTH OF NOVEMBER, 1992, AND THE FIRST HARVEST IS EXPECTED IN NOVEMBER, 1995.

ANNEX 5. WORK PLAN FOR PRORIEGO FINAL EVALUATION

Sunday 12 Salazar arrives in Tegucigalpa and coordinates with Armando Busmail.

Monday 13 Hargreaves arrives. Meeting with AID and DGRH to review evaluation process and plan consultants activities. Attend Glenn Strinham outbriefing and interview Glen for evaluation purposes.

Tuesday 14 Trip to Comayagua. Meet with officials of districts, Recursos Hídricos, and PRORIEGO. Make site visits to irrigation systems installed, Designed by PRORIEGO and to canals being rehabilitated by the districts.

Wednesday 15 Review of project documents in Tegucigalpa. Prepare outline of final report, questionnaires, and summarize information.

Thursday 16 Review of project documents. Visits to private irrigation designers, irrigation supply outlets, and banks.

Friday 17 Trip by Salazar to San Pedro Sula to obtain project information and to meet irrigation suppliers and designers. Visits by Hargreaves to banks and beginning of evaluation report.

Saturday 18 Salazar returns from San Pedro Sula. Hargreaves and Salazar summarize information and work on report.

Sunday 19 Crane arrives and Salazar departs.

Monday 20 Hargreaves and Crane visit Choluteca projects. Meetings with project personnel and visits to projects designed by PRORIEGO.

Tuesday 21 Continue activities of previous day and return to Tegucigalpa.

Wednesday 22 Crane visits project sites in San Pedro Sula and interview project personnel. Hargreaves summarizes information and works on report.

Thursday 23 Crane continues activities of previous day and returns to Tegucigalpa.

Friday 24 Hargreaves and Crane summarize information and write evaluation report.

Saturday 25 Continue previous day's activities.

Sunday 26 Crane departs.

Monday 27 Hargreaves submits preliminary review to USAID, and continues working of final report.

Tuesday 28 Hargreaves works on final report.

Wednesday 29 Hargreaves works on final report.

Thursday 30 Debriefing and submission of report.