PD-BAC-452 42
ISN 47592

UNCLASSIFIED

UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D. C. 20523

HONDURAS

PROJECT PAPER

IRRIGATION DEVELOPMENT

AID/LAC/P-334

Loan Number: 522-T-053
Project Number: 522-0268

UNCLASSIFIED

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Amendment Number: ____

DOCUMENT CODE: 3

2. COUNTRY/ENTITY: Honduras

3. PROJECT NUMBER: 522-0268 — 522-T-053

4. BUREAU/OFFICE: LAC — 05

5. PROJECT TITLE (maximum 40 characters): Irrigation Development

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09 DD 30 YY 93

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)
A. Initial FY 86 B. Quarter 4 C. Final FY 93

8. COSTS ($000 OR EQUIVALENT $1 = L2)

A. FUNDING SOURCE	FIRST FY 86 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	1145	315	1460	5,345	17,155	22,500
(Grant)	(960)	(205)	(1165)	(3,040)	(4,960)	(8,000)
(Loan)	(185)	(110)	(295)	(2,305)	(12,195)	(14,500)
Other U.S. 1.						
Other U.S. 2.						
Host Country	150	400	550	8,730	1,750	10,480
Other Donor(s)						
TOTALS	1,295	715	2,010	14,075	18,905	32,980

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) ARDN	210	050	064	–	–	1000	2500	8,000	14,500
(2)				–	–				
(3)									
(4)									
TOTALS						1000	2500	8,000	14,500

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 010 | 022 | 032 | 070

11. SECONDARY PURPOSE CODE: 280

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)
A. Code: BF
B. Amount:

13. PROJECT PURPOSE (maximum 480 characters)

To improve farmer productivity and production through the installation of irrigation systems and the provision of related improved agricultural practices.

14. SCHEDULED EVALUATIONS
Interim MM 07 YY 88 | MM 10 YY 90 | Final MM 05 YY 93

15. SOURCE/ORIGIN OF GOODS AND SERVICES
☒ 000 ☒ 941 ☒ Local ☐ Other (Specify) ____

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment)

N/A

17. APPROVED BY
Signature: Carl H. Leonard
Title: (A) Mission Director
Date Signed: MM 09 DD 19 YY 86

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION
MM DD YY

PROJECT AUTHORIZATION

NAME OF COUNTRY: Republic of Honduras

NAME OF PROJECT: Irrigation Development

NUMBER OF PROJECT: 522-0268

NUMBER OF LOAN: 522-T-053

1. Pursuant to Section 103 and Section 531 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Irrigation Development Project for the Republic of Honduras (the Cooperating Country) involving planned obligations of not to exceed $14,500,000 in Loan funds and $8,000,000 in Grant funds over a five-year period from date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing foreign exchange and local currency costs for the Project. The planned life of the project is seven years from the date of initial obligation.

2. The project's goal is to enhance the earning potential of Honduran farmers. The project will improve farmer productivity and production by providing irrigation technology and on-farm technical assistance related to improved agricultural practices.

3. The Project Agreement, which may be negotiated and executed by the Officer to whom such authority is delegated in accordance with A.I.D. regulations and delegations of authority, shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

   a. Interest Rate and Terms of Repayment

      The Cooperating Country shall repay the Loan to A.I.D. in US Dollars within forty (40) years from the date of the first disbursement of the Loan, including a grace period of not to exceed ten (10) years. The Cooperating Country shall pay to A.I.D. in US Dollars interest from the date of first disbursement of the Loan at the rate of (a) two percent (2%) per annum during the first ten (10) years, and (b) three percent (3%) per annum thereafter, on the outstanding disbursed balance of the Loan and on any due and unpaid interest accrued thereon.

   b. Source and Origin of Goods and Services (Loan)

      Goods and services, except for ocean shipping, financed by A.I.D. under the Project shall have their source and origin in the countries which are members of the Central American Common Market

V

and in countries included in A.I.D. Geographic Code 941 except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the Project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States, other countries included in Code 941, or countries that are members of the Central American Common Market.

c. Source and Origin of Goods and Services (Grant)

Goods and Services, except for ocean shipping, financed by A.I.D. under the grant shall have their source and origin in the United States and in the countries of the Central Common Market except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the Project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States.

4. Conditions Precedent and Covenants

a. Conditions Precedent

Prior to any disbursement, or the issuance of documentation pursuant to which disbursement will be made, except for technical assistance, including the Project Officer and the Technical Assistance Unit, the Borrower/Grantee shall, except as the Parties may otherwise agree in writing, furnish to A.I.D., in form and substance satisfactory to A.I.D.:

i. a document describing specific criteria to be used in the selection of irrigation infrastructure subprojects, including technical, economic/financial, social, and environmental aspects.

ii. an environmental review document which sets forth agreed procedures for determining positive or negative environmental impact of irrigation works.

iii. evidence that the Irrigation Financing Facility (IFF) has been established by the Central Bank and is operational.

b. Special Covenants

The Cooperating Country covenants to:

i. review, revise and submit to the National Congress a National Water Law, acceptable to the Parties, within eighteen months of the signing of this Agreement. Regulations of the Water Law will be drafted and issued by the Executive Branch no later than one year after Congress has approved the Water Law.

ii. develop a National Irrigation Plan within twenty-four months of the signing of this Agreement. The plan will serve as a blueprint for all irrigation programs in Honduras. The GOH and A.I.D. will conduct periodic reviews of the progress made towards achieving this covenant.

September 19, 1986

TABLE OF CONTENTS

		PAGE NO.
I.	**SUMMARY AND RECOMMENDATIONS**	
	A. Summary	1
	B. Recommendation	2
	C. PP Development Team	3
II.	**PROJECT RATIONALE/BACKGROUND DESCRIPTION**	
	A. Macroeconomic Status	3
	B. Social Indicators of Poverty	4
	C. Relationship to USAID Country Strategy	5
	D. Conformity with A.I.D. Policy	6
	E. Other Donor and Host Country Activity	6
	F. Impact of Small-Scale Irrigation	8
III.	**PROJECT DESCRIPTION**	
	A. The Problem	8
	1. Physical Resources	8
	2. Honduran Water Law	9
	3. Problem Summary	10
	B. Project Goal and Purpose	11
	C. General Project Strategy	11
	D. Project Components	12
	1. Irrigation System Construction	13
	a. System Definition	13
	b. Types of Systems	13
	i. Micro Irrigation Systems	13
	ii. Small Irrigation Systems	14
	iii. Medium Irrigation Systems	15
	iv. Drainage and Flood Control Works	16
	v. Rehabilitation	16
	c. Construction Execution	19
	d. Construction Contracting	23
	e. Systems Maintenance	24
	2. On-Farm Water Management	25
	3. Credit	26
	a. Credit Constraints	26
	b. Credit Strategy	26
	c. Trust Accounts	27
	i. Commercial Banks	27
	ii. Agricultural Development Banks	27
	d. Production Loans	28

6

PAGE NO.

e. Credit Application Process 30
i. Investment Credit 30
ii. Short-term Production Credit 30
f. Demand for Financial Resources 31

4. Institutional Development 35
a. Institutional Constraints 35
b. Strategies to Overcome Constraints 36
c. Directorate of Water Resources 40
d. Private Sector Institutions 41
e. Farmer Associations - Private Agroindustrial Firms 43
f. Water User Groups 44

E. Linkage to other AID Projects 44

F. Project Outputs - Verifiable Indicators 45

G. Project Inputs - Financial Plan 46
1. Flow of Funds to Implementing Agencies 46
a. A.I.D. Funds 46
i. Grant 46
ii. Loan 47
b. Host Country Contribution 48
i. In-kind 48
ii. Financial 48
2. Methods of Implementation and Financing 49

IV. PROJECT ANALYSES
A. Administrative Analysis 54
1. Directorate of Water Resources 54
a. Legal Status and Objectives 54
b. General Organization and Personnel 54
c. Capacity to Carry Out Project 54
2. The Honduran Central Bank 57
a. Legal Status and Objectives 57
b. Capability to Carry Out Project Responsibilities 57

B. Social Analysis 57
1. Types of Farmers Expected to Participate in the Project 57
2. Socio-Cultural Feasibility 58
a. Land Ceiling in Irrigation Districts 58
b. Land Tenancy 59
c. Farmer Entrepreneurship and Efficiency 60

6

PAGE NO.

d. Farmer Committment to Water User Group Obligations 61
3. Anticipated Project Benefits to Women 63

C. Economic Analysis 63
1. Introduction 63
2. Financial Analysis 65
3. Cost Recovery 66
4. Contribution to Jackson Plan Objectives 67
5. Contribution to USAID/Honduras Action Plan Objectives 67
6. Revised Economic Internal Rate of Return (EIRR) 68

D. Environmental Considerations 68
1. Introduction 68
2. Environmental Backdrop 69
3. Environmental Review Process 70
4. Environmental Review Document and its Use 71

E. Technical Analysis 71
1. Land Use Capability 71
2. Irrigation Technology 72
3. On-Farm Water Management 72

V. **PROJECT IMPLEMENTATION ARRANGEMENTS**
A. Administrative Arrangement 73
1. Role and Responsibilities of USAID 73
2. Role of the Directorate of Host Country 74
a. Directorate of Water Resources 74
b. Water User Groups 74
c. Central Bank of Honduras 75
3. Role and Responsibility of the Irrigation Advisory Group 75

B. Implementation Period 75

C. Implementation Plan 75

D. Evaluation Plan 82
1. General 82
2. Responsibilities 83
3. Data requirements 83
a. Survey Data 83
b. Project Data 83

7

E. Energy Requirements for Irrigation 84

ANNEXES

A. Logical Framework
B. 611(e) Certification
C. Application Letter
D. PID Guidance Cable
E. Statuatory Check List
F. Economic Analysis
G. IEE Checklist/Environmental Analysis
H. Draft Methodology for Energy Requirements

8

LIST OF ACRONYMS

1.	BANADESA	National Agricultural Development Bank
2.	CBH	Central Bank of Honduras
3.	CIDA	Canadian International Development Agency
4.	COHDEFOR	National Forestry Corporation
5.	DRH	Directorate of Water Resources
6.	EIIR	Economic Internal Rate of Return
7.	ERD	Environment Review Document
8.	FACACH	Federation of Savings and Credit Cooperative Associations
9.	FAO	Food and Agricultural Development
10.	FEPROEXAH	Federation of Agricultural Export Producers
11.	GDP	Gross Domestic Product
12.	GOH	Government of Honduras
13.	IAD	Integrated Agricultural Development
14.	IAG	Irrigation Advisory Group
15.	IBRD	The World Bank
16.	IDB	Interamerican Development Bank
17.	IEE	Initial Environment Examination
18.	IFF	Irrigation Financial Fund
19.	INA	National Agrarian Instute
20.	JICA	Japanesse International Cooperation Agency
21.	MNR	Ministry of Natural Resources
22.	MOE	Ministry of Economy
23.	ODA	British Overseas Development Administration
24.	RFTP	Request for Technical Proposal
25.	SANAA	National Water and Sanitation Authority
26.	SECOPT	Ministry of Communication and Transportation
27.	UNDP	United Nations Development Program
28.	UNIOCOOP	Union of Cooperatives
29.	WUG	Water User Group

LIST OF FIGURES

1. Examples of Irrigation Projects Previously Financed by USAID/Honduras
2. Map of Irrigation Regions
3. Phase-in Schedule of Systems
4. Irrigation Approval and Loan Process
5. Illustrative Interest Rate Distribution for Short-term Production Credit
6. Scenarios for Four Prototype Farm Units showing Total Gross Costs with and without Project
7. Credit Financial Plan
8. Credit Financial Balance
9. Credit Financial Needs
10. Organizational Matrix
11. Organizational Flow
12. SIPU Organizational Chart
13. Field Office Staffing
14. Irrigation Advisory Group
15. Methods of Implementation and Financing
16. Summary Cost Estimates
17. Summary Disbursement Schedule
18. Ministry of Natural Resources Organizational Chart
19. Economic and Financial Internal Rates of Return

I. Summary and Recommendations

A. Summary

The purpose of the project is to enhance the productivity and production levels of small and medium scale farmers through by providing of irrigation technology. Achievement of the purpose will contribute to increased farmer income and accelerate agricultural diversification for exports.

The project will consist of four integrally related components: construction and rehabilitation of irrigation systems; on-farm water management extension; strengthening of the Honduran institutional capability to plan and execute irrigation investments on a country-wide basis; and credit for infrastructure investment and production. The construction component will offer combinations of technologies (e.g., gravity flow distribution, PVC pipe networks, pump driven sprinklers, drip systems) for different types of irrigation networks. The choice of the technology will be a function of the size and physical make-up of the site, and a farm production plan. In general, simple, relatively inexpensive techniques, such as gravity flow earthen trenches, and polyvinylchloride (PVC) tubes will be used on the small systems where farmers have not had previous experience with irrigation while the larger networks will require more sophisticated irrigation technologies. It is anticipated between 6,000 to 7,000 hectares will be brought under irrigation over the project's seven year life.

The on-farm water management component will assist farmers to adapt new cropping patterns and modern agricultural inputs to take full advantage of the irrigation infrastructure. This assistance will consist of regular on-site consultations with benficiaries as well as group and individual training. It will be furnished by a private sector project advisory group, and will employ of paraprofessional extensionists to assist with technology diffusion.

The institutional building component will provide technical assistance, training and commodity inputs to the Ministry of Natural Resources, Water Resources Directorate (DRH) to improve the institution's managerial capacity of irrigation development. In addition, it will assist the Government of Honduras to formulate a comprehensive, national irrigation plan and a new water law and implementing regulations, to guide the rational utilization of water resources. The training will serve to upgrade the managerial and technical skills of public sector officials and private sector professionals involved with water resource development. The commodities will furnish the implementing units with the materials required to effectively carry out their tasks.

Project implementation will be the responsibility of the Directorate of Water Resources of the Ministry of Natural Resources, however, there will be a private sector technical assistance team, the Irrigation Advisory Group (IAG) which will assist the DRH to implement project activities. The IAG will assist the DRH central and field offices in promoting the project, preparating subproject feasibility studies, developing subproject irrigation systems proposals and providing

on-farm technical assistance. Most of the irrigation system construction activity will be carried out by private Honduran construction firms, which will be contracted by the DRH contract. In some special cases (e.g. micro-systems that are too isolated or too small to be finacially feasible for private sector construction), DRH will build the systems. The DRH and the IAG will work closely with existing private sector intermediaries to identify subprojects and enlist beneficiary participation. Water user groups will be created to facilitate subproject design, implementation and financing.

Credit provided through the project will enable beneficiaries to finance the construction of the irrigation networks and underwrite the costs of the production inputs needed to take full advantage of the infrastructure. The credit will be channeled through participating commercial banks under a trust arrangement. These banks, in turn, will lend directly to individual growers. The banks will be responsible for recovering loans made.

The project will directly benefit approximately 3,000 farm families yielding an estimated 18,000 beneficiaries. The majority of these beneficiaries are characterized by meager per capita incomes, low educational levels, poor living conditions and unbalanced diets. They will receive the benefits of increased incomes that will be derived from greater crop production yields generated by the irrigation systems and related technical assistance furnished by the project.

The project will last seven years. The total project cost is estimated at $ 32.98 million. The AID contribution will be $22.5 million: $14.5 million in loan funds and $8.0 million in grant funds. AID resources will be complemented by a $ 10.48 million GOH contribution. The counterpart contribution will be divided between $ 8.73 million borne on a financial basis and subject to the availability of ESF local currency generations, and the $ 1.75 million borne on an in-kind basis.

B. Recommendations

The proposed project is a key component of the USAID/Honduras agricultural sector's objectives of increasing agricultural production by $ 400 million by 1990, and increasing the income and standard of living of rural dwellers. It is designed to contribute directly to the attainment of the Central American Initiative goals. Conservative estimates indicate that irrigation and related production inputs can increase yields by 50-80 percent yearly, and that the production increases directly translate into greater income for farmers. The project also conforms to AID Policies on Food and Agriculture, Private Sector, Natural Resources, Credit, Institutional Development, and Installation of Rural Infrastructure. It is the opinion of the Project Development Committee that the project has sound technical, financial and economic bases, gives the appropriate consideration to social and environment issues, incorporates viable management mechanisms and can be successfully implemented. Accordingly, the USAID/Honduras Project Design Committee recommends that the PP be approved.

12

C. PP Development Team

1. The USAID/Honduras PP Development Team was composed of:

William G. Kaschak	Chief, Development Finance Office
Richard Owens	Office of Rural Development
Ernesto Bondy	Office of Rural Development
Gordon Straub	Office of Rural Development
Roberto Aguero	Office of Engineering
Guillermo Fú Peñalba	Office of Controller
Walter Gómez	Office of Economic Program Analysis
Orlando Hernández	Office of Development Programs

2. The following Honduran officials participated in the development and review of the PP:

Mario Maresma	Director, Water Resources Directorate
Roberto Rivera Lanza	Department Director, Water Resources Directorate
Jaime Lanza	Director, Planning Division of the Directorate of Water Resources
Cesar Carranza	Director, Office of Public Credit, Ministry of Finance

3. The PP was reviewed in the Mission by:

Carl H. Leonard	Deputy Mission Director
Richard Peters	Chief, Office of Rural Development
Phillip Amos	Mission Controller
Betty Facey	Chief, Office of Engineering
John Miller	Program Officer

4. The PP was approved by:

Anthony J. Cauterucci	Mission Director

II. Project Rationale/Background Description

A. Macroeconomic Status

Honduras is, by almost every economic measurement, one of the poorest countries in Latin America and exhibits a macroeconomic status that is extremently tenuous. In 1984 the per capita income was estimated at $776. After a number of years of negative growth rate from the mid-1970's thru the early 1980's, the Gross Domestic Product (GDP) showed a positive, but weak increase of 2.5 percent in 1984 and 3.0 percent in 1984.

The 1984-1985 period witnessed a limited improvement in the position of fiscal and balance of payments current account deficits and a limited improvement in the economy's external performance (e.g., in 1985 exports grew by a respectable 10.8 percent while imports grew by 8.3 percent). However, the limited nature of this progress must be emphasized. Real private sector

capital formation remains exceptionally weak, as indicated by the fact that real private sector capital formation in 1985 reached only 62 percent of the level realized in 1981. Growth in public sector expenditures on both current and capital accounts, which partly offset the decline in private sector investment, was accompanied by sharp growth in the fiscal deficit of the consolidated nonfinancial public sector, both in absolute terms and as a percentage of GDP. The continued growth of deficits of this magnitude would require a constraint of credit to the private sector. It would also necessitate maintenance of real interest rates at exceptionally high levels to contain overall credit demand limits consistent with the real resources available to the economy and to hold inflation to the favorable levels registered in the recent past.

With regard to external performance, in spite of the increased growth rate of exports over imports in 1985, the return to positive GDP growth rates in the 1984-1985 period was associated with a widening of the trade gap of imports over exports. The current account deficit in the balance of payments averaged over 11 percent of GDP in 1985. Financing these deficits has been accompanied by an accumulation of external debt, as well as growing averages in principal payments on government guaranteed external debt of the private sector. Between 1983 and 1985, total external debt rose by 28 percent, averages on publicly guaranteed external debt rose by 70 percent and the net international reserves fell by 34 percent to a level of - $112.5 million. Seriously affected by this unstable economic picture are the 2.6 million (60 percent of the entire population) poverty stricken Hondurans, the majority of whom are peasant farmers or farm laborers. It is estimated that in 1985 more than 80 percent of the peasants and farm laborers had earnings below the calculated economic poverty line income of $230.

B. Social Indicators of Poverty

The country's poverty is reflected in all of the key social indicators associated with underdevelopment. With respect to education, Honduras is plagued by an extremely weak human resource base. Available data indicate that 40 percent of the population has never attended school and is completely illiterate. Only 27 percent of the population over age 10 has completed the fourth grade, and less than 17 percent has finished the sixth grade. Levels of literacy and educational attainment are even lower in the rural areas. Moreover, the efficiency and quality of primary education are extremely poor. Only 28 percent of the children entering primary school are able to complete the sixth grade, although an estimated 85 percent of children of elementary school age have access to school.

The situation is similar in the health sector where generally poor health continues to limit the productivity, earning power and quality of life for Hondurans. Malnutrition, particularly protein deficiency, affects 70 percent of the population. Diarrhea, followed closely by respiratory and vector borne diseases (especially malaria), are the principal causes of morbidity and mortality among all age groups. In combination, these and other factors contribute to a comparatively high infant mortality rate (77 per 1,000 live births compared to 55 per 1,000 live births in Mexico) and a life expectancy of only 55 years.

With respect to agriculture, it is illustrative that 95 percent of the approximately 225,000 productive units in the country are operated under one of the various forms of small-scale peasant farming. The vast majority of these small farmers concentrate on basic grain cultivation. Production is used, primarily, to meet household subsistence needs, with only a minor portion of total output designated for market sale. The prevalent technology is dominated by traditional cultural practices with limited use of modern inputs. Access to the factors of production (i.e., land, machinery, pesticides and fertilizers, credit and technical assistance) that could increase output is curtailed by a variety of social and economic impediments. It is not uncommon to find farm families with yearly per capita incomes under $100.

C. Relationship to USAID Country Strategy

The USAID country development strategy is designed to support Honduras' development objectives. In the short-term, the Mission's goals are to bring about needed structural adjustments in the economy without setting off a destabilizing inflationary spiral; restore economic equilibrium; develop a policy base for achieving sustained economic growth; reduce current and potential social tension stemming from high unemployment levels; and meet basic human needs. Over the medium-term, the strategy emphasizes enhanced private sector investment, especially in exports, to achieve sustainable economic recovery. It also underscores bringing about a broader participation in the benefits of growth by assisting the country's poor through the strengthening of public and private services to better meet basic human needs.

The Mission's strategy for bringing about the broader participation in the benefits of growth (i.e., improving the living standards of the Honduran poor) consists of a multifaceted program to address a linked series of sectoral specific problems. As stated in Mission's FY 88 Action Plan, the key objective for the agricultural sector is to increase production by $400 million by 1990. The objective is base the assumption that: (1) Agrarian Reform Programs continue in a consistent and predictable manner; (2) the banana industry continue its current level of operation; (3) international coffee prices remain at reasonable prices; (4) capital flight from the agricultural sector to urban centers and abroad is reduced; and (5) private investment in agriculture is increased.

Progress toward attaining this objective has been made with the current USAID/Honduras agricultural portfolio. For example, the Export Promotion and Services Project (522-0207) is assisting with the development of foreign markets for agricultural commodities, while the Agricultural Research Foundation Project (522-0249) is developing the basis for new technology development. The Land Titling Project (522-0173) is providing growers with secure access to cultivable land. The Small Farmer Coffee Project (522-0176) effort is contributing to the production and marketing of an important foreign exchange commodity. The Rural Technologies Project (522-0157) is developing improved farming equipment and practices. Finally, the Small Farmer Organization Strengthening Project (522-0252) is assisting in the development of viable mechanisms for channeling productive inputs (e.g., credit, fertilizers, technical assistance) to improve grower productivity.

The Irrigation Development Project is an integral part of the USAID/Honduras agricultural development strategy. By providing irrigation systems and on-farm technical assistance, the Project will be improving and securing farmers' chances to increase their production and productivity, which, in turn, will translate into improvements in income. In so doing, this Project contributes directly to achieving the Mission's agricultural sector goal of increasing production by $ 400 million by 1990.

D. Conformity with AID Policy

The proposed project supports the Central American Initiative (CAI) recommendations on increasing agricultural production and non-traditional exports and the AID Policies on Food and Agriculture, Private Sector, Institution Building, Credit and the Development of Democratic Institutions.

As recommended by the CAI and the AID Policies on Food and Agriculture, the project will increase food availability by intensifying production and enhancing productivity. Moreover, providing irrigation systems will alleviate one of the major constraints to expanding production of export commodities. In consonance with AID Private Enterprise Policy, the project will foster the growth of the Honduran construction/engineering industry by financing their participation in the design and construction of irrigation systems. In addition, it will represent a first step toward developing a private sector extension service. In agreement with the Agency's Institution Building Policy, the project will upgrade the administrative and technical capabilities of the Water Resources Directorate of the Ministry of Natural Resources, thereby contributing to an improved GOH capacity to carry out irrigation efforts over the long-term. In line with the Agency policy on credit, this effort will support market interest rates for both medium-term investment and short-term production financing. Finally, the project focuses on cooperatives, producers associations and water user groups to further the development of grass roots democratic institutions.

E. Other Donor and Host Country Activity

Numerous International development organizations are currently financing, or are considering financing, activities in the agricultural sector related to irrigation. The Interamerican Development Bank (IDB) is considering the possibility of financing a project to rehabilitate and expand the El Coyolar Dam and two associated irrigation districts covering approximately 800 hectares in the Comayagua Valley, 82 kilometers north of the capital city of Tegucigalpa. The IDB's position on this project is not firm. If the Bank decides not to go forward, consideration will be given to amending this project at some point in the future to include the Coyolar drainage area.

The World Bank (IBRD) may fund a second phase of its Guayape Valley Project in the Department of Olancho, located in the east central part of the country. The first phase of the Project was essentially an Integrated Agricultural Development (IAD) initiative, that included penetration roads, credit for infrastructure and production, technical assistance, extension and irrigation. The proposed second phase project, if approved for financing, will follow the same IAD approach.

The Japanese International Cooperation Agency (JICA) has financed several small projects, involving the rehabilitation of irrigation projects for agrarian reform beneficiaries. Currently, the Japanese, in conjuction with the GOH, are in the final design stage of a large project focussed in southern Honduras. This project, which has an estimated cost in excess of $150 million, propose to construct a large dam (approximately a 100 meter structure on the Choluteca River) to irrigate as much as 20,000 hectares in the country's southern region. Dam construction would begin in 1987, however, irrigation systems will not be available under the project until sometime after 1990.

The United Nations Development Program (UNDP) and the Food and Agriculture Organization (FAO) are currently implementing in collaboration with the Ministry of Natural Resources (MNR) and the Directorate of Water Resources (DRH), a PL480 Title I/III local currency - supported irrigation development activity. This activity is financing credit for both irrigation and production, as well as technical assistance in farm water management, diversified crop production and marketing. This activity will conclude in 1987 and there is no Mission intention to apply additional PL480 local currency financing nor to extend the project beyond the current PACD.

USAID financed efforts in irrigation have included pilot-type appropriate technology activities under the Rural Technologies Project (522-0157) and the construction of 12 irrigation projects covering approximately 430 farm families under the recently terminated Agricultural Sector II Program (522-0150). The Rural Technologies Project has concentrated on small simple technology systems. As of the end of 1985, this project financed the construction of almost 400 sistems, all of which are less than one hectare in size. Most of the networks are gravity flow arrangements which use earthen canals or pipe to transport water from temporary dams to the crop areas. The cost of these systems ranges from $375 to $562. A recent evaluation of the project revealed that the growers had diversified production (moving from strict reliance on basic grains to a production regime which combines basic grains with vegetables) and their incomes have increased by an average of $350 per year. The Agricultural Sector II Program constructed simple and medium technology systems. The results have been generally positive, achieving production increases of as high as 50 percent in some cases. The Mission also financed the importation and installation of two high-tech drip irrigation systems in conjuction with a private Israeli firm. These systems are being used by two USAID supported Model Regional Cooperatives for production of high value export crops to the United States. The systems have contributed directly to recorded yield increases of more than 100 percent.

Also, beginning in the fall of 1986, USAID and an Israeli counterpart, will initiate a joint irrigation research effort in the Choluteca region of southern Honduras. This activity will test and adopt high-tech irrigation systems for use by small and medium producers involved in crop diversification for export.

Except for the Japanese financed initiative, which as mentioned previously will not be in full implementation for several years, the activities of other donors are relatively small and isolated. As will be discussed below, the

need for irrigation infrastructure and related institutional strengthening, in the country is enormous.

This project will capitalize on progress made and lessons learn from previous or ongoing USAID and international donor funded activities. Not only will the project provide funding for the construction of systems to irrigate between 6,000 and 7,000 hectares, but it will also establish the institutional base, in both the public and private sectors, required for Honduras to effectively use other donor funding as it becomes available in the future.

F. Impact of Small-Scale Irrigation

Small scale irrigation systems are very attractive to both developing country governments and small farmers. They offer the possibility of rapid implementation, development of new water and soil resources, increased and visible use of state funds in rural areas and potential benefits for small and marginal farmers.

Small scale irrigation systems help develop institutional capacity and experience in irrigation. The experience gained by comprehensive use of physical, technical, human, and financial resources required to plan, design and construct small scale irrigation systems forms the basis on which institutions can develop and execute larger scale irrigation project.

The local impact of small irrigation systems results from the use of a technology which encourages crop diversification, increased productivity and product quality, improved supply of local foodstuffs and the general impact resulting from employment generation in the affected area.

III. Project Description

A. The Problem

1. Physical Resources

Honduras has a total land area of just over 11,000,000 hectares of which about 2,750,000 hectares (25 percent) have soil and topographical characteristics that are suitable for agriculture. The best soils for intensive agricultural use are located on the coastal plains and river valleys of the north and south coasts (i.e., Nacaome and Choluteca in the south; Guayape, Patuca and Aguan in the central and northeast; and Sula and Lean in the north) and in the interior valleys of Zamorano and Comayagua. In comparing potential with actual land use, only about one-third of the land classified as adequate for annual crops is used in this manner.

Approximately 10 percent (1.1 million hectares) of the total land area is classified as valley land suitable for intensive cultivation, of which only about 650,000 hectares are currently under such production system. Research data indicate that about 40 percent (400,000 hectares) of the valley land can be adopted rapidly to irrigated agriculture. Currently however, only 54,000 hectares of this valley land, is under irrigation. Moreover, approximately 67 percent of the land presently under irrigation is controlled by the large holdings of the banana and sugar industries.

In addition to land, Honduras possesses a second important irrigation variable -- an abundant number of rivers. The major river networks and their associated watersheds include: the Chamelecôn, Ulúa-Humuya-Sulaco, Litoral Atlântico and Aguan systems in the northwest, Atlantic Coast and north-central region; the Sico-Paulaya-Plâtano and Guayape-Patuca system in the east-central and eastern regions; and the Choluteca, Nacaome, Goascorân and Lempa systems in the central, southern and southwestern regions. Each of these major networks is composed of numerous smaller systems and all offer potential for expanding surface water irrigation coverage.

Even though the supply of surface water is ample for the country as a whole, its distribution is not uniform. The combination of long dry seasons and irregular rainfall patterns in many parts of the country results in substantial seasonal variations of streamflow requiring careful crop scheduling and good management to insure harvest. Many of the regions with the highest population density and demand for irrigation water are located in zones with lower water yields (i.e., Comayagua, Zamorano, Choluteca and Nacaome). During the dry season, rivers in these regions have very little or no flow. The current dearth of irrigation infrastructure inhibits both the maximum use of a scarce water resource during the dry season, and the capture and storage of excess water during the rainy season for use during dry periods.

The possibilities for developing groundwater sources for irrigation are much less well defined than are those for surface water. While the data base on the quality and quantity of groundwater is sparse, the limited information that is available suggests that the prospects for this water resource making a significant contribution to irrigated agricultural are not bright. The GOH, in collaboration with Canadian International Development Agency (CIDA) and the British Overseas Development Administration (ODA), has attempted to develop groundwater for irrigation in two regions of Honduras. The ODA retired from this field in favor of an effort to promote groundwater for urban consumption in Tegucigalpa. The data yielded by these initiatives suggest that the presence of soft volcanic materials produced sediments too fine to form good groundwater aquifers. If any significant and productive aquifors exist in the agricultural valleys of Honduras, they have apparently not yet been discovered. As of this writing, there are no GOH nor other donor plans for ground water exploration and development for irrigation.

2. Honduran Water Law

In the United States, the legal basis for surface water use is complex. The federal government controls or owns most natural streams and lakes. Ownership rights to water use vary among geographic areas. For example, in the eastern United States and some parts of the west, the concept of "riparian rights" gives landowners the right to "ordinary" use of natural water adjacent to, or flowing through, their property. Unfortunately, the term "ordinary" is debatable, especially when supplies are limited and demand high. In most of the west, direct water-use rights have developed whereby landowners can legally claim a specified measured flow from a stream, whether or not the stream enters their property. Owners with a "first water right" can claim their share first, and those with a secondary right take their's next.

In Honduras, regulation of surface water use rights is confused and is governed by a plethora of often conflicting legislative actions and codes. A review of the literature indicates that some 25 different laws affect water resources use. Of these, the more important are: (1) the Civil Code which establishes that "the things which nature has made common to all men are not susceptible to domain," and "the rivers and all waters which flow through natural channels are national property for public use"; (2) the Law for the Utilization of National Waters, which was issued in 1927 assigns certain dominion of water to individual owners; and (3) the Agrarian Reform Law which establishes that infrastructure projects in excess of 100 hectares carry with them an immediate claim for land ownership and control of water resources. Taken in its totality, this body of legislation is not consistent and serves only to generate "use rights" debates and to frustrate investment in irrigation infrastructure.

Present irrigation systems have been constructed and used in an arbitrary and desultory manner. Honduras' large untapped potential for establishing an irrigated agricultural base must be developed in a manner congruent with the special geographic and financial characteristics of the country. Accordingly, a key basis for maintaining the long-term benefits of the project will be the approbation and implementation of a comprehensive water law.

To maintain project benefits and sustain rational development of irrigation, the law should incorporate regulations which: 1) assure a stable institutional coordination distinguished by well defined GOH agency jurisdiction on both the national and regional level; 2) establish sufficient guaranties and incentives for investment in irrigation infrastructure and; 3) assure water user participation at both the planning and implementation level.

3. Problem Summary

Agriculture is and will continue to be the most important sector of the Honduran economy. At present, it directly contributes over 30 percent of the GDP and is responsible, indirectly, for an additional 20 percent through the relationships of food commodities to industry and manufacturing. The sector contributes two-thirds of foreign exchange due to exports and employs over 60 percent of the country's economically active population.

While the agricultural sector has the human and physical resource base to generate sufficient food to satisfy both domestic demand and provide a surplus for export, increase small farmer income and contribute significantly to the growth of the economy as a whole, a series of deficiencies severely constrain realization of its potential. Critical among the impediments is a severe underdevelopment of the country's irrigation potential, as measured by its land and water resources. This potential can only be realized through the construction of irrigation infrastructure, provision of the accompanying technical assistance to producers in on-farm water management to facilitate full use of the infrastructure, and the enactment of a rational water law to guide the effective use of this natural resource.

Legislation has been proposed in the form of a 1979 Draft Water Law which was never submitted to Congress because of its controversial nature, and a revised draft which is being considered for Congressional submission now. The 1979 version had numerous problems, most notably in the area of providing private irrigators with sufficient protection under the law to make irrigation investments acceptable. The revised version of the draft law makes an effort to furnish investors with the needed safe guards. In addition, it makes a serious attempt at delineating interagency responsibilities in a logical way.

The Mission, in collaboration with the Directorate of Water Resources (DRH) and other GOH and public sector entities, convened a three-day workshop on water policy in Honduras during the last week of September, 1985. Follow through on these proceedings has continued and a revised water law has been drafted, as noted above. This law must be reviewed, revised and submitted to the Honduran Congress within eighteen months of the signing of this Project Agreement. Furthermore, regulations of this law hove to be issued no later than one year after the law has been approved by the National Congress. A special Covenant will be included in the Project Agreement to assure that the water law is drafted and submitted to the Honduran Congress in a time frame that is consistent with the implementation of this project and is responsive to the country's immediate need for a rational development of its water resources.

B. Project Goal and Purpose

The project's goal is to enhance the earning potential of Honduran farmers and contribute to the AID target of an increase in agricultural production of $400 million by 1990. According to the FY 88 Action Plan, this Irrigation Development project will contribute about $ 20 million to the $ 400 million target. The project's purpose is to improve farmer productivity and production by installating irrigation systems and providing on-farm water management extension to improve agricultural practices. These innovations will support the joint USAID/GOH effort to diversify production thereby raising the levels of domestic food supplies and agricultural exports.

The goal and purpose are linked by a series of assumptions. The most critical of these is a continuation of political stability to permit sustainable economic growth. Important ancillary assumptions include further cooperation between the Honduran public and private sectors in developing the agricultural sectors, and beneficiary receptivity to irrigation technology. Indicators of purpose achievement will include: (1) a doubling of on-farm productivity among participating farms; (2) a minimum 15 percent increase in participating real farmer income; and (3) a minumum of 6,000 - 7,000 additional hectares under irrigation.

C. General Project Strategy

To fullfill the project purpose, the project will use a market demand-pull strategy. It is reasoned that providing irrigation infrastructure, credit and on-farm technical assistance will stimulate increased production and productivity and enhanced market participation which, in turn, will result in

improved incomes and standards of living for project beneficiaries. Further, it is anticipated that increased market transactions will trigger secondary demand cycles. For example, greater production levels brought about by this project will heighten the demand for modern agriculture inputs such as chemical fertilizers, improved seed varieties and better plant stock. It will also increase the demand for quality technical assistance in the form of skilled researchers and extensionists to guide the application of the new technologies. In addition, productivity and production increases will raise the demand for access to credit to expand farming activities and further enhance output. Finally, the synergism of these factors will bring higher levels of income and heightened expectations to project participants raising the demand for consumer goods and the availability of basic social services. Within this overriding demand pull approach, the project will be implemented on a measured growth basis. The application of project inputs will be phased and the number of systems constructed, the amount of credit made available and the level of on-farm technical assistance will be progressively increased during the life of the project. Throughout, expansion will proceed only after preceeding experiences have been analyzed and project activities readjusted according to the result of those experiences.

Initial project activities will focus on providing technical assistance to carry out project tasks which will have national ramifications. These activities will include revising and submitting the water law to the National Congress, developing a national irrigation plan, refinement of existing DRH standards and norms for irrigation system construction, establishing guidelines for subproject feasibility studies, and developing a project promotion campaign. However, to achieve a rapid impact, a number of DRH "shelf" irrigation projects will be reviewed and constructed simultaneous with the design of the above mentioned initial tasks.

These shelf projects will be subject to the same criteria and review process that will be applied to the other systems constructed under this project (see Section III.D.1. Once the initial activities are completed, the project will concentrate on the construction and production functions of irrigated agriculture. Moreover, these activities will be applied in an increasingly intense fashion to bring about an expansion of irrigation throughout the country in an way that can be rationally managed and sustained.

D. Project Components

The project will consist of four integrated components: a) construction and rehabilitation of irrigation systems; b) the provision of on-farm water management technical assistance; c) credit resources for infrastructure and production; and d) development of the institutional capacity to plan and execute irrigation programs.

These four components will be linked by a National Irrigation Plan, which will be developed by the DRH with technical assistance from the project. The National Irrigation Plan will provide the framework and strategy for the rational use of natural, technical, human and financial resources in developing irrigation programs in Honduras. The Plan will thereby serve as a

22

basis for prioritizing and directing Project construction and extension activities. The Plan will be comprised of regional irrigation plans developed in the field, and will itself be a part of the Water Resources Management Master Plan, currently being developed by the DRH.

1. Irrigation System Construction and Rehabilitation

a. System Definition

For the purposes of this project, an irrigation system is defined as any process (other than natural precipitation) which provides water for cultivated plants. An irrigation system consists of four components - source, delivery, application and disposal. To have a technically sound system, all components must be designed so that they are mutually reinforcing and each one must be compatible with the particular physical, economic and social conditions which govern its use.

The irrigation technologies that will be financed under the project will vary according to system size, soil type, slope, relative sophistication of the producers, type and value of crops to be produced, the ability of the beneficiaries to pay for the system and energy requirements. While actual area irrigated will not be the sole determining factor regarding the selection of irrigation technology, in most cases, the smaller the size of the system the less complicated it will be. However, there exist numerous opportunities for the application of relatively high tech systems on small-and medium size farms. This is especially true of drip and low pressure sprinkler systems for the production of high value export crops.

The types of systems plus associated drainage works that will be included in the project are described in more detail below.

b. System Types

i. Micro Irrigation Systems

Generally, micro-scale technology systems for farm units of less than 5 hectares will be the least expensive networks financed by the project. In most cases they will be made available to independent subsistence farmers who have had limited use of modern inputs and sparse contact with markets. It is anticipated that the water source for these systems will be a stream or riverlets with seasonal water flow. Infrastructure will consist of a small retention dam or a temporary diversion structure without accompanying land leveling. The water distribution mechanism will consist of any one of several basic applied rural technologies such as a gravity flow earthen canal network or a simple plastic hose arrangement to carry water from the source to the crops. The estimated cost of this type of system is between $500-$1,000 per hectare.

An example of these system is the Victoria No. 1 irrigation project located in the Department of Cortés in north central Honduras that was financed under the Agricultural Sector II Program. The system was built on the force account

basis by the National Agrarian Institute (INA) and the Institute furnished on-farm water management technical assistance. Despite its small size (2.8 hectares) and elemental design, it is extremely effective in producing positive changes in cropping patterns of the beneficiaries. The project has allowed the farmers to diversify their production from growing only basic grains to producing watermelon, tomato and peppers. After approximately two years of operation, production has tripled and farmer income has risen dramatically, in some cases by as much as 100 percent. As a result of project success, the farmers were selected for participation in a special GOH technical assistance program. This program represented the first agricultural production assistance and training that these farmers received from their government. The irrigation system, which directly benefits 10 farm families, consists of a temporary river diversion structure made of sand bags and earth; 800 meters of 2 inch plastic pipe; a small retention pond; and a plastic pipe distribution base. Due to the highly porous soils in the area, it was not feasible to use earthen distribution canals.

ii. Small-Scale Irrigation Systems

Small-scale systems will benefit farmers or groups of farmers with holdings ranging in size from 6 to 50 hectares. Normally, these farmers have some, albeit limited, exposure to modern technologies and are active participants in the market place. Water supplies for these systems will include both temporary and permanent surface sources of sufficient volume to furnish permanent water storage capacity. Most, if not all sites will require some land leveling. Storage facilities will be drawn from an array of possibilities including artificially constructed lakes or ponds and storage tanks.

The use of heavy machinery for land leveling will be required in most cases and some of the sites will need pumping apparatus to lift water from the source to the fields or storage areas. The distribution systems will be site specific and will consist of one or a combination of earthen or cement-lined canals with a system of valves and control gates stationary sprinklers or mobile dispersion units. Drainage and water disposal networks will be required.

Due to the wide range in size (6 to 50 hectares) and perhaps increased sophistication of these small-scale technology systems there will be a pronounced variation in per hectare costs of these networks. Current estimates indicate a spread of between $1,000 and $3,000 per hectare. An example of a system at the lower end of the range is the 26 de Abril Project in the Department of Yoro financed under the Agriculture Sector II Program. This network is irrigating 30 hectares and directly benefits 50 participating families who are members of an agrarian reform group. Like the example given above, it was constructed under force account by INA. The project consists of a small diversion dam, 800 meters of a main earthen canal with 30 simple drop structures. It also has approximately 2 kilometers of earthen secondary canals which take the water from the primary channel to the production areas.

System installation included a moderate amount of machine land leveling. The total cost of the network was about $16,000. Under the influence of the project, the beneficiaries have diversified their farming practices, moving from exclusive basic grain production to a combination of basic grains and vegetables. The addition of the vegetable crops has heightened grower participation in market transactions. Preliminary data reveal that the project has achieved a reasonable level of success. Production has increased by 50 percent and farmer incomes have also risen.

At the more advanced/expensive end of the scale is the Algateca irrigation system located in the Talanga Valley, northeast of Tegucigalpa. The project irrigates approximately 28 hectares of land owned by 16 individual farm families. It was more complex to design and more costly to construct than the 26 de Abril project due to the greater distance between the water source and area under irrigation. The irrigation system includes a large, relatively sophisticated concrete intake structure in the river that serves as the water sources more than five kilometers of conduction canals with associated concrete drop structures, several kilometers of main distribution canals and associated concrete box-type distribution structure with metal canal gates, several kilometers of secondary distribution canals, and extensive land leveling. Overall construction cost is very high at almost $135,000. However, the intake structure and conduction canal were designed for eventual project expansion to cover an additional 60 to 70 hectares. As a result of irrigation participants have to add fruits and vegetables to their traditional basic grain production plan thereby increasing market involvement.

Participants have established a pre-cooperative/water user group, to manage the system. Maintenance aspects of the management scheme include assigning one day per month labor requirement for each participating family to maintain the "common" parts of the system (e.g., water source and main canal). The water used group by laws also provide for water rotation during the dry season.

iii. Medium-Scale Irrigation Systems

Medium-scale irrigation systems will be designed to benefit farmers associated with cooperatives, producers' associations or agrarian reform organizations. Within this beneficiary subset, the level of modern technology employed is extremely uneven, as is the degree of participation in the market economy. Farmers associated with export commodities (e.g., coffee, bananas, vegetables) produce mainly for market sale, while members of basic grain agrarian reform groups are more inclined to produce for subsistence needs. The only link which the basic grain producers have with the market place is through non-commercial subsidized governmental marketing programs. The project will irrigate expanses of between 50 to 150 hectares that are shared by as many as 20 to 50 growers. Major features of these systems will include a permanent surface or ground water source, good water storage capacity, careful and extensive land leveling (and associated drainage if needed), and use of more sophisticated and perhaps more permanent distribution and evacuation systems. The estimated costs of these systems range from $2,000 to $5,000 per hectare.

An example of this type of irrigation system is the Guangolola Project currently under construction in Morazân, Yoro in north central Honduras. The project will directly benefit 40 farm families who are associated with a USAID supported regional, model service cooperative. Once completed, the system will serve 130 hectares that will be producing rice and vegetables. The project when finished, will consist of a large, permanent diversion/intake structure, approximately 2 kilometers of a cement lined main conduction canal and 6 kilometers of cement lined lateral canals. Water flow through the canal system will be controlled by a series of drop structures and release gates. The project was designed to permit an expansion of the system by almost 100 hectares with minimal additional cost. Only secondary, lateral canals have to be added to the main canal and water diversion structure to service an additional 30 growers.

The model service cooperative will serve as the water use group -- a water use committee will be established as a part of the existing cooperative structure. The committee will set the rules for water use and the maintenance requisites of each participating family. In addition to a labor contribution for maintenance, each family will be expected to make a cash input. Current plans calls for the cash contribution to be collected from a product marketing fee charged by the cooperative.

iv. Drainage and Flood Control Works

Drainage works will be constructed, as needed, in association with medium and large irrigation systems, and also in special cases as independent subprojects not associated with irrigation. Generally the need for drainage is located in the northern and north central valleys and on the Atlantic Coast plain. In the majority of cases, the more economical gravity flow technique using earthen drainage ditches and evacuation canals will be used to remove excess water from farmer fields. When this technique is not possible, an economic and financial determination will be made as to the feasibility of using more sophisticated and more costly drainage methods. Per-hectare costs will vary greatly depending on soil types, topography, type of drainage employed and crops to be produced. Estimated costs are from $500 to $1,500 per hectare.

The La Masica effort, financed under the Agricultural Sector II Program and located on the Atlantic Coastal Plain, is an example of the drainage systems contemplated under this project. The system includes drainage ditches and collection/evacuation canals for 14 base farmer groups, covering 154 hectares. The base groups are all associated with a large, regional agrarian reform cooperative and are producers of cacao. The average cost of the drainage works was $500 per hectare. The per-hectare-cost was somewhat high due to the necessity of constructing drainage works in fields planted to permanent tree crops.

v. Rehabilitation

Under the project, rehabilitation of existing irrigation systems will be financed when justified. Selection of rehabilitation subprojects will be subject to the same criteria and review process that will be applied to

proposed new systems as described in Section III.D.1.c. of the paper. In addition, the background and history of the systems will be reviewed on a case-by-case basis to determine exactly why rehabilitation is needed and why system deterioration occured. Due to the Mission's extremely limited experience in this area, per-hectare-costs for the rehabilitation of existing irrigation systems are hard to determine. The Mission Agricultural Sector II Program, financed the rehabilitation of one 60 hectare irrigation system. This system is located on the grounds of the National Agricultural School in Catacamas. The per-hectare-cost of the project was approximately $934. This cost is artificially high because extensive land leveling was included as part of the rehabilitation effort. However, it is safe to say that like drainage works, the per-hectare-costs of rehabilitation will be variable. A current best estimate of cost for rehabilitation is from $500 to $1,500 per hectare.

FIGURE 1
EXAMPLES OF IRRIGATION PROJECTS PREVIOUSLY FINANCED BY USAID/HONDURAS

Project Type and Name	Project Location	Project Budget (US$)	No. Hectares Effected	Avg. Cost Per Hectare (US$)	No. of Direct Beneficiaries	Avg. Cost Per Beneficiary (US$)	No. of Indirect Beneficiary	Avg. Cost For All Beneficiaries	Type of Construction
Small Systems (5 Hcs.)									
Victoria No. 1*	Cortés	2,000	4	500	10	200	50	33	Contract
Medium Systems (6-50 Hcs.)									
El Encanto*	Copán	2,500	10	250	20	125	125	17	Contract
Exitos Campesinos*	Cortés	4,000	12	333	14	286	70	48	Contract
Valle Magdalena**	Copán	10,000	14	715	40	250	200	42	Contract
El Brazil	Choluteca	53,317	16	3,332	8	6,665	40	1,111	Force Account
El Misterio*	Comayagua	45,757	19	2,408	10	4,576	50	763	Force Account
Agalteca*	FM	134,957	28	4,820	16	8,435	80	1,406	Force Account
26 de Abril	Yoro	15,500	30	517	50	310	250	52	Contract
San Antonio*	Cortés	86,595	40	2,165	150	577	780	93	Force Account
Lincoln Coleman y El Esfuerzo*	Ocotepeque	55,000	50	1,100	70	786	350	131	Contract
Large Systems (51-100+ Hcs.)									
Palmerola*	Comayagua	145,758	65	2,242	43	3,390	215	565	Force Account
Guangolola	Yoro	195,000	130	1,500	40	4,875	200	813	Force Account
Rehabilitation									
ENA*	Olancho	55,800	60	930	-	-	-	-	Force Account
Drainage									
La Masica*	Atlântida	77,000	154	500	-	-	-	-	Force Account

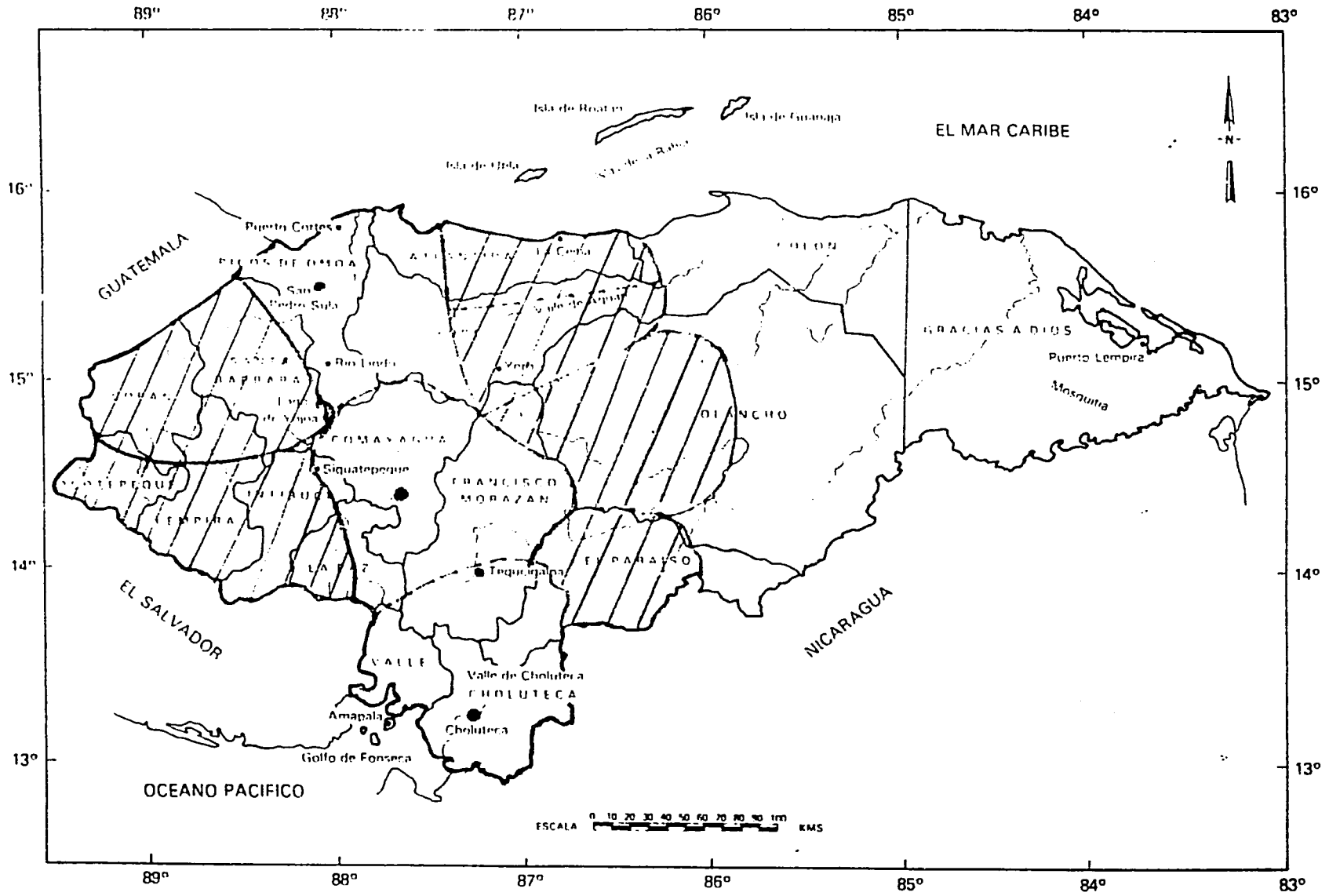
* Located in geographic region contemplated for inclusion in new Irrigation Project - Phase 1

c. Construction Execution

In keeping with the measured growth, demand-pull implementation strategy, the Project will initiate activities in three separate geographic regions of the country. Region Number One is the north coast centered in San Pedro Sula and its surrounding foodshed including the Atlantic Coastal Plain. Number Two is the country's central region with particular emphasis on the Comayagua Valley and the Siguatepeque area. Region Three is the southern portion of the country extending from the capital city of Tegucigalpa through the Departments of Choluteca and Valle. Each of these geographic areas is critical to the country's economic growth, especially in the context of developing the agricultural sector. Moreover, all three have large contingents of the project's intended target population, possess soils appropriate for intensive agricultural production and are serviced by one or more major river networks, so that water source is not a major constraint. In addition, each of these regions is within relatively close proximity to substantial markets, has an above average local road network and demonstrates potential for crop diversification, activities linked directly to exports and agroindustry development. As the project progresses, additional regions - in the East Central part of the country centering in the Guayape and Jamastrân valleys and expansion to the Western Highway including the Departments of Copân and Santa Bârbara, and in the North Atlantic Coast (La Ceiba) and the Southwest, will be added. This staged increment of regions will gradually expand the radius of influence of the project throughout the implementation period. Figure 2 graphically illustrates the project area.

It is anticipated that all three types of systems will be constructed in each of the regions. However, the distribution of systems among regions as well as the distribution of the types of systems within each given region will vary in accordance with specific and local characteristics -- e.g., target population densities, land tenancy patterns, topography, soil properties and water availability. Figure 3 furnishes a proposed construction schedule disagrregated by region and system type.

FIGURE 2 : Irrigation Regions



● Regions of Initial Project Activity

Regions for Future Phased-In Project Activity

30

Figure 3

*Proposed Phase-In of Irrigation Construction

REGION	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7			
	MI	S	M	D	MI	S	M	D	MI	S	M	D	MI	S	M	D	MI	S	M	D	MI	S	M	D	MI	S	M	D
North (San Pedro Sula)	7	1	-	1	9	2	1	1	10	2	1	1	11	3	1	1	11	4		2	11	4	2	2	11	5	1	3
Central (Comayagua-La Paz)	7	1	-	-	9	2	1	-	10	2	1	-	11	3	1	-	11	4	1	-	11	4	2	-	11	5	1	-
South (Francisco Morazán Choluteca-Valle)	7	1	-	-	9	2	1	-	10	2	1	-	11	3	1	-	11	4	1	-	11	4	2	-	11	5	1	-
North West (Copán-Sta. Bárbara)					7	1	-	-	9	2	1	-	10	3	1	-	11	3	1	-	11	4	1	-	11	4	1	-
East (Olancho-El Paraíso)					7	1	-	-	9	2	1	-	10	3	1	-	11	3	1	-	11	4	1	-	11	4	1	-
North East (Ceiba-Olanchito)									7	1	-	1	9	2	1	1	10	2	1	2	11	3	1	2	11	4	1	3
South West (Ocotepeque-Lempira-Intibucá)									7	1	-	-	9	2	1	-	10	2	1	-	11	3	1	-	11	4	1	-
	21	3	-	1	41	8	3	1	62	13	5	2	71	19	7	2	75	22	6	4	77	26	7	4	71	31	7	6

MI - Micro System = 424 *3 = 1272
S - Small System = 121 *15 = 1815
M - Medium System = 39 *60 = 2340
D - Drainage System = 20 *60 = 1200
604 6627 Has.

Total: 600

*This table is illustrative in nature. Actual construction and implementation schedules will be developed during annual work planning exercises.

As the chart demonstrates, construction activity will be phased in at a progressively accelerated pace during the life of the project. Initial construction will consist of micro irrigation systems drawn from DRH's existing ready list of shelf projects constructed by the DRH on a force account basis. Construction of these systems will serve to demonstrate tangible implementation activity while the project's guiding systems (e.g., water law, national and regional irrigation plans, credit lines, construction norms and standards and feasibility study procedures) are put in place.

The small-and medium-scale systems and drainage works, requiring credit, will be built by private sector construction companies. The number of systems installed will gradually increase over the life of the project reaching a total of approximately 600. The disaggregation of systems by size (424 micro units, 119 small units, 39 medium size units and 20 drainage systems) corresponds, in general, to the distribution of farm holding size in the proposed target group. Within the 424 micro size groups, there will be a subset of approximately 150 units that will be less than one hectare in size and will be built by DRH. The bias in favor of micro irrigation systems conforms to the structural realities of the Honduran agricultural sector and the Mission's goal of promoting economic growth with equity.

Throughout implementation, site visits will be carried out and interchanges with farmer organizations will be realized to identify potential subprojects. The most promising locations will then be subjected a comprehensive feasibility study to ascertain their compliance with a set of eligibility criteria which will include technical, economic/financial, social and environmental aspects.

- Technical Criteria: Will include engineering as well as some related production and environmental aspects, that must be considered in the design and construction of an irrigation system such as adequacy and suitability of water source, agricultural and engineering suitability of soils and topographical suitability.

- Economic and Financial Criteria: Each subproject will be subjected to an economic review to facilitate the selection for financing of those subprojects that offer the highest rate of return, measured in terms of increases in GDP.

- Social Selection Criteria: These criteria will include an assessment of land tenancy patterns (i.e., individual versus group holdings and prevalence of land titles); work cycle; preferences for division of labor within the household and within the community; social stratification; existing waer use arrangements; existing organizations (formal or non-formal) that could serve as a base for Water User Groups; payment for water systems construction and maintenance; leadership capacity; and marketing outlets for anticipated surplus production. In the case of agrarian reform groups, social selection criteria will be expanded to include degree of group cohesiveness and organizational structure.

- Environmental Selection Criteria: Irrigation systems cause different impacts to soil, water, air, vegetation, animals and human beings. These impacts can be beneficial or adverse. They are considered in the selection of irrigation systems to insure that projects are not only technically sound, but are also environmentally feasible. Environmentally nonfeasible irrigation projects seldom remain technically sound for long. Examples of the environmental factors that will be considered in subproject selection are: geologic, soils, water quality, biotic community, watershed, airshed, land use, local and regional planning, and public health concerns.

Through participation in the Agriculture Sector II Program, and with subsequent FAO assistance, the DRH has developed a preliminary set of selection criteria, as well as draft formulas for applying these criteria to carry out feasibility studies. These preliminary documents will be revised and finalized during the project's first five months. Project financial and technical expertise will assist in the revision process.

The feasibility studies will take place simultaneously in all of the participating regions and will be reviewed by the DRH on a quarterly basis. The approved proposals will be ranked on the basis of potential economic return and subprojects with the highest ranking will be constructed first. In addition to generating the data needed to determine whether or not a subproject should go forward, beneficiaries will be participating directly in the design of their own systems, when assisting in the preparation of the feasibility study.

d. Construction Contracting

As noted previously, the project will construct and/or rehabilitate irrigation systems covering 6,000 to 7,000 hectares of land. In all cases, infrastructure work will comply with construction norms and standards established by DRH and approved by AID. Furthermore, every system installed will be a part of a regional and national irrigation plan that will be developed by the DRH early in project implementation. Except for a number of micro-systems which will be built directly by DRH, all construction activities will be undertaken by private sector Honduran companies. USAID experience with this system under the Rural Roads I (522-0164) the Natural Resources

Management (522-0168) projects has been extremely positive and the Mission believes that this experience can be effectively transferred to irrigation construction.

To be eligible to participate in the project, local companies must be pre-registered with the Honduran Contractor Licensing Board and must be pre-qualified by DRH. Qualification requisites will include a statement of prior experience, verification of registration by the Licensing Board, descriptions of administrative and technical capacities and a financial statement. Award of contracts will be based on a review of proposals submitted by the companies in response to competitive bid packages issued by DRH in accordance with AID regulations. Contractors selected to execute construction activity will provide the machinery and work crews necessary for the tasks. The construction mix (i.e., machinery versus manual labor) will be determined by the particular requirements of each subproject. The contractors will carry out the work according to plans and specifications approved by DRH and AID, and they will adhere to work schedules established in the contracts.

e. Systems Maintenance

The principal responsibility for maintaining the irrigation systems will rest with the project beneficiaries. Water User Groups (WUGs) will be the main vehicle for assuring that the maintenance work is undertaken. The existence of such groups, will also be a requisite for subproject approval. The WUGs will take a variety of forms. For example, in cases in which the applicants are members of a cooperative, the water user group will be a committee within the existing cooperative structure that is concerned exclusively with water resources. In instances in which cooperatives or farmer associations are absent, a water user group will be formed for the expressed purpose of managing the irrigation network.

A key activity of the WUGs will be to develop a maintenance plan that must be approved by DRH prior to the issuance of infrastructure credit. This plan will detail a scheme for underwriting maintenance costs. Alternative approaches for generating maintenance resources will include a water user dues payment, a surcharge for marketed commodities, payment of a flat fee and participation in manual labor details. In every instance, determination of the mechanism to be employed will be made by the local group to assure compatability with beneficiary payment preferences and possibilities. Additional components of the maintenance plan will include a catalog of tasks to be carried out, a schedule for their execution, assignment of work responsibilities and sanctions against individual members for non-compliance. Failure of the group to implement this plan will serve as grounds for suspending on-farm technical assistance made available through the project. Gross non-compliance of individuals within the group will be countered by revocation of production credit eligibility and T.A. to the offending parties. It is the Mission's judgement that introducing mechanisms through which beneficiaries must contribute directly to the cost of maintaining their systems is a significant step toward eliminating the beneficiaries traditional mentality of depending on the Government, and will enhance the generation of a

new entrepreneurial attitude and a spirit of self-reliance. (A further description of, and an explanation of the need for, Water User Groups appears in Sections III.4.C vi.-Project Organizational Matrix and IV.B.-Social Analysis).

2. On-Farm Water Management

For the vast majority of project beneficiaries irrigated agriculture will be an entirely new undertaking that represents a relatively high element of risk. The perceived risk to farmers is that irrigation is a technology untested by the beneficiary, requires a financial investment and entails new agricultural production practices. Literature on the difussion of innovation and small farmer risk management behavior indicates clearly that new technologies are more readily adopted, used and sustained when the perceived risk is minimized. The literature further points out that an effective means of diminishing the perceived risk is though focussed, culturally sensitive technical assistance efforts complemented by training programs.

Experience with irrigation initiatives in Honduras supports these general research findings. Previous efforts concentrated on providing the physical infrastructure while relegating instruction for beneficiaries on the potential benefits and proper application of this technology to a secondary position. Results of these efforts show that the increases in production and productivity were generally favorable but they also indicate that the production improvements may not be sustainable, owing to deficiencies in technical assistance. The project will ameliorate this constraint by including a major program of on-farm water management implemented by the project technical assistance team (Irrigation Project Advisory Group - IPAG).

The centerpiece of the on-farm water management extension program will be an Agricultural Plan which will define technical assistance, training and financial needs for irrigated agriculture. Immediately after the approval for construction of each subproject, the beneficiaries, with the assistance of IAG technicians, will develop a thorough farm plan. This plan will include a calculation of the total area to be irrigated, disaggregated by the portions reserved respectively for traditional and non-traditional crops, crop rotation schemes, seed bed layouts for transplants, a production time frame, marketing arrangements and an overall farm budget. Based on the contents of the farm plan, specialized technical assistance in both agricultural production and irrigation management will be provided to the participants by IAG field agents.

The DRH, assisted by the IAG, will furnish the farmers with needed complementary training. The training will use on-the-job and group learning techniques (e.g., field days, seminars) and will focus on the proper use and maintenance of irrigation systems as well as applying modern production technologies. Advantage will be taken of the Japanese financed Water Resources Training Facility in Comayagua in realizing the training activities. In addition, mass media (e.g., the farmer newspaper "El Agricultor" supported by AID and the centrally funded Communications for Technology Transfer in Agriculture Project) will supplement formal training sessions.

The IAG will design and implement a communication support system using mass-media to promote the project in the selected regions of the country. This program will use radio, print and other channels as part of a network of information targeted at specific irrigation related technologies. The effective use of culturally sensitive communication will help integrate irrigation technologies into the farmer's own view of his problems and needs.

Although traditionally, the role of agricultural communications has been to motivate farmers to "want" to use new technologies, in this project it will be aimed at the farmer's needs, attitudes, perceptions and behaviors. The strategy will be to select the most appropriate mix of media, and combine detailed information about the project, irrigation technologies, costs and benefits as perceived by the farmer, etc. The messages will be simple clear and relevant, and a feedback mechanism which will privide information to the project concerning farmer's response to the messages will be used to improve the content, vocabulary, format, etc. of those messages.

In this project, the promotion/communication component will not be merely a link to the farmer, rather, it will provide a link between the farmer and the project.

3. Credit

a. Credit Constraints

A predominant characteristic of the agricultural sector is the extremely limited access of producers to credit resources. In the public sector, the National Agricultural Development Bank (BANADESA) has had a mandate, as well as considerable experience, to channel credit to the agricultural sector. Yet, through a combination of factors, including an inefficient bureaucracy and political influence on decisions related to lending, the Bank has had limited success in reaching the small farmer population. With respect to the private sector, the banking system traditionally has assumed a conservative position toward small farmer lending programs. Arguing that risk and transaction costs of such programs are high, banks require collateral and guarantees far in excess of the project beneficiaries means. In sum, it is generally recognized that less than 5 percent of the growers in the country have the benefit of formal credit resources.

The ready availability of credit is a critical ingredient to the success of this project. The project's beneficiaries do not have the resources to finance the irrigation infrastructure and modern production inputs, critical to breaking the poverty cycle and dependence which traditionally has conditioned, and continues to condition, the lives of the majority of the country's rural producers.

b. Credit Strategy

To address the credit access problem, the GOH will establish a trust account mechanism, the Irrigation Financing Facility (IFF), within the Central Bank of Honduras (CBH) using $ 10.0 million in AID loan resources to finance an

equivalent amount in Lempiras, and the equivalent of $ 2.5 million in counterpart resources provided under the project. The CBH will be responsible for the foreign exchange risk and the repayment of the AID loan funds. The trust account resources will be divided into two wholesale credit windows that will be managed through the participating commercial and agricultural development banks.

One credit line will furnish medium-term infrastructure credit, while the second window will finance short-term production credit. All lending through these trust accounts will be managed by strict eligibility criteria and will explore the use of new collateral and loan guarantee mechanisms. Reflows generated from these loan funds will be used in support of activities in the rural sector, as mutually agreed to by the GOH and AID. The GOH will covenant to maintain the Fund for a period of ten year's after the completion of the Project.

c. The Trust Accounts

i. Commercial Banks

The rationale of using private banks to manage trust accounts (fideicomisos) for onlending to intermediary organizations is to stimulate private banking community involvement in small farmer lending without requiring the banks to assume the risks of loan repayment. Past experience of the private banks in agricultural lending has been poor, and when combined with the lack of collateral among small farmers and the bank perception of the extremely high risks involved, it has resulted in a reluctance to lend for either production or investment within the sector. Private bank management of a trust account to finance rural intermediaries will provide a risk-free enviornment in which the banks may view and evaluate the Project-sponsored activities. As banks begin to feel more secure about the loan management capabilities of a borrower, their willingness to participate in agricultural lending is expected to increase.

A similiar strategy to encourage private bank agricultural lending was successful under the Small Farmer Coffee Improvement Project (522-0176). During the initial three years of this Project, A.I.D. credit resources were channeled through the private banking system for onlending to small farmers for investment and production. Private banks were allowed substantial margins (6% overhead and 4.5% reserves) to encourage their participation. Following three years of private bank lending and very high loan recovery rates (approximately 96%), the banks have recently agreed to use their own resources to finance the short-term production component, thus increasing the amount of A.I.D. resources that can be used to expand investment opportunities among the small farmer coffee producers.

ii. Agricultural Development Banks

The agricultural development banking system has been the traditional lender to the agricultural sector. Because of its experience in working in the rural sector and with agricultural credit, these banks will also be included in the project as Intermediate Credit Institutions.

Selection of the bank(s) to manage a trust account(s) will be made on a competitive basis, for which procedures will be established by A.I.D. and the CBH. The banks will be requested to submit proposals to the Central Bank indicating their interest; illustrating how the account would be managed; describing supplementary services that would be provided to borrowers and the management fee to be charged. Additional evaluation criteria to be used would include bank experience in agricultural lending, national agency outreach, demonstrated management ability, etc.. The initial number of banks selected will be limited (two to three banks) to reduce the complexity of managing a large number of sub-loans.

d. Production Loans

As stated previously, market conditions have failed to provide both incentives for, or access to, irrigation technology. In Honduras, irrigation systems have only flourished in relation to the banana and sugar cane industries. With limited exceptions micro, small, and medium-size growers have been unable to capitalize on this technology. Although there are several constraints toward expanding irrigation, the financial ones have played a determing role. Scarce resources for investments with long payback periods effectively preclude small farmer access to potentially profitable irrigation infrastructure. The project, through the Irrigation Financing Facility, will remove this constraint for the farmer-innovator willing to assume the risk involved in breaking the traditional cycles of poverty and dependence.

The Facility will make resources available for infrastructure development and short-term production in a closely linked methodology, and all requests for financing will originate with the beneficiary group. With the initiation of a publicity campaign advertising the project, the IPAG field agents will contact farmer intermediary organizations, private agroindustries and independent growers to solicit interest in irrigation technology. Favorable beneficiary response will initiate feasibility studies (i.e., farm plans) to determine the potential viability of an irrigation investment. These studies will assess the economic factors of an investment (e.g., rate of return, availability of inputs, and expected farmgate prices); the social considerations surrounding potential beneficiaries (e.g., water use group structure, work patterns, land tenency); as well as the technical and environmental aspects of the subproject.

The assessments will be conducted by IAG field agents using standard formula developed and adopted by the DRH and will be concluded in a relatively short period of time. Those studies yielding positive results will be turned into subproject proposals by IAG personnel and be presented jointly by the IAG and the beneficiaries to the DRH for review. To streamline the review process, proposals with a value of less than $25,000 will be considered by the DRH regional offices; subprojects in excess of $25,000 will require appraisal at the DRH central headquarters.

Approved subprojects will be awarded a Certificate of Eligibility which will entitle the beneficiary to apply for investment and production financing through a participating bank. Cooperatives and producer associations will be expected to provide their members with assistance, if needed, in this

application process. Once a loan is approved by a participating bank, the beneficiaries will enter into contractural agreement, sanctioned by the lending bank, with prequalified construction firms for the installing the system. Loan disbursements for investment credit will be made directly to the contractor based on prior approval of the borrower and the IAG field agents or the DRH central headquarters as appropriate.

Approval of investment financing assumes the need to provide the borrower with short-term production credit. In effect, an approved investment loan will also imply tacit approval of the first year's production credit. Although some borrowers may have access to production financing from non-project supported credit channels, it is expected that the majority of the beneficiaries will require both investment and production financing. First year production credit, if required, will be approved at the same time that the investment loan is approved. Subsequent year's production credit will be based on a farm management plan that will be completed on an annual basis with assistance from the DRH field agent. This will permit changes in crop selection to take advantage of market opportunities and to promote diversification activities. The beneficiary will be required to submit this annual farm plan and their financing request to the participating bank for consideration. Once approved, production financing will be disbursed directly to the beneficiary or through an intermediary as appropriate. Loan supervision and collection will remain the responsibility of the participating bank.
The following figure traces the steps from feasibility study through the issuance of credit for a loan-financed irrigation system.

Figure 4
Irrigation Approval and
Loan Process

Feasibility Study (IAG & Beneficiary)

Proposal Preparation (IAG)

Proposal Presentation (IAG & Beneficiary)

Proposal Review and Approval (DRH)

Certificate of Eligibility (DRH)

Investment Loan Negotiation (Bank & Beneficiary)

Contract Negotiation (Contractor & Beneficiaries)

Construction (Contractor)

Farm Plan (DRH & Beneficiaries)

Production Loan Negotiation (Bank & Beneficiary)

e. Credit Application Process

During the intensive review it became apparent that some potential beneficiaries possess a limited ability to absorb the risks of irrigation innovations. For this reason, consideration has been given to the feasibility of granting all or part of the infrastructure investment costs to these micro and small farmers. The Project is designed to provide such farmers with access to irrigation infrastructure; however, since providing such grants would not demonstrate the potential viability of such financing to the private banking system, and since the number of potential grantees would have been limited (i.e., 150 farmers), a decision on this grant option has been postponed until the completion of the credit analysis discussed below. This analysis will also be coupled with an assessment of actual farm plans for these potential participants to absorb medium term investment financing.

i. Investment Credit

Since limited lending is expected to occur during the first year of Project life, a determination of interest rates to be charged on medium and long-term lending will await an AID/W-USAID/Honduras joint task force report which is expected to analyze the national credit situation and interest rate policy in late 1986. At issue is the impact that GOH macroeconomic policies have had in constraining investment within the agricultural sector. Presently, virtually no credit resources are available for medium and long-term lending except for special credit lines created by international donors. Under the Jackson Plan, the U.S. Government has adopted ambitious goals for its assistance to the Central American region, and the stabilization and growth of the Honduran economy is a critical foreign policy objective. Some observers believe that in the light of these policy objectives, special measures are required to further promote investment. These measures include either reducing the ceiling on interest rates, accepting a slightly higher inflation rate as the cost of increased private sector credit supply, or providing more increased targeted credit programs with A.I.D. resources for medium and long-term investments at interest rates which reflect the long-term cost of capital to the Honduran economy rather than current austerity policies. Other observers believe that such measures would undermine the delicate balance of the current economic program and thwart efforts to stabilize the economy. On completing the credit analysis in late 1986, the Mission will negotiate with the GOH and establish the medium and long-term credit policies to be applied in such lending within the Project. This determination will address the need to provide micro and small farmers with grants for irrigation infrastructure.

It is anticipated that infrastructure loans will be for a period of up to seven years with up to three years grace on principal repayment.

ii. Short-Term Production Credit

Short-term production financing will likely be made available to the final borrower at market interest rates; however, an assessment of these rates will also be included in the previously mentioned credit analysis to be completed in late 1986. Figure 5 below outlines a potential interest rate distribution for short-term production financing based on the current range of 15-17 percent.

40

Figure 5

Illustrative Interest Rate Distribution
Short-Term Production Credit

AID
3.0%
CBH
.5%
Private Banks
4.0%
Federation's & National Intermediaries
4.0%
Cooperative Affiliates
4.0%
Beneficiaries
15.5

f. Demand for Financial Resources

The high yield agriculture promoted by this initiative demands larger amounts of working capital and investments than those normally available to the project's target group under their traditional methods. For example, with respect to coffee production, the $250 production costs of a traditional "manzana" (.7 hectares) producing between 5-8 hundredweights, increases to over $1,000 to yield 25 to 35 hundredweights. Similarly, corn's production costs increase from $175 to $325 to generate a 172 percent yield increase.

Four prototypes have been developed to analyze project impact at the farm level. Figure 6 illustrates with project and without project scenarios per farm unit.

Figure 6
Scenarios for Four Prototype Farm Units Showing
Total Gross Costs with and without Project
(Lempiras)

Prototype	W/O Project Total Gross Cost	W/Project Total Gross Cost
Basic Grain	2,812.61	4,393.08
Basic Grain/Vegetable	2,473.74	5,427.50
Non-traditional export oriented	5,259.37	16,179.58
Non-traditional	4,789.66	25,862.11

41

Demand for credit includes financing for capital improvements (i.e, the physical irrigation infrastructure) and production inputs (i.e., herbicides, plaquicides, fertilizers, improved seed, plant materials and labor). Most of these inputs can only be purchased with cash. Because most beneficiaries lack liquidity the project will provide financing to meet these needs. As documented in the economic analysis, the financing requirement will increase gradually, as the project progresses along its controlled expansion. By the last year of the project, production credit requirements will rise to approximately $5.7 million. Investment financing for irrigation construction would have increase to $10 million. Of this amount 22 percent (or $ 2.2 million) corresponds to infrastructure grants, while the remaining $7.8 million are credit loan resources. A schedule of annual credit needs is illustrated in figures 7 and 8. It has been assumed that 10 percent of all issued credit will result in, nonrecoverable loans that must written off. The reflows from payments on outstanding principal for infrastructure investment will begin at the end of the 5th year and continue to grow gradually as the project matures. Thus, the total loan financing needs for irrigation infrastructure will be around $7.5 million by the end of the project.

42

Figure 7
CREDIT FINANCIAL BALANCE
(Thousands of Lempiras of 1984)

INFRASTRUCTURE INVESTMENT

YEAR	TOTAL INVESTMENT	GRANT	CREDIT	DEBT SERVICE	INTEREST	AMORTIZATION	BAD DEBT	CHANGE IN NET CREDIT	OUTSTANDING CREDIT	FINANCIAL NEEDS
1	288	63	225	16	16			225	225	225
2	1,911	418	1,493	124	124			1,493	1,718	1,718
3	2,547	557	1,990	267	267			1,990	3,708	3,708
4	2,584	565	2,019	412	412			2,019	5,727	5,727
5	4,245	929	3,316	674	651	23	3	3,291	9,018	9,020
6	3,118	682	2,436	1,000	825	175	19	2,241	11,259	11,281
7	5,182	1,133	4,048	1,492	1,102	390	43	3,615	14,874	14,940
8				1,696	1,071	625	69	(694)	14,180	
9				2,030	1,021	1,009	112	(1,121)	13,059	
10				2,276	940	1,336	148	(1,484)	11,575	
11				2,684	833	1,851	206	(2,056)	9,519	
12				2,645	685	1,960	218	(2,178)	7,341	
13				2,387	529	1,859	207	(2,065)	5,276	
14				2,043	380	1,663	185	(1,848)	3,428	
15				1,694	247	1,447	161	(1,608)	1,820	
16				1,121	131	990	110	(1,100)	720	
17				700	52	648	72	(720)	0	
18										
19										
20										
21										
22										
23										
24										
25										
	19,875	4,348	15,527	23,261	9,286	13,974	1,553	0	113,447	46,619

Obs.: This table assumes that near 22% of Infrastructure Investment is finance through grants. Furthermore, 10% of all issued credit will never pay either interest or amortization. Those are irrecoverable loans, or "bad debt".

43

Figure 8
CREDIT FINANCIAL BALANCE
(Thousands of Lempiras of 1984)

WORKING CAPITAL

YEAR	CREDIT	INTEREST	AMORTIZATION	BAD DEBT	CHANGE IN NET CREDIT	OUTSTANDING CREDIT	FINANCIAL NEEDS
1	334	12	150	17	167	167	184
2	2,024	73	1,061	118	845	1,012	1,147
3	4,204	151	2,803	311	1,090	2,102	2,548
4	6,454	232	4,796	533	1,125	3,227	4,206
5	9,376	338	7,123	791	1,461	4,688	6,458
6	13,995	504	10,517	1,169	2,310	6,997	9,936
7	13,880	500	12,543	1,394	(57)	6,940	11,272
8	14,315	515	12,688	1,410	218	7,158	
9	14,921	537	13,156	1,462	303	7,460	
10	15,495	558	13,687	1,521	287	7,748	
11	15,914	573	14,134	1,570	209	7,957	
12	16,190	583	14,447	1,605	138	8,095	
13	16,437	592	14,682	1,631	124	8,219	
14	16,587	597	14,861	1,651	75	8,294	
15	16,587	597	14,928	1,659	(0)	8,294	
16	16,587	597	14,928	1,659	(0)	8,294	
17	16,587	597	14,928	1,659	(0)	8,294	
18	16,587	597	14,928	1,659	(0)	8,294	
19	16,587	597	14,928	1,659	(0)	8,294	
20	16,587	597	14,928	1,659	(0)	8,294	
21	16,587	597	14,928	1,659	(0)	8,294	
22	16,587	597	14,928	1,659	(0)	8,294	
23	16,587	597	14,928	1,659	(0)	8,294	
24	16,587	597	14,928	1,659	(0)	8,294	
25	16,587	597	22,193	2,488	(8,294)	(0)	
	342,585	12,333	34,259	(0)	162,999		

Obs.: 10% of all issued credit will never pay either interest or amortization. Those are irrecoverable loans, or "bad debt".

With respect to short-term production credit, total loan financing needs by the end of the project will be the outstanding credit of $3.5 million, plus unrecovered loans in the previous six years (estimated at $2.2 million) yielding a total of $5.7 million. The sum of investment (irrigation infrastructure) and production total loan financing needs will be $13.2 million by the end of the project. The annual credit needs of the project are presented in Figure 9, below.

Figure 9
CREDIT FINANCIAL NEEDS
(Thousands of Lempiras of 1984)

YEAR	INFRASTRUCTURE INVESTMENT	WORKING CAPITAL	TOTAL
1	225	184	409
2	1,718	1,147	2,865
3	3,708	2,548	6,256
4	5,727	4,206	9,933
5	9,020	6,458	15,479
6	11,281	9,936	21,217
7	14,940	11,272	26,212

4. Institutional Development

a. Institutional Constraints

A review of the literature indicates that defects in the administrative delivery system, including deficiencies in coordination among implementing agencies, the absence of clear, consistent policy; and the lack of user organizations impeds the achieving of irrigation project targets in many countries of the developing world. An analysis of the Honduran case suggests that similar drawbacks prevail. As a product of many, often conflicting, legislative decrees issued over time, five public sector entities have mandates to manage water resources. The Ministry of Natural Resources (MNR) has two semi-autonomous dependencies - the Directorate of Water Resources (DRH) the National Agrarian Institute (INA) -- actively involved in promoting and installing of irrigation systems. The Nation Forestry Corporation (COHDEFOR), which operates under the Ministry of Economy (MOE), has a mandate to carry out drainage projects on public land reserves. While there is close similarity in the irrigation activity carried out by these three entities, the division of labor is determined by artificial criteria such as geographic area, crops, and system type. In addition, the Ministry of Transportation and Communication (SECOPT) claims responsibility for managing water resources in relation to the country's primary and secondary road networks. This jurisdiction includes authority to change water courses for road drainage purposes. Finally, the National Water and Sanitation Authority (SANAA)

presides over water use for water and sanitation systems, including those installed in the rural areas. Each of these organizations tends to run its own program with little concern for, or awareness of, the activities of the colleague institutions. Moreover, all compete for the lion's share of the scarce public budget available for water resource management. While a varied institutional base per se is not bad, institutional jealousies and the chronic absence of workable linkages among the entities involved prevents the effective use of water resources and frustrates the delivery of irrigation technology to the agricultural sector.

A related constraint is a deficient human resource base within Honduran public sector entities. This situation applies principally to the administrative planning and management skill, of the agencies. The universities and technical schools responsible for training skilled man-power for public service are extremely weak. Within the development agencies themselves, in-service and on-the-job training programs are infrequent and poorly organized. Finally, staff turnover, due to political influences, unattractive salaries and below par working conditions, is a chronic problem which contributes to administrative inefficiencies.

A third institutional constraint is a cumbersome bureaucratic process, generic to the public sector, which dampens initiative and inhibits timely completion of activities. For example, all public sector institutions must course through a maze of bureaucratic procedures to secure budgeted operating finances. This process is extremely drawn out and without fail results in periodic work stoppages attributable to the lack of funding for logistic support (e.g., per diem, gasoline for vehicles, salaries) essential for the timely execution of activities and for the maintenance of personnel morale. Similarly, the GOH processes for procurement and personnel contracting are notoriously inefficient. USAID/H experience with public sector host country procurements is replete with cases of complete failure and instances of delays in excess of two years to affect the arrival of needed commodities. The personnel contracting procedures require that every discreet personnel action be authorized by the Minister of the participating host country organization and then signed by the President of the Republic. Recent history has demonstrated that this process takes weeks and occasionally months to complete.

b. Strategies to Overcome Constraints

To overcome the institutional constraints listed above, several alternative project administration models were considered. The PID proposed a predominantly public sector approach with DRH as the major of project implementor. The Directorate would directly carryout all planning functions, would design and approve subprojects and would be the principal provider of on-farm technical assistance. The role of the private sector under this scheme would be limited to construction of the larger irrigation systems by local firms and project promotion by farmer organizations. At the PID stage the question of credit was left open for further review.

Analysis conducted during the intensive review indicated strongly that the predominantly public sector model was inadequate for the task at hand. Key deficiencies identified focused on the plethora of public sector bureaucratic procedures to which the DRH is subjected. It was the judgement of the PP design team that even with institutional development support, the existing contracting commodity procurement and logistic support procedures to which the Directorate must adhere were simply too inefficient and put in doubt timely project implementation.

A second alternative considered was a private sector model in which a local consulting company would be hired to implement the project. The contractor would carryout all planning, logistic support system design and on-farm technical assistance activities. Irrigation construction would be sub-contracted to local firms and banks would be enlisted to furnish the required credit. The role of the public sector (viz. DRH) would be limited to general project monitoring and evaluation.

The attractiveness of this approach was its promise for a streamlined, rapid implementation process. However, this advantage was counter-balanced by recognition of the need to develop high caliber water management planning capacity within the public sector to assure rational use of this resource over the long-term. Moreover, the private sector model would have left begging the issue of overlap and lack of coordination among public sector organizations involved with water use.

The administrative model selected will provide the necessary degree of coordination within the public sector to eliminate duplication of effort while simultaneously providing ample private sector participation to assure timely project implementation leading to a rapid impact on the country's agricultural sector. In addition, the chosen approach will emphasize direct involvement of the beneficiaries in subproject design, subproject presentation and credit activities. This is included to promote a sense of proprietorship in infrastructure investment and an enterprenurial spirit among the participating farmers.

Figure 10

ORGANIZATIONAL MATRIX

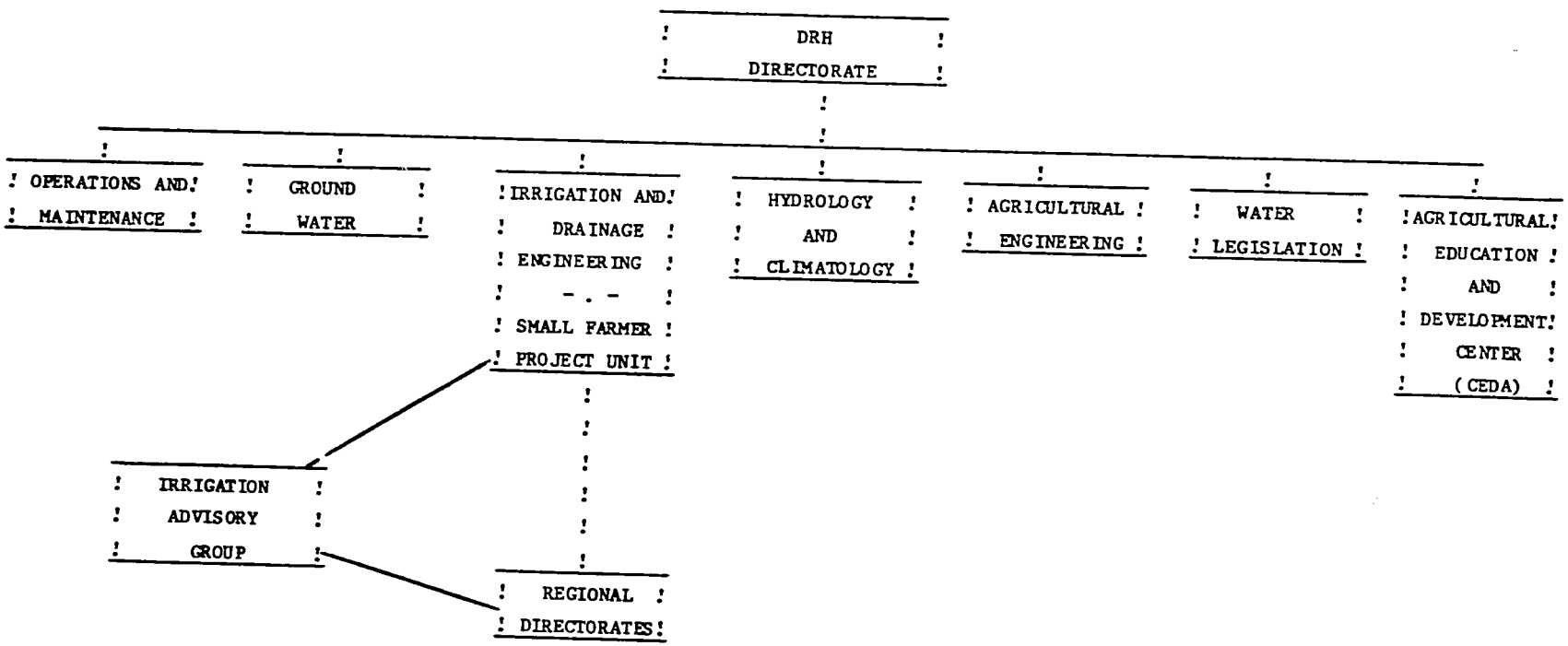
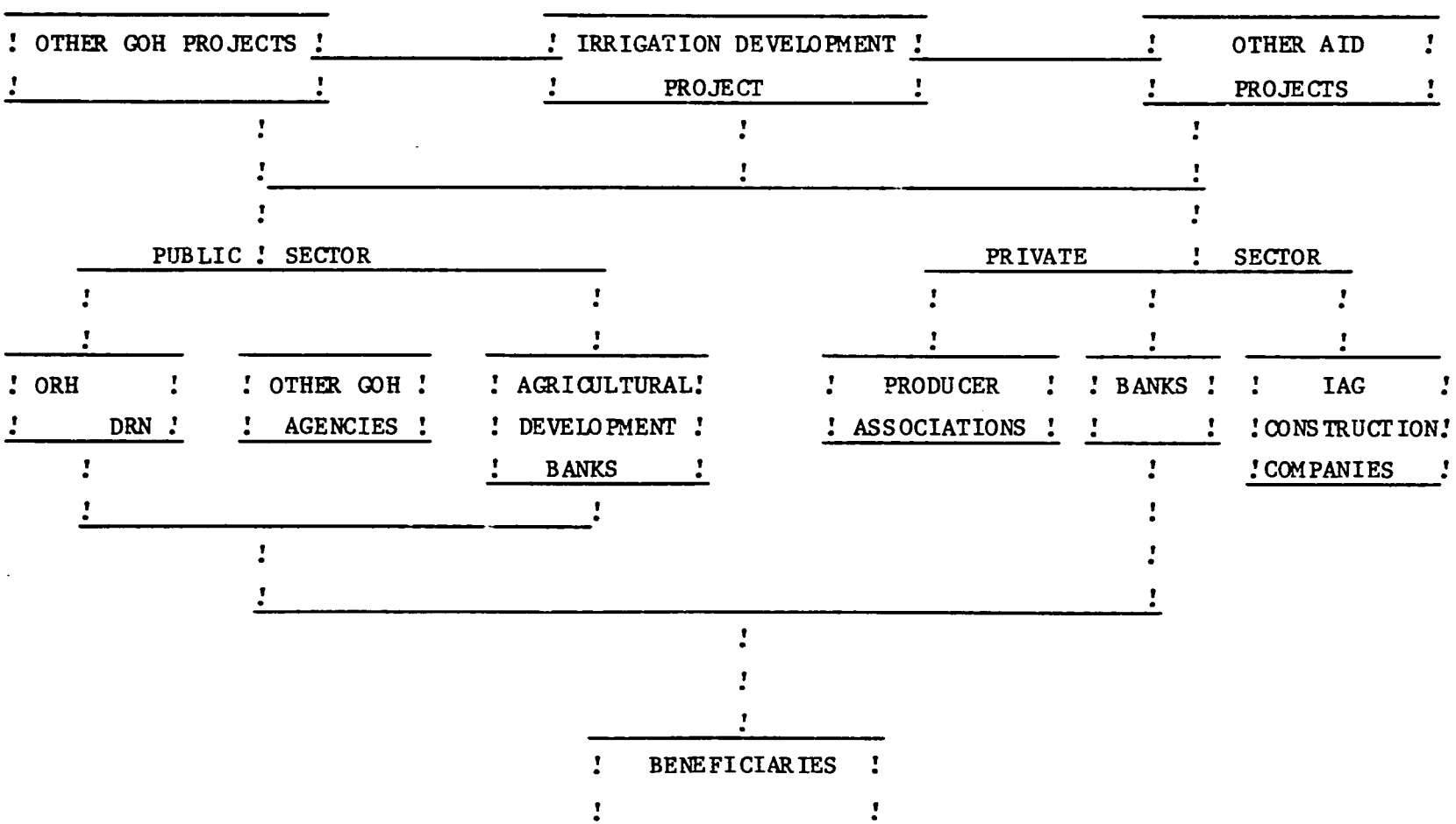


FIGURE 11

ORGANIZATIONAL FLOW



c. Directorate of Water Resources

The Directorate of Water Resources will be the lead GOH organization in the project. This component of the Project is directed at strengthening the capacity of the DRH to plan and implement irrigation programs. At a macro level, assistance will be provided to the DRH to upgrade its capability to develop the institutional and legal framework to establish an effective irrigation program. For example, project-contracted technical assistance will be provided to assist the DRH in drafting a National Water Law and its implementing regulations, improve its administrative and managerial skills in such areas as planning for irrigation development, review and approval of project proposals, contracting and supervising private sector construction, assessing and inventorying the country's needs for irrigation, and administering the National Water Law and the National Irrigation Plan. To this end the project will provide technical assistance, training for DRH staff, and commodities to upgrade its facilities.

Under the project, DRH administrators and technicians will receive long-term (M.A. level) training in such topics as hydrometeorology, hydrological engineering and construction, water resources management, agricultural economics, regional planning and hydrogeology. Short courses will also be offered in organizing and managing a water user groups, irrigation design and planning, computer analysis and agricultural extension, using particularly, the facilities of the Agricultural Education and Development Center (CEDA).

To assure consistency with project objectives and uniformity in methods and materials presented as one of its initial activities, the project will finance short-term technical assistance to develop a project training plan and training materials.

At the national level, the DRH's Small Irrigation Project Unit will coordinate project activities. The fact that the SIPU already exists will assist in achieving the desired rapid impact. Time requirements for recruiting personnel and "staffing up" will be reduced to a minimum. Nor will there be a recurrent cost burden to the Government as no new hiring will be necessary. However, the current staffing arrangement is overloaded at the national level and some reassigments, either to the regions or other units with DRH headquarters, will be effected. In its final configuration, the SIPU will be a streamlined unit consisting of a four person planning branch that will develop the national irrigation plan and monitor overall implementation progress, and an administration branch that be responsible for logistical support.

Figure 12
SIPU Organizational Chart

Director

Planning Branch	Administrative Assistant	Administration Branch
1 Economist		1 Project Controller
1 Social Scientist		1 Bookkeeper
1 Engineer		1 Logistical Support Specialist
1 Contract Specialist		1 Secretary
1 Secretary		

At the regional level, the SIPU will carryout its responsibilities through DRH field offices, all of which are already in place. The following exhibit shows the configuration of a typical field office.

Figure 13
Field Office Staffing

Office Director

(Reg. Project Director)

Admin. Assistant

Irrigation Project Advisory Group

1 Subproject Design Director
1 Construction Engineer
1 Topographer
1 Administrator
1 Draftsman
2 Senior Agronomists
3 Agronomists
10 Paratechnicians

Administrative Branch

1 Controller/Paymaster
1 Motor Pool Operator
1 Secretary

Construction Branch

1 Agricultural Engineer
1 Construction Engineers
2 Topographers
6 Manual Laborers
1 Secretary

d. Private Sector Institutions

Under this Component, the project will assist the private sector in developing its ability to respond to irrigation construction needs and in developing a private sector extension service to complement irrigation construction. The project will fund technical assistance and short-term training for private sector firms prequalified to participate in the project.

The Irrigation Advisory Group will implement the farm technical assistance program and will serve as the advisor to the DRH. This IAG will be selected by a combined USAID-DRH panel after a review of responses to Requests for Technical Proposals (RFTP's). USAID/H will issue the RFTP and the selection of the contractor will be made in accordance with AID procedures for formal advertising and competition.

It is expected that the IAG will be the result of a joint venture between an American private consulting firm or university and a Honduran company (ies). The IAG will provide assistance to the DRH in the overall planning and programming aspects of the project. This will include advice on the formulation of the revised water law, development of the national irrigation plan, revision of guidelines for construction norms and standards and programming of on-farm extension expertise, training as well as the developing and implementing a national irrigation promotion campaign. This effort will use mass media (e.g., advertising in the farmer newspaper "El Agricultor" and radio slots) and personal contact with farmer organization leaders, private vendors of agricultural input commodities, and individual farmers to promote both the project and the benefits of irrigated agriculture.

The IAG will organize field teams that will work closely with each of the DRH regional office staffs, to implement the on-farm extension program. The entire personnel cadre will be recruited, hired and managed by the IAG. In line with the measured growth strategy of the project, the number of IAG field teams will be increased gradually over the course of implementation in harmony with the growth in the number of regional offices.

Providing extension services through the private sector (viz., the IAG) is a new approach for Honduras and marks a significant departure from the traditional public sector approach to providing extension services. Assuming success in this irrigation effort, the private sector extension cadre developed by the IAG will link with the proposed FY 88 "extension amendment" to the Agricultural Research Foundation project. These two initiatives will form the base of the Mission's effort to make the delivery of extension services more efficient.

Figure 14

IRRIGATION ADVISORY GROUP

Foreign Company	Honduran Company
- 1 Chief of Party	1 Lawyer
- 1 Irrigation Planning Specialist	1 Irrigation Engineer
- 1 Ag. Prod. Specialist	1 Accountant
- 1 On-form Water Management Specialist	1 Social Scientist
- 1 Social Scientist	1 Administrator
- 1 Extension Specialist	4 Logistical Support
1 Secretary	1 Secretary

As noted earlier, except for a small number of micro systems, all irrigation construction under the project will be carried out by Honduran private sector construction and building firms. Project design related research revealed that there are more than 100 such enterprises are registered with the Honduran College of Civil Engineers.

A sample of 62 of these firms indicated a strong interest in participating in th project. Owing to the limited irrigation construction market, none of the construction companies specialize in the installation of irrigation systems. However, all have qualified technical staffs (i.e., cadre of civil engineers, topographers and drafstmen) and several have had experience in the construction of rural water systems and civil work related agricultural development. In addition, approximately 25 percent of those companies included in the sample, have the equipment (e.g., tractors, backhoes, graders) needed to carry out irrigation related earth moving activities. Finally, as a standard operating procedure, all of the firms contacted have ample experience in contracting and managing manual laborers.

A general deficiency in the organizational structure of many of the firms visited was a lack of qualified administration specialists, especially in accounting. Nor was their much evidence of skill in preparing and submitting bid proposals for contracts awarded on a competitive basis.

Project funded technical assistance will ameliorate the identified institutional constraints. In the first year of implementation, and periodically thereafter, training will be offered to those companies that have been pre-qualified for participation in the project by DRH. This training will consist of short courses and seminars carried out in country. It will focus on such topics as management, accounting, proposal writing and construction for water resource utilization.

e. Farmer Associations - Private Agroindustrial Firms

Among the countries in Central America, Honduras has the broadest farmer organization network. For example, in the coffee sector, more than 7,000 growers are associated with the Honduran Federation of Coffee Cooperatives (FEHCOCAL). Through its 28 affiliates, the Federation provides technical assistance, input supplies and market services to its membership. The Federation of Savings and Credit Cooperatives Associations (FACACH) has almost 90 affiliated credit unions servicing more than 39,000 individuals with credit and agricultural inputs. The Union of Cooperatives (UNIOCOOP), a set of model coops established under the AID financed Agricultural Sector II Program (522-0150), is furnishing technical assistance and marketing expertise to approximately 1,500 farm families who are producing both domestic consumption and export. Finally, the Honduran Federation of Agricultural Export Producers (FEPROEXAAH) is promoting export commodities to approximately 5,000 growers.

In addition to these farmer organizations, there are private sector agroindustries which have contact with sizeable number of small farmers on a contract-for-produce basis. For example, Tabacalera S.A. has working arrangements with approximately 1,000 growers for tobacco production. Mejores Alimentos, a state-controlled enterprise that is a candidate for divestiture, has a working relationship with 500 farmers producing vegetables in the Comayagua valley. Isletas, a small land owner held production company, has approximately 2,000 members and a working agreement with Standard Fruit Company for marketing agricultural commodities.

A denominator commonly shared by all of these organizations is that they are in contact with, and have access to, considerable numbers of growers. Accordingly, they will be enlisted by both DRH and IAG, to serve as a conduit for promoting the project and identifying potential subprojects. This role of subproject identification will be especially important to achieving a quick impact during the project's start-up phase. After the systems have been constructed, these organizations, especially the farmer intermediary groups, will play an important role in channeling production related technical assistance and credit to the beneficiaries.

f. Water User Groups (WUGs)

The Mission is cognizant of the fact that poorly organized (or non-existent) user groups seriously reduced the effects of prior AID, and other donor, irrigation projects in many developing countries. Accordingly, the use of beneficiary organizations will be an integral part of the delivery system development component of this project. As part of the project promotion effort, the IPAG will help communities organize WUGs to manage and maintain their irrigation systems. In areas where cooperatives or rural organizations exist, a WUG will be incorporated into the organization's existing structure. In other areas, user groups will be created using the leadership, organizational and participation principles which exist at the community level.

The function of the user groups will be to achieve direct beneficiary participation in the identification, installation operation and maintenance of irrigation systems. In addition to the system maintenance function described above, the WUGs will play a role in assuring the repayment of loans for both infrastructure and production, and assisting in the delivery of technical assistance. The WUG's role is critical to the success of this project. To assure that they operate properly project funds will fund two long-term specialists (one expatriate and one Honduran) in organizing and managing WUGs.

E. Linkage to other AID Projects

The Mission's areas of focus in the agricultural sector are: (1) increased productivity and diversification of the productive base into export commodities; (2) enhanced access to resources (land, water, capital and modern technological inputs) to improve productivity; (3) development and diffusion of production technologies; and (4) an upgrading of the human resource base. The strategy to achieve these objectives involves designing and implementing of a linked series of projects which will simultaneously attack the major constraints in the sector.

In keeping with the approach, this Irrigation Project will be closely tied to a number of on-going and planned AID initiatives. For example, the project will be tied directly to the on-going Land Titling, Export Development and Services, Natural Resources Management, Small Farmer Organization Strenthening (SFOS) and Rural Roads II efforts. Yearly implementation plans will be shared with the Titling project's executing agency, INA, coordinate the issuance of land titles and irrigation construction. The Export Development and Services

Project, through FEPROEXAAH, will be one of the vehicles for accessing project participants, particularly those involved in production of commodities for export. The Natural Resources Management project will serve as a repository of technical assistance on production questions and will augment DRH field office staffs in the Choluteca River Basin. The Farmer Intermediary groups strengthened by the SFOS project will provide access to irrigation beneficiaries. The Rural Roads I Project, through the improvement of secondary and tertiary routes, will enhance the market contact of produce grown under irrigation. Finally, this Irrigation Project will be linked to two activities planned for the near future -- Domestic Marketing and an amendment that will add a "wholesale" extension function to the on-going Agricultural Research Foundation effort. The former will furnish increased market outlets for the products grown. The latter as noted previously, will reinforce the private sector extension activities pioneered by this irrigation initiative.

F. Project Outputs - Verifiable Indicators

By the PACD it is anticipated that the following outputs will have been achieved:

- An effective and just water law in place.
- Approximately 600 irrigation systems constructed/rehabilitated servicing about 3,000 farm families.
- Sustainable GOH capacity to respond to the irrigation needs of the country's agricultural sector.
- Improved Honduran private sector capacity to construct irrigation systems.
- Sustainable private banking sector involvement in small farming lending.
- Sustainable system in place for maintaining irrigation interventions.

These outputs will be measured by the following indicators:

- Doubling of on-farm productivity among participating farm units.
- Minimum 15 percent increase in farm income among participating units.
- Between 6,000 and 7,000 additional hectares under irrigation.
- Approximately 45 DRH technicians trained in water management (15 long term at the master's level and 30 through short courses).
- At least 400 construction contracts with local Honduran firms let and successfully executed.

- Approximately 2,800 medium-term infrastructure credit loans made.
- A minimum of 8,000 short-term production credit loans made.
- A minimum of 70 paratechnicians trained in on-farm water management.
- A minimum of 2,500 farmers trained/assisted in on-farm water management.

G. Project Inputs-Financial Plan

1. Flow of Funds to Implementing Agencies

The total cost of the activities to be financed under the project is $ 32.98 million. The AID contribution will be $22.5 million consisting of a loan for $14.5 million and a grant for $8.0 million. The loan funds will be distributed among: (1) institutional strengthening ($ 1.600 million); (2) system construction ($ 100,000); (3) Water Resources Management ($ 300,000); and (4) credit (11.470 million); (5) contingency and inflation ($700,000). The grant funds will be applied to technical assistance and commodities for institutional strengthening and system construction purposes. The counterpart contribution totals $ 10.48 million and will be used for institutional support ($ 5.48 million) and short-term production credit ($ 5.0 million). The multiple funding sources (e.g.,AID grant, AID loan, host country in-kind contribution and ESF host country cash input), coupled with multiple implementing agencies involved with the project, account for a complex disbursement system. The following description, which emphasizes the types and amounts of funds to be managed by each executing agency, explains the way in which project resources will be channeled.

a. A.I.D. Funds

i. Grant

- DRH

A sum of $7.400 million will be provided for the services of the Irrigation Advisory Group. This team will be made up of a joint venture between a U.S. consulting company or university and a Honduran management firm. The expatriate part will include a long term chief of party for the first four years of the project, a social scientist and an extension specialist, a specialist each in irrigation planning, organizational development and on-farm water management, each for the first two years of implementation. It is expected that by the end of the fourth year of the project, the Honduran part of the joint venture will be able to provide the needed project management functions for the balance of the LOP. This long-term T.A. will be complemented by 30 person-months of short-term technical expertise in such specialties as commodity procurement, mass media communications, law (reparian rights) agronomy, hydrological engineering, logistical planning, soils analysis, marketing, training and rural organizations.

At the national level, the Honduran partner will provide one irrigation engineer who will serve as subproject design manager, an administrator, a commodity procurement specialist, one economist and one social scientist. In addition, for each of the seven field offices, the Honduran partner will supply a subproject development and extension personnel. The subproject development staff will consist of an irrigation subproject design director, a construction engineer, a topographer, a draftsmen and an administrator/accountant. The extension cadre will consist of two full agronomists, three apprentice agronomists and ten paraprofessionals. In keeping with the measured growth strategy, the field personnel will be hired in an incremental fashion as the regional offices are phased into the project. All grant disbursement will be made directly by AID to the IAG on satisfactory presentation of the necessary voucher documentation. A portion of these grant resources will be used to procure commodities (viz., vehicles) and provide per diem funds in support of the technical assistance.

- Project Liaison Officer

Project grant funds, up to a maximum of $200,000, will be used to contract the services of a Project Liaison Officer who will asssist the USAID/Honduras project manager with project implementation. The incumbent will be a local hire with expertise in irrigated agricultural development. She/he will be contracted directly by the USAID/Honduras Mission and will serve for the first four years of the project.

- Evaluations and Audits

One hundred and fifty thousand dollars ($150,000) in grant funds has been reserved for project evaluations and audits. Interim evaluations will take place in the second and fourth years of implementation and the final evaluation will be carried out in the seventh shortly before the project ends. It is anticipated that the audits will take place after the second year of project implementation and thereafter. The Project will be periodically audited by the A.I.D. Inspector General, however, project funds will be available for contracting an audit firm in the event the Inspector General is unable to devote staff resources for the reviews.

ii. Loan

- DRH

Project loan funds in the amount of $ 1.530 million will be made available to DRH for training and commodity procurement. The training resources ($ 600,000) will finance 15 master's level scholarships in various sub-fields of water management as well as a series of short courses, on the same topic, to be held in the United States and third countries. These resources will also be used to carry out periodic seminars on irrigation and water resource managementing Honduras. A portion of the commodity procurement funds ($900,000.00) will be used to purchase 10 vehicles for use in micro-system construction and construction contractor supervision and 35

trailbike type motorcycles for on-farm water management services to be carried out by the IAG. A source-origin waiver will be drafted to permit the procurement of the trailbikes from a AID Geographic Code 935 country. The commodities will also include a micro computer and micro irrigation system construction aids.

- Central Bank of Honduras - Participating Banks

A total of $ 11.470 million of loan funds will be made available to the GOH for credit related to irrigation construction. As described previously, the Central Bank will assume the foreign exchange for these resources which will be managed under a trust account and channeled through participating banks for on-lending to the final borrowers. These funds will be released by USAID to the CBH in a tranched fashion in accordance with periodic, six-month, disbursement scheduled. The CBH will be required to provide AID with quarterly accountings of the use of these monies.

b. Host Country Contribution

i. In-kind

- DRH

The equivalent of $ 1.75 million will be made available to DRH over the life of the project. The funds will be used to pay salaries of direct-hire employees, physical plant maintenance expenses and logistic support costs. They will be disbursed yearly on the basis of an annual project implementation plan.

ii. Financial

- DRH

A counterpart contribution in an amount equivalent to $ 3.73 million will be also provided to DRH for project implementation purposes. These funds will be used to pay for the services of contract personnel (extensionists, university graduate trainees, paratechnicians, etc) needed by the project. They will also fund certain local commodity procurements (e.g., office furniture and materials) required by the regional and national offices. These funds will be drawn from ESF generations, as available, and will be disbursed to DRH in a tranched fashion after joint GOH-AID programming exercises are completed.

- Central Bank - Participating Banks

The equivalent of $ 5.0 million will be provided by the GOH to the Central Bank to establish a trust fund short-term production credit line. As in the case of the U.S. loan funds, these local currency funds will be placed in a trust account within the CBH and made available to commercial and agricultural development banks for lending to beneficiaries. These will come from ESF generations, as available, and will be programmed jointly by USAID and the GOH.

2. Methods of Implementation and Financing

Financing of project costs will follow procedures of direct payment and reimbursement that are used by A.I.D. Claims for costs of technical assistance, training, procurement of commodities and vehicles will be made directly by A.I.D. to the suppliers. Local currency operating costs will be made directly to the local supplier or reimbursed to the implementing agency. A revolving fund using ESF sources, as available, will be established to provide the implementing agency money to pay operating costs. Direct disbursements will be made to the Central Bank on submission of documentation showing the amount of certificates of credit elegibility approved for financing. The following table illustrates the implementation and financing method for each type of assistance.

FIGURE 15
METHODS OF IMPLEMENTATION AND FINANCING
($.000)

METHOD OF IMPLEMENTATION		METHOD OF PAYMENT	APPROXIMATE AMOUNT
I	Technical Assistance		$ 6,850
	Personal services contractor	Direct payment	
II	Commodities		
	Purchase Orders/Profit making contractor	Direct payment	$ 1,645
	Host Country Administration	Reimbursement	$ 185
III	Training		
	Personal Service Contract	Direct payment	$ 300
	Host Country Contract	Reimbursement	$ 300
IV	Credit Funds Host Country	Direct payment	$ 11,470
V	Evaluation and Audits Profit making contractorl	Direct payment	$ 150
VI	Other Local Support Costs	Direct payment or reimbursement	$ 900
VII	Contingency And Inflation		$ 700
	Total		$ 22,500

60

Figure 16
SUMMARY COST ESTIMATES
($ 000)

	U.S. CONTRIBUTION					HONDURAN CONTRIBUTION			
	GRANT		LOAN						
	FX	LC	FX	LC	U.S. TOTAL	ON FINANCIAL BASIS	IN-KIND	GOH TOTAL	PROJECT TOTAL
I. CONSTRUCTION COMPONENT	2340	2800	100	-	5240	250	250	500	5740
1. IRRIGATION ADVISORY GROUP									
A. CENTRAL OFFICE									
Personnel	1700	900			2600			-	2600
Per diem	200				200			-	200
Fuel, Lubricant & Maintenance					-			-	
Materials, Equipment & Supplies	100				100			-	100
Vehicles	60				60			-	60
Contingencies								-	
B. REGIONAL OFFICE									
Personnel		1500			1500			-	1500
Operating Costs		400			400		250	250	650
Vehicles					-			-	
Training					-	250		250	250
Equipment	80		100		180			-	180
C. USAID									
Project Officer	200				200			-	200
II. CREDIT FUND	-	-	-	11470	11470	5000	-	5000	16470
Infrastructure funds									11470
Ag. Production Credit				11470	11470	5000		5000	5000
III. ON FARM WATER MANAGEMENT	300	2160	330	300	3090	1600	1000	2600	5690
Personnel		1600			1600	1000	500	1500	3100
Per diem		200			200				200
Fuel, lubricant & Maintenance		300	100		400			-	400
Materials, equipment & supplies	90	60	125		275			-	275
Vehicles	210				210		500	500	710
Motorcycles			105		105			-	105
Training				300	300	600		600	900
IV. INSTITUTIONAL STRENGTHENING	250	-	1175	425	1850	1580	500	2080	3930
Technical Assistance	250				250			-	250
Personnel				200	200	700	500	1200	1400
Per diem				100	100	200		200	300
Fuel, Lubricant & Maintenance			100		100	230		230	330
Materials, Equipment & Supplies			125	125	250	200		200	450
Vehicles			150		150			-	150
Training			300		300	250		250	550
Irrigation Equipment			500		500	-		-	500
V. EVALUATION AND AUDIT	150	-	-	-	150	-	-	-	150
VI. CONTINGENCY AND INFLATION	-	-	700	-	700	300	-	300	1000
GRAND TOTALS	3040	4960	2305	12195	22500	8730	1750	10480	32980

61

Figure 17A
SUMMARY DISBURSEMENT SCHEDULE

A.I.D.	YEAR 1 FX	YEAR 1 LC	YEAR 2 FX	YEAR 2 LC	YEAR 3 FX	YEAR 3 LC	YEAR 4 FX	YEAR 4 LC	YEAR 5 FX	YEAR 5 LC	YEAR 6 FX	YEAR 6 LC	YEAR 7 FX	YEAR 7 LC	TOTAL
Grant															
I. Construction Component	750	100	690	100	400	100	400	150	100	150	-	150	-	150	5140
II. Institutional Strengthening	50	-	50	-	50	-	50	-	50	-	-	-	-	-	250
III. Project Liasion Officer	50	-	50	-	50	-	50	-							200
IV. Evaluations and Audits			30	-	-	-	30	-	40	-	-	-	50	-	150
V. On-Farm Water Mgt.	110	105	80	170	70	285	10	400	10	400	10	600	10	400	2460
Loan															
I. Construction Component	-	-	50	-	50	-	-	-	-	-	-	-	-	-	100
II. Credit	-	-	-	500	-	1500	-	2000	-	2000	-	2000	-	3470	11470
III. On Farm Water Management	10	50	60	50	60	50	60		70	50	70	50	-	-	630
IV. Institutional Strengthening	75	60	275	60	275	60	200	60	200	60	100	60	50	65	1600
V. Contingency	100		300			100		100		100					700
TOTAL	1145	315	1585	880	955	2095	800	2710	470	2760	180	2860	110	4085	22700

Figure 17B
SUMMARY DISBURSEMENT SCHEDULE

GOH	YEAR 1 FX	YEAR 1 LC	YEAR 2 FX	YEAR 2 LC	YEAR 3 FX	YEAR 3 LC	YEAR 4 FX	YEAR 4 LC	YEAR 5 FX	YEAR 5 LC	YEAR 6 FX	YEAR 6 LC	YEAR 7 FX	YEAR 7 LC	TOTAL
I. Construction	-	-	35	-	35	-	35	-	35	-	35	-	35	-	250
II. Production Credit	-	200	-	400	-	500	-	700	-	900	-	1100	-	600	5000
III. On-farm Water Mgt.	100	100	150	150	150	150	150	200	150	250	150	300	150	450	2600
IV. Institutional Strenthening	50	100	100	150	100	200	100	250	50	290	50	290	50	300	2080
TOTAL	150	400	285	700	285	850	285	1150	235	1440	235	1690	235	1350	9930

63

IV. PROJECT ANALYSES

A. Administrative Analysis

1. Directorate of Water Resources

a. Legal Status of Objectives

The Directorate of Water Resources was established by a Decree Law in 1977 as a dependency of the Ministry of Natural Resources. Its charter gives it a mandate to manage the country's water resources, especially as they pertain to rural areas. This responsibility includes the promotion, planning and execution of irrigated agriculture, both in terms of infrastructure development and on-farm water management.

b. General Organization and Personnel

Organizationally, DRH is headed by a Director General who reports, through the Secretary of Natural Resources, to the Minister of Natural Resources. At the central office level, the Directorate has a staff of 35 professionals distributed among staff and line divisions. The principal staff offices are Administration and Planning. The former carries out all office support functions (personnel, accounting, etc.) while the latter is responsible for the overall programming of water resource management interventions. Major line units include: (1) Operations and Maintenance; (2) Groundwater; (3) Irrigation and Drainage Engineering; (4) Hydrology and Climatology; (5) Agricultural Engineering; (6) Law; (7) Training and (8) the Small Irrigation Projects Unit. Each of these units is managed by a division director and staffed with professional and administrative support personnel. Figure 18 schematically demonstrates the organizational matrix of the Directorate's central office staff.

Seven regional units complement the central office. These units are located in Choluteca, Comayagua, San Pedro Sula, Santa Bârbara, La Ceiba, Olanchito and Santa Rosa and are responsible for carrying out water resources activities (e.g., irrigation system construction, drainage works installation and on-farm water management) in the neighboring geographic areas. Ideally, each of these field offices would have full complements of engineering and extension staffs under the supervision of a regional director. However, actual staffing patterns reveal a considerable number of vacancies, particularly with respect to agronomist-extension agents.

c. Capacity to Carry Out the Project

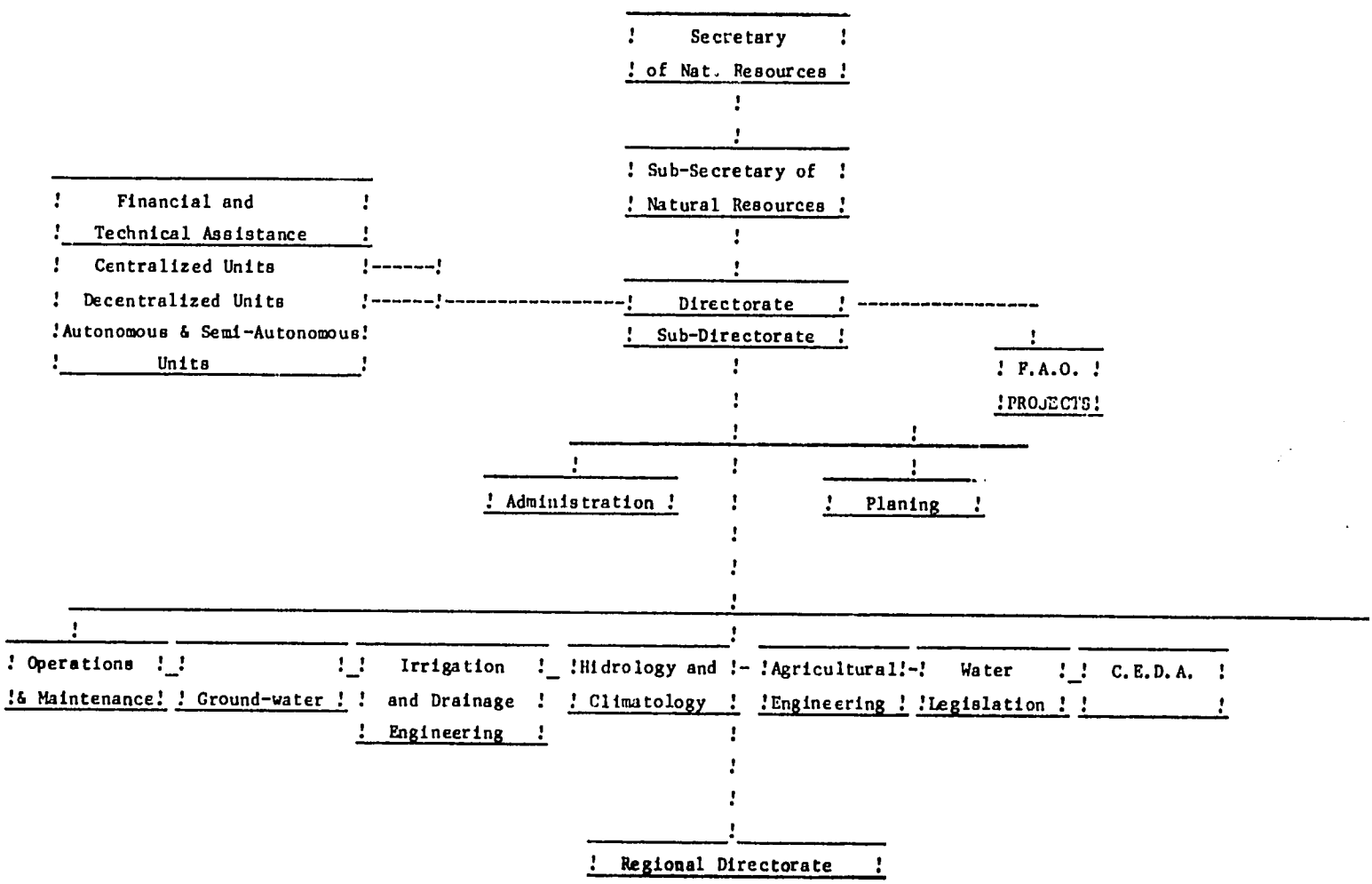
DRH has used AID loan and grant funds, under the Agriculture Sector II Program (522-0252), to put in place a number, of simple and medium technology irrigation systems. Through its Small Irrigation Project Unit, the Directorate is currently involved in implementing a micro-irrigation system program with assistance from the Food and Agricultural Organization. This

effort, funded with PL480 local currency generation will have installed approximately 80 systems by its conclusion early in calendar year 1987. It is the judgement of Honduras Mission that, this prior experience, coupled the presence of a cadre of highly trained professionals (approximately 12 of whom received training to the Master's level in U.S. universities under the Agriculture Sector II Program) in Hydrology, Agricultural Engineering and other sub-fields of water resources management, gives DRH a sound basis for successfully carrying out its role in the project.

Figure 18

MINISTRY OF NATURAL RESOURCES

ORGANIZATIONAL CHART



2. The Honduran Central Bank

a. Legal Status and Objectives

The Honduran Central Bank was founded by Congressional Decree No. 53 in February, 1950. According to this Decree, and subsequent legislation, the Bank's principal responsibilities are to define and exercise the monetary policy of the country, arbitrate on foreign exchange matters, and sanction the existence and operating procedures of the private banking system.

b. Capability to Carry Out Project Responsibilities

As discussed previously, the project will establish a mechanism (Irrigation Financing Facility-IFF) within the Central Bank to provide both medium-term investment credit and short-term production credit to project participants. The CBH will be responsible for the foreign exchange risk for that portion of the trust funds ($11.470 million) that will be furnished by AID loan resources. The trust funds will be channeled from the CBH to private and agricultural development banks for on-lending to the ultimate borrowers.

USAID has no reservation of the CBH's capability to manage the trust fund and guide the process of monitoring the participating private banks. In 1985 the CBH assumed responsibility for a number of trust accounts related to credit lines under AID funded projects (e.g. coffee cultivation and transportation, export promotion, cattle raising and housing). The total amount of funds encompassed by these credit lines approaches $100 million. In each instance, the CBH has also been a key player in selection of participating private sector financial institutions. While there have been isolated incidents of moderate delays in bringing such credit lines on-stream, especially with respect to negotiating private bank spreads, the system has functioned well. The Mission has every reason to believe that it will do so under this project.

B. Social Analysis

This social analysis will address three questions: first, the characteristics of farmers that live in the area where the project will be implemented; second, factors affecting the project's socio-cultural feasibility; and third, the anticipated project benefits to women.

1. Types of Farmers Expected to Participate in the Project

Project participants may be grouped into two main categories: independent farmers and land reform beneficiaries. Independent farmers may be affiliated to a credit or service cooperative, and land reform beneficiaries may be affiliated to a production cooperative. In the case of production cooperatives, land may be cultivated collectively. Collective land cultivation will probably exist when land reform beneficiaries are producing mainly for the market and not for family consumption. Based on the characteristics of the target population, three different types of irrigation systems will be constructed: (a) single farm-unit systems benefitting small independent farmers, unassociated with any type of cooperatives; (b) systems

shared by a group of independent farmers cultivating adjacent plots and possibly affiliated to credit or service cooperatives; and (c) systems for agrarian reform farms where land is cultivated collectively. It is anticipated that system rehabilitation will benefit the same types of farmers.

Geographical variations between the different groups of project participants also exist. The Departments of Choluteca and Francisco Morazán, in south and south central Honduras, are characterized by a high degree of "minifundismo" (micro farming units) and hillside agriculture over eroded soils. The Departments of Atlántida, Cortés and Yoro, in Northern Honduras, on the other hand, are characterized by less minifundismo, larger sized farms and flat land agriculture. In addition, the agrarian reform cooperatives basically producing for the market and having achieved greater success are located in the north. As a result of these characteristics, it is likely that the extension and degree of poverty will be greater in the south than in northern Honduras. This is applicable both for independent farmers and land reform beneficiaries.

It is expected that the baseline study to be conducted as part of the evaluation activities of this project and the social analysis components of the infrastructure feasibility studies will provide specific up-dated socio-economic data on project participants, and that these data will assist project implementers in designing regional strategies to accomplish project objectives.

2. Socio-Cultural Feasibility

There are certain legal, socio-economic and cultural factors that will most likely affect project implementation. These are: (a) the land ceiling established by law for irrigation districts; (b) the land tenancy patterns prevailing throughout the country; (c) the various degrees of farmer entrepreneurship and managerial capacity; (d) the expected farmer's role in water user groups and the appropriate function of these groups in implementation; and (e) legal status. The purpose of this section is to discuss these factors as they effect project implementation, and when appropriate, the strategies included in the project to deal with them.

a. Land Ceiling in Irrigations Districts

According to Articles 24 and 25 of the Agrarian Reform Law, all privately owned latifundios (large landing holdings) are subject to expropriation. Further, the law specifies that farms over 100 hectares located in state irrigation districts are considered latifundios, hence these properties could be expropriated. These legal regulations are particularly important in the case of irrigation systems that will be shared by independent farmers if the combined area is in excess of 100 hectares and if the system is to be located in a "state irrigation district." Systems built under such a combination of circumstances can contribute to conflicting claims of land ownership.

The project will ameliorate this problem by limiting the number of systems in excess of 100 hectares to exceptional cases. In these rare instances, the sub-project feasibility studies must demonstrate in a clear fashion that the proposed land area is free of legal entanglements for the subproject to be considered for financing. If this requisite cannot be met, the sub-project will not be financed.

b. Land Tenancy

Land tenancy is an important issue because it directly effects motivation to assume a medium-term investment and effects farmer ability to meet loan application requirements. Despite the AID Land Titling Project currently under implementation, insecure land tenure continues to characterize the majority of small farms in the country. There are experiences in Honduras where small farmers have decided to make medium-term investments despite insecure tenure. However, this has been limited to instances in which the crop (e.g., coffee) that is cultivated assures farmers that land will not be subject to expropriation according to the Agrarian Reform Law, thereby eliminating the possibility of a counter claim of ownership or cases, where the investments are small and farm improvements have not required formal credit. Decree 71, "the Coffee Law", also provides for the granting of fee simple titles to coffee growers with farm sizes of less than five hectares. The critical point is, that to the degree that land tenancy is unsettled, farmer inclination to undertake a significant investment is reduced. Furthermore, the possession of a fee simple title is a key bank criterion, for loan approval, particularly with respect to investment loans. Although such titles are not the sole required condition for obtaining credit, the absence of such a title is sufficient cause for banks to not even consider a loan application. However, experience in Honduras indicates that these several sets of conditions under which this general principal does not apply. For instances: (1) in cases where loans are channeled through intermediary organizations which assume liability for loan delinquency and have grass-root systems to affect collection; (2) in cases where specialized institutions provide technical support to producers and assist banks in supervising loans; (3) when farmers are affiliated to multi-service cooperatives where they hold capital shares which could be used as collateral; (4) where the type of agriculture activity to be supported by the loan offers special guarantees of success and special loan repayment conditions are established or; (5) when farmers self-finance a portion of the total investment.

The project design includes several mechanisms to diffuse the problems generated by the land tenancy question. First, there will be a concerted effort to establish a close working relationship between DRH and the National Agrarian Institute (INA) -- the GOH entity responsible for implementing the Land Titling Project. Second, attempts will be made to assure that land holdings improved through irrigation, which are economically viable can be declared eligible for titling, in a range from one hectare up to a maximum which is consistent with the Agrarian Reform Law.

Third, through the Irrigation Financing Facility, the project will establish a system whereby farmers will have access to credit for infrastructure and for production. Fourth, on-farm water management technical assistance will be provided to participants by the IAG. As pointed out in Section III, D, 2 this assistance will include the developing a Farm Plan that will be a prequisite for production credit loans. Fifth, credit resources furnished by the project will be managed by a trust fund arrangement. Finally, loan repayment terms will include special financing arrangements to assure that the credit can be extended in a way that is compatible with the beneficiaries capacity to absorb it. For example, medium-term investment financing arrangements will include a reasonable grace period on interest. Moreover, payment schedules will coincide with planting cycles to assure that due dates coincide with farmer cash flows and installment amount will be tailored to individual borrower financial condition. It is the Mission's belief that this "package of strategies" will be adequate to assure that the land tenancy constraint is minimized.

c. Farmer Entrepreneurship and Efficiency

Honduran farmers, working individually or collective farms, show varying degrees of entrepreneurship and managerial capacity. Using the motive of production as a classifying criterion, several categories of farmers could be constructed. Subsistence farmers and entirely commercial enterprises, represent the extremes. Commercial enterprises geared toward profit-making, yet still producing for family consumption would constitute intermediate categories. While commercial enterprises work with a certain degree of efficiency, it is not likely that they will qualify for inclusion in the project. Project participants will be drawn from the subsistence and partial market integration categories; grower subsets that exhibit only minimal efficiency.

It has been argued that peasants manage production factors to allow system survival and not growth (Gould, 1986). This is the result of the fact that access to land, capital and markets is limited, despite the existence of a labor surplus. When access to the factors of production and the market increase transformation of the traditional peasant production system may take place. The transition from a traditional peasant farm to a commercial enterprise, however, is obviously not simple. Peasants becoming farmers must learn to manage available family labor differently and to handle credit, new technologies, new agricultural practices, and market forces in order to generate economic benefits that can allow them to raise the living standard of their families.

The geographical area for the project is the country's central development corridor. It is an area where important valleys characterized by higher national road density, a tradition of institutional activity to modify traditional peasant agriculture and proximity to important urban markets, are located. The presence in this area of producer organizations, land reform production cooperatives and service cooperatives, managed by professionals, will help channel resources to the target population and provide assistance in credit management, adequate irrigation use and marketing of surplus production.

To address these problems, the social analysis component of the infrastructure investment feasibility studies must demonstrate that the labor, technical, managerial and marketing issues entailed by irrigation technology can be reasonably managed by farmers with limited sophistication. For example, the farmer will probably depend on family labor to take initial advantage of these systems. It has been estimated that on farms of under 35 hectares from 50 percent to 75 percent of the available family labor is used (AID, 1978; Harrison and Hernández, 1983). Even when seasonal off-farm employment is taken into account, the percentage of unused family labor should remain high. However, regions may differ from national trends due to the types of crops cultivated (e.g., sugar or coffee) or because of the proximity to urban centers. Consequently, loan approval for the construction of irrigation infrastructure must demonstrate labor availability.

There will be situations, nevertheless, where this institutional network will not exist nor function inefficiently. Absence of supportive institutions is likely to occur in the case of independent farmers, whereas presence of deficient institutions is likely to be found in the case of collective farmers benefiting from agrarian reform adjudications.

d. Farmer Commitment to Water User Group Obligations

The project proposes to organize water user groups to identify, install, manage and maintain three different types of irrigation systems. By definition, water user groups would not be needed in the case of irrigation systems to benefit only one farmer.

On this point there are three social feasibility issues of relevance: 1) liability in the case of loan repayment or outstanding debts; 2) equal access to water, and 3) distribution of responsibilities for system maintenance.

Potential project beneficiaries will participate in project identification and in providing information regarding physical variables (e.g., climatic, environmental, agronomic) that may affect system design and operation. This participation will contribute to legitimize any future activity and to develop a sense of system ownership.

In the case of cooperative farmers benefitting from the project, it is expected that the cooperative or a section of the cooperative will become the water user group. Power sharing in system management in the case of these farmers will have to follow existing cooperative organizational principles.

The organization of individual farmers sharing an irrigation system into a water user group will take into account the farmers' previous organizational experience. To the extent possible, water user groups will be based upon informal organizations that may exist in project areas. Nevertheless, informal linkages will become formal through the water user groups. The transition from informal to formal linkages will be needed as leaders of water user groups must demonstrate accountability both to their constituency and to the project's implementing agency. Accountability upward or downward will not exist if only informal linkages are kept.

Formalization of linkages, should not be to favor powerful or certain sub-groups to the detriment of others, as for example in the precedence of the power of larger over smaller farmers, of older over younger participants, and of male over female beneficiaries. The project will also provide technical assistance to communities in organizing and managing water user groups.

Liability is an important issue, particularly because the irrigation systems to be constructed under this project will include instances of collective property. In the case of the agrarian reform groups, the commercial agriculture activities in which they are involved normally take place on undivided plots of collective farmland. Irrigation systems will be constructed to support or expand these activities. If this farmland is already owned and used collectively, it can be assumed that farmers will be interested in collective ownership and collective liability of the new infrastructure. However, in the case of individual farmers benefiting from shared irrigation systems, or producer associations capable of providing institutional support for project implementation, the sense of shared liability will be absent. There will be more concern for, "one's own portion of the system." In these instances liability will concentrate on the individual portion, but will also include shared responsibility for the financing and maintenance of common parts of the system -- e.g. reservoirs and main distribution canals.

The experience of small farmer loan repayment in Honduras is extremely uneven. Debt cancellation has been very good among independent growers with a high value commodity, such as coffee, and cooperative groups involved in both export and basic grain production. Results have been less favorable with agrarian reform groups. Frequently, such units are poorly organized and use tangible assets (e.g., production) as collateral. The group, and not the individual farmer, is liable in the case of credit default. When producers confront losses, they tend to leave the group. New members refuse to pay old debts for which they were not responsible, and the lender, in most instances BANADESA, is unable to obtain repayment. The question is whether loans should be granted to groups, particularly when farmers cannot mortgage their land.

The project includes several strategies to address this constraint. First, there will be a bias in favor of participants (individuals or groups) with positive credit ratings. It is expected that through concentrating on relatively more credit worthy clients overall delinquency rates will be reduced. Second, whenever possible, the liability for both infrastructure and production crdit will rest with the individual borrower and not any organizaton to which a participant may belong. In those cases, loan collection will be matter to be resolved strictly between the bank and the borrower. This arrangement will eliminate the historical practice of growers renegging on repayment and saddling the organizational entity with the liability. Third, the organization of water user groups will be a requisite for the issuance of infrastructure investment credit. Water user groups will be expected to play a role in loan repayment. The by-laws and regulations of each water user group's charter, will contain a section or sanctions against members for delinquent loan payments.

The Water User Group by-laws that will be developed by each association of irrigators will regulate the operaton and maintenance of the irrigation system constructed. Specifically, they will regulate access to water and the distribution of responsibilities for system maintenance. One of the problems confronted by farmers sharing irrigation systems is that users furthest away from the source of water may have restricted access to the resource. To prevent disputes between group members regarding this issue, the by-laws must clearly establish how water will be distributed. Possible solutions include the implementation of irrigation schedules or the establishment of mechanisms whereby farmers furthest away from the source get water first. In addition, the by-laws should establish what contributions will be expected from farmers to maintain the system. In the case of farmers coming together for the first time to share an irrigation system, DRH and the IAG will provide assistnce in setting up a system for managing and accounting for contributions received. As noted previously, project funded technical assistance will be provided to establish and sustain effective WUGs.

The operation and maintenance of irrigation system includes preparing work plans, distributing water, control of water use, resolving conflicts between users, collecting fees for water use, preparating and implementing a budget, and applicating sanctions. To date, existing water user associations have not been involved in each one of those activities. Consequently, they have not faced the need to have legal status (e.g., "personería jurídica"). The situation will be quite different in the case of the water user groups to be created in connection to this project. Given their expected involvement in financial management, conflict resolution, and sanction application the enforcement of decisions made may require legal support. The new water law to be enacted must address this issue, stipulating the need for WUG's to have legal status. If personería jurídica becomes mandatory, the DRH will assist WUGs to obtain it.

3. Anticipated Project Benefits to Women

It is anticipated that women will have three main benefits from this project. One, access to infrastructure and production loans when they are land owners and/or are responsible for farm use. Two, reductions in the amount of time previously dedicated to the transport of water from water sources to the household. And three, access to employment opportunities that may develop through the more intensive use of land that irrigation will generate.

C. ECONOMIC ANALYSIS

1. Introduction

The principal benefits of irrigation projects and, in particular, those incorporated in the financial and economic evaluation of this project, derive from three sources:

- Increase in agricultural yields, brought by the use of new technologies in production, made feasible by the availability of irrigation water.

- Increase in cropping intensity, due to the availability of water during periods when fields would otherwise be unproductive.

- Change in the cropping pattern to reflect the increase of crops that require irrigation, and which are now possible.

Certain other benefits were not quantified to derive economic and financial rates of return. For example, irrigation will also benefit non-project farmers, because it will make available water that was previously wasted. Also, there is likely to be a demonstration effect that will induce other farmers to expand irrigated agriculture.

The economic costs of the project include farm production costs (labor, inputs, machinery services); working capital investment, irrigation system investment and maintenance costs; extension services, training, purchase of equipment and other technical assistance expenditures; and administration, evaluation, and auditing costs.

The key results of the economic analysis are set forth in Figure 19A. It provides estimates of the economic rate of return for 12 representative irrigation prototypes of the sort the project may finance. These 12 prototypes are derived from applying three different scales of irrigation systems to four farm models. The three different scales of irrigation system are simple, medium and sophisticated. The four farm models are distinguished by the type of technology applied (traditional or intermediate) and by the accessibility to transport infrastructure (normal access or remote access) for input delivery/output marketing.

Figure 19A
Economic Internal Rate of Return (EIRR)
by Farm Model, and by Scale of Irrigation System
(Percentage)

Scale of System	FARM MODEL			
	Traditional Technology		Intermediate Technology	
	Normal Access	Remote Access	Normal Access	Remote Access
Simple	22.8	15.2	24.7	16.0
Medium	19.0	12.4	20.2	12.9
Sophisticated	16.9	10.8	17.8	11.1

Source: Table 28, Annex H.

As is apparent from Figure 19A, the economic rates of return for the 12 prototypes range from about 10.8% to 24.7%. In general, according to these data, irrigation investment is more profitable in locations with normal access to transportation facilities, and on farms employing

intermediate technology of production. Furthermore, smaller irrigation systems are preferable to larger ones. A most likely combination of the above farm models and irrigation systems was chosen, and the EIRR for such case was estimated at 18.3%.

Sensitivity analyses show that even under unexpected changes in the projections, the EIRR is still high enough to justify the project based on economic considerations. It was found that cattle raising and fruit production are less profitable than other land uses. These two activities should be avoided when implementing the project unless new cost and production data show that our estimates are unduly pessimistic.

In brief, the information set forth in Figure 19A derives from farm models. For each farm model, with- and without-project profiles are characterized through farm budgets. These farm budgets estimate cropping pattern's, use of inputs and machinery, employment and net return. The differences between with- and without-project scenarios provide estimates of the anticipated benefits.

Details on the economic and financial analyses summarized here are set forth in Annex F. Those analyses start from crop budgets and go to farm model budgets, to end with the economic analysis of the entire project in a variety of alternative formulations.

2. Financial Analysis

This analysis refers to costs and benefits as perceived by the farmers participating in the project. It uses financial or market prices for production and inputs, as opposed to economic prices. In addition, there are some costs which are economic costs, but are not financial costs to the farmer, such as project administration and technical assistance. The financial analyses of farm models indicate that the average (weighted) value of annual net returns per hectare increases from L193 in the without-project situation to L2,775 in the with-project situation at full development, measured in constant 1984 Lempiras, e.i., an increase in net returns of L2,582. The large L2,582 increase in the net return.per hectare, supposes not only the availability of irrigation but simultaneously the adoption and correct application of modern technologies related to new cultural practices. As such, a farmer will take four years to reach full development yields if his previous technology is intermediate, and six years if it is traditional. Such increase in net returns per hectare should easily permit cost recovery of the irrigation investment. These net return figures, moreover, are largely indicators of farm profits. As such they do not include increases in farm wage income brought by the expansion of employment on the farm, employment that will be absorbed mainly by the farmer's family.

Taking into account the investment costs of providing irrigation, as well as the foregone benefits of the previously non-irrrigated agriculture exploitation, financial internal rates of return have been calculated for the 12 farm prototypes, as presented in Figure 19B. These financial

IRR's are higher than the economic IRR's presented in Figure 19A mainly because costs such as Technical Assistance, Extension, and Project's Administration, although part of the economic costs of the Project, are not costs to the individual farmer participating in the project. Accordingly, the project is also financially sound, because the investment in irrigation infrastructure is financially profitable for the participating farmer.

Figure 19B

Financial Internal Rate of Return (IRR) Before Financing
(Percentage)

Scale of System	FARM MODEL			
	Traditional Technology		Intermediate Technology	
	Normal Access	Remote Access	Normal Access	Remote Access
Simple	28.5	20.7	29.3	20.4
Medium	22.9	16.5	23.1	16.0
Sophisticated	21.2	15.2	21.3	14.6

3. Cost Recovery

The high returns per hectare easily provide a basis for full cost recovery, while simultaneously enabling farm net income to rise substantially. This analysis is developed in detail in Tables 22-a and -b, and 23-a and -b, in Annex F. Those tables calculate the cash balance of the farmer under alternative financial terms, i.e. different combinations of interest rate, grace period and maturity, for the two extremes of farm models: the worst and the best case. The worst case refers to a traditional technology farm, with remote access to transport, and medium size irrigation system. The best case refers to an intermediate technology farm, with normal access to transport, and micro size irrigation system.

It was found that with an 8% real interest rate (to which, inflation should be added to have nominal interest rate); grace periods of 3 to 5 years, and maturities from 8 to 14 years farmer can pay for irrigation investment, leaving him a cash balance of at least L300 per hectare every year. However, the results indicate that some of the farms will require support credit the first two years after starting irrigation.

Applying a 12% real interest rate to farm credits with the same grace periods and loan maturities still provides a financially feasible alternative to the farmer, as long as additional support credit is provided during the first one to three years.

76

The sum total of the financial and economic results are indicative, as distinct from definitive, because they are based on "type" systems and average costs. Clearly there will be variations in cost and construction design as the systems are de-facto put in place.

It is important to mention that according to observed experiences, project success will greatly depend on the adequate provision of extension, credit, and marketing services. Extension and credit are included in this project.

4. Contribution to Jackson Plan Objectives

Once the project's benefits stabilize at the full development stage of the project, that is after its 15th year of implementation, its annual contribution to Jackson Plan objectives (in constant 1984 Lempiras) will be as follows:

- Net economic benefits of L19.7 million per year.
- Labor income of L6.9 million.
- Provide employment of 1.36 million man-days, equivalent to agricultural employment for 6,800 persons.
- Annual farm income of L28 million, equivalent to L5,900 per family for the expected 4,830 farms families that will participate in the project.
- GDP generated by the project will be valued at L29.0 million, that is 0.4% of present GDP.
- Net exports of L784 thousand a year.

5. Contribution to USAID/Honduras Action Plan Objectives

Among Action Plan Objectives for Agriculture of USAID/Honduras, there are three which are particularly relevant with respect to this project. They are: agricultural production, per capita GDP, and irrigated area.

With project implementation beginning in 1987, its contribution to these objectives by 1990 will be:

- US$5.90 million of agricultural production (Table 32, Annex F).
- Agricultural GDP (farm income, Table 31, Annex F) of US$2.49 million. Assuming 730,000 workers in agriculture, this represents US$3.41 per worker, which is 1% of per capita GDP of 1986 (US$343).
- 2520 ha. irrigated (Table 30, Annex F).

6. Revised Economic Internal Rate of Return (EIRR)

All the above economic and financial results were obtained assuming:

i) A land use pattern that included 26% of pasture for cattle raising, and 16% for the production of fruits (Table 1, Annex F).

ii) An implementation schedule that irrigated a total of 7730 ha, with most of this area corresponding (66.3%) to simple irrigation systems (Table 25, Annex F).

iii) Total project expenditures of approximately US$27 million during the first seven years of the project, as presented in Tables 26 and 27 of Annex F.

It is worth nothing that subsequent economic analyses based upon slightly different parameters determined that, the EIRR of the Project would be somewhat higher at 19.8%. Specifically, these parameters are:

i) Because of the low profitability of permanent crops, it was decided to eliminate pasture from the project. The resulting land use pattern is presented in column A of Table 29 in Annex F.

ii) An alternative implementation schedule was proposed, reducing the total irrigated area to 6,627 ha, as presented in Table 30, Annex F.

iii) Finally, total project expenditures were also modified, to the figures presented in the PP.

Considering all these modifications, the EIRR of the project was recalculated, giving a figure of 19.8%. Thus, the economic internal rate of return slightly increased with these new parameters. This confirms of course, that previously obtained conclusions have been improved or at worst have not been negatively affected by a new set of parameters.

D. Environmental Considerations

1. Introduction

The Project will finance construction and rehabilitation of new or existing irrigation systems plus associated drainage works where necessary. Accordingly, the potential for both beneficial and adverse environmental impacts will exist. All of these potential impacts will be maximized (beneficial) or controlled/avoided through prudent irrigation system design and construction practices. For example, the possibility of erosion caused by too rapid water flow will be minimized or eliminated by the proper design and construction of irrigation distribution systems and/or by means of proper land leveling.

The Project's environmental effects will be both direct, affecting the land under irrigation, and indirect, affecting the people and lands served by or surrounding the systems. Direct effects will include such

things as reducing erosion and improving drainage in farmers fields, and eliminating pools of water associated with poor irrigation design and construction and which often serve as breeding grounds for the vectors of water borne diseases.

Following the example of the Rural Roads II Project (522-0214), this Project will rely on an environmental review process to ensure that specific subprojects are environmentally sound. The review process will make use of a matrix of environmental conditions and proposed subproject actions to compare the expected environmental results of a subproject to the existing state of the environment. If it appears from the matrix that a proposed subproject will have an adverse impact on the environment that subproject will not be accepted.

To attain uniform application of the environmental review process, the project will conduct a series of training sessions on how to apply the process. Subproject evaluation will include an environmental component to determine how land use has been affected by the subproject. Measures will be taken to alleviate any irrigation and associated land use practices that tend to degrade the environment. It should be noted that, while the aspects described above are not so serious as to warrant an environmental assessment (and in fact a negative determination was recommended in the IEE) steps will be taken in the course of the Project to examine the environmental implications of subsequent work to assure minimal impact at any given work site.

2. Environmental Backdrop for the Project

Most of the land affected by this Project supports a complex array of land use practices. The land itself tends to have very variable quality and productive capacity. Land quality changes markedly over short distances. Typically, the land is hilly with very little level land. Slopes vary from moderate (15%) to extreme (70%). Soils vary in fertility, depth and susceptibility to erosion. Ordinarily better soils occur on level or gently sloping land, whereas the steeper slopes only support rocky, more primitive soils.

The most intensive and most productive land use logically occurs on the best land. Here, mixed annual crops, perenniel crops, tree crops and confined livestock raising can be observed. Often one notes that stable agroforestry has developed on these lands and will probably continue.

Most steep, poor land is also used, however, often beyond its capacity, so that its low productivity actually decreases over time and probably will continue to do so. People farm the hillsides, mainly to grow corn, Honduras' basic subsistence crop, without practicing any form of soil conservation. The hillsides are also grazed by cattles and sometimes by goats. The hillsides support scrubby forests which yielded their best timber long ago, but which continue to provide firewood, fence posts, wood for crude construction and some lumber for furniture and housing.

Much of the land, especially the hillsides used for cultivation and grazing, is burned frequently, usually annually. Burning makes it easier to clear and prepare land for cultivation. It also promotes growth of tender pasture. Ashes from the burning add quick-release nutrients to the soil. But burning provokes erosion, reduces diversity of plants and animals, and destroys humus. In the long run, frequent wide-spread burning does not enhance land quality but causes land to deteriorate.

The lands affected by this Project have been settled for some time. Their population appears stable. Improvement of access by the project will probably not attract new settlers; it will probably not promote out-migration either.

3. The Environmental Review Process

To assure that ecological concerns are taken into consideration with all Project related activities an Environmental Review will be a standard component of the selection process. A matrix of environmental review criteria will be applied in the field, during the subproject feasibility study. Ten existing environmental conditions will be listed along the left side of the matrix and ten proposed subproject actions will be listed across the top. Each of the 100 boxes in the matrix will be divided diagonally allowing insertion of two numbers in each box. In the upper left half of each box the environmental reviewer will insert number that indicates the status of each existing condition before the subproject. A number that indicates the anticipated status of each condition after the subproject will be inserted in the lower right half of each box. All the numbers for existing conditions before the subproject are summed and so are all the numbers for anticipated conditions after the project. The two totals will be compared as the ratio of pre-existing conditions to anticipated conditions. This ratio is then converted to percent. To be approved a subproject must attain at least 75% on the environmental review matrix. That is environmental deterioration anticipated by the subproject cannot exceed 25%. If a subproject does not attain the required 75%, it will be rejected on environmental grounds. However, it is anticipated that improvements made by the project would produce review results that exceed 100%.

The environmental review matrixes will prepare definitions and instructions to the reviewer. Nonetheless, each reviewer's application of the criteria may be somewhat different, resulting in different results. It could be possible that in a close case one reviewer could approve a subproject, while another could reject it.

A greater uniformity in the environmental review-process will be achieved by holding a seminar, lasting two or three days, on application of the review process. The seminar will bring together the technicians who will perform the reviews in the field to apply the review process to several actual proposed subprojects. Using the proposed irrigation subprojects as models, the seminar participants will discuss each environmental condition and each proposed action to reach consensus on what each means

and how to determine it in the field. It is possible that in the course of the Seminar environmental criteria or methodology could be modified. If the seminar is successful, it might be repeated several times during the life of the project.

Periodic evaluation of irrigation subprojects will include environmental evaluation. This evaluation will compare actual environmental conditions in a subproject area a year or two after completion of the subproject with the anticipated environmental condition set out in the matrix for the subproject. Where actual environmental conditions after the subproject show significant deterioration, the project will bring environmental technical services to the subproject area. These services will come from sources outside the project, e.g., from the Ministry of Health for public health services, from the Ministry of Agriculture for soil conservation services.

4. The Environmental Review Document and its Use

The Environmental Review for each subproject will be carried out by means of an Environmental Review Document (ERD). The purpose of the ERD is twofold: 1) the ERD will help subproject evaluators to identify major direct and indirect environmental impacts that might occur in any given subprojects, and 2) the ERD will enable all evaluators to determine which subprojects are unacceptable from an environmental perspective.

The ERD itself will consist of a standard package including cover sheet, instructions for the use of the ERD, a matrix, a sample ERD which has been completed, a section for comments and recommendations with respect to overall subproject impact on the environment and finally, an environmental determination (positive or negative) signed by the field evaluator and reviewed by the Administrative Unit in Tegucigalpa.

For each construction contract, an insert section will be used to describe in detail the subproject(s) to be considered in the Environmental Review. The description will include the number of subprojects, area to be irrigated, and a map showing the relationships and locations of the subprojects.

E. Technical Analysis

1. Land Use Capability

Land use capability is a critical pre-requisite to planning for successful and sustainable rural land occupancy. The term refers to the ecological suitability of any homogeneous plot of land for specified types of economic uses on a continuous basis without causing deleterious effects in the short-term or long-term in the original productive capacity of the land. As noted earlier in the body of the paper, of the approximately 11,000,000 hectares of agricultural land in Honduras about 2,750,000 hectares are classified as valley land suitable for

irrigation. This valley land has the soil properties, topography and potential water availability to sustain production without deleterious impact, not only under the current low level of technology, but also with advanced technology systems associated with irrigated agriculture.

2. Irrigation Technology

To increase the production potential of the agricultural lands that will be included in the project requires a change in the production system through the introduction of an improved technology (irrigation) and the more efficient use of resources available to the farmer. As described previously, the irrigation technologies to be used in the project vary considerably, spanning the range from simple gravity flow earthern canals or hose arrangements to sophisticated mechanical lift sprinkler or drift irrigation systems. All of these approaches are generally recognized as being sound mechanisms for conducting irrigated farming. The choice of technology to be applied in a particular situation will be determined by the ecological conditions of the particular site, the size of the system, the financial possibilities of the intended beneficiaries and the sophistication level of the producers vis-a-vis the proposed technology. Such determinations will be based on feasibility studies which will include, inter alia, an assessment of the technology that would be appropriate for the situation.

3. On-Farm Water Management

Previous experience, both in Honduras and elsewhere has demonstrated that the absence of on-farm water management technical assistance, inhibits the potential output of irrigated agriculture. There is a clear need for ample, sustained and appropriate extension services to assist farmers to take full advantage of the technology newly at their disposal.

The project will address this need through the IAG extension cadre. The IAG will assign two senior agronomists and two agronomists to each of the seven regional offices that will participate in this effort. Their principal task will be to assist farmers in the proper application of modern inputs (e.g., seeds, fertilizers, improved plant stock) and appropriate cultural practices required by irrigation. The outreach capacity of these professional extensionists will be complemented by the use of paratechnicians (10 per regional office). The paratechnicians will be selected from among farmer leaders, will be trained by DRH and will provide follow up to site visits carried out by the IAG extensionists.

Project financed training and use of the mass media will be used to amplify the efforts of the extensionists and paratechnicians. The training will be for the most part, practical encounters such as on-farm demonstrations and field days. In addition, there will be seminars and short courses on specific water management related topics. All training will be organized by DRH.

The mass media activities will consist of articles in the farmer newspaper "El Agricultor" and radio messages to reinforce the technical assistance and training. Again, the information will be practical, relevant and presented in a fashion that is congruent with the sophistication level of the beneficiaries.

V. Project Implementation Arrangements

A. Administrative Arrangements

1. Role and Responsibilities of USAID

A.I.D. project monitoring and coordination will be the responsibility of a Project Officer designated by the Office of Rural Development, and assisted by other appropriate offices within USAID/Honduras. The Project Officer will be responsible for monitoring the flow of inputs, gauging the progress of project activities, and coordinating with the GOH and private sector implementing institutions. The Project Officer will work closely with the DRH to supervise the IAG and to assure compliance with the terms and conditions of the Agreement, to verify that all proper procedures are followed for all commodity procurement, contracting and project management, and to help resolve any implementation problems and project issues which may arise.

A Mission project committee, composed of the project manager and representatives of other appropriate Mission offices will review project status on a quarterly basis, identify potential problems in implementation, and develop appropriate solutions. The Office of Development Finance (O/DF) will be responsible for preparing the Project Agreement and will support the project manager with the preparation of other project documentation. The Mission's Engineering Office will approve feasibility study guidelines, model construction contracts. The Engineering Office will also monitor construction. The Office of the Controller will review all disbursement requests for conformity with AID regulations and ensure that appropriate accounting procedures are followed by the DRH, the IAG and the participating banks. The Office of Program Development (O/DP) will coordinate all evaluations in conjuction with the project manager and will advise on data base requirements for the project.

All commodities and services, except services for construction of irrigation works, will be procured directly by A.I.D., in conjunction with the DRH. This will include purchase of local and off-shore commodities, and hiring of local personnel.

The Misssion intends to seek the highest quality technical assistance possible, in an expenditious manner.

In light of this, given the facility of 8-A contracting to expedite procurement of T.A. and given the Mission's committment to Grey Amendment goals, 8A set aside contracting will be seriously explored in long term T.A. procurement, evaluations and other assistance required.

2. Role and Responsibilities of Host Country

a. Directorate of Water Resources

The DRH, through its Small Irrigation Project Unit (SIPU), will serve as the lead counterpart agency for the project. It will be responsible for overseeing and coordinating the implementation of project activities. The Directorate and the SIPU will also be responsible for elaborating yearly implementation plans and securing counterpart resources in a timely fashion, monitoring of A.I.D. loan funds and 60H Lempiras used for credit which will be carried out jointly by the DRH and the Central Bank and, and overseeing jointly with A.I.D., the performance of the IAG and private sector contractors, as well as supervising construction. The DRH will also provide A.I.D. with quarterly progress reports on all phases of project implementation and work in conjunction with A.I.D. in conducting project evaluations.

At the onset of the Project, the DRH will initiate a number of projects for which technical designs have been carried out but which have not been executed for lack of funds. Once the project's technical assistance is in place, the DRH's role will focus on planning, establishing construction norms and standards, and supervision.

As mentioned, an initial task of the DRH's SIPU will be to begin work on projects it has alrealy developed. Other tasks will include: prequalifying local construction firms; negotiating the Irrigation Financial Facility with the Central Bank; making initial contacts with potential beneficiaries; and appointing a drafting committee for the National Water Law. The DRH and the SIPU will receive project financed assistance to complete these tasks. After completing the above listed initial tasks, the SIPU will focus on reviewing existing irrigation construction standards, refining guidelines for subproject feasibility studies and proposals, qualifying construction firms, developing the National Irrigation Plan, and implementing the National Water Law.

The regional offices will construct the small irrigation systems assigned to the DRH, develop regional irrigation plans, supervise, jointly with A.I.D., the work of the IAG and supervise the construction of the irrigation systems.

b. Water User Groups.

The use of beneficiary organizations will be an integral part of the project implementation. As part of the project promotion effort, the IAG along with the DRH, will help communities organize water user groups to manage and maintain irrigation systems.

In areas where cooperatives or rural organizations exist, a water user group will be incorporated into the organization's existing structure. In other areas, water user groups will be created using the leadership, organizational and participation principles that exist at the community level.

The function of the water user groups will be to achieve direct beneficiary participation in identifying, installing and maintaining the irrigation systems. In addition to these functions, the water user groups will play a role in assuring the repayment of loans, and assisting in the delivery of technical assistance. To assure that these groups function properly, the project will fund two long-term specialists in organizing and managing water user groups to assist communities in establishing their asociations.

c. Central Bank of Honduras (CBH). The CBH will establish an Irrigation Financing Facility (IFF) to provide an investment and working capital credit through commercial and public banks. The Central Bank, A.I.D. and DRH will begin to establish the Facility immediately after the Project Agreement is signed.

3. Role and Responsibility of the Irrigation Advisory Group (IAG).

The IAG will be a joint venture between U.S. and Honduran private consulting firms. The IAG will be selected by a panel composed of DRH and A.I.D. personnel. The expatriate partner of the joint venture firm will provide technical assistance to the DRH in overall planning, programming and implementing of project activities. The assistance will include advice on revising the Draft National Water Law and drafting subsequent regulations, developing the National Irrigation Plan, revising the guidelines for construction norms and standards, and programming on-farm extension. In addition to these activities, the expatriate team will assist in developing and implementing the national irrigation promotion campaign. This effort will use mass media and personal contact with potential beneficiaries, as well as venders of agricultural inputs, to promote both the project and the benefits of irrigated agriculture.

Responsibilities of the Honduran partner will include legal assistance in revising the Draft Water Law and drafting subsequent regulations, carrying out the subproject feasibility studies, preparing and presenting subproject proposals, and providing the on-farm extension technical assistance. To this end, the IAG will organize field teams that will work directly with each of the DRH regional offices.

B. Implementation Period

A seven year implementation period is projected for the AID participation in this initiative. A four year AID obligation cycle is planned. Equipment purchases and delivery should be completed within 24 months. Participation of long-term and short-term technical assistance will be phased over the life of the project to coincide with implementation of discrete activities.

C. Implementation Plan

The following is a tentative chronological listing of the project actions to be taken by AID and the implementing entities over the project's seven year life. This listing may be revised consistent with

implementation experiences and needs, through project implementation letters.

Date	Activity
1986	
September	Project Agreement signed
October	Initial CP's met; first disbursement made
	-Water Law Committee formed - RFP for T.A. prepared - Scope of Work for Project Liaison Officer prepared - IFB's for first tranch of commodities (15 vehicles, 15 trailbikes and computer ordered) - Recruitment of DRH extension agents and paratechnicians begins - Shelf-projects (25) reviewed by A.I.D. - Work on water law begins - Project Liaison Officer hired - Short-term T.A. to develop project training plan
November	- Farmer training seminar held - Public relations campaign continues - Water Law Seminar held
December	- Yearly implementation plan developed - Year end work shop to review progress held (AID/DRH)
1987	
January	- Responses to RFP's reviewed - Responses to IFB's reviewed - First set (9) of microsystems initiated - Central Bank local solitation of interest for bank participation issued - Construction begins on second set microsystems
February	- Joint venture contractor selected - First group (30) paratechnicians selected and trained - Construction companies pre-qualified - Construction begins on third set microsystems
March	- Contract awarded for long term T.A. - Contract(s) awarded for first off-shore procurement - First set microsystems completed, on-farm T.A. begins
April	- First group (5) of DRH technicians selected for long term training - Participating banks (2) selected - Second set of microsystems completed

May	- Advance party, expatriate technical assistance arrives; local technical assistance in place - Feasibility studies carried out on first set (4) of loan financed systems - Third set microsystems completed - First set of production loans made - IPAG establishes 3 field offices with personnel
June	- Expatriate T.A. team arrives in force - Water law draft reviewed by IPAG and DRH - Subproject selection criteria revised. - Training given to pre-qualified - Construction companies (8) - Workshop with beneficiaries held on-farm water management. - Construction begins on first set of loan financed systems - Farmer training seminar held
July	- Forms for feasibility studies revised - Water law submitted to Congress - Public relations mass media blitz carried out
August	- Construction standards and norms revised - First group of long-term trainees departs - Water law passed - Second off-shore commodity procurement initiated
September	- Work begins on fourth set microsystems - Feasibility studies carried out for second set loan financed systems
October	- Regional (3) and national irrigation plan completed - IAG presents subproject proposals to DRH. - DRH approves subprojects and awards certificate of eligibility for investment financing - Investment credit loans made for second set of loan financed subprojects - Construction contracts signed for second set of loan financed subprojects
November	- Two additional field offices (Santa Barbara and La Ceiba) added - IAG adds two field staffs (Santa Bârbara and La Ceiba) - Construction begins on second set of loan financed subprojects loan financed systems - Public relations campaign continues - Project vehicles and motorbikes arrive (first lote of 15)

December	- Yearly implementation plan prepared - Year end workshop to review progress undertaken (AID/DRH/IAG)
1988	
January-March	- Fourth set of micro-system completed - Work begins on fifth set microsystems - Public relations campaign continues - On-farm T.A. continues - Construction finished second set of loan financed subprojects - Feasibility study on third set of loan financed subprojects - IAG presents proposals to DRH for third set of loan financed subprojects - DRH approves third set of subprojects
April	- Second group (5) of DRH long-term trainees selected - Construction loans made for third set of loan financed subprojects - Construction begins on third set of loan financed subprojects
May	- Fifth set of microsystems completed - Sixth set of microsystems started - Second off-shore commodity lote arrives - Second set of production credit loans made
June	- Public relations campaign continues - Second group of paratechnicians (20) selected trained and assigned - Farmer training seminar held
July-Sept.	- Third set of loan financed systems completed - Feasibility studies for fourth set loan financed subprojects - IAG presentation to DRH of proposals for fourth set of loan financed subprojects - Construction credit loans made for fourth set of loan financed subprojects - Construction begins on - Second group of DRH long-term trainees departs - First interim evaluation carried out - Sixth set of microsystems completed - Seventh set of microsystems initiated
October	- Two additional regions (west central and east) added - Construction continues - Short-term training for DRH personnel carried out - Public relations campaign continues

November	- Farmer training seminar held - Public relations campaign continues
December	- Seventh set of microsystems completed - Yearly implementation plan developed - Year end work shop to review progress held (AID/DRH/IAG) - Feasibility studies carried out on fifth set of loan financed subprojects
1989	
January-March	- Eighth set microsystems initiated - Fourth set of loan financed subprojects completed - IAG prepares proposals for fifth set of loan financed subprojects - DRH approves fifth set of loans financed subprojects - Construction loans made and construction contracts signed on - Fifth set of loan financed subprojects - Work initiated on fifth set of subprojects
April	- Third group (5) of DRH long term trainees selected - Public relations campaign continues - Short-term training for DRH personnel carried out.
May	- Construction begins on ninth set of microsystems - Farm plans completed and production loans made
June	- Third set (20) of paraprofessionals selected and trained - Feasibility studies carried out for sixth (35) set of loan financed subprojects - First group of long-term DRH trainees returns
July-Sept.	- Construction completed on fifth set of loan financed subprojects - Construction completed on nineth set of micro projects - IAG presents proposals for sixth set of subprojects - Construction begins on sixth set of subprojects
October	- Construction continues - Public relations campaign continues
November	- Farmer training seminar held - Interim project audit carried out
December	- Yearly implementation plan prepared - Year end workshop to review progress undertaken (AID/DRH/IAG)

- Ninth set of micro-systems completed
- Feasibility studies carried out for seventh set of financed subprojects

1990

January-March

- Tenth set microsystems initiated
- Public relations campaign continues
- Sixth set of loan financed subprojects completed
- IAG presents proposals for seventh set of loan financed subprojects
- DRH approves seventh set of loan financed subprojects
- Construction loans made, contracts signed and work begins on seventh set of loan financed subprojects
- Tenth set of micro projects completed
- Eleventh set micro projects initiated

April

- Public relations campaign continues
- Short-term training for IAG/DRH professionals and paratechnicians carried out
- Construction completed on tenth set of microsystems

May

- Construction begins on eleventh set of microsystems
- Production credit loans made
- Eleventh set of micro projects completed
- Twelth set of micro projects initiated

June

- Feasibility studies for eight set of loan financed subprojects
- Second group of long-term trainees returns

July-Sept.

- Construction completed on twelth set of microsystems
- IAG presents proposals for eight set of loan financed subprojects
- DHR approves eighth set of loan financed subprojects
- Construction loans made, contracts signed and construction begins on eighth set of subprojects

October

- Construction begins on thirteenth set of microsystems
- Second interim evaluation carried out
- Construction completed on thirteenth set of microsystems
- Public relations campaign continues
- Construction begins on fourteenth set of microsystems

November	- Farmer training seminar held - Construction continues
December	- Yearly implementation plan prepared - Year end work shop to review progress undertaken (AID/DRH/IAG) - Feasilibity studies carried out for nineth set of loan financed subprojects - Construction completed on fourteenth set of microsystems
1991	
January-March	- Construction begins on fifteenth set of microsystems - IAG presents proposals for nineth set of loan financed subprojects - DRH approves nineth set of loan financed subprojects - Construction loans made, construction contracts signed and work begins on ninth set of loan financed projects - Construction completed on fifteenth set of microsystems
April	- Public relations campaign continues - Short term training for DRH personnel carried out - Construction begins on sixteenth set of microsystems
May	- Forms plans completed and production loans made - Sixth set of loan financed subprojects approved and construction contracts let - Fifth set of loan financed subprojects completed - Ninth set of loan finances systems
June	- Third group of long-term trainees returns - Feasibility studies for tenth set of loan financed subprojects carried out. - Training seminar for DRH professionals and partechnicians carried out.
July-Sept.	- Construction completed on sixteenth set of microsystems - IAG presents proposals for tenth set of loan financed subprojects - DRH approve proposals - Construction contracts signed,, construction begins
October	- Construction completed on sixteenth set of microsystems - Farmer training seminar held - Feasibility studies carried out for eleventh set of loan financed subprojects - Construction begins on seventeenth set of micro projects

November	- Construction completed on tenth set of loan financed subprojects - IAG presents proposals on eleventh set of loan financed projects - DRH approves projects - Loans made, construction contracts signed, construction begins
December	Construction completed on seventeenth set of micro systems - Yearly Implementation plan prepared - Year end work shop to review progress undertaken (AID/DRH/IAG) - Feasibility studies carried out for twelth set (43) of loan financed subprojects - Twelth set of loan financed subprojects completed
1992	
January-March	- Eigteenth set microsystems initiated - IAG present proposals for twelth set of loan financed subprojects - Constructin contracts signed, loans approved, construction begins
April	- Eigtheenth set of micro projects completed - Work begins on nineteenth set micro projects - Feasibility studies for thirtheen set of loan financed subprojects carried out - Production credit loans made
May-July	- Project final evaluation carried out - Twelth set of loan finance projects completed - IAG presents proposals - DRH approves proposals - Construction begins
August	- Construction completed on nineteenth set of micro projects
September	- Construction of thirteenth set of loan finance subprojects completed - PACD

D. Evaluation Plan

1. General

The evaluation plan is designed to examine activities as they relate to the achievement of the project purpose. During the course of the project three evaluations will be carried out. There will be two interim evaluations, at

the end of year two and at the end of year four, and a final evaluation at the project's conclusion The interim evaluations will provide the opportunity to measure intermediate progress in relation to established implementation benchmarks, as well as to make mid-course adjustments in project design, if warranted. The final evaluation will measure the extent to which the project achieved its purpose.

2. Responsibilities

DRH, in conjunction with the USAID/Honduras Office of Development Programs will be responsible for assuring that the evaluations are carried out. DRH will coordinate to gauge progress toward realization of benchmarks related to all project components. These data will then be made available to consultants, contracted by AID, too be used in carrying out the interim and final evaluations.

3. Data Requirements

The data requirements for the evaluation exercise are divided into two types:

a. Survey Data

A sample survey format will provide the framework for collecting the information required to measure the impact of project activities on the recipient population at intervals during the life of the project. Included among the data items to be measured are:

- receptivity of beneficiaries to irrigation technology
- yield levels of crops
- changes in crop mix-degree of change from traditional cropping system
- change in income
- performance of water user groups
- performance of credit mechanisms

Information gathered by the periodic sample surveys will be completed by the data furnished by the feasibility studies relative to the design of subprojects

b. Project Data

Project data will include financial expenditures, project acquisitions, and outputs (e.g. number of feasibility studies carried out, number of systems constructed, number of contracts with private sector construction companies, number of loans (investment and production) made). Financial data will be obtained from the accounting branch of the SIPU and from the IAG on a regular, quarterly basis. Information on inputs and outputs, and some of the immediate effects of the project as it is implemented will be obtained by the USAID Project Manager through the SIPU and the IPAG. These data will, in turn, be converted into periodic (semi-annual) progress reports which the Mission will share with AID/W.

E. Energy Requirements for Irrigation

The vast majority of the irrigation systems currently in operation in Honduras have little or no direct energy requirements. Most are simple, gravity flow systems using a surface water source. It is expected that the majority of the new irrigation systems constructed under this project will fit the current pattern regarding energy requirements. However, in the past several years, pumping systems have grown rapidly in two regions of the country. These regions, Comayagua and Choluteca are targeted to be two out of the three geographic regions where project activities will be initiated.

In both regions limited use is made of electric pumps. The regional grids of the rural electrification systems are not very extensive, so that agricultural producers not located on the fringes of urban areas are precluded from using electricity driven pumping systems. In both the Comayagua and Choluteca areas the use of electric pumps for irrigation is restricted to high-tech drip irrigation system employed by the regional agricultural cooperatives in the production of winter fruit and vegetables for the U.S. export market.

However, the vast majority of pumping systems, especially in the Choluteca region, use diesel powered pumps in surface water sources (rivers, farm ponds, small reservoir, etc). The actual costs of operating these systems, and the percentage represented by pumping costs as part of normal irrigation costs, is not known. Most producers do not know what their pumping costs are, and in many cases the investment and operations/maintenance costs of the pumping systems are not factored into their overall agricultural production costs. There are several reasons behind this.

First, fuel for the pumps is relatively inexpensive as diesel is subsidized by the GOH. Second, nine farmers out of ten do not keep detail records of their production costs, and, third the investment cost of pumping equipment is usually counted as a separate cost when farmers apply for production loans, or the actual cost of the system is so high that it takes a separate loan to finance the purchase. Therefore, farmers tend not to include it as a project cost factor and seldom even amortize the investment costs.

To address issues such as; pumping costs, efficiency, correct operations and maintenance, the project will draw upon the expertise of the AID S&T/EGY office to provide short term technical assistance to help DRH design both training and evaluation systems relating to pumping. This topic is covered in more detail in Annex H of the Project Paper.

LOGICAL FRAMEWORK

Irrigation Development Project

NARRATIVE	OBJECTIVE VERIFIABLE	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Goal: Enhance the earning potential of Honduran farmers and contribute to the AID target of increase in agricultural production of $400 million by 1990.	Average yearly contribution of $5.0 million/year to agriculture production from project.	- Central Bank Reports - CONSUPLANE reports - Project reports - NBCCA tracking system	- Continuation of the democratic process - Central American regional political stability - Domestic and international markets for cash crops will continue to develop
Purpose: Improve farmer productivity and production through the provision of irrigation technology.	Conditions that will indicate purpose has been achieved: EOPS 1. Irrigation System Construction: - Approximately 600 systems constructed/ rehabilitated - Approximately 350 contracts between the beneficiaries and private sector construction firms signed and honored	- Project monitoring - Periodic evaluations - DRH records - PMC contract reports - Periodic site visits	1. Irrigation System Construction - Beneficiary receptivity to technology - Continued private sector/public sector cooperation in promoting Honduran development - Positive private sector construction company response to construction opportunities
	2. Credit: - A self-sustaining system for medium term investment and short-term production credit in place which include positive, market interests - Approximately 3,000 investment loans made by the LOP - Approximately 7,000 production loans made by the LOP - Aggregate loan recovery rates of more than 90 percent	- Periodic project evaluations - Central Bank records - Records of participating private banks - Regular project monitoring	2. Credit: - Central Banks capable of negotiating trust fund terms with private banks - Commercial banks continue to be interested in development lending - Rates to final borrowers are within the borrower's means - Banks will take the necessary measures to assure loan collection

LOGICAL FRAMEWORK

Irrigation Development Project

NARRATIVE	OBJECTIVE VERIFIABLE	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
	3. On-farm Water Management: - Minimum 15 percent increase in farm income among participants - Minimum of 2,500 farmers trained/ assisted in on-farm water management - Significant crop diversification among participant - Significant increased demand for agriculture inputs - Productivity increase of at least 50 percent	- Project monitoring - Periodic evaluations - DRH records on field Visits and training interventions	3. On-Farm Water Management: - No severe or prolonged weather or other environmental conditions occur which affect agricultural production - AID financed domestic marketing project comes on stream as planned in FY 87 - Technical assistance is available in a timely fashion - Participants are receptive to the offered technologies - Paratechnicians candidates are available as needed
	4. Institutional Development: - An effective public sector system in place for carrying out irrigation planning and the management of water resources - An effective system of Water User Groups in place to carry out systems maintenance and water use functions - Enhanced private sector capacity to plan and construct irrigation systems	- Periodic project evaluations - Normal project monitoring - DRH records - Field visits - Construction supervision - Reports of T.A. team members - Reports on participant trainees - USAID/Honduras controller records on disbursement systems	4. Institutional Development: - GOH willing and able to change role of DRH to "regulatory" rather than system construction - Private sector construction companies adapt to the "irrigation system construction

LOGICAL FRAMEWORK

Irrigation Development Project

NARRATIVE	OBJECTIVE VERIFIABLE							MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Outputs:	Magnitude of Outputs:								
	1 yr.	2 yr.	3 yr.	4 yr.	5 yr.	6 yr.	7 yr.		
1. Irrigation System Construction:									
- Number of Systems constructed	25	48	75	92	100	106	114	- Periodic project evaluations	- Sufficient interest by construction firms
- Number of construction contracts signed	4	36	50	60	70	80	80	- Consultants reports - Project monitoring	- Prequalification of construction firms done on a timely basis
2. Credit:									
- Trust account established with Central Bank		One all years						- Periodic project evaluations	- Trust accounts established with commercial banks on a timely basis
- Participating Private Banks		2	(12) = 4 over balance LOP					- Consultants reports	
- Number of investment loans made	40	200	610	510	760	570	570	- Project monitoring	- Sufficient private bank interest exists for involvement with the trust mechanism
- Number of production loans made	100	600	1040	1100	1100	1400	1500		
3. On-farm Water Management:									
- Site visits to participating farms	108	288	486	552	654	804	924	- Periodic project avalations	- farmer interest in participating in program
- Training (short courses and seminars)	1	3	5	6	7	8	9	- Project monitoring	- Suitable technological packages available
- Field days	1	3	5	6	7	8	9	- DRH reports	- Media willingness to cooperate
- Radio slots	52	52	52	104	156	208	260	- Consultants reports	
- Newspaper messages	52	52	52	52	52	52	52	- Site visits	
4. Institution Building:									
- Construction companies trained	8	-	8	-	-	-	-	- Periodic evaluations	- Trainees available
- DRH professionals (Water level Training)	5	5	4	-	-	-	-	- Project monitoring	- Training T.A. available in a timely fashion
- DRH short-term training (Number trained)	-	4	6	10	10	-	-	- DRH reports	
- Paraprofessionals trained	9	6	6	-	-	-	-		
- Student graduates trained	3	3	3	-	-	-	-		

LOGICAL FRAMEWORK

Irrigation Development Project

NARRATIVE SUMMARY	OBJECTIVE VERIFIABLE INDICATORS							MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Inputs:	Magnitude of Inputs (US$000)								
	1 yr.	2 yr.	3 yr.	4 yr.	5 yr.	6 yr.	7 yr.		
1. AID									
a. Grant								- AID Controller's records	
- Construction	850	1150	1150	1150	200	200	210	- Project semi-annual reports	
- Institutional Strengthening	-	30	40	50	60	90	120	- GOH financial records	
- Project Liasion Officer	60	60	60	60	-	-	-		
- Audits and Evaluations	-	30	-	30	-	-	60		
- Contingency			200						
b. Loan									
- Construction	400	200	470	400	600	800	1000		
- Credit	-	500	1500	2000	2500	2500	2500		
- On Farm Water Management	-	60	70	105	105	120	80		
- Institutional Strengthening	300	100	300	100	100	100	130		
- Contingency			?						
2. GOH									
a. In-kind									
- Construction	35	35	35	35	35	35	35	- USAID Controller's records	
- On Farm Water Management	30	60	75	100	200	250	285	- Audits	
- Institutional Strengthening								- GOH records	
b. Cash									
- Production Credit	30	150	200	300	400	450	470		
- On Farm Water Management	50	100	150	200	300	400	500		
- Institutional Strengthening	100	200	400	500	600	800	820		

ANNEX B

CERTIFICATION PURSUANT TO SECTION 611(e) OF THE
FOREIGN ASSISTANCE ACT OF 1961, AS AMENDED

I, Carl H. Leonard, the principal Officer of the Agency for International Development in Honduras, having taken into account among other factors the maintenance and utilization of projects in Honduras previously financed or assisted by the United States, do hereby certify that in my judgement Honduras has both the financial capability and human resources capability to effectively maintain and utilize the capital assistance project: Irrigation Development.

Carl H. Leonard
Acting Mission Director
USAID/Honduras

ANNEX C

08-332

SECRETARIA DE HACIENDA Y CREDITO PUBLICO
REPUBLICA DE HONDURAS

Tegucigalpa, D. C., Agosto 27 de 1986 No. CP-SF-012

OFFICE	ACTION	INFO
MD		/
DMD		/
MGT		/
M/CTR		
M/CM		
M/FS		
DP		/
DF		
CONT		/
RD		/
HRD		
HRD/[illegible]		
HRD/M		
HRD/P		
HRD/[illegible]		
PSP		
EPA		/
ENGR		
RIG		
RHU. D		
CHRON		/
REA[illegible]		/
OTHER		
C&R		
DUE DA[illegible] 9/9		
ACTION TAKEN ☐ NAU		
ATTACHM. ☐ YES NO☐		
INITIALS		

Señor
Carl H. Leonard
Agencia para el Desarrollo
Internacional (A I D)
Presente.

Señor Director Interino:

La Secretaría de Hacienda y Crédito Público, en nombre y representación del Gobierno de la República de Honduras y en atención a solicitud presentada por la Secretaría de Recursos Naturales, muy atentamente se permite presentar a la Agencia para el Desarrollo Internacional, una Solicitud formal de Financiamiento por US$ 14.5 millones en calidad de préstamo y US$ 8.0 millones en carácter de donación para desarrollar un proyecto que tiene como meta acrecentar el potencial de ganancia de los Agricultores Hondureños y el propósito de mejorar la productividad y producción de los Agricultores proporcionándoles Tecnología de Irrigación y Asistencia Técnica en la Finca relacionada con prácticas agrícolas mejoradas.

Las actividades de riego del proyecto serán inicialmente emprendidas en tres regiones geográficas de Honduras: San Pedro Sula, la región Central con énfasis particular en el Valle de Comayagua y el area de Siguatepeque; y la región Sur extendiéndose desde Tegucigalpa hasta el Departamento de Choluteca.

El proyecto será ejecutado por la Secretaría de Recursos Naturales a través de la Dirección de Recursos Hídricos.

Mucho apreciaré sus gestiones a fin de que esta Solicitud sea aprobada en el menor tiempo posible.

Asimismo, aprovecho la oportunidad para patentizar al Señor Director las muestras de mi distinguida consideración y estima.

Atentamente,

SECRETARIA DE HACIENDA Y CREDITO PUBLICO Honduras, C. A.

J. EFRAIN BU GIRON
Ministro

OFFICIAL FILE COPY

CFC/ GdC/nih.

100

1/3 UNCLASSIFIED STATE 381907/01 ANNEX D 0268

ACTION: AID-2 INFO: AMB DCM ECON/S

RECEIVED
USAID/HONDURAS
16 DEC 1985 16 28
C&R UNIT

YVZCZCTG0919
OO RUEETG
DE RUEEC #1907/01 3501926
ZNR UUUUU ZZH
O 161922Z DEC 85
FM SECSTATE WASHDC
TO AMEMBASSY TEGUCIGALPA IMMEDIATE 1193
BT
UNCLAS SECTION 01 OF 03 STATE 381907

10-DEC-85 TOR: 10:28
CN: 16243
CHRG: AID
DIST: AID

AIDAC

E.O. 12356: N/A
TAGS:
SUBJECT: IRRIGATION DEVELOPMENT PROJECT (522-0263)

1. BUREAU REVIEWED AND APPROVED PID FOR THE SUBJECT PROJECT ON NOVEMBER 26. THE MISSION IS COMMENDED FOR THE THOROUGH WORK DONE IN PREPARING THE PID AND IS AUTHORIZED TO DEVELOP AND APPROVE THE PP IN THE FIELD.

THE FOLLOWING GUIDANCE IS PROVIDED TO THE MISSION TO BE USED IN PREPARING THE PP.

2. ECONOMIC CONSIDERATIONS. THE GENERAL PROCEDURES DISCUSSED IN THE PID FOR THE ECONOMIC ANALYSES AND THE SELECTION CRITERIA ARE APPROPRIATE. IT WAS AGREED IN THE LAEC THAT BECAUSE NO PRELIMINARY ECONOMIC WORK HAD BEEN CARRIED OUT, THE MISSION PROJECT TEAM SHOULD CONDUCT ECONOMIC/FINANCIAL ANALYSES OF THE DIFFERENT ANTICIPATED IRRIGATION SYSTEMS EARLY IN THE INTENSIVE REVIEW PROCESS.

THIS PROCEDURE SHOULD HELP ASSURE THAT THE IDENTIFIED SYSTEM DESIGNS ARE THE ONES MOST APPROPRIATE FOR THE HONDURAS SITUATION AND ARE ECONOMICALLY AND FINANCIALLY VIABLE. FOR EXAMPLE, IT MAY WELL BE THAT SOME OF THE SYSTEMS, WHICH CURRENTLY ARE BEING CONSIDERED FOR REHABILITATION, HAVE FALLEN IN DISREPAIR PRECISELY BECAUSE THEY ARE NOT FINANCIALLY VIABLE -- OR, IT MAY BE THAT IT IS AN ORGANIZATIONAL OR INFORMATION PROBLEM. ECONOMIC AND FINANCIAL ANALYSIS WILL PROVIDE AN IMPORTANT PART OF THE ANSWER.

3. SMALL FARMER PARTICIPATION. CONCERN WAS EXPRESSED AT THE LAEC THAT THE SUB-PROJECT SELECTION CRITERIA MIGHT BIAS SELECTION IN FAVOR OF LARGER FARMERS. TO PRECLUDE THIS POSSIBILITY, MISSION REPRESENTATIVES AGREED THAT THE PP WILL INCLUDE DETAILED PROJECT SELECTION CRITERIA DESIGNED IN SUCH A WAY AS TO ENSURE THE SIGNIFICANT PARTICIPATION OF SMALL FARMERS IN THE PROJECT ON A PROFITABLE BASIS.

4. COST RECOVERY. THIS IS A COMPLEX SUBJECT WHICH WE BELIEVE WARRANTS FURTHER EXAMINATION DURING INTENSIVE REVIEW. THE FOLLOWING POINTERS SHOULD BE CONSIDERED IN

ACTION RD
No.....
INFO OFFICES
D....
DMD....
MGT....
DP....
DF....
CONT....
RD....
HRD....
HRD/E....
HRD/H....
HRD/F....
HRD/FFP....
FSP....
EPA....
EDCR....
EDC....
RHUD....
JAD....
CHRON....
READER....
COMMUT....
OTHER....

101

DEVELOPING THE PP.

--THE PP SHOULD LAY OUT FULL COST RECOVERY CRITERIA FOR UNITS OF A CERTAIN SIZE OR INCOME LEVEL TO BE DETERMINED BY THE MISSION AND CONTAIN A GRADUATED COST SHARING SCHEME FOR SMALLER UNITS.

-- THE MISSION SHOULD CARLFULLY LOOK AT ALL COST RECOVERY METHODS FOR CONSTRUCTION AND OPERATIONS AND MAINTENANCE WHICH ARE ADMINISTRATIVELY FEASIBLE AND DEVELOP A METHODOLOGY FOR DETERMINING WHO CAN PAY AND HOW MUCH FOR EACH OF THE SYSTEM TECHNOLOGIES CONTEMPLATED IN THE PID.

-- WHILE WE WOULD EXPECT THAT DIFFERENT LEVELS AND KINDS OF CONTRIBUTIONS (I.E., LABOR, TOOLS, MATERIALS, AND PAYMENTS IN VARYING AMOUNTS) WOULD BE MADE UNDER EACH OF THE TECHNOLOGIES MENTIONED, MINIMUM CONTRIBUTION LEVELS

SHOULD BE SET TO ENSURE A MODICUM OF COST RECOVERY FROM BENEFICIARIES IN EACH CASE. AN ANALYSIS OF THE DEGREE TO WHICH BENEFITS OF EACH IRRIGATION TECHNOLOGY ARE CAPTURED BY THE RECIPIENT FARMER OR ACCRUE TO SOCIETY GENERALLY WOULD BE USEFUL. EXAMPLES OF THESE LATTER EXTERNALITIES MIGHT INCLUDE INCREASED ECONOMIC ACTIVITY, CONSERVATION OF NATURAL RESOURCES, AND SO ON.

-- THE PP SHOULD ALSO DISCUSS THE MISSION'S LONGER TERM COST RECOVERY STRATEGY AND HOW IT WILL RELATE TO THE CONTROL OF RECURRENT COSTS ARISING FROM THE PROJECT DURING THE LIFE OF THE PROJECT AND BEYOND.

-- THE MISSION SHOULD EXAMINE DIFFERENT STRATEGIES FOR MOTIVATING WATER USER GROUPS TO CONTRIBUTE AS MUCH AS POSSIBLE TO THEIR OWN PROJECTS AND PROVIDE ILLUSTRATIVE CASES OF HOW THE STRATEGIES SELECTED FOR THE PROJECT WILL WORK. THE MISSION MAY WANT TO CONSIDER USING PRIVATE VOLUNTARY ORGANIZATIONS WHICH HAVE EXPERIENCE IN COMMUNITY DEVELOPMENT AND ORGANIZATION IN THIS ASPECT OF THE PROJECT. IN ANY EVENT, THE MISSION WILL WANT TO CONTRACT SYSTEMS DESIGN PEOPLE WHO HAVE EXPERIENCE IN PUTTING TOGETHER COMMUNITY WATER SYSTEMS, AND DEVELOPMENT OF COST RECOVERY STRATEGIES. THE SOUTH BUREAU'S WATER MANAGEMENT SYNTHESIS II PROJECT IS A USEFUL RESOURCE FROM WHICH SUCH INDIVIDUALS MIGHT BE DRAWN.

-- PPC HAS RECENTLY COMPLETED A STUDY ON COST RECOVERY ISSUES TITLED IRRIGATION PRICING AND MANAGEMENT. COPIES OF THIS STUDY WERE POUCHED TO THE MISSION DIRECTOR ON DECEMBER 2 AS PART OF A JOINT PPC-DISTRIBUTION. THE MISSION SHOULD BE ABLE TO MAKE USE OF THIS STUDY IN FORMULATING ITS APPROACH TO COST RECOVERY.

Best Available Document

102

-- THE ISSUES OF COST RECOVERY AND HENCE THE APPROPRIATE PAYMENT AND MEANS OF PAYMENT ARE COMPLICATED AND CRITICAL ISSUES WHICH NEED TO BE DEALT WITH QUITE EARLY IN THE INTENSIVE REVIEW PERIOD AND DISCUSSED QUITE EXTENSIVELY IN THE PP. AS FOR GUIDANCE ON THESE ISSUES, WE HIGHLY RECOMMEND THE RECENTLY COMPLETED STUDY, IRRIGATION PRICING AND MANAGEMENT BY DEVRES, INC. UNDER CONTRACT TO PPC/PDPR. THE MISSION SHOULD HAVE RECEIVED A COPY OF THIS STUDY BY NOW. IF IT HAS NOT, PLEASE CONTACT JOAN ATHERTON, PPC/PDPR/IP, 202-647-8952 FOR ADDITIONAL COPIES. ALL OBVIOUS AND RELEVANT IRRIGATION QUESTIONS ARE ADDRESSED AND RECOMMENDATIONS MADE. THE STUDY

CONTAINS AN EXCELLENT ANNOTATED BIBLIOGRAPHY WHICH SHOULD PROVE QUITE USEFUL. WE WOULD ALSO RECOMMEND THE PERTINENT SECTIONS IN J. PRICE GITTINGER'S 2ND EDITION OF ECONOMIC ANALYSIS OF AGRICULTURAL PROJECTS, AND THE WORLD BANK'S DOCUMENT, IRRIGATION WATER CHARGES, BENEFIT TAXES, AND COST RECOVERY POLICIES, CN-88. WASHINGTON, D.C.: ECONOMIC DEVELOPMENT INSTITUTE, WORLD BANK.

5. PRIVATE SECTOR PARTICIPATION. THERE WAS GENERAL AGREEMENT THAT PRIVATE SECTOR PARTICIPATION BEYOND THAT MENTIONED IN THE PID SHOULD BE ENCOURAGED. WHILE WE ARE NOT IN A POSITION TO ESTIMATE WHERE AND HOW THAT PARTICIPATION MIGHT HAVE THE BEST EFFECT, THE BUREAU'S SENSE IS THAT LARGER AND MEDIUM FARMERS SHOULD BE ABLE TO PARTICIPATE DIRECTLY IN THE PROJECT WITHOUT DRH INTERMEDIATION, BY CONTRACTING DIRECTLY WITH PRIVATE SECTOR ENGINEERING FIRMS OR SUPPLIERS FOR THE INSTALLATION OF IRRIGATION SYSTEMS. WITH THIS IN MIND, WE ASK THAT FOR THOSE FARMING UNITS WHICH ARE DEMONSTRABLY CAPABLE OF SHOULDERING HEAVIER ECONOMIC AND FINANCIAL BURDENS AND STILL OBTAINING ATTRACTIVE RATES OF RETURN, THE MISSION MAKE BEST POSSIBLE EFFORTS TO TAILOR A PRIVATE SECTOR PROJECT WITHOUT THE DRH AND USE CREDIT TO ALLOW THE FARMERS TO WORK WITH SUPPLIERS AND CONTRACTORS.

6. WATER LAW. THE RELEVANCE OF A NEW WATER LAW TO THE PROJECT WAS DISCUSSED AT THE ISSUES MEETING. MISSION REPRESENTATIVES STATED THAT THE WATER LAW AS DRAFTED WOULD HAVE NO ADVERSE EFFECT ON PROJECT IMPLEMENTATION OR ITS BENEFICIARIES, AND ITS PASSAGE PRIOR TO IMPLEMENTATION OF THE PROJECT IS NOT NECESSARY. THE BUREAU ACCEPTED THIS AND AGREED THAT PASSAGE OF THE NEW LAW NEED NOT BE MADE AN INITIAL CONDITION PRECEDENT TO DISBURSEMENT FOR THE SUBJECT PROJECT. THE MISSION AND THE BUREAU DID AGREE, HOWEVER, THAT THE RELATIONSHIP BETWEEN THE LAW AND PROJECT SPONSORED ACTIVITIES IS SUFFICIENTLY STRONG THAT ITS PASSAGE SHOULD BE A CONDITION TO DISBURSEMENT OF FUNDS AT SOME POINT DURING THE PROJECT. TIMING OF A CONDITION FOR THE PASSAGE OF THE LAW WILL THEREFORE BE DETERMINED DURING PREPARATION OF THE PROJECT PAPER.

7. INSTITUTIONAL CONSIDERATIONS. GIVEN THE ABSORPTIVE

103

CAPACITY CONSIDERATIONS IMPLICIT IN A PROJECT OF THIS SIZE AND COMPLEXITY, THE MISSION SHOULD CAREFULLY REVIEW INSTITUTIONAL CAPABILITIES OF IMPLEMENTING ENTITIES SUCH AS THE DRB, OTHER GOVERNMENT AGENCIES (PARTICULARLY THE AGRICULTURAL EXTENSION SYSTEM) AND PRIVATE CONTRACTING FIRMS TO CARRY OFF THE ACTIVITIES ENVISIONED, AS PART OF THE INSTITUTIONAL ANALYSIS. AS WITH THE QUESTION OF COST RECOVERY AND COMMUNITY ORGANIZATION, THE MISSION SHOULD CONSIDER THE POTENTIAL OF PVOS FOR ASSISTING IN THE IMPLEMENTATION OF THE PROJECT WITH BOTH COMMUNITY AND MICRO-SYSTEMS.

8. INTERAGENCY COORDINATION. IN VIEW OF THE MALARIA CONTROL CONSIDERATIONS AND CREDIT NEEDS ARISING FROM THE PROPOSED PROJECT ACTIVITIES, THE PP SHOULD SHOW HOW ASSISTANCE REQUIRED FROM THE MINISTRY OF HEALTH AND CREDIT INSTITUTIONS WILL BE COORDINATED WITH THE DRB.

9. CREDIT. IN CONSIDERING THE INSTITUTIONAL AND COORDINATION IMPLICATIONS OF ADMINISTERING CREDIT FOR THE PROJECT, THE MISSION SHOULD LAY OUT IN THE PP HOW THOSE INSTITUTIONS WOULD ADMINISTER THE CREDIT. ALTERNATIVELY, IF ARRANGEMENTS WITH THOSE ENTITIES PROVE TO BE UNDULY DIFFICULT, THE MISSION MAY CONSIDER PROGRAMMING PART OF THE PROJECT RESOURCES FOR CREDIT.

10. IMPLIMENTATION PLAN/LOG FRAME/EVALUATION PLAN. THE PP SHOULD CONTAIN A DETAILED IMPLEMENTATION PLAN, LOG FRAME, AND EVALUATION PLAN. EACH OF THESE SECTIONS SHOULD INCLUDE DETAILED GOALS, OBJECTIVES, OR OUTPUT INDICATORS THAT WILL ALLOW MONITORING AND EVALUATION OF THE PROJECT. THE LOG FRAME SHOULD HAVE BOTH QUALITATIVE AND QUANTITATIVE INDICATORS. THE EVALUATION PLAN SHOULD DISCUSS THE KINDS OF EVALUATIONS PLANNED, RESOURCE REQUIREMENTS, AND ISSUES TO BE ADDRESSED AT THE TIME OF EVALUATION, SUCH AS PROGRESS MADE ON COST RECOVERY, INSTITUTION BUILDING, BENEFICIARY IMPACT, SUSTAINABILITY OF ACTIVITIES AFTER THE END OF THE PROJECT, AND SO ON. A

DESCRIPTION OF BASELINE DATA COLLECTION ACTIVITIES FOR ASSESSING PROGRESS AND IMPACT OF PROJECT ACTIVITIES ON BENEFICIARIES SHOULD BE INCLUDED IN THE PP. FINALLY, AN EVALUATION OF THE PROJECT SHOULD TAKE PLACE WITHIN 15 MONTHS OF THE DATE OF OBLIGATION.

11. ENVIRONMENTAL CONSIDERATIONS. THE PROJECT IEE HAS BEEN APPROVED SUBJECT TO PP DESIGN WORK WHICH SHOULD CONSIDER THE ISSUE OF WHAT SPECIFIC MECHANISM WILL BE DEVELOPED TO ENSURE EFFECTIVE DRH ENVIRONMENTAL REVIEW OF IRRIGATION SCHEMES AS THEY ARE SUBMITTED FOR APPROVAL UNDER THE PROJECT. THE BUREAU RECOMMENDS THAT ENVIRONMENTAL SPECIALIST ON DESIGN TEAM WORK WITH DRH STAFF TO DEVELOP USABLE GUIDELINES AND CHECKLIST TO BE INCLUDED IN THE STANDARD DRH REVIEW. THE NEED FOR SHORT-TERM TRAINING OF DRH STAFF IN HOW TO EVALUATE ENVIRONMENTAL IMPACTS SHOULD BE INCLUDED IN PP DESIGN. ALSO, ENVIRONMENTAL SPECIALISTS SHOULD STUDY HOW UPSTREAM LAND USE AND DOWNSTREAM WATER USERS WILL AFFECT OR BE IMPACTED BY THIS PROJECT. DEGRADATION AND REDUCTION OF WATER SUPPLY ON THE DOWNSTREAM END OF IRRIGATION PROJECTS CAN CREATE SOCIAL PROBLEMS AND NEGATIVELY IMPACT OTHER CURRENT USES OF WATER SUPPLY. LACK OF WATERSHED MANAGEMENT IN THE UPSTREAM AREAS CAN CAUSE LOSS OF WATER TO IRRIGATION PROJECTS. FINALLY, HEALTH IMPACTS SHOULD BE EXAMINED BY INCLUDING JEFF STIVERS OR OTHER APPROPRIATE MISSION HEALTH ADVISOR IN PP DESIGN TO DETERMINE, WITH ENVIRONMENTAL SPECIALIST, IF MALARIA AND OTHER WATER RELATED DISEASES WILL BECOME A PROBLEM IN PROPOSED IRRIGATION AREAS.

12. OTHER RELEVANT EXPERIENCE. PPC/CDIE WILL POUCH COPY OF JUST COMPLETED DRAFT OF PROJECT MANAGER'S GUIDE TO IRRIGATION WHICH DISCUSSES EXPERIENCES OF A.I.D. AND OTHER DONORS IN IRRIGATION PROJECTS ELSEWHERE AND HIGHLIGHTS GENERIC ISSUES TO BE CONSIDERED IN DESIGNING AND IMPLEMENTING PROJECTS OF THIS TYPE.

13. GENERAL GUIDANCE.

-- PIL LENGTH. THE BUREAU NOTED THAT THE PID CONTAINED 29 PAGES. PLEASE BEAR IN MIND FOR FUTURE REFERENCE THAT AGENCY POLICY CALLS FOR MISSION TO KEEP PIDS TO A MORE REASONABLE LENGTH OF 15 PAGES. ANNEXES ARE ACCEPTABLE FOR SUCH SUPPORTING DOCUMENTATION AS MIGHT BE NECESSARY.

-- PAYMENT VERIFICATION. THE MISSION IS REMINDED THAT ALL PROJECT PAPERS MUST FOLLOW THE GUIDANCE PROVIDED ON PAYMENT VERIFICATION BY AA/M TO MISSION DIRECTORS ON DECEMBER 27, 1983, PARTICULARLY PP. 6-8, WHICH DEAL SPECIFICALLY WITH PP CONSIDERATIONS.

-- GRAY AMENDMENT. GRAY AMENDMENT POLICIES SHOULD BE CAREFULLY CONSIDERED DURING PP PREPARATION. A PLAN FOR THE UTILIZATION OF MINORITY AND WOMEN OWNED BUSINESSES SHOULD BE PRESENTED IN THE PP.

105

-- PARTICIPATION OF WOMEN IN THE PROJECT. THE PROJECT DEVELOPMENT PROCESS WILL HAVE TO FOCUS TO A SIGNIFICANT EXTENT ON THE CHARACTERISTICS OF THE BENEFICIARY POPULATION IN ORDER TO DETERMINE THE EXTENT TO WHICH THE DIFFERENT TYPES OF FARMERS HAVE THE PROPER INCENTIVES TO CONTRIBUTE TO FUNDING THE SYSTEM, PARTICIPATE IN THE COOPERATIVES/WATER USERS GROUPS, AND ADOPT NEW AGRICULTURAL PRACTICES. EXISTING ORGANIZATIONAL STRUCTURES MUST BE CAREFULLY EXAMINED. AS A RESULT, GENDER-RELATED ISSUES MUST BE CONSIDERED THROUGHOUT THE DESIGN PROCESS. (A) THE PP SHOULD STATE CLEARLY THE RELATIVE SHARE OF WOMEN IN THE BENEFICIARY POPULATION, THE EXTENT TO WHICH WOMEN-HEADED HOUSEHOLDS EXIST, AND THE CONSTRAINTS WHICH MAY PRECLUDE THEIR SHARING IN THE PROJECT BENEFITS. THE PP SHOULD DEVELOP GENDER DISAGGREGATED BENEFICIARY DATA WITH REGARD TO MEASURING IMPACT. (B) ADDITIONALLY, THE PP SHOULD EXAMINE THE EXTENT OF WOMEN'S PARTICIPATION AND THEIR ROLE IN THE COOPERATIVES/WATER USERS GROUPS, AND DEVELOP SOME APPROACHES WHICH WOULD ENSURE THAT WOMEN ARE NOT MARGINALIZED AS A RESULT OF THE GROUP'S CREATION, ORGANIZATION AND STRENGTHENING. (C) WITH REGARD TO HOUSEHOLD DIVISION OF LABOR, STUDIES INDICATE THAT THIS FACTOR REPRESENTS A KEY VARIABLE IN DETERMINING THE DEGREE OF EFFECTIVENESS OF COOPERATIVES/WATER USER GROUPS, THE EXTENT TO WHICH THESE ORGANIZATIONS ARE SELF-SUSTAINING, AND THE RATE AT WHICH NEW TECHNOLOGIES ARE ADOPTED. AS SUCH, IT IS IMPORTANT TO EXAMINE THE DIVISION OF LABOR WITHIN THE HOUSEHOLD. WHITEHEAD
PT
#1997

NNNN

5C(2) PROJECT CHECKLIST

Listed below are statutory criteria applicable to projects. This section is divided into two parts. Part A. includes criteria applicable to all projects. Part B. applies to projects funded from specific sources only: B.1. applies to all projects funded with Development Assistance loans, and B.3. applies to projects funded from ESF.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

The country's checklist for FY86 is included in the Primary Education Efficiency Project Paper.

A. GENERAL CRITERIA FOR PROJECT

1. FY 1986 Continuing Resolution Sec. 524; FAA Sec. 634A.

   Describe how authorizing and appropriations committees of Senate and House have been or will be notified concerning the project.

   A Congressional Notification was submitted and expired on June 27, 1986.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $500,000, will there be (a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimte of the cost to the U.S. of the assistance?

   Items 2(a) and 2(b) have been completed.

3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?

   The Honduran Congress will approve the project upon signature of the Executive Branch Representatives.

4.	FAA Sec. 611(b); FY 1986 Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the principles, standards, and procedures established pursuant to the Water Resources Planning Act (42 U.S.C. 1962, et seq.)? (See AID Handbook 3 for new guidelines.)	Yes
5.	FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	Yes
6.	FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.	No
7.	FAA Sec. 601(a). Information and conclusions whether projects will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.	The project will encourage 7(a), (b), (c) and (e); will be neutral on 7(f); will take steps to prevent 7(d).

8. FAA Sec. 601(b). Information and conclusions on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	A major portion of the technical asssitance will be procured from U.S. sources.
9. FAA Sec. 612(b), 636(h); FY 1986 Continuing Resolution Sec. 507. Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars.	Honduras has agreed to provide counterpart financing of local costs to the extent possible.
10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?	No
11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?	Yes
12. FY 1986 Continuing Resolution Sec. 522. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?	It is anticipated that the commodities will not be in surplus on world markets. The commodities produced will not cause substantial injury to U.S. producers.

13. FAA 118(c) and (d). Does the project comply with the environomental procedures set forth in AID Regulation 16. Does the project or program take into consideration the problem of the destruction of tropical forests?	A.I.D. Environmental Regulations have been followed. The project received a negative determination for the Threshold Decision.
14. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate sysem for accounting for and controlling receipt and expenditure of project funds (dollars or local currency generated therefrom)?	N/A
15. FY 1986 Continuing Resolution Sec. 533. Is disbursement of the assistance conditioned solely on the basis of the policies of any multilateral institution?	No
16. ISDCA of 1985 Sec. 310. For development assistance projects, how much of the funds will be available only for activities of economically and socially disadvantaged enterprises, historically black colleges and universities, and private and voluntary organizations which are controlled by individuals who are black Americans, Hispanic Americans, or Native Americans, or who are economically or socially disadvantaged (including women)?	Competitive procedures will encourage participation by these groups.

110

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(a), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status, (e) utilize and encourage regional cooperation by developing countries?

The Project's main focus is small and medium scale farmers in rural areas. The Project will increase the productivity and production of these farmers by providing appropriate irrigation technology, and on-farm water management extension assistance. The Project will use cooperatives, wherever possible, to organize Water User Groups, thereby expanding the services cooperatives provide. Where appropriate, women will participate equally in all aspects of the Project.

b. FAA Sec. 103, 103A, 104, 105 106. Does the project fit the criteria for the type of funds (functional account) being used? — Yes

c. FAA Sec. 107. Is emphasis on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most appropriate for the small farms, small businesses, and small incomes of the poor)? — Yes

d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to whch the assistance is to be furnished (or is the latter cost-sharing requirement being waived for a "relatively least developed country)? — Yes

e. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities and self-sustaining economic growth? — Yes

f. FAA Sec. 128(b). If the activity attempts to increase the institutional capabilities of private organizations or the government of the country, or if it attempts to stimulate scientific and technological research, has it been designed and will it be monitored to ensure that the ultimate beneficiaries are the poor majority?	Yes
g. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental processes essential to self-government.	The country's intellectual resources will be used in building both private and public sector capacity to manage the country's irrigation needs in a rational way.

2. Development Assistance Project Criteria (Loans Only)

a. FAA Sec. 122(b). Information an conclusion on capacity of the country to repay the loan, at a reasonable rate of interest.

The Mission has determined that the loan is within the capacity of the GOH to repay.

b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?

The Honduran productive enterprises will be competing with other foreign importers and not U.S. enterprises.

3. Economic Support Fund Project Criteria

a. FAA Sec. 531(a). Will this assistance promote economic and political stability? To the maximum extent feasible, is this assistance consistent with the policy directions, purposes, and programs of part I of the FAA?

Yes

b. FAA Sec. 531(c). Will assistance under this chapter be used for military, or paramilitary activities?

No

c. ISDCA of 1985 Sec. 207. Will ESF funds be used to finance the construction of, or the operation or maintenance of, or the supplying of fuel for, a nuclear facility? If so, has the President certified

No

that such country is a party to the Treaty on the Non-Proliferation of Nuclear Weapons or the Treaty for the Prohibition of Nuclear Weapons in Latin America (the "Treaty of Tlatelolco"), cooperates fully with the IAEA, and pursues nonproliferation policies consistent with those of the United States?

d. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made? Yes

5C(3) - STANDARD ITEM CHECKLIST

Listed below are the statutory items which normally will be covered routinely in those provisions of an assistance agreement dealing with its implementation, or covered in the agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

1.	FAA Sec. 602. Are there arrangements to permit U.S. small business to participate equitably in the furnishing of commodities and services financed?	**Yes, normal A.I.D. procedures will be followed.**
2.	FAA Sec. 604(a). Will all procurement be from the U.S. except as otherwise determined by the President or under delegation from him??	**Yes**
3.	FAA Sec. 604(d). If the cooperating country discriminates against marine insurance companies authorized to do business in the U.S., will commodities be insured in the United States against marine risk with such a company?	**Honduras does not practice such discrimination.**
4.	FAA Sec. 604(e); ISDCA of 1980 Sec. 705(a). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity? (Exception where commodity financed could not reasonably be procured in U.S.)	**No offshore procurement of agricultural commodities or products are contemplated.**

5.	FAA Sec. 604(g). Will construction or engineering services be procured from firms of countries which receive direct economic assistance under the FAA and which are otherwise eligible under Code 941, but which have attained a competitive capability in international markets in one of these areas? Do these countries permit United States firms to compete for construction or engineering services financed from assistance programs of these countries?	Yes
6.	FAA Sec. 603. Is the shipping excluded from compliance with requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S. flag commercial vessels to the extent such vessels are available at fair and reasonable rates?	No
7.	FAA Sec. 621. If technical assistance is financed, will such assistance be furnished by private enterprise on a contract basis to the fullest extent practicable? If the facilities of other Federal agencies will be utilized, are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?	Yes

8. International Air Transportation Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will U.S. carriers be used to the extent such service is available? — Yes

9. FY 1986 Continuing Resolution Sec. 534. If the U.S. Government is a party to a contract for procurement, does the contract contain a provision authorizing termination of such contract for the convenience of the United States? — Yes

B. Construction

1. FAA Sec. 601(d). If capital (e.g., construction) project, will U.S. engineering and professional services be used? — Yes

2. FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable? — Yes

3. FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million (except for productive enterprises in Egypt that were described in the CP)? — Yes

C. Other Restrictions

1. FAA Sec. 122(b). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter? — Yes

2. FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights? — N/A

3. FAA Sec. 620(h). Do arrangements exist to insure that United States foreign aid is not used in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the Communist-bloc countries? — Yes

4. Will arrangements preclude use of financing:

   a. FAA Sec. 104(f); FY 1986 Continuing Resolution Sec. 526. (1) To pay for performance of abortions as a method of family planning or to motivate or coerce persons to practice abortions; (2) to pay for performance of involuntary sterilization as method of family planning, or to coerce or provide financial incentive to any person to undergo — Yes

19

sterilization; (3) to pay for any biomedical research which relates, in whole or part, to methods or the performance of abortions or involuntary sterilizations as a means of family planning; (4) to lobby for abortion?

b. FAA Sec. 488. To reimburse persons, in the form of cash payments, whose illicit drug crops are eradicated? — Yes

c. FAA Sec. 620(c). To compensate owners for expropriated nationalized property? — Yes

d. FAA Sec. 660. To provide training or advice or provide any financial support for police, prisons, or other law enforcement forces, except for narcotics programs? — Yes

e. FAA Sec. 662. For CIA activities? — Yes

f. FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unless a waiver is obtained? — Yes

g. FY 1986 Continuing Resolution, Sec. 503. To pay pensions, annuities, retirement pay, or adjusted service compensation for military personnel? — Yes

h. FY 1986 Continuing Resolution, Sec. 505. To pay U.N. assessments, arrearages or dues? — Yes

i. FY 1986 Continuing Resolution, Sec. 506. To carry out provisions of FAA section 209(d) (Transfer of FAA funds to multilateral organizations for lending)? — Yes

j. FY 1986 Continuing Resolution, Sec. 510. To finance the export of nuclear equipment, fuel, or technology? — Yes

k. FY 1986 Continuing Resolution, Sec. 511. For the purpose of aiding the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights? — Yes

l. FY 1986 Continuing Resolution, Sec. 516. To be used for publicity or propaganda purposes within U.S. not authorized by Congress? — Yes

121

ANNEX F

ECONOMIC ANALYSIS

I. INTRODUCTION

The principal benefits of irrigation projects and, in particular, those incorporated in the financial and economic evaluation of this project, derive from three sources:

- Increase in agricultural yields, brought by the use of new technologies in production, made feasible by the availability of irrigation water.

- Increase in cropping intensity, due to the availability of water during periods when fields would otherwise be unproductive.

- Change in the cropping pattern to reflect the increase of crops that require irrigation, and which are now possible.

Certain other benefits were not quantified for the purpose of deriving economic and financial rates of return. First, irrigation will also benefit non-project farmers, because it will make available water that was previously wasted. Second, there is likely to be a demonstration effect that will induce other farmers to expand irrigated agriculture.

The economic costs of the project include farm production costs (labor, inputs, machinery services); working capital investment, irrigation system investment and maintenance costs; extension services, training, purchase of equipment and other technical assistance expenditures; and administration, evaluation, and auditing costs.

The allocation of irrigation interventions will be producer driven. Only those instances where financial and economic considerations justify an irrigation system will be selected. Thus the project is not site specific. Therefore, the analysis has been directed to a broad range of alternatives designed to represent the typical cases to be addressed by the project.

II. SUMMARY

1. Economic Analysis

The economic analysis of this project is based on calculations of the economic internal rate of return (EIRR), for three different scales of irrigation systems (micro, small, medium) applied to four farm models, making a total of 12 prototype farm models.

The four different types of farm models are distinguished by the type of technology applied (traditional or intermediate), and by the accessibility to transport infrastructure for input delivery/output marketing. For each farm model, with- and without-project profiles are

characterized through farm budgets. These farm budgets estimate cropping patterns, use of inputs and machinery, employment, and net return. The differences between with- and without-project scenarios provide estimates of the anticipated benefits. With irrigation, as well as without, every crop exhibits a different profitability. At this stage of the project the best that can be done is to make a judgmental assessment of a most likely combination of crops for the with- and without-project situations. During the implementation stage crops will be planned according to the agronomic and climatic characteristics of the plots, in order to achieve maximum profitability. It must be pointed out that most decisions concerning agroeconomic data used in this document were taken in consultation with personnel from the Water Resources Office (Recursos Hídricos).

The economic rates of return corresponding to each of the 12 prototype farm models are set forth in Summary Table 1.

Summary Table 1
Economic Internal Rate of Return (EIRR)
by Farm Model, and by Scale of Irrigation System
(Percentage)

Scale of System	FARM MODEL			
	Traditional Technology		Intermediate Technology	
	Normal Access	Remote Access	Normal Access	Remote Access
Micro	22.8	15.2	24.7	16.0
Small	19.0	12.4	20.2	12.9
Medium	16.9	10.8	17.8	11.1

Source: Table 28.

As is apparent from Summary Table 1, the economic rates of return for the 12 prototypes range from about 10.8% to 24.7%. In general, according to these data, irrigation investment is more profitable in locations with normal access to transportation facilities, and on farms employing intermediate technology of production. Furthermore, smaller irrigation systems are preferable to larger ones.

To provide a point estimate of the economic results, the EIRR for a representative combination of these 12 farm prototypes was estimated at 18.3%.

123

A number of sensitivity analyses were performed. Those analyses show that even under unexpected changes in the projections, the EIRR is still high enough to justify the project based on economic considerations. It was found that cattle raising and fruit production are less profitable than other land uses. Thus, the EIRR of the project is reduced to 12.4% if all the irrigated area is dedicated to cattle production, and to 13.3% if put into fruit production. These two activities should be avoided when implementing the project unless new cost and production data show that our estimates are unduly pessimistic.

In brief, the information set forth in Summary Table 1 derives from farm models. For each farm model, with- and without-project profiles are characterized through farm budgets. These farm budgets estimate cropping pattern's, use of inputs and machinery, employment and net return. The differences between with- and without-project scenarios provide estimates of the anticipated benefits.

2. Financial Analysis

This analysis refers to costs and benefits as perceived by the farmers participating into the project. It uses financial or market prices for production and inputs, as opposed to economic prices. In addition, there are some costs which are economic costs, but are not financial costs to the farmer, such as project administration and technical assistance. The financial analysis of farm models indicates that the average (weighted) value of annual net returns per hectare increases from L193 in the without-project situation to L2,775 in the with-project situation at full development, measured in constant 1984 Lempiras, i.e., an increase in net returns of L2,582. The L2,775 figure refers to returns before any charge is levied for cost recovery. The large L2,582 increase in farm's net return per hectare, assumes not only the availability of irrigation but simultaneously the adoption and correct application of modern technologies related to new cultural practices. As such, a farmer will take four years to reach full development yields if his previous technology is intermediate, and six years if it is traditional. Such increase in net returns per hectare leaves ample space for cost recovery of the irrigation investment. Moreover, this net return figures do not include increases in farm income brought by the expansion of employment on the farm, employment that will be absorbed mainly by the farmer's family.

Taking into account the investment costs of providing irrigation, as well as the foregone benefits of the previously non-irrrigated agriculture exploitation, financial internal rates of return have been calculated for the 12 farm prototypes, as presented in Summary Table 2. These financial IRR's are higher than the economic IRR's presented in Summary Table 1 mainly because costs such as Technical Assistance, Extension, and Project's Administration although are part of Economic Costs of the

124

Project, they do not enter as costs for the individual farmer participating into the project. According to these results, the project is also financially sound, because the investment in irrigation infrastructure is financially profitable for the participating farmer.

Summary Table 2

Financial Internal Rate of Return (IRR) Before Financing
(Percentage)

Scale of System	FARM MODEL			
	Traditional Technology		Intermediate Technology	
	Normal Access	Remote Access	Normal Access	Remote Access
Micro	28.5	20.7	29.3	20.4
Small	22.9	16.5	23.1	16.0
Medium	21.2	15.2	21.3	14.6

3. Cost Recovery

The high returns per hectare easily provide a basis for full cost recovery, of the irrigation investment. That is, even after covering the amortization and interest costs of the irrigation infrastructure, the farmer will be much better off with the irrigation infrastructure than without it. This analysis is developed in detail in Table 22-a and -b, and 23-a and -b, in this annex. Those tables calculate the cash balance of the farmer under alternative financial terms, i.e., different combinations of interest rate, grace period and maturity, for the two extremes of farm models: the worst and the best case. The worst case refers to a traditional technology farm, with remote access to transport, and medium size irrigation system. The best case refers to an intermediate technology farm, with normal access to transport, and micro size irrigation system.

It was found that paying an 8% real interest rate (to which, inflation should be added to have nominal interest rate); grace periods of 3 to 5 years, and maturities from 8 to 14 years would be sufficient for the farmer to pay for the irrigation investment, leaving him a cash balance of at least L300 per hectare every year. However, the results indicate that some of the farms will require support credit the first two years after starting irrigation. The variation dependent on the scale of irrigation system, and on the farm model.

125

Applying an alternative 12% real interest rate to farm credits, it was verified that the same grace periods and maturities still hold, as long as additional support credit is provided during the first 1 to 3 years of the project.

4. Complementary Remarks

The sum total of the financial and economic results are indicative, as distinct from definitive, because they are based on "type" systems and average costs. Clearly there will be variations in cost and construction design as the systems are de-facto put in place.

It is important to mention that according to observed experiences, project success will greatly depend on the adequate provision of extension, credit, and marketing services. Extension and credit are included in this project.

5. Contribution to Jackson Plan Objectives

Once the project's benefits stabilize at the full development stage of the project, that is after its 15th year of implementation, its annual contribution to Jackson Plan objectives (in constant 1984 Lempiras) will be as follows:

- Net economic benefits of L19.7 million per year.
- Labor income of L6.9 million.
- Provide employment of 1.36 million man-days, equivalent to agricultural employment for 6,800 persons.
- Annual farm income of L28 million, equivalent to L5,900 per family for the expected 4,830 farms families that will participate in the project.
- GDP generated by the project will be valued at L29.0 million, that is 0.4% of present GDP.
- Net exports of L784 thousand a year.

6. Contribution to USAID/Honduras Action Plan Objectives

Among Action Plan Objectives for Agriculture of USAID/Honduras, there are three particularly relevant with reference to this project. They are: agricultural production, per capita GDP, and irrigated area.

If this project starts implementation in 1987, its contribution to the above objectives by 1990 will be:

- US$5.90 million of agricultural priduction (Table 32).

126

TABLE 1
LAND USE
(Percentage)

	Without Project		With Project
	Tradit. Technol.	Interm. Technol.	
Corn	80	56	19
Sorghum		4	
Beans	10	5	5
Rice		2	40
Fruits (orange)		3	16
Vegetables (tomato)			16
Soja			24
Cantaloupe			13
Total crops	90	73	149
Pasture		20	26
Fallow		10	
Total use	90	93	201

Sources: Without project:
Censo Nacional Agropecuario 1974.
Encuesta Agricola Nacional 1984.
With project:
Several irrigation studies.

TABLE 3

DERIVATION OF ECONOMIC FARM GATE PRICES FROM WORLD MARKET PRICES FOR SELECTED GRAINS

(US$ dollars and Lempiras of 1984 per ton)

	Unit	Corn Import	Corn Export	Rice Import	Rice Export
World market price, 1984 (1)	($/t)	138	138	255	255
Projection for 1990 (1)	($/t)	116	116	348	348
Adjustment for quality differential	(%)	100	100	85	85
Price adjusted for quality	($/t)	116	116	296	296
International Shipping and Handling	($/t)	20	-20	20	-20
Price at Honduras port	($/t)	136	96	316	276
(2)	(L/t)	367	259	853	745
Local port charges	(L/t)	20	-20	20	-20
Transport and Handling to port	(L/t)	80	-80	80	-80
Importer's margin	(L/t)				
Ex-mill price	(L/t)	467	159	953	645
Processing rate	(%)	100	100	65	65
Processing cost	(L/t)			-110	-110
By-products sale	(L/t)			65	65
Mill-gate price	(L/t)	467	159	574	374
Local Transportation Cost	(L/t)	-7	-7	-7	-7
Farm-gate price	(L/t)	460	152	567	367

Source: Feasibility Study of Choluteca Project, 1984

Note: (1) World Bank prices and price forecasts, January 1986.

(2) Using 1.35 as the shadow price of foreign exchange.

The with-project pattern of land use presents a more balanced distribution of crops. Corn is drastically reduced, while more profitable commercial crops appear. Orange production has been selected to represent all fruit production, while tomato production represents all vegetable production. Land use intensity increases from 0.90 in traditional farms and 1.10 in intermediate farms without-project, to 2.00 in the with-project situation (Table 1).

This is a conservative estimate of land use patterns with irrigation. It probably represents adequately the first 5 to 10 years of exposure to irrigation practices, when some farmers will stick to less profitable crops like corn. However, with time the more profitable crops will totally replace the others and land use intensity will further increase, towards three instead of two crop cycles a year in many farms.

2. Financial and Economic Prices

Financial prices refer to prices prevailing in the market. They are the prices actually paid by the purchasers of products or services.

Economic prices try to estimate the cost of a product or service in terms of foregone GDP, when such product or service is applied to an alternative use.

Since the intervention under analysis is directed to farms, all prices used to measure costs and benefits will be farm gate prices.

To avoid confusions brought out by inflationary changes in the price level, constant prices of 1984 have been used throughout the study. Interest rates are then real interest rates obtained after substracting expected inflation rates, from nominal interest rates. For example, a 12% nominal interest rate in a context of a 4% permanent inflation, is equivalent to just 8% of real interest.

2.1 Farm Gate Prices of Agricultural Products

There is not a single official source for farm gate prices in Honduras, so in each case different sources had to be used, looking for the most adequate one.

a. Basic Grains

In the case of basic grains, the reference point is the support price of IHMA ("Instituto Hondureno de Mercadeo Agrícola").

In the case of tomatoes, there are price differences among different types of tomatoes. The main difference originates in the use of the product, either for direct consumption, or to process tomato paste. These two basic types of tomatoes also have different production costs. Here we have taken tomatoes for direct consumption as representative of all vegetables to be produced. The farm gate financial price quoted by Recursos Hîdricos is of L4 per box of 28 lbs. This amounts to L14.27 per qq, and L314 per ton. The economic price is also considered identical to the financial price.

c. Cantaloupe and Orange

For cantaloupe we have information on prices from cooperatives working with A.I.D. support. The production of a typical 1 ha. farm includes: 2/3 of export quality cantaloupes at L18 a box of 60 lbs., that is L660 per ton, and 1/3 of production for domestic consumption at L264 per ton. The average price is then of L528 per ton.

Table 4

Farm Gate Prices of Cantaloupe
(Lempiras of 1984 per ton)

Weight %	Financial Prices	Correction Factor	Economic Prices
67	660	1.35	891
33	264	1	264
100	528	1.30	684

Adjusting by 35% (the standard correction factor for foreign exchange) the financial price of the exported cantaloupes, the economic price of total production rises to L684 per ton.

For orange the price quoted from the Quimistan Project Study and Recursos Hîdricos, is of L154 per ton. This price refers to oranges directed to domestic markets. The economic price has been considered identical to the financial price.

d. Livestock

Financial prices for livestock products have been obtained by observations in the field, and interviews at milk processing plants. They are:

Milk:	0.43 L per litre
Meat:	1.11 L per kg of live cattle
Breeding cattle:	800.00 L per head

130

Since livestock products are tradeable, the economic prices are calculated applying to financial prices the standard conversion factor (SCF) of the shadow price of foreign exchange. (See section 2.2.e)

2.2 Farm Gate Prices of Inputs

a. Seed Prices

Seed prices have been obtained from Recursos Hîdricos and from the Choluteca, Guayape and Quimistan project studies. Since these are seeds and seedlings produced domestically, financial and economic prices are considered identical.

Table 5
Farm Gate Seed/ling Prices
(Lempiras of 1984 per unit)

	UNIT	
Corn	KG	1.90
Beans	"	1.00
Rice	"	1.39
Sorghum	"	1.70
Soybean	"	0.77
Melon	"	48.50
Tomato	"	186.00
Orange seedling	(u)	2.00

Source: Recursos Hîdricos. Choluteca, Guayape and Quimistan project studies.

b. Inputs

The price for fertilizers was obtained from Recursos Hîdricos, at L0.67 per kilogram. Prices of insecticides, herbicides, fungicides, etc. were taken from cost budgets of the respective crops, coming from Recursos Hîdricos and from the Choluteca, Guayape and Quimistan project studies. The unit prices of such products vary, since their type depends on the crop to which they are applied. Since inputs are mostly imported, their economic prices are calculated multiplying financial prices by the SCF of the shadow exchange rate. For pesticides, one must also consider the 10% import tariff, which has to be deducted from financial prices. Their correction factor is then:

$$SCF/1.10 = 1.23.$$

131

c. Labor

Daily salary obtained from Recursos Hîdricos is L5. The shadow price of labor was estimated at L2.5 a day, considering the substantial degree of rural unemployment (1), and considering also that most agricultural employment corresponds to family labor. In the family, when one worker is removed, others will assume most of his chores, and foregone output will be quite below labor's marginal product.

d. Machinery and Animal Traction

Financial prices for the use of machinery and animal traction were obtained from "PROMECA, Programa Nacional de Mecanizaciôn Agrîcola", and from Recursos Hîdricos.

Animal traction was valued at L15/day, while a tractor plus implements costs L30/hour. Harvesting grains was rated at L82.5/ton, and threshing at L30/ton.

To obtain economic prices of machinery use, it was estimated that 75% of the cost of machinery services corresponds to imported inputs. The correction factor to obtain economic prices is then:

$$0.25 \times 1.00 + 0.75 \times SCF = 1.26.$$

e. Shadow exchange rate

The standard correction factor (SCF) for the shadow price of foreign exchange was estimated as 1.35, considering that the real trade weighted effective exchange rate had fallen around 75% by the end of 1984, taking 1978 as base year.(2) This means that the shadow exchange rate (SER) is:

$$SER = SCF \times OER = 1.35 \times 2 = L/US\$\ 2.70,$$

where OER refers to the official exchange rate.

3. Financial Analysis of Typical Farms

A typical farm is a farm model that represents the average farming practices and results of a particular group.

(1) The rate of rural unemployment and underemployment was 38% for 1980-1982, according to "Plan Nacional de Desarrollo Agrîcola, 1982-1986". Secretarîa Têcnica del Consejo Superior de Planificaciôn Econômica.
(2) IMF report on Honduras, 1/86.

132

Two types of farms have already been identified according to the production technologies they use. Those types are:

- Traditional technology farms,
- Intermediate technology farms.

According to the access to transportation facilities farms will be further classified in farms close to markets or normal access farms, and farms far from markets, which are referred to as remote farms. The characteristic of remote-access farms is that they receive product prices 10% lower, while non-labor inputs and services costs are 10% higher than those prevalent in normal-access farms. These two farm types represent the two extremes in the range of farm accessibility to markets.

In the without-project situation all farms are treated as normal access farms, under the assumption that their modest outputs are largely either self consumed or marketed locally, and their few inputs are also locally supplied. Therefore their distance to markets is not a factor in output or input prices.

3.1 Crops' Budgets

For each crop grown by traditional farms and by intermediate farms, a crop financial budget has been elaborated. These budgets show average yields, costs, and financial returns. These budgets are illustrative of the wide range of situations that will be faced depending on previous production technology and access to markets. They do not include investment and maintenance costs of the irrigation infrastructure.

A contingency cost equal to 5% of above costs is included in projected budgets, for the with-project situation. A real interest rate of 8% a year is applied to costs. Considering that working capital loans will have maturities below six months, only 1/2 of the interest rate is applied, that is 4%.

Table 6 presents crop budgets for traditional technology farming without irrigation. Net returns are minimal, and the main benefit the farmer gets is the salary assigned in the budget for his labor services.

Table 7 gives budgets for crops under intermediate technology production, without irrigation. Net returns are slightly better than those prevalent in traditional technology. Net returns are fairly similar across all crops.

With-project budgets of annual crops are presented in Table 8. Net returns are now larger and also more heterogeneous. Rice is more profitable than other grains. Cantaloupe and vegetables (tomato) are far more profitable than the other annual crops. These budgets refer to normal access farms. For remote access farms, prices of output and non-labor inputs must be adjusted.

TABLE 6

FINANCIAL ANALYSIS OF ALTERNATIVE CROPS PER HECTARE

TRADITIONAL TECHNOLOGY, WITHOUT PROJECT

CORN

	Unit	Quantity	Price	Value
Yield	(t)	1.17	330	386.10
Labor	(m-d)	54	5	270.00
Inputs				
Seed	(kg)	9.5	1.9	18.05
Other				16.00
Interest (4%)				12.16
Total var. costs				316.21
Net return				69.89

BEANS

	Unit	Quantity	Price	Value
Yield	(t)	0.56	968	542.08
Labor	(m-d)	64	5	320.00
Inputs				
Seed	(kg)	26	1	26.00
Other				9.00
Interest (4%)				14.20
Total var. costs				369.20
Net return				172.88

Source: "Modelo Sectorial de Programacion Lineal para la Produccion Nacional de Granos Basicos". SIECA. Doct.No.48/84, July 1984.

TABLE 7

FINANCIAL ANALYSIS OF ALTERNATIVE CROPS PER HECTARE

INTERMEDIATE TECHNOLOGY, WITHOUT PROJECT

	CORN			
	Unit	Quantity	Price	Value
Yield	(t)	2.9	330	957.00
Labor	(m-d)	42	5	210.00
Inputs				
Seed	(kg)	23	1.9	43.70
Fertilizer	(kg)	136	0.67	91.12
Herbicide	(kg)	2	18	36.00
Pesticide				40.00
Animal traction	(day)	6	15	90.00
Interest (4%)				20.43
Total var. costs				531.25
Net return				425.75

Source: Guayape Project Study, and Recursos Hidricos.

	BEANS			
	Unit	Quantity	Price	Value
Yield	(t)	0.8	968	774.40
Labor	(m-d)	41	5	205.00
Inputs				
Seed	(kg)	52	1	52.00
Fertilizer	(kg)	91	0.67	60.97
Herbicide	(kg)			
Pesticide				40.00
Animal traction	(day)	6	15	90.00
Interest (4%)				17.92
Total var. costs				465.89
Net return				308.51

Source: Guayape Project Study, and Recursos Hidricos.

	RICE			
	Unit	Quantity	Price	Value
Yield	(t)	2	484	968.00
Labor	(m-d)	41	5	205.00
Inputs				
Seed	(kg)	91	1.39	126.49
Fertilizer	(kg)	136	0.67	91.12
Herbicide	(kg)			70.00
Pesticide				60.00
Animal traction	(day)	6	15	90.00
Interest (4%)				25.70
Total var. costs				668.31
Net return				299.69

Source: Guayape Project Study, and Recursos Hidricos.

	SORGHUM			
	Unit	Quantity	Price	Value
Yield	(t)	2.5	308	770.00
Labor	(m-d)	49	5	245.00
Inputs				
Seed	(kg)	10	1.7	17.00
Fertilizer	(kg)	160	0.67	107.20
Herbicide	(kg)			
Pesticide				35.00
Animal traction	(day)	6	15	90.00
Interest (4%)				19.77
Total var. costs				513.97
Net return				256.03

Source: Choluteca Project Study, and Recursos Hidricos.

TABLE 6-A

FINANCIAL ANALYSIS OF ALTERNATIVE CROPS PER HECTARE

WITH PROJECT, AT FULL DEVELOPMENT YIELDS

	Unit	CORN Quantity	Price	Value
Yield	(t)	5	330	1650.00
Labor	(m-d)	32	5	160.00
Inputs				
Seed	(kg)	21	1.9	39.90
Fertilizer	(kg)	209	0.67	140.03
Herbicide	(kg)			
Pesticide				
Machinery				
Tractor	(hours)	8	30	240.00
Threshing	(t)	5	30	150.00
Contingencies (5%)				36.50
Interest (4%)				30.66
Total var. costs				797.08
Net return				852.92

Source: "Programa de Fincas Piloto". CIDA - Recursos Hidricos, Olancho 1984.

	Unit	BEANS Quantity	Price	Value
Yield	(t)	2	968	1936.00
Labor	(m-d)	63	5	315.00
Inputs				
Seed	(kg)	52	1	52.00
Fertilizer	(kg)	136	0.67	91.12
Herbicide	(kg)	2	35	70.00
Pesticide				30.00
Machinery				
Tractor	(hours)	6.5	30	195.00
Harvester	(t)	2	82.5	165.00
Contingencies (5%)				45.91
Interest (4%)				38.56
Total var. costs				1002.59
Net return				933.41

Source: Guayape Project Study, and Recursos Hidricos.

	Unit	RICE Quantity	Price	Value
Yield	(t)	5.5	484	2662.00
Labor	(m-d)	28	5	140.00
Inputs				
Seed	(kg)	80	1.39	111.20
Fertilizer	(kg)	185	0.67	123.95
Herbicide				84.00
Pesticide				144.00
Machinery				
Tractor	(hours)	5	30	150.00
Harvester	(t)	5.5	82.5	453.75
Contingencies (5%)				60.35
Interest (4%)				50.69
Total var. costs				1317.93
Net return				1344.07

Source: Guayape Project Study, and Recursos Hidricos.

	Unit	SOYBEAN Quantity	Price	Value
Yield		2.2	594	1306.80
Labor	(m-d)	38	5	190.00
Inputs				
Seed	(kg)	50	0.77	38.50
Fertilizer	(kg)	90	0.67	60.30
Herbicide				60.00
Pesticide				50.00
Machinery				
Tractor	(hours)	5.5	30	165.00
Harvester	(t)	2.2	82.5	181.50
Contingencies (5%)				37.27
Interest (4%)				31.30
Total var. costs				813.87
Net return				492.93

Source: Guayape Project Study, and Recursos Hidricos.

TABLE 3-B

FINANCIAL ANALYSIS OF ALTERNATIVE CROPS PER HECTARE
WITH PROJECT, AT FULL DEVELOPMENT YIELDS

CANTALOUPE

	Unit	Quantity	Price	Value
Yield (1)	(t)	10	528	5280.00
Labor	(m-d)	149	5	745.00
Inputs				
Seed	(kg)	1.5	48.5	72.75
Fertilizer	(kg)	430	0.67	288.10
Fungicides	(kg)	22.7	34	771.80
Insecticides	(kg)	12	35	420.00
Other				45.00
Machinery				
Tractor	(hours)	8	30	240.00
Contingencies (5%)				129.13
Interest (4%)				108.47
Total var. costs				2820.25
Net return				2459.75

(1) 67% for exports, at L 18 a 60 lb box, or 660 L/t; and 33% for domestic consumption, at 264 L/t.

Source: Choluteca and Guayape Project Studies, and Recursos Hidricos.

TOMATO

	Unit	Quantity	Price	Value
Yield	(t)	23	314	7222.00
Labor	(m-d)	322	5	1610.00
Inputs				
Seed	(kg)	0.43	186	79.98
Fertilizer	(kg)	300	0.67	201.00
Pesticides				350.00
Other				560
Machinery				
Tractor	(hours)	8	30	240.00
Contingencies (5%)				152.05
Interest (4%)				127.72
Total var. costs				3193.03
Net return				4028.97

Source: "Programa de Fincas Piloto". CIDA - Recursos Hidricos, Olancho 1984.

Table 9 represents the production of orange with intermediate technology without irrigation. Table 10 shows annual production and cost figures for one hectare of orange with the project.

Table 11 gives data on cattle exploitation, basically milk production under without and with-project conditions. The with-project situation assumes irrigation by aspersion. The additional costs of maintenance and operation of the aspersion equipment are incorporated into this budget. However, the investment figure in the first year, which includes the purchase of cattle to start the growth of a new herd, has not been added up to the totals.

3.2 Typical Farm Without-Project

Based on the land use profile for the typical farm as described in Table 1, and the financial budgets of Tables 6 and 7, financial budgets of typical one hectare farms have been designed both, for the traditional technology farm (Table 12), and for the intermediate technology farm (Table 13), in the without-project situation.

Total employment and agricultural income for the farmer will obviously depend on the size of his farm. As a reference, the "Censo Nacional Agropecuario" of 1974 indicates that 88% of all farms are below 20 ha, with an average size of 1.6 ha each.

A 1.6 ha typical farm gives 116 man-days of employment with traditional technology, and 53 man-days of employment with intermediate technology. These employment days are concentrated in the winter, when the crops season for non-irrigated farming occurs.

3.3 Typical Farm With-Project

The profile of the typical farm with project is based on an illustrative land use profile. Table 14 presents the financial analysis of the annual crops in one hectare of the typical farm, this farm type refers to farms having normal access to transportation facilities. Furthermore, estimated yields correspond to the irrigated farm at full development, that is after the farmer has absorbed the new technological package and is able to apply it as recommended by the agronomist.

When a farm receives the project intervention, that is provision of irrigation and technical assistance, plus access to credit and services of complementary projects, the farm will not reach full development yields at once. It has been assumed that the change from without-project to with-project yields of annual crops will be gradual, as described by Tables 15 and 16. Thus, the farm previously using intermediate technology will reach full development yields on its 4th irrigation year, and the farm previously using traditional technology will reach those yields only on its 6th year of irrigation. However, those farms will spend the full with-project costs from their first year of irrigation.

TABLE 9

FINANCIAL ANALYSIS OF ONE HECTARE EXPLOITATION OF ORANGE, WITHOUT PROJECT

	Units	Farm year 1	2	3	4	5	6	7	8 to 25	AVERAGE
Labor	(m-d)	60	70	70	70	70	70	70	70	69.6
	(L)	300	350	350	350	350	350	350	350	348.0
Inputs										
Seedlings	(u)	224	20							9.8
	(L)	448	40							19.5
Fertilizers	(kg)	10	10	10	10	10	10	10	10	10.0
	(L)	7	7	7	7	7	7	7	7	6.7
Other inputs	(L)	15	15	15	15	15	15	15	15	15.0
Machinery	(hours)	8								0.3
	(L)	240								9.6
Harvesting										
Materials	(L)				150	150	150	150	150	132.0
Transportation	(L)				67	156	244	311	356	287.1
Recollection	(L)				65	152	239	304	348	280.9
Interest rate (4%)	(L)	40	16	15	26	33	40	45	49	44.0
Total var. costs	(L)	1,050	428	387	680	863	1,045	1,183	1,274	1142.8
Output	(t)				3	7	11	14	16	12.9
Value of output	(L)				462	1,078	1,694	2,156	2,464	1989.7
Net return	(L)	(1,050)	(428)	(387)	(218)	215	649	973	1,190	847

Source: Quimistan Project Study.

TABLE 10

FINANCIAL ANALYSIS OF ONE HECTARE EXPLOITATION OF ORANGE, WITH PROJECT

	Units	1	2	3	4	5	6	7	8	9 to 25	AVERAGE
Labor	(m-d)	105	94	94	101	105	105	105	105	105	104.0
	(L)	735	658	658	707	735	735	735	735	735	727.7
Inputs											
Seedlings	(u)	211	3								8.6
	(L)	633	9								25.7
Fertilizers	(kg)	105	122	179	238	358	358	358	358	358	326.5
	(L)	70	82	120	159	240	240	240	240	240	218.7
Other inputs	(L)	126	116	116	116	370	370	370	370	370	329.8
Machinery	(hours)	6									0.2
	(L)	480									19.2
Harvesting											
Materials	(L)				150	150	150	150	150	150	132.0
Transportation	(L)				167	333	600	733	933	1,133	881.3
Recollection	(L)				163	326	587	717	913	1,109	862.2
Contingencies (5%)	(L)	102	43	45	73	108	134	147	167	187	159.8
Interest (4%)	(L)	86	36	38	61	90	113	124	140	157	134.3
Total var. costs	(L)	2,232	944	976	1,597	2,352	2,929	3,217	3,649	4,081	3,490.7
Output	(t)				7.5	15.0	27.0	33.0	42.0	51.0	40.0
Value of output	(L)				1,155	2,310	4,158	5,082	6,468	7,854	6,163.1
Net return	(L)	(2,232)	(944)	(976)	(442)	(42)	1,229	1,865	2,819	3,773	2,672

Source: Quimistan Project Study, and The Citrus Commodity System, a Component of the Agribusiness Export Development and Services Program for Honduras. AID, Doct. No.0745F,F, June 1984.

TABLE 11

FINANCIAL ANALISIS OF ONE HECTARE EXPLOITATION OF CATTLE

	Units	Without Project	Farm year, With Project 1	2	3	4	5	6	7 to 10	11+	End year
Labor	(m-d)	14	86	86	86	101	101	101	115	115	115
	(L)	68	432	432	432	504	504	504	576	576	576
Inputs, tools, maint., etc.	(L)	72	149	262	308	353	377	379	386	386	386
Breeding bulls	(L)				110		164		82	82	82
Maint. irrigation equipment	(L)				293	293	293	293	293	293	293
Investment	(L)		4,430								(5,844)
Contingencies (5%)	(L)		251	35	57	57	67	59	67	67	67
Interest work. capital (4%)	(L)	6	33	29	48	48	56	49	56	56	56
Total variable costs	(L)	145	865	758	1,248	1,255	1,461	1,284	1,460	1,460	(4,383)
Output											
Milk	(litres/ha)	355	873	1,510	2,124	3,180	5,428	6,032	6,032	6032	6,032
Meat	(kg/ha)	69	93	137	209	246	153	171	171	171	171
Cattle	(heads/ha)							0.94	0.94	0.94	0.94
Total revenue	(L)	229	478	801	1,145	1,641	2,504	3,535	3,535	3,535	3,535
Net return	(L)	84	(387)	43	(103)	385	1,043	2,251	2,074	2,074	7,918

Source: Guayape Project [illegible]

Note: Investment costs have not been added up to costs. They will be considered together with irrigation investment in Tables 22 and 23.

TABLE 12
FINANCIAL ANALYSIS OF TYPICAL ONE HECTARE FARM
TRADITIONAL TECHNOLOGY, WITHOUT PROJECT
(Lempiras of 1984)

Description	Units	Corn	Beans	TOTAL
Acreage	(ha)	0.8	0.1	0.9
Total Output	(L)	309	54	363
Labor Costs	(L)	216	32	248
Total var. costs	(L)	253	37	290
Net Return	(L)	56	17	73

Source: Tables 1, 6.

TABLE 13
FINANCIAL ANALYSIS OF TYPICAL ONE HECTARE FARM
INTERMEDIATE TECHNOLOGY, WITHOUT PROJECT
(Lempiras of 1984)

Description	Units	Corn	Sorghum	Beans	Rice	Fruits	Livestock	TOTAL
Acreage	(ha)	0.56	0.04	0.05	0.02	0.07	0.2	0.9
Total Output	(L)	536	31	39	19	60	46	730
Labor Costs	(L)	118	10	10	4	10	14	166
Total var. costs	(L)	298	21	23	13	34	29	418
Net Return	(L)	238	10	15	6	25	17	312

Source: Tables 1, 7.

TABLE 14
FINANCIAL ANALYSIS OF ANNUAL CROPS WITH PROJECT
TYPICAL ONE HECTARE FARM AT FULL DEVELOPMENT
(Lempiras of 1984)

Description	Units	Corn	Beans	Rice	Vegetab.	Soybean	Cantal.	TOTAL
Acreage	(ha)	0.19	0.05	0.4	0.16	0.24	0.13	1.17
Total Output	(L)	314	97	1065	1156	314	686	3631
Labor Costs	(L)	30	16	56	258	46	97	502
Total var. costs	(L)	151	50	527	511	195	367	1802
Net Return	(L)	162	47	538	645	118	320	1829
OUTPUT AT WITHOUT PROJECT YIELDS								
INTERMEDIATE TECHNOLOGY								
Yield	(t/ha)	2.9	0.3	2	12	1.3	4	
Total Output	(L)	182	39	387	603	185	275	1671
TRADITIONAL TECHNOLOGY								
Yield	(t/ha)	1.17	0.56	1	6	0.65	2	
Total Output	(L)	73	27	194	301	93	137	825

Source: Tables 1, 6, 7, 8.

TABLE 15

TRANSITION COEFFICIENTS FOR THE VALUE OF ANNUAL CROPS FROM THE WITHOUT TO THE WITH PROJECT SITUATION

OUTPUT = OUTPUT w + a * (OUTPUT W - OUTPUT w)

Where: OUTPUT W, output with project at full development.
OUTPUT w, output at without project yields.

Irrigation year	FACTOR "a" Traditional Technology	Intermediate Technology
1	0.35	0.50
2	0.55	0.80
3	0.75	0.90
4	0.85	1.00
5	0.95	1.00
6+	1.00	1.00

TABLE 16

VALUE OF ANNUAL CROPS OUTPUT OF TYPICAL ONE HECTARE FARM WITH PROJECT

Irrigation year	1	2	3	4	5	6+
Traditional	1,8[illegible]	2,368	2,929	3,210	3,490	3,631
Intermediate	2,228	3,070	3,350	3,631	3,631	3,631

Source: Tables 14, 15.

In order to calculate yields in the transition period, from the without-project situation to the full development with-project case, the value of annual crops in the with-project cropping pattern, but at without-project yields was calculated at the bottom of Table 14. This calculation was done for farms previously using intermediate technology, and also for those using traditional technology.

For the production of fruits (orange) and cattle, which take several years to reach full development output, no transition coefficients have been applied to yields and outputs. The assumption is that these activities give the farmer enough time to adapt to the new technologies.

Tables 17 to 20 present the financial budgets for one hectare of typical farm with-project, in the four farm models. These budgets do not include any payment for the irrigation infrastructure received, or for the operation and maintenance of such infrastructure. The only exception to this omission is cattle production, where the costs of investment, operation and maintenance of farm equipment for irrigation by aspersion, as well as the costs of the initial herd have been included in total costs.

At full development, a 1.6 ha typical farm will provide 154 man-days of employment (L770 of labor costs, at L5 per day). This employment figure, although still below full employment (1), is far better than 53 and 116 man-days at the without-project situation. It must be remembered also that part of the farmer contribution to the maintenance of the irrigation system will be in the form of labor-days.

The average increase in annual net return (cash surplus in with-project budgets) is from L192.5 per ha without-project, to L2,775 per ha with-project. The average increase in farmer's annual income is from L400 per ha without-project, to L3,545 per ha with-project.

It should be noted again that farmers are expected to achieve these full benefits only after 4 to 6 years of learning-by-doing. Only then irrigation technology will be established on a base firmer than present, and the technology will start to spread through the demonstration effect.

(1) It is ambiguous to set a full employment figure for a typical farm. It could be assumed that the typical farm has a man-power potential of two: family head (1), wife (0.5), and two children (0.5). Having 200 employment days on a year on agriculture would be probably close to full employment. That makes 400 man-days a year for full employment at the family farm.

TABLE 17

FINANCIAL ANALYSIS FOR ONE HECTARE OF TYPICAL FARM WITH PROJECT

PREVIOUS TECHNOLOGY: TRADITIONAL

ACCESS TO TRANSPORTATION: NORMAL

(Lempiras of 1984 per hectare)

Item		Irrigation year 1	2	3	4	5	6	7	8	9	10 11 to 24	25
Value of Output	(A)	1,932	2,577	3,227	3,821	4,511	5,215	5,363	5,585	5,806	5,806	5,806	5,806
Credit needs													
Working Capital		2,292	2,067	2,195	2,292	2,460	2,504	2,592	2,659	2,725	2,725	2,725	2,725
Cattle operation		1,152											
Labor costs	(B)	732	720	720	746	751	751	770	770	770	770	770	770
Total variable costs	(C)	2,384	2,150	2,282	2,383	2,558	2,604	2,696	2,765	2,834	2,834	2,834	1,315
Net return	(D)	(452)	427	945	1,438	1,953	2,611	2,667	2,820	2,972	2,972	2,972	4,491
Farmer's income	(E)	280	1,147	1,665	2,184	2,704	3,362	3,437	3,589	3,742	3,742	3,742	5,261

Source: Tables 1, 10, 11, 16.

Note: D = A - C

E = D + B

Total variable costs include a 5% provision for contingencies, plus a 4% payment on working capital. They do not include investment costs in the cattle operation and in the irrigation infrastructure.

146

TABLE 18

FINANCIAL ANALYSIS FOR ONE HECTARE OF TYPICAL FARM WITH PROJECT

PREVIOUS TECHNOLOGY: INTERMEDIATE

ACCESS TO TRANSPORTATION: NORMAL

(Lempiras of 1984 per hectare)

Item		Irrigation year 1	2	3	4	5	6	7	8	9	10	11 to 24	25
Value of Output	(A)	2,352	3,278	3,648	4,242	4,651	5,215	5,363	5,585	5,806	5,806	5,806	5,806
Credit needs													
Working Capital		2,292	2,067	2,195	2,292	2,460	2,504	2,592	2,659	2,725	2,725	2,725	2,725
Cattle operation		1,152											
Labor costs	(B)	732	720	720	746	751	751	770	770	770	770	770	770
Total variable costs	(C)	2,384	2,150	2,282	2,383	2,558	2,604	2,696	2,765	2,834	2,834	2,834	1,315
Net return	(D)	(31)	1,128	1,366	1,859	2,093	2,611	2,667	2,820	2,972	2,972	2,972	4,491
Farmer's income	(E)	701	1,848	2,085	2,605	2,844	3,362	3,437	3,589	3,742	3,742	3,742	5,261

Source: Tables 1, 10, 11, 16.

Note: D = A - C

E = D + B

Total variable costs include a 5% provision for contingencies, plus a 4% payment on working capital. They do not include investment costs in the cattle operation and in the irrigation infrastructure.

TABLE 19

FINANCIAL ANALYSIS FOR ONE HECTARE OF TYPICAL FARM WITH PROJECT

PREVAILING TECHNOLOGY: TRADITIONAL

ACCESS TO TRANSPORTATION: REMOTE

(Lempiras of 1984 per hectare)

Item		Irrigation year 1	2	3	4	5	6	7	8	9	10	11 to 24	25
Value of Output	(A)	1,738	2,319	2,904	3,439	4,060	4,694	4,827	5,026	5,226	5,226	5,226	5,226
Credit needs													
Working Capital		2,448	2,202	2,342	2,446	2,630	2,679	2,775	2,848	2,921	2,921	2,921	2,921
Cattle operation		1,267											
Labor costs	(B)	732	720	720	746	751	751	770	770	770	770	770	770
Total variable costs	(C)	2,546	2,290	2,436	2,544	2,736	2,786	2,886	2,962	3,038	3,038	3,038	1,366
Net return	(D)	(808)	29	469	895	1,324	1,907	1,941	2,065	2,188	2,188	2,188	3,859
Farmer's income	(E)	(75)	749	1,188	1,641	2,075	2,658	2,711	2,834	2,958	2,958	2,958	4,629

Source: Tables 1, 10, 11, 16.

Note: D = A - C

E = D + B

Total variable costs include a 5% provision for contingencies, plus a 4% payment on working capital. They do not include investment costs in the cattle operation and in the irrigation infrastructure.

TABLE 20

FINANCIAL ANALYSIS FOR ONE HECTARE OF TYPICAL FARM WITH PROJECT

PREVIOUS TECHNOLOGY: INTERMEDIATE

ACCESS TO TRANSPORTATION: REMOTE

(Lempiras of 1984 per hectare)

Item		Irrigation year 1	2	3	4	5	6	7	8	9	10	11 to 24	25
Value of Output	(A)	2,117	2,950	3,283	3,818	4,186	4,694	4,827	5,026	5,226	5,226	5,226	5,226
Credit needs													
Working Capital		2,448	2,202	2,342	2,446	2,630	2,679	2,775	2,848	2,921	2,921	2,921	2,921
Cattle operation		1,267											
Labor costs	(B)	732	720	720	746	751	751	770	770	770	770	770	770
Total variable costs	(C)	2,546	2,290	2,436	2,544	2,736	2,786	2,886	2,962	3,038	3,038	3,038	1,366
Net return	(D)	(429)	660	847	1,274	1,451	1,907	1,941	2,065	2,188	2,188	2,188	3,859
Farmer's income	(E)	303	1,380	1,567	2,020	2,202	2,658	2,711	2,834	2,958	2,958	2,958	4,629

Source: Tables 1, 10, 11, 16.

Note: D = A - C

E = D + B

Total variable costs include a 5% provision for contingencies, plus a 4% payment on working capital. They do not include investment costs in the cattle operation and in the irrigation infrastructure.

3.4 Financial Analysis of Farms Under Irrigation, and Cost Recovery

The financial and economic cost of irrigation infrastructure will vary according to the type of irrigation system (Table 21). These costs have been calculated from average figures obtained in actual experiences in the Guayape Valley, where there are 12 irrigation systems installed, servicing a total area of 375 ha. The relative differences in investment costs and the composition of costs, according to the system's size were suggested by A.I.D.'s Engineering Office (Roberto Aguero).

In Table 21, estimated investment costs include design costs and implementation costs. Operation and maintenance costs were estimated at 5% of investment costs. Estimated investment costs refer to gravity irrigation systems which do not use pumping. A system requiring pumping will usually have smaller up front cost, and higher operation and maintenance costs. It was assumed that one cancels the other, and the proposed investment costs appropriately represent both alternatives.

There are four farm models and three types of irrigation system, giving 12 possible combinations. For these 12 prototypes, incremental benefits before financing were calculated after substracting investment costs and foregone benefits from net benefits. In order to simplify the analysis, detailed tables are presented only for the two extreme cases: the "worst case", refering to the prototype with the most difficult payment schedule during the initial 10 to 15 years, and the "best case" or the prototype with the easiest payment schedule for irrigation infrastructure costs. Furthermore, two real interest rates were applied to all credit, 8% and 12%. Nominal interest rates would be the real interest rate plus inflation rate. 8% is the lowest real interest rate presently available for agricultural credit. 12% is the present real interest rate that predominates in banking credit in Honduras. The real interest rate that will prevail will probably be within that range, depending on economic policies of the GOH.

- The traditional remote farm having a medium size irrigation system (Tables 22-a and 22-b). This is the least profitable farm model facing the most expensive irrigation investment alternative. This is the "worst case"; its credit program requires a maturity of 14 years with 5 years of grace for amortization. Using an 8% real interest rate, this farm model needs a supplementary support credit of L1200 during the first two years, in order to achieve a minimum cash balance of L300 per ha for the farmer. If a 12% real interest rate were to prevail, the farm would need a supplementary support credit of L2,050 during the first three years to allow a minimum cash balance for the farmer.

TABLE 21

INVESTMENT AND MAINTENANCE COSTS OF IRRIGATION INFRASTRUCTURE
BY TYPE OF IRRIGATION SYSTEM
(Lempiras of 1984 per Hectare)

System	Financial Costs		Composition of costs			Economic Costs	
	Invest.	Oper. & Mainten.	Unskilled Labor	Other Domestic	Foreign Exchange	Invest.	Oper. & Mainten.
Micro	1,757	88	50%	40%	10%	1,379	69
Small	3,218	161	45%	30%	25%	2,776	139
Medium	3,807	190	30%	30%	40%	3,769	188

TABLE 22-a

COST RECOVERY FEASIBILITY, THE WORST CASE

SOURCES AND USES OF FUNDS FOR ONE HECTARE OF TYPICAL FARM WITH PROJECT

PREVIOUS TECHNOLOGY: TRADITIONAL

ACCESS TO TRANSPORTATION: REMOTE

IRRIGATION SYSTEM: MEDIUM

(Lempiras of 1984 per hectare)

Item	0	1	2	3	4	5	6	7	8	9	10	11 to 14	15 to 24	25	Financial IRR (%)
	Irrigation year														
Value of Output		1,738	2,319	2,904	3,439	4,060	4,694	4,827	5,026	5,226	5,226	5,226	5,226	5,226	
Farm costs		2,448	2,202	2,342	2,446	2,630	2,679	2,775	2,848	2,921	2,921	2,921	2,921	1,326	
O & M of Irrig. System		190	190	190	190	190	190	190	190	190	190	190	190	190	
Investment															
Incremental working capital		1,224	(123)	70	52	92	24	48	37	37	0	0	0	(1,460)	
Cattle operation	1,267														
Irrigation Infrastructure	3,807														
Net Benefits before Financing	(5,074)	(2,124)	50	302	750	1,147	1,800	1,814	1,952	2,028	2,115	2,115	2,115	5,170	16.1
FINANCING															
Support credit		1,000	200												
Incremental working capital		1,224	(123)	70	52	92	24	48	37	37	0	0	0	(1,460)	
Cattle operation	1,267														
Irrigation Infrastructure	3,807														
Credit costs															
Working Capital		98	88	94	98	105	107	111	114	117	117	117	117	117	
Cattle operation		101	101	101	101	203	203	203	203	203	203	203			
Irrigation Infrast.		305	305	305	305	609	609	609	609	609	609	609			
Support		80	96	96	96	192	192	192	192	192	192	192			
Net Benefits after Financing	(0)	(484)	(463)	(224)	203	130	713	746	870	993	993	993	1,998	3,593	34.3
Labor income		789	777	777	804	808	808	827	827	827	827	827	827	827	
Farmer's cash balance		305	314	553	1,006	938	1,521	1,573	1,697	1,820	1,820	1,820	2,825	4,420	
Foregone Benefits		73	73	73	73	73	73	73	73	73	73	73	73	73	
Incremental Benef. bef. Finan.	(5,074)	(2,197)	(23)	229	677	1,074	1,727	1,741	1,878	2,005	2,041	2,041	2,041	5,097	15.2
Incremental Benef. aft. Finan.	(0)	(557)	(536)	(297)	130	57	639	673	797	920	920	920	1,925	3,520	28.3

Source: Tables 1, 10, 11, 16, 21.

Interest rate (%)	8
Grace period	5 years
Maturity	14 years

TABLE 22-b

COST RECOVERY FEASIBILITY, THE WORST CASE

SOURCES AND USES OF FUNDS FOR ONE HECTARE OF TYPICAL FARM WITH PROJECT

PREVIOUS TECHNOLOGY: TRADITIONAL

ACCESS TO TRANSPORTATION: REMOTE

IRRIGATION SYSTEM: MEDIUM

(Lempiras of 1984 per hectare)

Item	Irrigation year 0	1	2	3	4	5	6	7	8	9	10	11 to 14	15 to 24	25	Financial IRR (%)
Value of Output		1,738	2,319	2,904	3,439	4,060	4,694	4,827	5,026	5,226	5,226	5,226	5,226	5,226	
Farm costs		2,448	2,202	2,742	2,44[illegible]	[illegible]	2,679	2,775	2,848	2,921	2,921	2,921	2,921	1,326	
O & M of Irrig. System		190	190	190	1[illegible]	1[illegible]	190	19[illegible]	190	190	190	190	190	190	
Investment															
Incremental working capital		1,224	(123)	70	52	92	24	48	37	37	0	0	0	(1,460)	
Cattle operation	1,267														
Irrigation Infrastructure	3,807														
Net Benefits before Financing	(5,074)	(2,124)	50	302	750	1,147	1,800	1,814	1,952	2,078	2,115	2,115	2,115	5,170	16.1
FINANCING															
Support credit		1,330	570	150											
Incremental working capital		1,224	(123)	70	52	92	24	48	37	37	0	0	0	(1,460)	
Cattle operation	1,267														
Irrigation Infrastructure	3,807														
Credit costs															
Working Capital		147	132	141	147	159	161	166	171	175	175	175	175	175	
Cattle operation		152	152	152	152	238	238	238	238	238	238	238			
Irrigation Infrast.		457	457	457	457	714	714	714	714	714	714	714			
Support		160	228	246	246	385	385	385	385	385	385	385			
Net Benefits after Financing	(0)	(485)	(472)	(473)	(199)	(256)	326	358	480	602	602	602	1,939	3,534	22.1
Labor income		789	777	777	804	808	808	827	827	827	827	827	827	827	
Farmer's cash balance		304	305	304	604	552	1,134	1,185	1,307	1,429	1,429	1,429	2,766	4,361	
Foregone Benefits		73	73	73	73	73	73	73	73	73	73	73	73	73	
Incremental Benef. bef. Finan.	(5,074)	(2,197)	(23)	229	677	1,074	1,727	1,741	1,878	2,005	2,041	2,041	2,041	5,097	15.2
Incremental Benef. aft. Finan.	(0)	(558)	(545)	(547)	(272)	(329)	253	285	407	529	529	529	1,866	3,461	18.7

Source: Tables 1, 10, 11, 16, 21.

Interest rate (%)	12
Grace period	5 years
Maturity	14 years

- The intermediate normal access farm having a micro size irrigation system (Tables 23-a and 23-b). This is the most profitable farm model combined with the cheapest irrigation investment alternative. This is the "best case"; it requires only 8 years of maturity, and 3 years grace period for amortization payments. Applying to this model a 12% real interest rate on loans, a support loan of L50 the first year keeps the farmer's cash balance over L300 per hectare.

In Tables 22 and 23, net benefits before financing were obtained after substracting from the value of output, farm costs, operation and maintenance costs as well as investment costs of the irrigation infrastructure, and also investment costs of the cattle operation in the farm.

Applying the "time adjusted" convention (1), investment costs are considered to happen at the end of the year previous to the first project results. Incremental working capital is also deducted as an investment cost. Working capital is estimated as 50% of farm costs. It is assumed that before the project the farmer held no working capital, so that in the first project year the working capital increases from zero to 50% of current farm costs. On the 25th year the accumulated incremental working capital is recovered.

Assuming now that all farm investments are financed with credit, and adding a support credit for the "worst case" farm, the net benefits after financing have been calculated. Considering that most labor will be family labor, labor costs are added to net benefits after financing, to obtain farmer's income per hectare.

At the bottom of Tables 22 and 23, incremental benefits have been calculated, after deducting foregone benefits from net benefits. For each one of the concepts, net and incremental benefits, before and after financing, a financial internal rate of return was calculated. The financial impact of the project on the farm operation can be better appreciated through the incremental benefits before financing, which show IRR's ranging from 15.2% to 29.3%. If the farmer receives credit financing, the IRR of his own contribution to the project rises to a range from 18.3% to 61.2% in the incremental benefits after financing.

(1) This convention is financially convenient. It introduces some slack time into the financial analysis, leaving a safe margin in the farmer's credit program.

TABLE 23 a

COST RECOVERY FEASIBILITY, THE BEST CASE

SOURCES AND USES OF FUNDS FOR ONE HECTARE OF TYPICAL FARM WITH PROJECT

PREVIOUS TECHNOLOGY: INTERMEDIATE

ACCESS TO TRANSPORTATION: NORMAL

IRRIGATION SYSTEM: MICRO

(Lempiras of 1984 per hectare)

Item	0	1	2	3	4	5	6	7	8	9	10	11 to 24	25	Financial IRR (%)
		Irrigation year												
Value of Output		2,352	3,278	3,648	4,242	4,651	5,215	5,363	5,585	5,806	5,806	5,806	5,806	
Farm variable costs		2,292	2,067	2,195	2,292	2,460	2,504	2,592	2,659	2,725	2,725	2,725	1,206	
O & M of Irrig. System		88	88	88	88	88	88	88	88	88	88	88	88	
Investment														
Incremental working capital		1,146	(112)	64	49	84	22	44	33	33	0	0	(1,363)	
Cattle operation	1,152													
Irrigation Infrastructure	1,757													
Net Benefits before Financing	(2,909)	(1,174)	1,235	1,302	1,814	2,020	2,601	2,638	2,805	2,960	2,993	2,993	5,875	36.3
FINANCING														
Support credit		0												
Incremental working capital		1,146	(112)	64	49	84	22	44	33	33	0	0	(1,363)	
Cattle operation	1,152													
Irrigation Infrastructure	1,757													
Credit costs														
Working Capital		92	83	88	92	98	100	104	106	109	109	109	109	
Cattle operation		92	92	288	288	288	288	288						
Irrigation Infrastructure		141	141	440	440	440	440	440						
Support		0	0	0	0	0	0	0						
Net Benefits after Financing	(0)	(352)	807	549	1,042	1,277	1,795	1,850	2,732	2,884	2,884	2,884	4,403	223.6
Labor income		776	764	764	790	795	795	814	814	814	814	814	814	
Farmer's cash balance		424	1,571	1,313	1,832	2,072	2,589	2,664	3,545	3,698	3,698	3,698	5,217	
Foregone Benefits		313	313	313	313	313	313	313	313	313	313	313	313	
Incremental Benef. bef. Finan.	(2,909)	(1,487)	922	988	1,500	1,706	2,288	2,325	2,491	2,646	2,680	2,680	5,562	29.3
Incremental Benef. aft. Finan.	(0)	(666)	494	236	729	963	1,481	1,537	2,418	2,571	2,571	2,571	4,090	61.2

Source: Tables 1, 10, 11, 16, 21.

Interest rate (%)	8
Grace period	3 years
Maturity	8 years

Table 23 b

COST RECOVERY FEASIBILITY, THE BEST CASE

SOURCES AND USES OF FUNDS FOR ONE HECTARE OF TYPICAL FARM WITH PROJECT

PREVIOUS TECHNOLOGY: INTERMEDIATE

ACCESS TO TRANSPORTATION: NORMAL

IRRIGATION SYSTEM: MICRO

(Lempiras of 1984 per hectare)

Item	0	1	2	3	4	5	6	7	8	9	10	11 to 24	25	Financial IRR (%)
	Irrigation year													
Value of Output		2,352	3,278	3,648	4,242	4,651	5,215	5,363	5,585	5,806	5,806	5,806	5,806	
Farm variable costs		2,292	2,067	2,195	2,292	2,460	2,504	2,592	2,659	2,725	2,725	2,725	1,206	
O & M of Irrig. System		88	88	88	88	88	88	88	88	88	88	88	88	
Investment														
Incremental working capital		1,146	(112)	64	49	84	22	44	33	33	0	0	(1,363)	
Cattle operation	1,152													
Irrigation Infrastructure	1,757													
Net Benefits before Financing	(2,909)	(1,174)	1,235	1,302	1,814	2,020	2,601	2,638	2,805	2,960	2,993	2,993	5,675	36.3
FINANCING														
Support credit		50												
Incremental working capital		1,146	(112)	64	49	84	22	44	33	33	0	0	(1,363)	
Cattle operation	1,152													
Irrigation Infrastructure	1,757													
Credit costs														
Working Capital		136	124	132	136	148	150	156	160	164	164	164	164	
Cattle operation		138	138	320	320	320	320	320						
Irrigation Infrastructure	-	211	211	487	487	487	487	487						
Support		6	6	14	14	14	14	14						
Net Benefits after Financing	(0)	(470)	544	413	904	1,135	1,652	1,766	2,678	2,830	2,830	2,830	4,349	142.2
Labor income		776	764	764	790	795	795	814	814	814	814	814	814	
Farmer's cash balance		306	1,408	1,177	1,694	1,930	2,447	2,520	3,492	3,643	3,643	3,643	5,163	
Foregone Benefits		313	313	313	313	313	313	313	313	313	313	313	313	
Incremental Benef. bef. Finan.	(2,909)	(1,487)	922	988	1,500	1,706	2,288	2,325	2,491	2,646	2,680	2,680	5,362	29.3
Incremental Benef. aft. Finan.	(0)	(784)	330	99	591	822	1,339	1,393	2,365	2,516	2,516	2,516	4,036	51.7

Source: Tables 1, 10, 11, 16, 21.

Interest rate (%) 12

Grace period 3 years

Maturity 8 years

158

To give a better idea of the range of financial profitability of the irrigation investment, financial Internal Rates of Return (IRR) of Incremental Benefits before financing were calculated for the 12 prototypes. These IRR's are presented in Table 24. The range goes from 14.6% to 29.3%. It must be explained that eventhough the prototype with traditional technology, remote access, and medium scale has an IRR of 15.2%, higher than the 14.6% IRR of the intermediate technology, remote access and medium scale prototype, the last one was not selected as the "worst case" because it show greater capacity to pay for the irrigation investment. Its lower IRR is due to higher foregone benefits.

TABLE 24

Financial Internal Rate of Return (IRR)
Before Financing
(Percentage)

Scale of System	FARM MODEL			
	Traditional Technology		Intermediate Technology	
	Normal Access	Remote Access	Normal Access	Remote Access
Micro	28.5	20.7	29.3	20.4
Small	22.9	16.5	23.1	16.0
Medium	21.2	15.2	21.3	14.6

It was verified that fruit production and cattle raising are particularly less profitable for the farmer. The IRR of incremental benefits before financing ranges from 11.4% to 19.6% for fruit production, and from 8.9% to 15.2% for cattle raising. Thus eliminating cattle raising from the project increases the IRR of incremental benefits before financing to a range from 18.3% to 41.8% and eliminating orange as well, to a range from 21.6% to 56%.

The results obtained indicate that policies regarding cost recovery, grace period and maturity, will have to be flexible depending on the type of farm, the cost of the irrigation infrastructure, and the real interest that prevails. They also show that the inclusion of credit programs serves as an incentive to promote farmer's participation in the project since credit greatly increases the financial IRR of the farmer's contribution to the project.

4. Economic Cost-Benefit Analysis

This analysis refers to all the project, and must draw a profile of the projects implementation, including all components that are part of either economic costs or economic benefits.

4.1 Implementation Schedules

There are two implementation schedules, giving total hectares to receive the project intervention every year. One schedule disaggregates the totals according to the type of farm (Table 25). The other schedule presents total irrigated areas by type of irrigation system (Table 25).

In the preliminary implementation schedule, which was assumed for this analysis, the number of irrigated hectares increases from 505 ha the first year, to 1560 ha the seventh year. Small irrigation systems account for most of the total (66.3%), while micro systems represent 21.5%, and medium systems 12.2% of the total irrigated area. Traditional technology farms, with normal access account for 35% of the total, and with remote access account for 15%. Intermediate technology farms, with normal access are 40% of the total, and with remote access 10% of the total. That is half the farms previously employ each technology-traditional and intermediate-, and remote access farms account for only 25% of the total.

4.2 Net Agricultural Benefits

These figures appear in the first five columns of Table 27. They were obtained substracting from the value of output at economic prices the costs of inputs, labor and contingency costs. Credit costs were not considered because interest payments are just an income transfer and therefore are not accounted as an economic cost. During the first years net benefits are negative because it was assumed that even though farmers incur 100% of full development costs since their first production year. They enjoy full development yields only after 3 to 5 years of production, once they have enough experience with the new technologies.

4.3 Investment, Operation and Maintenance

The investment, operation and maintenance costs of the irrigation infrastructure vary according to the type of irrigation system. Table 21 shows that the larger the system, the greater the unit costs of the irrigation infrastructure. Those investment costs include the design and construction costs. Annual operation and maintenance costs have been estimated as 5% of total investment costs. Applying again the "time adjusted" convention, the investment costs of irrigation infrastructure are considered to happen a period previous to the attainment of irrigation benefits at the farms. This convention introduces a realistic deduction in the project's IRR.

158

TABLE 25
IMPLEMENTATION SCHEDULE BY FARM TYPES
(Hectares of irrigation)

PROJECT YEAR	TRADITIONAL TECH. Normal Access	TRADITIONAL TECH. Remote Access	INTERMEDIATE TECH. Normal Access	INTERMEDIATE TECH. Remote Access	TOTAL
1	177	76	202	51	505
2	278	119	318	80	795
3	350	150	400	100	1000
4	394	169	450	113	1125
5	459	197	524	131	1310
6	502	215	574	144	1435
7	546	234	624	156	1560
Total	2706	1160	3092	773	7730
	35.0%	15.0%	40.0%	10.0%	100.0%

IMPLEMENTATION SCHEDULE BY TYPE OF IRRIGATION SYSTEM
(Hectares of irrigation)

PROJECT YEAR	MICRO	SMALL	MEDIUM	TOTAL
1	120	250	135	505
2	160	500	135	795
3	240	625	135	1000
4	240	750	135	1125
5	300	875	135	1310
6	300	1000	135	1435
7	300	1125	135	1560
Total	1660	5125	945	7730
	21.5%	66.3%	12.2%	100.0%

TABLE 26
OTHER EXPENSES
(Thousands of Lempiras of 1984)

Project Year	Equipment	Training	Other Tech.Assis	Evaluat. Audit.	Total
1	430	130	800	15	1375
2		130	800	15	945
3		130	800	15	945
4		130	800	15	945
5		130	800	15	945
6		130	800	15	945
7		130	800	60	990
8+			800		800

TABLE 27

ECONOMIC COSTS AND BENEFITS OF IRRIGATION PROJECT

(Thousands of Lempiras of 1984)

Project Year	NET AGRICULTURAL BENEFITS: Traditional Tech. Normal	Traditional Tech. Remote	Intermediate tech. Normal	Intermediate tech. Remote	Total	INVESTMENT AND OPERATING COSTS: Irrigation Investment	Oper. & Mainten.	Working Capital	Extension Services	Foregone Benefits	Credit Services	Administ.	Other Expenses	Total Costs	NET ECONOMIC BENEFITS
0						1,368								1,368	(1,368)
1	(334)	(185)	(295)	(104)	(919)	2,117	68	588	566	122	27	790	1375	5,654	(6,571)
2	(418)	(278)	(199)	(123)	(1,019)	2,575	174	852	566	313	54	790	945	6,268	(7,286)
3	(295)	(301)	147	(92)	(541)	2,921	303	1094	566	553	82	790	945	7,254	(7,795)
4	77	(233)	788	2	633	3,351	449	1254	566	824	111	790	945	8,289	(7,656)
5	634	(113)	1,604	123	2,248	3,698	617	1527	566	1,139	147	790	945	9,429	(7,181)
6	1,530	131	2,775	319	4,755	4,045	802	1696	566	1,485	185	790	945	10,513	(5,758)
7	2,642	449	4,168	557	7,816		1,004	1888	566	1,860	226	790	990	7,323	493
8	5,071	1,450	6,772	1,186	14,479		1,004	111	566	1,860	180	790	800	5,311	9,169
9	6,304	1,901	7,791	1,400	17,397		1,004	405	566	1,860	188	790	800	5,613	11,784
10	7,391	2,302	8,795	1,613	20,101		1,004	306	566	1,860	194	790	800	5,519	14,582
11	8,249	2,617	9,517	1,765	22,148		1,004	278	566	1,860	200	790	800	5,497	16,650
12	8,844	2,837	10,107	1,892	23,680		1,004	149	566	1,860	203	790	800	5,371	18,309
13	9,032	2,901	10,322	1,934	24,190		1,004	148	566	1,860	206	790	800	5,373	18,816
14	9,200	2,961	10,515	1,974	24,649		1,004	90	566	1,860	208	790	800	5,317	19,332
15	9,288	2,991	10,615	1,994	24,889		1,004	47	566	1,860	209	790	800	5,275	19,614
16	9,288	2,991	10,615	1,994	24,889		1,004	0	566	1,860	209	790	800	5,228	19,661
17	9,288	2,991	10,615	1,994	24,889		1,004	0	566	1,860	209	790	800	5,228	19,661
18	9,288	2,991	10,615	1,994	24,889		1,004	0	566	1,860	209	790	800	5,228	19,661
19	9,288	2,991	10,615	1,994	24,889		1,004	0	566	1,860	209	790	800	5,228	19,661
20	9,288	2,991	10,615	1,994	24,889		1,004	0	566	1,860	209	790	800	5,228	19,661
21	9,288	2,991	10,615	1,994	24,889		1,004	0	566	1,860	209	790	800	5,228	19,661
22	9,288	2,991	10,615	1,994	24,889		1,004	0	566	1,860	209	790	800	5,228	19,661
23	9,288	2,991	10,615	1,994	24,889		1,004	0	566	1,860	209	790	800	5,228	19,661
24	9,288	2,991	10,615	1,994	24,889		1,004	0	566	1,860	209	790	800	5,228	19,661
25	14,837	5,608	16,957	3,738	41,140		1,004	(10,433)	566	1,860	209	790	800	(5,205)	46,345

ECONOMIC INTERNAL RATE OF RETURN (%)	18.3
PRESENT VALUE OF NET BENEF. DISCOUNTED AT 9%	52,755
PRESENT VALUE OF NET BENEF. DISCOUNTED AT 12%	26,991
PRESENT VALUE OF NET BENEF. DISCOUNTED AT 15%	11,489

4.4 Extension Services

Annual costs of extension services have been estimated for each of 7 agricultural regions, as follows:

2 engineers	L48,000.00
Per diems	4,800.00
Transportation	24,000.00
Materials	2,000.00
Other	2,000.00
SUB - TOTAL	80,800.00
TOTAL FOR SEVEN REGIONS	L565,600.00

This annual expense has been included in Table 27. The first seven years the costs will be born by the project, Afterwards, the GOH should take over these costs.

4.5 Foregone Benefits

In the economic analysis it is necessary to include among costs, the benefits foregone when agricultural land is incorporated into the project. These benefits have been calculated and included in Table 27.

4.6 Working Capital

The average value of working capital along every year, represents a costs of inventories in the project. Annual working capital needs have been multiplied by a 0.5 factor considering that the predominant pattern is two crops a year, and it can be assumed that working capital needs will be regularly distributed along the year. (For livestock production the factor should be smaller, but for fruits larger, and it is considered that they balance each other). The incremental working capital needs have been introduced in Table 27 with the total recuperated at the end of the project's life.

4.7 Credit Services

These are the effective costs of providing credit services. They refer to human and resource costs, other than the cost of the financial resources. These costs have been estimated at 2% of total credit provided for working capital needs, and also for the initial investment in dairy production. The costs of providing credit for the construction of irrigation systems are assumed to be included in the costs of technical assistance.

162

4.8 Administration

This is the most important contribution of the GOH. It refers to costs of the local and national offices of the Water Resources Direction (Direcciôn de Recursos Hîdricos, DRH).

4.9 Other Expenses

It has been estimated that the project will have also expenses for the purchase of equipment, training of personnel, other technical assistance, and evaluation of auditing costs, as presented in Table 26.

4.10 Cost Benefit Analysis

Taking into account all economic costs and benefits attributable to the project, Table 27 calculates the economic internal rate of return (EIRR). The internal rate of return is the discount rate that makes the present value of net economic benefits equal to zero. The 18.3% EIRR obtained is highly attractive, and makes this project very convenient.

4.11 Sensitivity Analysis

The first area to explore in the sensitivity analysis concerns the design of the project. What would happen to the EIRR if the combination of farm types and irrigation systems is modified? To answer this question, the EIRR was calculated assuming that the entire project is concentrated into each one of 12 possible combinations. The results are the following:

Table 28
Economic Internal Rate of Return (EIRR)
by Farm Model, and by Scale of Irrigation System
(Percentage)

	Traditional Technology		Intermediate Technology	
Scale of System	Normal Access	Remote Access	Normal Access	Remote Access
Micro	22.8	15.2	24.7	16.0
Small	19.0	12.4	20.2	12.9
Medium	16.9	10.8	17.8	11.1

Any particular combination of the farm models and irrigation systems would result in an EIRR for the project obtained as a combination of the above rates. For example, increasing the weight of farms with

intermediate technology and normal access, and furnished with a micro system, would rise the EIRR towards the 24.7% level. In the same manner, increasing the importance of farms with traditional technology and remote access, and using medium irrigation systems, would lower the EIRR of the project towards the 10.8% level.

Table 28 indicates that irrigation investment will be more profitable in locations with normal access to transportation facilities, and on farms employing intermediate technology of production. Furthermore, smaller irrigation systems are more profitable than larger ones.

For the project analysis, a particular combination of the farm models and irrigation systems was selected as the most likely to happen. This combination is presented in Tables 24 and 25. The EIRR obtained for such a combination was 18.3% (Table 27).

Looking now in other direction for the sensitivity analysis, it is obvious that many parameters and data used in the economic cost benefit analysis, are subject to estimation errors and unexpected changes that could affect the economic IRR.

It is important to know how sensitive the analysis is to changes in the variables, especially changes that would make the project less profitable. The alternatives considered are the following:

Sensitivity Table of EIRR

		EIRR	CHANGE (%)
a.	Best project estimate (base case)	18.3	0
b.	Shadow wage rate equal to one	13.4	-4.9
c.	Shadow exchange rate equal to one	20.7	2.4
d.	Both rates equal to one	15.0	-3.3
e.	Investment costs of infrastructure + 20%	17.1	-1.2
f.	Value of agricultural output - 10%	14.8	-3.5
g.	Agricultural costs + 10%	15.3	-3.0

h. Decrease by one year the transition period. It has been considered that farmers will take 4 to 6 years to reach full development yields in the with project situation (table 15). The successful provision of technical assistance could shorten the transition period. If this period is shortened to 3 to 5 years instead of the estimated 4 to 6 years, the EIRR of the base case increases to 22.8%.

Of the multiple land uses considered in the project two are less profitable, they are fruit production and cattle raising.

Fruit production requires four years to start production, and only from the seventh year on net returns are positive. The EIRR of the project with fruit production is 13.3%. Thus, the EIRR would improve in the base case is fruit production is replaced by temporary crops.

Cattle raising is the least profitable activity considered in the project. The EIRR of the project with cattle raising is only 12.4%. This is an activity subject to questioning. In irrigation projects, pasture is sometimes justified when soil is fragil, and pasture rotation is the cure to improve soil conditions. Also in family farms cattle raising usually is one of the activities that makes the farm an integrated exploitation. However, from an economic perspective it would pay to eliminate cattle raising from the irrigation project.

Thus, two additional alternatives were considered important enough to deserve special attention.

i. Eliminate pasture, that is cattle, and increase all other land uses by the same proportion. Eliminate both pasture and fruit production. The resulting land use patterns for the with-project situation are as follows:

Table 29
Alternative Land use Pattern With Project

	No Pasture A	No Pasture No Fruit B
Corn	26%	33%
Beans	7%	9%
Rice	54%	69%
Fruit	21%	
Vegetables	21%	27%
Soybean	32%	41%
Cantaloupe	18%	22%
Land Use Intensity	200%	201%

With the "A" land use pattern, the EIRR increases to 21.5%, that is 3.2 percentage points over the base case. The economic profitability of cattle raising is smaller than the average of the other crops, and eliminating pasture allows the project's EIRR to rise. Eliminating both pasture and fruit production, the EIRR increases to 25.2%, since fruit production is also less profitable than temporary crops.

j. Later, during the review of the PP, it was decided to eliminate cattle raising from the project, and simultaneously change both, the implementation schedule for farms and irrigated areas (Table 30), and the projected expenditure figures for the whole project, as stated in the PP (Figure 15).

165

Table 30
Alternative Implementation Schedule
Number of Farms and Irrigated Area

Scale/Year	1	2	3	4	5	6	7	TOTAL
Micro No.	21	41	62	71	75	77	77	424
Drainage No.	1	1	2	2	4	4	6	20
Area (ha)	123	183	306	333	465	471	591	2,472
Small No.	3	8	12	19	22	26	31	121
Area (ha)	45	120	180	285	330	390	465	1,815
Medium No.		3	5	7	7	10	7	39
Area (ha)		180	300	420	420	600	420	2,340
Area (ha)	168	483	786	1,083	1,215	1,461	1,476	6,627

Under this situation, the EIRR becomes 19.8%, still over the 18.3% base value.

The sensitivity analysis gives positive results. Different pessimistic scenarios would reduce the projects EIRR, but the resultant rates still justify this investment as economically sound.

Contribution to Jackson Plan Objectives

The economic and financial cost-benefit data can be expressed in terms of the project's contribution to Jackson Plan objectives. Such presentation (Table 31) provides additional insight to the evaluation of the project.

a) Net Economic Benefits

Column 1 presents the net economic benefits attributable to the project. During its first 7 years the project will absorb resources from the economy, mainly investment resources. Once the project reaches full development, its net annual contribution to the economy will be of L19.7 million. The IRR of 18.3% indicates that total project's net addition in terms of economic benefits is equivalent to a permanent flow of L18.3, for every L100 invested.

b) Employment and Labor Income

The project will provide additional employment and labor income as farms enter into a more intensive mode of production. Labor income attributable to the project gradually grows up to a level over L6.8 million a year. Employment increases to a level over 1.36 million man-days. Considering 200 man-days a year as full employment, the project will provide employment for 6,800 persons once it reaches its full development stage.

TABLE 31
CONTRIBUTION TO JACKSON PLAN OBJECTIVES
(Thousands of Lempiras of 1984 and man-days)

Project year	Net Economic Benefits (L)	Labor Income (L)	Employment (man-days)	Farm Income (L)	Share in GDP (L)	Net Exports (L)
0	(1,368)	621	124	621	0	(428)
1	(6,571)	1,533	307	785	232	(1,872)
2	(7,286)	2,396	479	1,573	1,070	(2,874)
3	(7,795)	3,283	657	2,898	2,458	(3,808)
4	(7,656)	4,316	863	4,978	4,470	(4,549)
5	(7,181)	5,474	1,095	7,572	7,112	(5,372)
6	(5,758)	6,738	1,348	11,028	10,563	(5,880)
7	493	5,908	1,182	12,866	14,629	(5,079)
8	9,169	5,535	1,107	18,131	18,522	(1,288)
9	11,784	5,845	1,169	21,035	21,386	(721)
10	14,582	6,182	1,236	23,692	24,019	104
11	16,650	6,407	1,281	25,666	26,020	621
12	18,309	6,616	1,323	27,191	27,557	997
13	18,816	6,754	1,351	27,807	28,199	839
14	19,332	6,832	1,366	28,320	28,740	787
15	19,614	6,863	1,373	28,577	29,021	763
16 to 24	19,661	6,836	1,367	28,551	29,021	784
25	46,345	6,836	1,367	36,762	41,059	17,816
Total						(2,892)
NPV 9%	52,755					
NPV 12%	26,991					
NPV 15%	11,489					
IRR (%)	18.3					

c) Farm Income

The project brings some losses during its first two years due to the assumed low speed of yields increase from the without- to the with-project situation. Still, later farm income provided by the project rapidly grows up to over L28 million a year. With 7,730 ha irrigated by the project, and assuming 1.6 ha for the typical farm, then the total farm income for the average farmer participating in the project is around L5,900 a year, once the farm reaches its full development stage.

d) Share in GDP

The share of this project in total GDP has been calculated as the total value of production at financial or market prices, minus the value of intermediate inputs for the production of farm products and for the maintenance of the irrigation infrastructure.

Our estimates suggest that during its first three years the participation of this project in total GDP will be over L2 million. In the following years, it will grow up to a full development level of L29.0 million a year, which represents over 0.4% of total current GDP.

e) Net Exports

This projects employs imported agricultural inputs (fertilizers, pesticides) and also uses tradeable inputs in the development of cattle exploitations. Since its main objective is not export promotion, it only includes cantaloupe and dairy products as exportable outputs. It is not surprising that the project appears as a net importer.

This outcome could be improved during the implementation stage, if the project is coordinated with a marketing project capable of opening export outlets to farmers. Only in such instance will be profitable to the farmer to face the additional risks and uncertainty of export markets, with either exportable crops not considered in this study, or expanding their exportable products beyond the scales assumed here.

5. Total Output Projections

It has been stated several times that the crop mix proposed in this annex is only illustrative, since the incidence of crops will be highly flexible, depending on how the characteristics of each irrigation system, and the accessability to markets after the profitability of crops. Still, it was considered interesting to calculate total output of individual products under the assumption used in this annex, to have a feeling of how the project may compare its output with total national production.

Thus, based on the with-project yields, the transition coefficient from without- to with-project yields, the alternative land use pattern (column A, Table 29), and the alternative implementation schedule (Table 30), the total project's output for each crop was calculated giving the results presented in Table 32.

Projected increases in Honduras' demand estimated by CONSUPLANE from 1985 to 1989 far exceed the production figures of the project in its 3rd year. (If the project starts in 1987, its 3rd year will by 1989). After its 3rd year, the project's production increases gradually giving time and space for the project's output to adapt to the market needs. This applies also to crops geared to export markets (such as cantaloupe), whose production will adapt to the expansion of profitable marketing outlets, in much the same manner of the other products.

Drafted by: EPA:WGomez/trm
(0240M) 8/29/86

TABLE 32
TOTAL PRODUCTION

Project Year	Corn (tons)	Beans (tons)	Rice (tons)	Vegetab. (tons)	Soybean (tons)	Cantal. (tons)	Fruit (tons)	TOTAL VALUE (L x 000)
1	154	16	313	[illegible]	86	194	0	549
2	727	75	1,507	[illegible]	406	933	[illegible]	2,618
3	1,745	183	3,654	[illegible],456	970	2,277	0	6,346
4	3,218	339	6,914	11,919	1,780	4,248	115	11,797
5	5,013	532	10,913	18,551	2,764	6,686	674	18,565
6	7,273	773	15,950	26,984	4,000	9,756	2,027	27,181
7	9,620	1,026	21,275	35,312	5,276	12,989	4,451	36,356
8	10,440	1,122	23,535	38,815	5,692	14,310	8,010	40,280
9	10,951	1,180	24,891	40,726	5,950	15,106	12,728	43,056
10	11,237	1,211	25,543	41,776	6,094	15,548	18,282	45,054
11	11,382	1,226	25,855	42,295	6,166	15,757	23,165	46,355
12	11,430	1,231	26,112	42,465	6,190	15,826	26,698	47,080
13	11,430	1,231	26,112	42,465	6,190	15,826	26,739	47,394
14 to 25	11,430	1,231	26,112	42,465	6,190	15,826	29,541	47,518
				(thousands of tons)				
National								
Production 1983-85	530.0	40.7	51.0	26.8	0.5	6.0	194.9	280,876
Target for 1989	650.0	60.4	59.0	35.7	4.7	8.2	322.2	369,473
Increase	120.0	19.7	8.0	8.9	4.2	2.2	127.3	88,597

Source: Tables 8 to 11, 29, 30. Secretar[illegible] CONSUPLANE.

Initial Environmental Examination

Project Location:	Honduras
Project Title:	Irrigation Development
Funding:	$ 8.0 Million Grant $14.5 Million Loan
Life of Project:	7 years (FY86-92)
IEE Prepared by:	William G. Kaschak, O/DF
Date:	October 25, 1985
Threshold Decision:	a) Recommendation: Negative Determination b) Concurrence

Anthony J. Canterucci
Director, USAID/Honduras

1. Environment Statement

The project will focus on the construction and rehabilitation of irrigation systems. Such construction, turn, will have a direct impact on the environment through, for example, altered use of water sources and land leveling. In addition, the potential exists for indirect ecological impacts such as disturbance of wildlife habitants and an increase in the amount of land cleared for farming. These and other potential impacts will be controlled through prudent subproject selection and construction practices.

To assure that ecological concerns are given serious consideration an Environmental Review will be a standard component of the selection process for each subproject and will be carried out in conjuction with the economic and social feasibility analyses. The Environmental analysis will follow the procedures of an Environmental review Document (ERD). This document will assist evaluators to identify major direct and indirect environmental effects that might occur with a given subproject thereby providing a basis for eliminating the intervention or for constructing the system in a way which minimizes the impact. The ERD will consist of a standard package, including constructions for use, a matrix, a section for comments and recommendations, and space for an environmental determination (positive or negative) signed by the field evaluator and reviewed by the IMU Regional Office Director. For each intervention, an insert section will be used to describe the proposed site in terms of topography, water sources, distance to population settlements, proximity to national parks and forests, etc.

During the intensive review the Mission will contract the appropriate technical assistance to develop the analysis for the PP and design the ERD. USAID will request AID/W assistance in identifying individual(s) with the proper expertise.

2. Recommendation for Environmental Action

Having evaluated the proposed project for potentially significant, reasonably foreseable environmental impacts, it is the Mission's judgement that proper precautions will be taken in the design to assure that generally no significant negative impacts are likely to occur. Therefore, a negative determination is recommended.

3. Impact Identification and Evaluation Form

Impact Identifications and Evaluation

Impact Areas and Sub-Areas

A. LAND USE

1.	Changing the character of the land through:	
	a. Increasing the population	N
	b. Extracting natural resources	L
	c. Land clearing	M
	d. Changing soils character	M
2.	Altering natural defenses	M
3.	Foreclosing important uses	N
4.	Jeopardizing man or his works	N
5.	Other factors	

B. WATER QUALITY

1.	Physical state of water	M
2.	Chemical and biological states	M
3.	Ecological balance	M
4.	Other factors	

1/ Symbol meanings:

N - No environmental impact
L - LITTLE environmental impact
M - MODERATE environmental impact
H - HIGH environmental impact
U - UNKNOWN environmental impact

C. ATMOSPHERIC

1.	Air Additives	N
2.	Air pollution	N
3.	Noise pollution	N
4.	Other factors	
	Short term Construction Air Pollution	L

D. NATURAL RESOURCES

1.	Diversion. altered use of water	M
2.	Irreversible, inefficient commitments	N
3.	Other factors	

E. CULTURAL

1.	Altering physical symbols	M
2.	Dilution of cultural traditions	L
3.	Other factors	

F. SOCIO-ECONOMIC

1.	Changes in economic/employment patterns	M
2.	Changes in population	N
3.	Changes in cultural patterns	M
4.	Other factors	

G. HEALTH

1.	Changing a natural environment	M
2.	Eliminating an ecosystem element	M
3.	Other factors	

H. GENERAL

1.	International impacts	N
2.	COntroversial impacts	N
3.	Larger program impacts	M
4.	Other factors	

E. OTHER POSSIBLE IMPACTS (not listed above)

April 3, 1986

TO: William G. Kaschack, ADMD

THROUGH: Richard L. Owens, O/RD

FROM: Homero Silva, PhD
Experience, Inc. Review Team

RW for H.S.

SUBJECT: Environmental Considerations and Criteria Review

Attached is the subject review of recommended environmental criteria and training plan to be used by United States Agency for International Development (USAID) and the Directorate of Hydraulic Resources (DRH). Also attached are the results from the examination of potential health impacts, and the initial environmental assessment for the Irrigation Development Project.

Title	Page No.
Task I	1
Environmental Criteria for the Selection of Irrigation Areas	1
Table 1	3
Environmental Impact Report	8
A. Introduction	8
Section I: Description of the Project	8
Precise Location and Boundaries	9
Statement of Objectives	9
Description of Project Characteristics	9
Table 2	10
Table 3	11
Section I: Description of the Environmental Setting	12
The Environment in the Project Vicinity	12
Table 4	13
Section III: Environmental Impact	16
The Impact of the Proposed Action	16
Direct and Indirect Impacts	16
Any Adverse Effects Which Cannot be Avoided if the Proposal is Implemented	17
Adverse Impacts	17
Adverse Impacts Needing an Alternative Design	17
Impacts on Aesthetics or Human Health	17
Mitigation Measures Proposed to Minimize the Impact	18
Avoidable Adverse Impacts	18
Alternative Mitigation Measures	18
Alternatives to the Proposed Project	18
Alternatives which Reduce Impacts	20
Figure 1	21
Table 5	22

177

Title	Page No.
The Relationship Between Local Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity	23
Cumulative and Long-Term Effects	23
Reasons why the Sponsor Believes Project is Justified Now	23
Irreversible Changes which Would be Involved in the Proposed Action Should it be Implemented	24
Irretrievable Commitment of Resources	24
Primary and Secondary Impacts	25
Environmental Accidents	25
The Growth Inducing Impact of the Proposed Action	26
Ways the Project Could Foster Growth	26
Other Projects that May Encourage Growth	26
Task II	28
Task III	31
Biological Disease Causing Factors	32
Table 6	33
Water-Related Diseases	35
Non-Water Related Diseases	34
Diarrhea	34
Table 7	37
Malaria	38
Chemical Disease Causing Factors	39
Fertilizer	39
Pesticides	40
Salts	41
Initial Environmental Assessment	

178

Task I Develop the environmental criteria to be used in the selection of irrigations systems to be constructed, and the criteria to be used in the monitoring process during actual construction and operation of the systems.

Environmental Criteria for the Selection of Irrigation Areas

Irrigation systems cause different impacts to soil, water, air, vegetation and animals. Those impacts can be beneficial or adverse. They are considered in the selection of irrigation systems to insure that projects are not only technically sound but also environmentally feasible.

To develop the environmental criteria, interviews were first held with people from different government and private agencies. The objective was to get a better idea of the legal situation, the manpower availability, and laboratory resources in Honduras.

These findings were taken into consideration to formulate a questionnaire which will be used in the pre-selection of projects. The questionnaire will help to rank all the potential projects in a certain area, in order to select those which are the most environmentally sound. A more elaborated environmental impact report must be conducted on those areas selected for final design, only if an adverse impact was predicted during the pre-selection.

The questionnaire is presented in Table 1. It contains 30 questions. Each question has two answers: Yes or No. If the answer is yes, a value of -1 is given to it. On the other hand, if the answer is no, a value of +1 is given to it. After all the questions are answered, all the values are added. A negative value means the adverse impacts exceed beneficial impacts. A positive value means the opposite. This value will be used in the ranking of projects.

Several environmental factors are considered in this questionnaire: geologic, soil, biotic community, watershed, airshed, land use, local and

regional planning. Each factor considers first the existing conditions relevant to the project site and then the impact the project may have. All sources of information from which the impact was determined are to be cited for each factor.

180

TABLE 1

QUESTIONNAIRE OF ENVIRONMENTAL FACTORS FOR THE RANKING OF IRRIGATION SYSTEMS

A. Geologic Factors

1. Is the site subject to geologic hazards (seismic, landslide or mudflow)?

Yes: ____ No: ____

2. Will the proposed project create a geologic hazard or increase the intensity of such hazard?

Yes: ____ No: ____

3. Has the site been officially designated as having preservation value, either natural (open space, unique biotic habitat, mineral resource, etc.) or cultural (prime cultural land, archaeologic, paleontologic, historic, etc.)?

Yes: ____ No: ____

B. Soil Factors

4. Is the site subject to soil hazards (slump, soil creep, subsidence, erosion, stream siltation, etc.)?

Yes: ____ No: ____

5. Will the project generate erosion or stream siltation?

Yes: ____ No: ____

C. Biotic Community Factors

6. Is the site subject to fire hazard from flammable brush, grass or trees?

Yes: ____ No: ____

7. Will the project generate any of the above hazards?

Yes: ____ No: ____

8. Are there any rare or endangered plant or animal species, historically important trees, or unique biotic habitat on site?

Yes: ____ No: ____

9. Will the project disturb any of the above environmental factors?

Yes: ____ No: ____

10. Is the site used as a nesting place for migrating fowl?

Yes: ____ No: ____

11. Will the project involve disturbance of a nesting area for migrating fowl?

Yes: ____ No: ____

D. Watershed Factors

12. Is the site located in a floodplain area?

Yes: ____ No: ____

13. Will the project be subject to damage from flooding?

Yes: ____ No: ____

14. Is there a source of public water on-site?

Yes: ____ No: ____

182

15. Does the quality of water existing on-site meet water quality standards?

Yes: ____ No: ____

16. Will the project generate pollutants (human waste, toxic wastes, surface water runoff, etc.) that will seriously affect any on-site sources of water?

Yes: ____ No: ____

17. Will the project seriously interfere with the present rate of soil and subsurface percolation?

Yes: ____ No: ____

E. Airshed Factors

18. Does the present on-site air quality comply with applicable air quality standards?

Yes: ____ No: ____

19. Will the project generate pollutants (dust or smoke particulates, pesticides, etc.) that will seriously impact the present air quality on-site or the surrounding area?

Yes: ____ No: ____

20. Will any features of the project (trees, utility lines, soil, etc.) be exposed to hazardous high winds?

Yes: ____ No: ____

F. Land Use Factors

21. Does the site have officially designated historic, archaeologic or paleontologic importance?

Yes: ____ No: ____

22. Will the project disturb any items of historic, archaeologic or paleontologic importance?

Yes: ____ No: ____

23. Has the site been officially designated as a scenic vista-point, or being located in a scenic corridor, along a scenic highway or having a unique aesthetic value?

Yes: ____ No: ____

24. Will the project conflict with any adopted scenic/aesthetic values?

Yes: ____ No: ____

G. Local/Regional Plan Factors

25. Does the proposed use of the site not conform to the adopted or proposed local general plan or any of its state mandated elements (land use, housing, circulation, open space, conservation, seismic safety, etc.)?

Yes: ____ No: ____

184

26. Does the project not conform with the established character of the surrounding area, set a precedent for similar projects not in character with the surrounding area or exceed projected growth rates for the area?

Yes: ____ No: ____

27. Are any of the public facilities (roads) or public utilities (electricity, water supply, sewage and storm drainage discharge lines) serving the site at or over capacity?

Yes: ____ No: ____

28. Will the project generate any demands that will cause a public facility or utility to reach or exceed its capacity?

Yes: ____ No: ____

29. Is or has the site been the subject of any public controversy resulting from environmental concerns?

Yes: ____ No: ____

30. Will the project or can the project be expected to generate any public controversy over environmental concerns?

Yes: ____ No: ____

185

Environmental Impact Report

A. Introduction

In case that a potential adverse impact be predicted to occur as a result of the construction or operation of the irrigation project, measures shall be provided to make sure that remedial actions are considered during the final design. To achieve that, an Environmental Impact Report (EIR) shall be prepared. Basically, an EIR should be divided into sections and subsections as shown in Table 2. This includes a discussion of existing environmental conditions and environmental impacts. The DRH selection committee should decide if the project is economically feasible and environmentally sound based on this EIR.

In the following paragraphs a more detailed discussion of each topic that should be covered in the EIR is made.

SECTION I: DESCRIPTION OF THE PROJECT

The description of the project shall contain the following information but should not supply extensive detail beyond that needed for evaluation and review of the environmental impact.

a. The precise location and boundaries of the proposed project shall be shown on a detailed map, preferably topographic. The location of the project shall also appear on a regional map.

b. A statement of the objective sought by the proposed project.

c. A general description of the project's technical, economic, and environmental characteristics, considering the principal engineering proposals and supporting public service facilities.

PRECISE LOCATION AND BOUNDARIES

Two maps are required. The first map to be included should be a regional map that identifies the proposed projects as well as its over-all, relative location.

The second map may be a large scale map which shows the proposed project's precise location and boundaries. This map should be topographic.

On both maps, well-known landmarks should be indicated in order to graphically locate the proposed project region and site.

STATEMENT OF OBJECTIVES

In order to identify the project's objectives, its purposes and developmental phases should be detailed. The action proposed and the project type shall be indicated in order to illustrate the project purpose. Once the project purpose has been identified, developmental phasing, if any, and their impacts should be detailed.

DESCRIPTION OF PROJECT CHARACTERISTICS

To adequately describe the project's characteristics, it is helpful to use a checklist similar to the one shown in Table 3.

Table 3

PROPOSED CONTENTS OF AN ENVIRONMENTAL IMPACT REPORT

Section I Descripcion of the Project

a. Precise Location and Boundaries
b. Statement of Objectives
c. Description of Project Characteristics

Section II Description of the Environmental Setting

a. The Environment in the Project Vicinity
b. Related Projects

Section III Environmental Impact

a. Impact of the Proposed Action

Direct and Indirect Impacts

b. Adverse Effects

Adverse impacts; adverse impacts needing an alternative design; impact on aesthetics or human health

c. Mitigation Measures

Avoidable adverse impacts; alternative mitigation measures.

d. Alternatives to the Proposed Project

Reasonable alternatives; alternatives which reduce impacts.

e. The Relationship Between Short-Term Uses...and Long-Term Productivity

Cumulative and long-term effects; reasons why the district engineer believes the project is justified

f. Irreversible Changes

Irretrievable commitment of resources: primary and secondary impacts; environmental accidents.

g. The Growth Inducing Impact

Ways the project could foster growth; other projects that may encourage growth.

128

TABLE 3

A BASIC CHECKLIST FOR USE IN DESCRIBING AN IRRIGATION PROJECT

I Planning Activities
- A. Project Planning
  - 1. Site Design
    - a. Size
    - b. Channels
    - c. Impoundment
    - d. Intake Structure
    - e. Pumping Station
    - f. Access Roads
    - g. Drains
  - 2. Construction Design
    - a. Basic features
    - b. Special Construction Design Features
- B. Economics
  - 1. Basic Data
  - 2. Cost/Benefit Analysis

II Construction Activities
- A. Site Preparation
  - 1. Removal Action
  - 2. Grading
  - 3. Site Improvements
  - 4. Temporary Facilities
  - 5. Time Factors
- B. Construction Actions
  - 1. Structures
  - 2. System Installation
    - a. Impoundment
    - b. Pumping Station
    - c. Canals
    - d. Roads
    - e. Drains

III Operational Activities
- A. Consumption
  - 1. Water (gallons/month)
  - 2. Electricity (KWH/month)
  - 3. Gas (cubic feet/month)
- B. Discharge
  - 1. Solid Wastes (pounds/month)
  - 2. Liquid Wastes (gallons/month)
  - 3. Surface Water Run-off (cubic feet/year)
- C. Pollution Generated
  - 1. Air Pollution (tons/year)
  - 2. Water Pollution (p.p.m./year)
  - 3. Noise Pollution (d.b. max at peak hour)

SECTION II: DESCRIPTION OF THE ENVIRONMENTAL SETTING

An EIR must include a description of the environment in the vicinity of the project as it exists before commencement of the project, from both a local and regional perspective. Knowledge of the regional setting is critical to the assessment of environmental impacts. Special emphasis should be placed on environmental resources that are rare or unique to that region. Special reference to related projects, both public and private, both existent and planned, in the region should also be included, for purposes of examining the possible cumulative impact on such projects.

THE ENVIRONMENT IN THE PROJECT VICINITY

To adequately describe the environment in the vicinity of the proposed project, one can compile an inventory of the existing environmental phenomena, shown in Table 4.

Although topics contained within this table are not exhaustive, they are indicative of the type of information which might be incorporated into the description of existing environmental conditions. This inventory will provide a basis for a later comprehensive impact assessment. Additionally, such an inventory of existing conditions will later form a descriptive and analytic basis for approving or denying the project development.

190

TABLE 4

A BASIC CHECKLIST WHICH CAN BE USED TO COMPILE THE DESCRIPTION OF THE ENVIRONMENTAL SETTING

1. Basic land conditions
   a. Geologic conditions
      Major land formations (valleys, rivers)
      Geologic structures (sub-strate, etc.)
      Geologic resources (minerals, oil, etc.)
      Seismic hazards (faults, liquefaction, tidal wave, etc.)
      Slope stability and landslide potential
   b. Soil conditions
      Soil conservation service classification
      Hazard potential (erosion, subsidence or expansiveness)
      Natural drainage rate
      Subsoil permeability
      Runoff rate
      Effective depth (inches)
      Inherent fertility
      Suitability for method of sewage disposal

2. Biotic community conditions
   a. Plant
      General type and dominant species
      Densities and distributions
      Animal habitat value
      Historically important specimen
      Watershed value
      Man-introduced species
      Endangered species (location, distribution and condition)
      Fire potential (chaparral, grass, etc.)
      Timber value
      Specimen of scientific or aesthetic interest
   b. Animal
      General types/dominant species(mammal, fish, fowl, etc.)
      Densities and distributions
      Habitat (general)
      Migratory species
      Game species
      Man-introduced species
      Endangered species
      Commercially valued species

3. Watershed conditions
   Water quality (ground water and surface water)
   Sources of public or private water supply on-site
   Watershed importance (on-site and surrounding area)
   Flood plain importance (on-site and surrounding area)
   Water run-off rate
   Aquifer recharge rate

TABLE 4

A BASIC CHECKLIST WHICH CAN BE USED TO COMPILE THE DESCRIPTION OF THE ENVIRONMENTAL SETTING

Streamside conditions (habitat conditions and streamflow rate)
Location of wells, springs
Marshlands, lakes, ocean frontage importance

4. Airshed conditions
General climatic type
Air quality
Airshed importance
Wind hazard area (min/max speeds)
Odor levels
Rainfall (average)
Temperature (average highs and lows)
Prevailing winds (direction and intensity)
Fog conditions (hazard potential

192

When describing land characteristics, it is important to focus specific attention on geologic and soil conditions if large grading operations and deep hillside cuts are anticipated as part of the site preparation. When describing the existing biotic community, it is important to identify rare or endangered plant and animal species. Description of the last topic, which deals with air and watershed conditions, should emphasize the quality of air and water.

Related Projects

Assessment of related projects must be done carefully, since it will become important in the third section of the EIR. More specifically, this assessment will form a basis upon which cumulative and long-term environmental impacts will be determined. For example, if demands on surrounding water sources are near capacity, that demanded by the proposed project may overburden those sources and may lead to adverse cumulative impacts. Furthermore, long-term adverse impacts may be realized if, for instance, the proposed project will add pollution to an already heavily polluted river.

SECTION III: ENVIRONMENTAL IMPACT

All phases of a project must be considered when evaluating its impact on the environment: planning, acquisition, development and operation.

Because of the importance and intricacy of this section, each subsection is presented and discussed separately below. Section III should concentrate on analysis of those impacts identified as significant in the pre-selection phase.

THE ENVIRONMENTAL IMPACT OF THE PROPOSED ACTION

Describe the direct and indirect impacts of the project on the environment, giving due consideration to both the short-term and long-term effects.

This description should include specifics of the area, the resources involved, physical changes, alterations to ecological systems and changes induced in population distribution, population concentration, the human use of the land and other aspects of the resource base such as water, scenic quality and public services.

Direct and Indirect Impacts

Identify the beneficial and adverse direct and indirect impacts. Provide a clear, concise and objective description, quantified where possible, of their direct impacts (resulting primarily from the project itself, e.g., precedent for other such projects in an area where no similar projects presently exist).

ANY ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED IF THE PROPOSAL IS IMPLEMENTED

Describe any adverse impacts, including those which can be reduced to an insignificant level but not eliminated.

Adverse Impacts

Adverse impacts to be dealt with are of two types: potential adverse project impacts which could be reduced significantly but not eliminated; and those which cannot be reduced.

Adverse Impacts Needing an Alternative Design

Describe here the implication, i.e., effects of potential negative environmental impacts which cannot be eliminated unless an alternative design is imposed. Justification of the proposed project by the project designer must be presented. Such a justification must provide a rational explanation for the project and its approval even though adverse impacts would result. The following questions may be a helpful guide in providing the explanation: Why is the project being proposed? What environmental and economic trade-offs can be made? Are these trade-offs consistent with community goals, resident values and attitudes? What are the costs and benefits to the community?

Impacts on Aesthetics or Human Health

The following questions should be considered carefully and answered in detail in analyzing and describing impacts on aesthetics and human health. Aesthetically, will the project destroy scenic views, remove or disturb historically important trees, or have similar negative aesthetic impacts? Specific health considerations might be: How is the incidence of malaria and diarrhea? Will the project increase this incidence?

195

MITIGATION MEASURES PROPOSED TO MINIMIZE THE IMPACT

Describe avoidable adverse impacts and the measures proposed to minimize these impacts. This discussion shall include an identification of the acceptable levels to which such impacts will be reduced, and the basis upon which such levels were identified. Where alternative measures are available to mitigate an impact, each should be discussed and the basis for selecting one alternative should be identified.

Avoidable Adverse Impacts

Here, refer back to the adverse impacts defined previously in this section and describe relevant mitigation measures. Attention should be given to two considerations: first, include only those mitigation measures which would reduce project impacts without altering the project scope; second, specify if these measures will eliminate the effect of the impact. If it will not eliminate the impact but will reduce it to what might be considered an "acceptable" level, explain the basic logic used to determine what an "acceptable" level is.

Alternative Mitigation Measures

In addition to describing avoidable adverse impacts and mitigation measures, other feasible mitigation measures are to be identified. Each alternative should be identified along with reasons for not incorporating each alternative. It is suggested that each alternative mitigation measure be evaluated in a cost-benefit analysis.

ALTERNATIVES TO THE PROPOSED PROJECT

Describe reasonable alternatives to the project, or to the location of the project, which could feasibly attain the basic objectives of the project and why they were rejected in favor of the ultimate choice. The specific alternative of "no project" must also always be evaluated, along

with the impact. Describe alternatives capable of substantially reducing or eliminating any environmentally adverse impacts, even if these alternatives substantially impede the attainment of the project objectives, and are more costly.

There are four types of alternatives to the proposed project which can be included here:

- Alternative projects which share objectives similar to those of the proposed project;
- Alternative site locations;
- Alternative projects which serve different objectives; and
- The "no project" alternative.

Alternative projects which share similar objectives are defined here as those which propose a different project size than that already proposed. While land use intensity suggested by the proposed project should correspond to general and community plans, alternative plans explore land utilization at different intensities.

Alternative site locations which are available and suitable for development should also be identified. When locating alternative sites, identify those areas which would generate fewer adverse impacts than those detailed for the proposed project site.

Thirdly, point out alternative projects which serve different objectives from those of the project in order to illustrate the range of uses suited for the proposed site. Not only should these alternative plans correspond with community goals and policies, but they must also be economically feasible.

Lastly, the "no project" alternative along with its impact must be evaluated. By analyzing characteristics of the existing site conditions identified in the description of the environmental setting, one can

define beneficial and adverse environmental impacts resulting from not implementing the proposed project.

Alternatives Which Reduce Impacts

Alternative designs which may reduce adverse impacts associated with the proposed project must be considered. Alternative designs are defined here as those which alter the project's scope by changing the size, magnitude or objectives of development. Once alternative designs have been described, the proposed project must be evaluated with illustrated alternatives. If the proposed project cannot be favorably compared to available alternatives, it must be redesigned or rejected. In order to compare the project and alternatives, a matrix and a user guide have been included as Figure 1 and Table 5. Using this matrix as a basis for comparison, physical, social and economic benefits, costs and risks of the proposed project and its alternatives can be considered objectively.

142

Figure 1
Alternatives Comparison Matrix

PRPOSED PROJECT AND ALTERNATIVES / IMPACT AREA	ADVERSE										BENEFICIAL							
PROJECT PROPOSED																		
ALTERNATIVES DESIGN																		
ALTERNATIVES TYPE																		
DIFFERENT LOCATIONS																		
NO PROJECT																		

TABLE 4

INSTRUCTIONS FOR USE OF THE ALTERNATIVES COMPARISON MATRIX

Use of the matrix illustrated in Figure 1 involves the following steps:

Step 1: In the left hand vertical column, identify the project and list all available feasible alternatives.

Step 2: In the top horizontal column, list the adverse and beneficial impacts identified in the Initial Study and during the analysis of the Environmental Impacts of the Proposed Action performed in the previous section.

Step 3: Analyze the alternatives in the same manner as the project. Also, add to the top column those impacts that the alternatives will generate. The No Project alternative should be analyzed in terms of the impacts generated by maintenance of existing conditions.

Step 4: By direct comparison, identify the intensity of the impacts generated by the project and its alternatives. A useful designation to the decision maker would be to differentiate between the levels of significance in the following manner:

For significant adverse impacts, use a lower case 'a' for significant mitigatable impacts, i.e., those that can be reduced to an acceptable level. Use a capital 'A' for those not so reducible. Use 'i' for insignificant.

For significant beneficial impacts, differentiate by using a lower case 'b' for those impacts that will produce only a minor benefit. Use a capital 'B' for major benefits generated.

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Describe the cumulative and long-term effect of the proposed project which adversely affect the state of the environment. Special attention should be given to impacts which narrow the range of beneficial uses of the environment or pose long-term risks to health and safety. In addition, the reasons why the proposed project is believed by the district engineer to be justified now rather than reserving an option for further alternatives should be explained.

Cumulative and Long-Term Effects

Project impacts which will affect both natural and man-made life systems, and those which pose long-term risks to health and safety, must be delineated here. When describing these effects, the following questions might be considered: Will soil eroding from grading operations cause stream siltation or damage to aquatic life? What are the possible uses of the site and in what ways will the project narrow these uses to eliminate future development options? Will toxic substances be discharged into river or oceanic resources? Will the project cause long-term air quality degradation?

Reasons Why the District Engineer Believes Project is Justified Now

Trade-offs between short-term uses and long-term losses should be analyzed together with those involving short-term losses and long-term uses. In order to specify these relationships, consider the reasons for project justification and for allocating public resources in order to develop the project. While justification should be also identified in other sections of the EIR, the reasons should be explored and interrelated here. Some questions allow such interrelations to be discussed: Is the Project's development justified because short and long-term gains outweigh losses? For what reasons should the project be built now rather than in future years? What gains or losses accrue by development now? Is there

data available to support these arguments? How do the beneficial and adverse impacts compare with one another?

IRREVERSIBLE CHANGES WHICH WOULD BE INVOLVED IN THE PROPOSED ACTION SHOULD IT BE IMPLEMENTED

Uses of non-renewable resources during the initial and continued phase of the project may be irreversible, since a large commitment of such resources makes removal or non-use thereafter unlikely. Primary impacts and particularly secondary impacts (such as road improvements which provide access to non-accessible areas) generally commit future generations to similar uses. Also, irreversible damage can result from environmental accidents associated with the project. Irretrievable commitments of resources should be evaluated to assure that such current consumption is justified.

Irretrievable Commitment of Resources

Those non-renewable resources committed to the project should be identified and analyzed here to assure that their consumption is warranted. Non-renewable resources are not only those related to labor and materials, but are also "the natural and cultural resources committed to loss or destruction." In short, common resources which can be identified are gas, oil, gravel, historically important trees, and the like which may be lost should the project be developed. Additionally, analysis of such non-renewable resource utilization should focus on whether commitment of land for the proposed project is justified and whether the land can ever be returned to a natural or original state once graded, filled, or utilized in a different manner. The key phrase to keep in mind is, "commitment of such resources makes removal or non-use thereafter unlikely.

Primary and Secondary Impacts

Here, primary and secondary impacts which commit future generations to use the land in a similar manner must be identified and interrelated with direct and indirect project impacts. For purposes of definition, in this context, primary impacts can be said to result from land-use conversions (forest land converted to agricultural, for example), while secondary impacts result essentially from the creation of infrastructures such as roads, sewage and treatment plants, power lines, etc. Once land is converted and infrastructures created, future generations are committed to the continuation of similar usage because of a need to reclaim public funds which were invested initially.

While primary and secondary impacts must be indicated, it is also important to include tertiary and quaternary impacts as they may occur. These later impacts are also indirect consequences of the project and are spin-offs from primary and secondary impacts. For example, if an irrigation system were built, a primary impact would include hiring people, some of whom would not be currently living in that community. By employing these people from outside the community, the new housing needed for accomodation would become a secondary impacts. An increase of sewage discharge into streams and subsequent degradation of water quality, would be come tertiary and quaternary impacts.

Environmental Accidents

Potential for a means of anticipating and preventing environmental accidents must be discussed here. Potential accidents could incude: pesticide spillage in a river, landslides resulting from grading operations, flood damage to projects built in a flood plains, and vegetation destruction by wild fires. When discussing the potential for accidents, include measures which can be taken to prevent or minimize occurrence.

THE GROWTH INDUCING IMPACT OF THE PROPOSED ACTION

Discuss the ways in which the proposed project could foster economic or population growth, either directly or indirectly, in the surrounding environment. Included in this are projects which could remove obstacles to population growth (a better water supply will reduce child mortality). Increases in the population may further tax existing community service facilities so consideration must be given to their impacts. Also discuss the characteristics of some projects which may encourage and facilitate other activities that could significantly affect the environment, either individually or cumulatively. It must not be assumed that growth in any area is necessarily beneficial, detrimental or of little significance to the environment.

Ways the Project Could Foster Growth

In evaluating population and economic growth inducements created by the project, is is important to determine if such growth will have direct or indirect, beneficial or adverse impacts. The nature of these impacts should be identified and the following questions considered. Does the project remove an obstacle to population growth? Does the proposed project set a precedent which may foreclose future options? Would the project set a trend of similar land use conversions in the region? Will increased employment and taxes be generated? Will public utilities be overloaded? Will people move in from within or from without the community? Will the economic growth offset costs of increased public service demand?

Other Projects That May Encourage Growth

The specific characteristics which should be assessed here focus on the spin-off activities resulting from the proposed project, that may encourage or facilitate construction of other similar projects - in essence, initiate or stimulate a "domino effect." By assessing these characteristics, one should be able to identify significant environmental effects resulting from the development of the project

204

and from other projects which are located in the same region. Such an assessment may also determine whether the community has effectively planned for future growth, and whether the community could support increased financial allocations for public services.

Task II Develop a training plan/guide for use by both the GOH and private engineering/construction firms related to the environmental criteria in No. 1 above.

To insure that irrigation sites considered under this project achieve the maximum economic benefit under a balanced environment; consciousness of environmental protection should be generated in decision-makers as well as campesinos.

To achieve that, a training plan for environmental protection should reach all of the people involved in irrigation systems:

1. Decisions makers
2. District Engineers
3. Medium Level Staff
4. Design Engineers
5. Extensionists
6. Campesinos

Decision makers should receive at least one day of training. It may be in Tegucigalpa and before the project is initiated. General concepts on ecology, environmental impacts of irrigation systems, environmental analysis techniques and design of irrigation systems shall be taught.

District engineers and medium level staff should receive at least two days training. This can be held in Tegucigalpa, before the project is initiated. They shall learn about ecology, environmental impacts of irrigation systems, environmental analysis techniques and design of irrigation systems.

Design engineers and extensionists should be trained for three months, two months of theory and one of practice, two hours a day. This training will be coordinated with the irrigation design courses taught at the Training Center for Agricultural Development (Centro de Entrenamiento de Desarrollo Agrícola) at Comayagua. This training should start as soon as possible. The topics that should be covered are environmental

biology, ecology, water chemistry, hydrology, water supply, sanitation, air pollution, environmental geology, environmental impact of irrigation systems, environmental analyses techniques and environmental design of irrigation systems.

Campesinos will be trained by the Extensionists during the design period. They will be trained on health hazards from irrigation systems, hygiene and environmental protection.

A textbook and teaching material should be prepared prior to the start of training. The textbook should cover all topics described before. Teaching material will aid during the presentation of topics. At this time, it has not been decided between slides or videotapes. This will depend on the amount of funds allocated to this activity. This will speed up the exposition of materials and give more time for detailed discussion of topics.

Pamphlets with graphic illustration should be used to teach campesinos about pesticide and fertilizer application; operation and maintenance of intake structures, impoundments, channels and drains; hygiene and environmental protection.

An environmental specialist should be hired at the very start of the project. He will prepare the textbook and the teaching material. He also will coordinate all the different courses discussed above. If deemed necessary, local instructors will be hired to cover some of the basic topics. The environmental instructor should stay in Honduras at least 9 months the first year and 3 months the subsequent years, for a total of 24 months.

The environmental specialist should also help in the execution of the first environmental impact assessments. He shall have the following qualifications: Experience in less developed countries in the fields of environmental impacts, water supply, sanitation and design of irrigation

systems; R-4, S-4 level fluency in Spanish; teaching and short course organization experience.

Sampling and laboratory equipment should be acquired to perform physical chemical and biological analysis of water. Equipment needed for physical tests of soils is already available in CEDA.

The equipment that should be provided is for normal physical, chemical and bacteriological analysis such as pH, temperature, electric conductivity, dissolved oxygen, turbidity, total alkalinity, total hardness, calcium, magnesium, iron, manganese, nitrogen (all forms), phosphates (all forms), solids (all forms), biochemical oxygen demand (BOD), chemical oxygen demand (COD), chlorides, sulfates, and coliforms.

Laboratory and field apparatus that should be provide are as follows:

Laboratory: BOD tester, nitrogen digester, deionizer, BOD incubator, high temperature oven, refrigerator, microscope, incubator for bacteriological tests.

Portable: Water analysis kit, pH, conductivity, dissolved oxygen, turbidity, and temperature meters.

Equipment for more sophisticated analysis such as pesticides should not necessarily be provided to the CEDA, because this equipment is rather expensive to be used only for teaching purposes. This does not mean that pesticides are not going to be analyzed during the environmental evaluation. Funds will be better spent if this sophisticated equipment is provided to the Centro de Análisis de Suelos, Aguas y Plantas (Analysis Center for Soils, Water and Plants), Ministry of Natural Resources. This center has trained personnel to do all the required analysis for soils, water and plants. However, some of the personnel should receive some training on the use and interpretation of the gas chromatograph (pesticide analyzer). Most of the time, chemical companies include training with the purchase of gas chromatographs. Training should be held in Honduras, to get the most people trained.

Task III Examine potential health impacts of irrigation systems to determine if malaria and other water related diseases will become a problem in areas proposed for irrigation interventions

Irrigation systems have both beneficial and adverse impacts on health. When irrigation systems are not properly planned, designed, constructed and maintained, adverse impacts surpass beneficial ones. Adverse impacts on health are caused by biological and chemical factors; diseases vary from a simple diarrhea to terminal cancer.

Economic losses due to adverse impacts on health may vary from a few dollars to several thousand dollars. This reduces the already scarce monetary resources of "campesinos". Some studies (*) show that 93% of the population expend $0.50 to $1.00 three times a month on shots. Up to one third of the population expends money to receive daily shots for a period of two weeks a year; or has to live close to medical treatment centers for a period of 2 months a year. An average of $8.25 is spent each time medical treatment is received. Private services are the most expensive, being the most economic the ones provided by the Health Centers. Even in cases where medical treatment is received at home, the average cost is $2.25, being, for the most part, drugs (**).

Irrigation systems are not the only factors responsible for adverse impacts on health, hygienic practices also play a major role on it. It has been found that hygienic education plays a major role on the incidence of diarrhea. Rural families frequently are not conscious about diseases transmitted by insects and animals. They do not emphasize

---

* Foff, Gretchen. "Vista Socio Cultural de la Salud Rural y la Entrega de Servicios de Salud. Mito y Realidad". Mayo, 1980. Tegucigalpa, D.C., Honduras. C.A.

** Banco Central de Honduras. "Informe Económico 1984". Departamento de Estudios Económicos. Tegucigalpa, D.C., Honduras, C.A.

209

hand cleaning before meals, and animals are often present in the eating areas. There is lack of prevention measures among rural population.

Health services are sought only during sickness. Prevention measures for a healthy child are not usually observed. For example, after a radio message about boiling water to prevent diarrhea reached 100% of the rural population, only 1.8% followed this advice. Twenty percent of the families studied believe that water loses "vitamins and power" during boiling; 70% do not boil water because of laziness or because they do not want water to lose its taste. However, it is deemed that people do not accept the existence of organisms in water because they are not able to see them. Parents will give boiled water to a child when he is sick, but do not see any need when the child is healthy.

To better explain what has been stated before, further discussion of biological and chemical disease causing factors is presented in the next paragraphs:

Biological Disease Causing Factors

Biological disease causing factors are virus, bacteria, nematodes, etc. They proliferate because of changes in the ecological setting caused by the irrigation system. These diseases can be classified as water-related and non-water-related. Water related diseases are those where the infectious agent lives in water or needs an aqueous medium during a certain part of its life cycle. Non-water related diseases are those where the infectious agents does not need an aqueous medium.

The Ministry of Health has records of each disease treated in the health centers located around the country. These records were analyzed and only those diseases related to agricultural practices were selected. They are shown in Table 6, "Disease Occurrence by Type and Area Related to Agricultural Practices".

TABLE 6

DISEASE OCCURRENCE BY TYPE AND AREA, RELATED TO AGRICULTURAL PRACTICES, 1985

Disease	Metropolitan*	Rural
Amoebiasis	6,899	4,978
Dengue	2	369
Bacillary Dysentery	116	262
Viral Encephalitis	0	0
Diarrhea	43,884	141,173
Typhoid	153	313
Paratyphoid	5	13
Infectious Hepatitis	546	1,096
Leishmaniasis	0	175
Malaria	296	27,036
Poliomyelitis	11	46
Rabies	0	5
Total	51,912	175,469

* Includes only Tegucigalpa

Source: "Boletín de Estadística e Información de la Salud", Departamento de Estadísticas de Salud, Ministerio de Salud.

211

Water Related Diseases

This group includes: amoebiasis, dengue, bacillary dysentery, viral encephalitis, diarrhea, typhoid, paratyphoid, infectious hepatitis, malaria and poliomyelitis.

Non-Water Related Diseases

Irrigation systems cause an imbalance within the ecosystem they are constructed in. The final result is a potential increase of selected animal species, especially rats, and the consequent hazard for transmission of diseases. The common non-water related diseases in rural areas of Honduras are leishmaniasis and rabies.

From the information in Table 1, it is possible to observe that diarrhea and malaria are the main diseases that occur in rural areas of Honduras. About 80% of the cases are diarrhea and 15.4% malaria cases. Because of that, both are discussed in deeper detail.

Diarrhea

The diarrhea situation in Honduras is of concern. It is estimated (*) that 2,000,000 cases of diarrhea per year occur in the age group 5 years or less. Each child incurs 2 to 5 episodes per year with an average of 3. The morbidity rate during 1983 was 219.4 per thousand children. Diarrhea is the top killer in children one year old or younger.

---

* Organización Panamerican de la Salud/OMS. "Curso Gerencial Sobre Planificación y Administración del Programa Nacional de Enfermedad Diarréica." Washington, D.C., 1982.

** Dr. José Enrique Zelaya, et al "La Terapia de Rehidratación Oral. Evaluatión de la Experiencia en Honduras", Ministerio de Salud, Honduras, 1985.

212

Diarrhea is a syndrome of diverse etiology. Its common signs are loose fecal depositions, frequently accompanied with vomit and fever. It is a sympton of cholera, shigelosis, salmonellosis, amoebasis, giardasis and viral gastroenteritis. It can be also caused by Escherichia Colie and campylobacter cultures and intestinal helmynthes.

Irrigation systems on one hand reduce the amount of water available to communities located downstream of them. On the other hand, they increase the concentration of pollutants (chemical, physical and biological). The final result being an increase on the occurrence potential of water-borne diseases.

The potential for water borne diseases varies with the level of service for water supply and excreta disposal practices. Rural communities without a safe water supply source and without appropriate excreta disposal will be most prone to adverse health impacts. Even more, those communities with a source of supply but with inadequate treatments (virtually all the rural residents use water which is not disinfected) will also have an increase of diarrhea occurence.

According to CONSUPLANE 24.2% of the rural population has piped water, 51.3% has wells and 24.5% has no service. Also 44% have a safe disposal of excreta. This situation places in a very delicate condition the effort of improving the economic conditions of the rural population through the development of irrigations systems.

In a brief research conducted by the Health Centers around the nation, information on diarrhea occurence, source of water supply and excreta disposal practices was obtained. Data collected are shown in Table 2 "Diarrhea Occurrence in Children 5 Years Old or Younger, According to Water Supply and Excreta Disposal Practices". In this table, it is possible to observe no big difference between water supply source and percentage of children with diarrhea. Also, no big

difference exists between excreta disposal practices and percentage of children with diarrhea. This corroborates what has been stated before.

214

TABLE 2

DIARRHEA OCCURENCE IN CHILDREN 5 YEARS OLD OR YOUNGER, ACCORDING TO WATER SUPPLY AND EXCRETA DISPOSAL PRACTICES

Type of Service	Percentage %
Water Supply	
Patio connection and in-house service	18.8
Standpost	25.6
Well	20.6
Excreta Disposal	
Toilet	14.6
Latrine	21.4
None	22.0

215

Malaria

In rural Honduras, 15.4% of all water-related and non-water related diseases are malaria cases. This disease has a very high economic impact on rural areas because an infected campesino needs about three months to fully recover from malaria.

Irrigation systems have a potential to increase malaria occurrence in a rural area because water is essential for irrigation systems and for mosquito proliferation. A mosquito spends 8 to 10 days in water during its metamorphic cycle from egg to mosquito.

There are four potential areas for mosquito proliferation in irrigation systems: irrigation canals, land along canals, cultivated land and downstream from the cultivated area.

Mosquito problems exist on all of the irrigation canals, but a higher potential exists in the small irrigation distribution canals. Lack of maintenance by the user is the main factor. Potential mosquito proliferation exists when water flow is slow (less than 3 or 4 inches/sec), or canal walls are eroded or emerging plants are along the canal or transverse sections are irregular. Experience shows that the smaller the canal, the higher the probability for mosquito proliferation.

Water losses due to infiltration and cracks raise the groundwater level along the canal. Sometimes, groundwater rises and appears at natural or artificial low lands, forming pools. These pools along the canal are good sites for mosquito proliferation. Overflow of water due to poor management during water transportation and distribution and "borrow areas" also have a potential for mosquito proliferation.

Controlled and non-controlled flooding irrigation methods have a potential to form pools on the cultivated area and hence a potential for mosquito proliferation exists. Preventive measures do not exist

for the non-controlled flooding irrigation. Furrow irrigation has less potential for mosquito proliferation than flooding, but drip irrigation, underground irrigation and sprinkler irrigation are better. Of great importance is the provision for a complete and rapid water drainage in the irrigated field and for a drying period which assures the destruction of larvae.

The actual design practice of irrigation systems is to insure that water leaves the cultivated field through a series of drains which generally discharge into a natural watercourse. In such cases, the designer need not give as much attention to prevention of the formation of pockets of water which serve as mosquito proliferation sites.

Chemical Disease Causing Factors

The agricultural chemicals that pose a major threat to the general health of the rural community are fertilizers and pesticides. Salts indirectly cause an adverse impact on health. Each group will be discussed in more detail in the following paragraphs:

Fertilizer

Fertilization is one of the few methods by which man can exert a major influence on the natural process governing plant growth. Fertilizers contain nitrogen, phosporus, and potassium. Nitrogen is the only one associated with health problems. Nitrogen in water is in the form of nitrites, nitrates and ammonia.

Nitrites are very toxic. If ingested in water or food they interfere with the oxygen carrying capacity of blood. Nitrites can also combine with other chemicals and cause cancer. Fortunately, nitrites in water and soil are readily converted to nitrates.

Nitrates are five to ten times less toxic than nitrites. It has been found that high concentrations of nitrates may cause

methemoglobinemia in infants. For this reason the U.S. Public Health Service Standards limit the nitrate content of drinkign water to 45 mg/l.

Ammonia can be converted to toxic nitrite by nitrobacters. Also, high levels of ammonia are toxic to fish.

Pesticides

A multitude of chemicals in the general category of pesticides are used in agriculture to control weeds (herbicides), insects (insecticides, miticides), nematodes (nematocides), fungi (fungicides), rodents (rodenticides) and other animals.

Pesticides can get into a person's system in four ways: by inhalation, by absorption through skin, by drinking water and by food ingestion. Campesinos are vulnerable in all four ways. Downstream inhabitants are exposed only to the last two ways.

Pesticides can cause intoxication and death when safety measures are not taken during handling and application of concentrated products. Pesticides, once in the body, are accumulated in tissues specially fatty tissues; consequently, they are stored in the liver where they interfere with its normal function. They are responsible for several forms of cancer: breast, liver, pancreas, brain, etc.

In Honduras, the most serious problems from the use of pesticides are the lack of use of protective equipment and the lack of training of the user on the use of pesticides. During field trips made to Juticalpa and Choluteca there were several instances of the application of pesticides to cultivated fields. Face masks, gloves and shoes were not consistently being used by the campesino while applying the chemical. In certain occasions, a campesino was bare-backed while carrying fumigation tanks on his back. He claimed to have headaches during evenings but nothing else. He expressed the

belief that he was "immune" to pesticides after several years of using it.

People living downstream from an irrigation system are exposed to pesticides by drinking water and consumption of agricultural products. A high chance for pesticide ingestion through drinking water by the rural population exists because many people get water from creeks and because the chance for pesticide contamination is much greater for surface water than for groundwater. (This is because pesticides tend to be absorbed by soil particles, which can be carried downstream from treated fields).

Cases of contamination of surface water by pesticides have been documented in Honduras (*). Water quality data showed that DDT, Dieldrin, Toxaphene, Methyl and Ethyl Parathion and Endrin were utilized heavily in cotton growing areas in Choluteca and Olancho.

Salts

Salts in moderate concentrations do not directly have an adverse impact on health, but indirectly they may have. On the other hand, salts in high concentrations interfere with the normal function of kidneys and cause high blood pressure.

All irrigation waters contain some amount of soluble salts, which are left in the irrigated system after pure water has been lost through evapotranspiration. For example, if 1 acre-ft (1,233M^3) of irrigation water having 200 mg/l of salt is applied to 1 acre (4,047M^2) of soil, approximately 0.3 ton (272.2 kg) of salt will be left behind. If these salts are not leached out by regularly applying more irrigation water than needed for evapotranspiration, salts accumulate in the root zone and the land eventually becomes

---

* ICAITI, 1976, "Estudio de las Consecuencias Ambientales y Económicas del Uso de Plaguicidas en la Producción de Algodón de Centroamérica", Guatemala

too salty for agriculture. Leaching occurs in most surface irrigation systems. It is estimated that 30 to 50% of the irrigation water becomes deep-percolation water. Deep-percolation water from irrigation systems often is the main cause of quality degradation of underlying groundwater. Degraded groundwater leads campesinos to use unsafe surface water for domestic consumption.

220

INITIAL ENVIRONMENTAL ASSESSMENT
FOR THE
IRRIGATION DEVELOPMENT PROJECT

PART I

Description of the Project

The project's purpose is to enhance farmer productivity and production through the installation of irrigation systems and the provision of related improved agricultural practices. These innovations will support the joint USAID/Honduras effort to diversify production thereby increasing domestic food supplies and agricultural exports.

The project will consist of two closely related components - the design and installation of irrigation systems and development of the institutional capacity to plan and execute irrigation interventions.

The project will be targeted to benefit the small and medium farmer population of Honduras. Numerically, this group is dominated by growers with postage stamp holdings (less than 5 hectares) who employ traditional rudimentary technology and whose primary production orientation is to satisfy household subsistence needs. A second important farmer group are growers with modest size holdings (up to 30 hectares), who utilize a limited degree of modern inputs and are active market participants. In many instances the combined land area of cooperative base group members is significant, in some cases exceeding 100 hectares.

The project will include five different irrigation systems: micro-systems, small systems, medium systems, large systems and drainage and flood control systems.

Micro-systems will be provided for land areas of less than 5 hectares supplied by small diversion structures and simple manual or gravity fed systems.

221

Small systems will be provided to areas between 6 - 30 hectares supplied by either a temporary or permanent surface water source, and having a limited potential for water storage.

Medium systems will be provided to areas between 31 - 100 hectares supplied by a permanent water source and possessing reasonably good water storage potential.

Large systems will be provided to land areas of more than 100 hectares that are supplied by permanent water sources and posses excellent water storage potential

Drainage and flood control systems - covering areas in excess of five hectares and which will serve to stabilize water availability, and counteract flooding, erosion and other damage, or eliminate excess superficial water and lower the water table.

The irrigation technology that will be used will vary according to system, and will range from simple methods (hand-dug canals) for micro-systems to relatively sophisticated procedures (drip irrigation) for networks encompassing 100 or more hectares.

PART II

Description of the Environmental Setting

Specific irrigation sites are undefined at this moment. However, the areas under consideration will be those of gentle slopes and most of them are presently being agriculturally exploited.

Soil erosion on these areas is not as rampant as those soils on steep areas. Therefore, siltation caused to streams is minimum or nil and water holding capacity may not be as deteriorating as on steeper slopes.

Honduras does not have a regulation for the protection of wildlife. Attempts are made to protect several species with certain laws. The end

222

result of this situation is that several plant and animals are endangered. Some information collected shows that 35 animal species are endangered and 4 are extinct. No information, if any, was obtained on endangered vegetal species. A partial list of endangered species is as follows: Andora Grandis (casco de burro), Crotalus Durissus (víbora cascabel), Dermochelys Corvacea (Tortuga Baula), Caretta Caretta (Caguama), Caiman Crocodilus (caimán), Harpyhaliaetus Solitarius (Aguila), Ara Ambigua (Guara Verde), Ateles Geoffroy (Mono Araña), Felis Corcoles (Puma), etc.

Archeological resources are widely spread. Olmec, Maya and Chibchan structures, tools and utensils can be found. Funds and personnel are scarce to prevent any action to preserve and study all sites.

Water resources are limited in several basins, specially during dry weather. Therefore, new water uses cannot be introduced. Some other areas still have plenty of water resources.

Quality of water in creeks and rivers is adequate for irrigation, but it is unsuitable for direct consumption. Raw sewage is discharged into streams. Sometimes not enough time for natural self purification is allowed. About 24.2% of the rural population has piped water, 51.3% has wells and 24.5% has no service, relying heavily on streams and rivers. Around, 44% of the population has a safe excreta disposal method, latrine or toilet. No treatment is given before disposal.

Groundwater potential has not been fully studied. Certain areas are heavily exploited, mainly for irrigation purposes. Groundwater quality information was not available in those offices visited. People at Olancho and other places said water is salty in the shallow aquifer, but good at deeper places.

The diarrhea situation in Honduras is of concern. It is estimated that 2,000,000 cases of diarrhea per year occur in the age group 5 years or less. Each child incurs 2 to 5 episodes per year with an average of

3. The morbidity rate during 1983 was 219.4 per thousand children. Diarrhea is the top killer in children one year old or younger.

In rural Honduras, 15.4% of all water-related and non-water related diseases are malaria cases. This disease has a very high economic impact on rural areas because an infected campesino needs about three months to fully recover from malaria.

Eutrophication problems (premature aging) have appeared in several water courses. This is believed to be caused by agricultural practices and raw sewage discharges. Rio Guacerique is an example of these phenomena; eutrophication has appeared at Los Laureles Reservoir just where the river reaches it.

Honduras is one of the poorest countries in Latin America. In 1984 the annual per capita income was $776. The Gross Domestic Product (GDP) has been in decline to reach a negative rate of about 1 per cent. Peasant farmers or farm laborers are the hardest hit due to this economic downturn. About 80 percent of this group had earnings below the calculated poverty line income of $230 per capita per year. Malnutrition affects 70% of the population.

Part III

Identification and Evaluation of Environmental Impacts

The Project has been designed to provide irrigation systems economically and environmentally sound, to develop the institutional capacity within the DRH to plan and execute irrigation interventions and to environmentally train people involved in irrigation.

By doing so, several beneficial impacts will be attained. Land productivity is expected to increase 30 - 40% and hence the economic condition of campesinos. This will lead to increased labor demand and, in some cases, population inflows with accompanying increases on utility

224

services and demand of goods. A secondary impact will also be the increment on commercial trading.

Basic natural resource data will be increased by collecting data on water quality, soil properties, plants and animals during the environmental assessment.

Malaria incidence may be reduced by reducing mosquito breeding sites with appropriate design of irrigation systems. Diarrhea may also be reduced, if the supply of safe water for domestic purposes and waste disposal practices are an integral part of irrigation projects.

By ecologically training the campesinos about the environment and his impact upon it, awareness will be increased. Endangered species used as food will not be disturbed if an alternate source of food is available to campesinos; spare time for hunting will already be reduced by the introduction of more intense irrigaton practices.

Some unavoidable adverse impacts would exist. They can be minimized if adequate operation and maintenance of irrigation systems is observed.

Sources of water will be under higher stress, specially on those areas where water resources are scarce. This impact is minimized by reducing water losses in canals and selecting appropriate crops.

Pesticide concentration in water courses will increase due to increase on land use. Salt concentrations will increase both in surface water and groundwater. Nitrogen and phosphates concentration in water courses will also increase, therefore, a higher potential for eutrophication may exist.

Some erosion of productive soils and siltage of water courses will result from construction activities, also some dust will be produced during construction and operational activities.

225

Part IV

Recommendations for Environmental Action

Having evaluated the Irrigation Development Project for potentially significant environmental impacts, it is concluded that the overall impact of this project will be beneficial and that the majority of any potential negative impacts will be minimized by careful design, construction and maintenance of irrigation facilities, and raising the awareness level of the participants in the project.

226

A DRAFT METHODOLOGY FOR DETERMINING THE COST OF PUMPED WATER

1.0 INTRODUCTION

1.1. Background

Most pumping systems to be implemented under this Project seem to be diesel systems. So far there has been no standard method of field testing/evaluation of diesel water pumping systems. Various donors have used different methods. Thus, few reliable field test data have been collected and they are hard to compare since they have been generated using different assumptions and methods. Purchase/installation decisions are generally based on inadequate data thereby reducing the chance that the investment in the pumping system is best for the site.

While the criteria for selecting a pumping system depends on site conditions (hydraulic head, well diameter, delivery pipe system) and the load (time distribution of water demands) it is almost impossible to give a generalized set of guidelines.

The activity outlined in this chapter will contribute indirectly to the selection criteria by offering a simple methodology to determine the cost of water at the delivery point by factoring all cost components including energy. The methodology requires testing and field evaluation in order to generate data and information needed for better financial/economic analysis of production cost in irrigation systems. This will be done by attaching a relatively realistic price-tag to a unit of water used so that water can be considered as an important, and proper, input.

The issue of the cost of pumped water (by various pumping systems and the comparison) is not simple nor is it unknown to the major donor organizations. In 1985 A.I.D. took the lead in developing a methodology for determining water costs and thus comparing between different pumping systems. The activity has been initiated by the Bureau for Africa, Office of Technical Resources, Special Development Program Division (AFR/TR/SDP); the Regional Economic Development Support Office for East and Southern Africa (REDSO/ESA); and the Science and Technology Bureau, Office of Energy (S&T/EY). Since the methodology issue has been a problem to many donors, Germany, Britain, Canada, the Netherland, FAO, and the World Bank are all participating in this effort. It is presently expected that a draft of the methodology will be available by the end of this calendar year and a reviewed/corrected multi-donor publication of it by March 1987.

Most of the material presented in this chapter draws upon the experience of A.I.D. and other donors and is based on preliminary work done by Associates in Rural Development Inc. and I.T. Power Inc.

1.1.1 Relation Between the Methodology and the Project

Almost no data on the cost of water pumping for small and medium size irrigation systems exists in Honduras. Pumping costs are not negligable and must be factored into any financial/economic analysis of irrigated crop production. By introducing this methodology into the Project and through proper training applied in selected irrigation subprojects, the Project will contribute to better evaluation of the economics associated with irrigation. This in turn may have a significant impact on the planning of future irrigation activities in Honduras.

1.2. Purpose

The purpose of the proposed evaluation methodology is to define a simplified, workable, and standard procedure to field-test pumping systems and to suggest a format for the presentation of the results. The methodology will also define a basic procedure for the comparative evaluation of different diesel pumping systems (as well as others).

Thus it is primarily a procedure to obtain the information necessary to make an informed choice of pumping systems based on dates collected during the first few years of this Project.

1.3. Required Skills of Implementation

The overall supervision of a field-testing program and data collection activities should be carried out by individuals with engineering and economic skills. This Project will provide focused and adequate training for such individuals (as will be discussed in Section 4).

Data collection/generation is to be undertaken at two levels.

(a) short-term technical performance to be undertaken by engineers with special training provided by this Project
(b) long-term performance data to be collected by the pumping user, selected farmers, and/or technicians after minimal training that will be provided by this Project.

There is a clear need to distinguish early between:

(a) a test on a pumping system to determine the potential output (the output if unconstrained by actual water demand, breakdown time, etc.) -- this is a measure of its technical performance, and;
(b) a test to enable the calculation of a unit water cost based on the water that was actually delivered; this cost needs to be the basis for the financial/economic comparison of irrigation systems.

1.4. Normalized Water Cost

At the outset we stress that there is a need to determine the life cycle cost of a unit of water. This could be done by simply giving the cost in terms of dollars per meter cube ($\$/m^3$). However,

if this is done for two different cases in which the water is pumped from different levels (heads) then different results will be obtained (all other parameters held constant) since it takes more energy to pump from a deeper level. To facilitate the comparison of pumping costs from different water levels there is a need to "normalize" the cost per unit volume of water. This can be done by giving the cost per unit volume on a basis of pumping water up one meter. Thus the normalized cost to be used in economic calculation is given in terms of the cost of a unit volume ($\$/m^3$) divided by the head (m): ($\$/m^3xm$)*. The illustrative example in Section 2 will clarify this point.

1.5 Monitoring

In view of the large potential for irrigation in Honduras it is important that the project serves as a guide for future irrigation activities and analysis in the country. Thus it important that this project has a monitoring component to ensure that economic benefits of water pumping can be assessed. The project will select typical sites with typical irrigation techniques (gravity, trickle, etc.) and monitor their performance and collect data for economic evaluation. The following should be viewed in support of such activities.

* The product (m^3xm) is directly related to the energy required to pump one cubic meter up one meter.

2.0 ECONOMIC ANALYSIS RELATED TO PUMPING

2.1 Introduction

This section outlines typical pumping related data which is necessary to arrive at an economic or financial analysis of water pumping systems. While the examples are oversimplified, their purpose is not to perform an economic analysis per se but to merely illustrate those elements which need to be included in any analysis of this kind.

In this section, life-cycle costing (LCC) is used to evaluate various water pumping scenarios. Life-cycle cost analysis, which calculates the present value of all costs, capital, operation and maitenance, and replacement parts over the lifetime of the system, is the standard method used for the financial and economic comparison. Data is required on energy and labor costs, interest rates, volume of water pumped, etc. A final comparison between systems can be made by comparing the water delivered per unit of head or the unit cost ($/m *m). Once this data is quantified, it is possible to determine the most viable pumping system. In this case, one diesel system is more cost-effective than the other two examined.

2.2 Life-Cycle Costing

Two spreadsheets are included in this section: one examining recurrent costs and the other being an illustrative economic/financial example comparing 3 diesel water pumping systems. These spreadsheets are shown in Tables 1 and 2.

In Table 1, recurrent cost information is calculated and then incorporated into the total picture in Table 2. Table 1 illustrates this information for three different diesel systems. Labor charges, annual recurrent costs of materials for routine maintenance, energy costs, non-annual recurrent costs for expected maintenance, energy costs, non-annual recurrent costs for expected maintenance and repair procedures, are all included in the recurrent cost total. This is elaborated as follows:

- pumping system -- direct labor charges from day-to-day system operation;

- annual O&M -- annual recurrent cost of materials used for routine operation and maintenance and transportation charges, since the shadow-pricing of labor does not affect transportation costs, and annual recurrent labor and transport charges and manitenance;

- non-annual maintenance -- non-annual recurrent costs for expected maintenance and repair procedures, such as cylinder replacement on a five-year basis and the replacement of down-hole piping every 10 years (this includes associated labor and transport charges);

- annual -- total recurrent costs for each year, or the sum of figures in the first four rows.

Table 2 is an illustrative example of a financial/economic analysis for pumping systems. Numerous assumptions and variables go into calculating the unit cost of water and include the following categories: system/site data, cost data, information on project benefits, and LCC data.

The three systems analyzed in the spread-sheets represent typical costs for diesel installations (although these systems do not have to be necessarily sized similarly). The categories in Table 2 are described below:

- upper section -- technical performance summation in terms of annual average water output (the daily average in terms of m^3/day) and total pumped head, volume head product (indicating magnitude of the hydraulic energy demand), and assumed amortization period and discount rate (while an amortization period of 10 years is shown, this does not imply that the economic life of all components is 10 years -- many systems components will need to be replaced during that period, as discussed under "non-annual maintenance.";

- initial capital cost -- including such items as major system components for diesel: pump, engine, fuel storage, pump house, etc.;

- installation cost -- all labor and transportation costs incurred during installation;

- present value (PV) of recurrent costs -- present value of all expected operation and maintenance costs over the system lifetime, including any spare or replacement parts or labor and transportation charges that will be incurred;

- LCC -- present value of all costs incurred in purchase, installation, operation, maintenance and repair over the system lifetime;

- benefits -- annual volume of water pumped, value of that water at the rate assumed ("Value of Water: at top of spread-sheet), present value calculated over the amortization period, and benefit/cost ratio based on that assumption;

2.2.1 Assumptions

Assumptions in the analysis should include the following:

- For financial analyses, loan interest charges (if any) must be included in the life-cycle costs, as should any variations between official government wage rates and those applicable to the private sector. Interest rates should be analyzed for sensitivity. Depreciation and other tax-related considerations should be included where applicable.

- For economic analyses, shadow-pricing of local labor, foreign exhange, and any other variable the government chooses to

shadow-price must be included in the analysis. Reflecting often abundant local labor and a scarcity of foreign exchange, typical values in developing countries are 0.5 and 1.1, respectively (i.e., local labor costs are reduced in value by 50 percent, and imported equipment cost is increased by 10 percent in the analysis). Sensitivity analyses should be performed on these assumptions as well.

- Incremental training costs for pump technicians dealing with hitherto unfamiliar equipment should somehow be factored into the recurrent operation and maintenance costs of the systems. The magnitude of this incremental cost if often difficult to evaluate. In areas where the de facto standard is diesel pumping, much of the training expenses associated with the diesel pump maintenance infrastructure are sunk costs, but estimates of their value should nonetheless be included in the comparative evaluation of pumping technologies.

- The price of fuel varies depending upon such variables as the distance from the prospective pump site to the nearest storage depot, whether the fuel is obtained through official or parallel marked channels, and whether fluctuations in availability of fuel on a national or regional level have generated local scarcity of supplies. Such factors should be considered when performing an analysis for a specific site.

- Salvage values for all equipment are most conveniently assumed to be zero. However, this can be varied to fit local practice as required.

- Calculations should be made in constant dollars rather than local currency, where possible, to avoid the difficulties associated with varying time-dependent rates of exchange.

- In order to estimate the division of capital expenditure and long-term recurrent operation and maintenance costs, the ratio of installed capital equipment costs to LCC was calculated for each pumping system. This reflects the need for the availability of capital in each case. An alternative formulation would be the ration of recurrent costs to LCC.

- Assumptions of discount rates and any real cost increases (or decreases) of equipment, labor, materials or fuel above the general rate of inflation should be taken to be six percent and zero percent respectively, reflecting fairly standard assumptions for public-sector financing. Local government figures for these assumptions can be used in subsequent analysis. Private-sector discount rates will be somewhat higher (16 percent interest rates for private-sector financing are common). Assumptions of lower discount rates tend to bias the analysis in favor of technologies with higher initial capital costs and lower long-term recurrent costs (i.e., PV and wind will seem relatively more favorable than diesel because of such an assumption).

2.3 Relationship to Project

This information will help determine the economic viability of irrigation systems that use pumping. Specific questions that this information will resolve includes:

- What is the percentage of pumping costs to overall production costs?
- How are related operation and maintenance costs (primarily energy-related) factored into overall water delivery costs?
- How does one compare and evaluate different modes of water pumping in term of cost and performance?

This project will provide training to help collect better data on pumping in order to attain idea of the economic viability of these systems (see Section 4.0).

2.4 Additional Data Needs

There is a quantifiable value that can be assigned to the crops grown because of the irrigation provided. While this can be difficult to quantify, it is nonetheless a real, not arbitrary, value. The purchase of an irrigation system must result in greater life-cycle benefits (in terms of the incremental value of crops grown) than life-cycle costs, or it is not a reasonable investment. The same cannot necessarily be said about potable water supplies, although there are limits to reasonable investments, at which point relocation of consumers becomes a viable alternative.

In addition to the information collect at the pumping site that related to economic and reliability issues, it is necessary to compile a base of cost and policy information on which a complete financial and economic evaluation can be made. This information falls into three areas -- equipment, labor costs, transportation costs.

First, it is important to collect all information pertaining to the cost of pumping equipment (including shipping and taxes), all piping, rods, cylinders, cement, etc., required for system installation. Included in this should be the current exchange rate in the country of interest.

Second, labor costs should be quantified. Government rates for supervisory, skilled and unskilled labor should be included. Private sector labor rates should also be included, as they may vary significantly from government pay scales and may have a significant impact on the economics of public versus private sector installations.

The third area, transportation costs, is difficult to quantify when wear and tear on vehicles is included (as it should be). Some reasonable values for transportation costs are necessary, as they can play a significant role, particularly in the recurrent costs of system operation. In many cases,

government economists have set rates for the cost per kilometer (or mile) of various types of vehicles over various types of roads. Where available, these should be recorded.

Standard economic assumptions, such as discount rate and the commercial interest rate, should be determined from government economists or commercial bankers.

TABLE 1

Recurrent Cost by Year for Each System*

Year	1	2	3	4	5
Diesel #1					
Pump System	0	0	0	0	0
Annual O+M	1389	1389	1389	1389	1389
Non. Ann. Main.	0	0	0	0	0
Annual Total	1389	1389	5610	1389	1389
Diesel #2					
Pump System	$0	$0	$0	$0	$0
Annual O+M	$1389	$1431	$1474	$1518	$1563
Non. Ann. Main.	$0	$0	$4229	$0	$0
Annual Total	$1389	$1431	$5685	$1518	$1563
Diesel #3					
Pump System	$0	$0	$0	$0	$0
Annual O+M	$1389	$1431	$1474	$1518	$1563
Non. Ann. Main.	$0	$0	$4221	$0	$12,000
Annual Total	$1389	$1431	$5695	$1518	$13,563

* Recurrent costs are calculated for 10 years of life of equipment.

TABLE 2

Illustrative Example of Financial/Economic Analysis for Water Pumps

Value of Water $\$/m^3$ = \$0.30

System/Site	Dies.#1	Dies.#2	Dies.#3
Water (m^3/day) :	67	67	67
Total Head (m) :	80	80	80
Vol$Head Prod. :	5360	5360	5360
Amortiz. Period :	10	10	10
Discount Rate :	12	12	12
COSTS			
Capital Cost :	12,000	12,000	12,000
Installation M :	1,000	1,000	1,000
Installation L :	1,000	1,000	1,000
PV Recurr. Cost :	16,279	12,661	26,545
Life Cyc. Cost :	30,279	26,661	40,545
BENEFITS			
Annual Volume :	24455	24455	24455
Value of Water :	7337	7337	7337
PV of Benefits :	46,491	46,491	46,491
Ben/Cost Ratio :	1.54	1.74	1.15
Inst. Cost/LCC :	.46	.53	.35

Cost & Inst. m+
Inst L - LLC
LCC - PV -
Annual Vol
Water Performed
Ann LCC ($\$/m^3$):
Ann LCC ($\$/m^4$):

3.0 DATA COLLECTION

3.1. Objectives

Two performance tests* to generate data for the financial/economic performance analysis are described in this Section. The first is a short-term intensive test that is conducted over several days. Its objectives are to determine the pumping systems' overall efficiency and thereby determine whether the system is correctly sized for the output required; to determine how closely the system is operating to its performance specifications; to provide indication of component or operational shortcomings that may be improved or corrected. This test covers the entire system, from the energy/fuel input to the point of water discharge and, as such, determines the overall performance of the water delivery system.

The second is a long-term test that is performed over a minimum period of one year and indicates how well a system performs at a particular site (accounting for all events). Energy input and water output are recorded at a site logbook by the user, and the test provides information to determine unit water costs.

3.2. Short-Term Testing

For the short-term test, energy output is determined by measuring water volume and static head for a 10-minute period. From the measurement of water volume over a period of ten minutes the average flow rate can be calculated to give the hydraulic output of energy per unit time:

hydraulic energy output per unit time (watts)= water mass flow rate x g x static head

where g is the gravitational constant (9.81 m/s^2). This output of power (energy per unit time) will be less than the driver-pump system develops due to delivery losses.

The energy input is determined, for diesel/gasoline/kerosene pumping systems by the fuel consumption per unit time (where the heating value per unit time is converted into watts). The ratio of energy output per unit time to energy input per unit time will determine the systems efficiency.

The short-term test procedure, measurements, instruments, and reporting formats will be discussed in detail in Appendix A.

3.3. Long-Term Testing

Long-term testing is essentially an extension of the short-term test and its goal is to generate information for standardized financial/economic analysis. Since this requires that factors such as O&M be recorded as well as

* These tests do not disrupt the pumping for irrigation process.

other factors affecting the analysis -- a site logbook should be kept. This logbook must contain all the information relevant to long-term pumping system performance. Each time a site is visited an appropriate entry should be made (fuel delivery, repair, adjustment, labor, etc.). The dates and times for system failure and shut-down information should also be recorded. Finally, readings should be taken from all the instruments at each visit. Subsequently, the information in the logbook should be reduced to provide the following:

(a) percentage availability of the pumping system over the irrigation season;
(b) cost of labor, transportation, and materials required for operation and maintenance;
(c) cost of labor, transportation, and material for repairs;
(d) a detailed description of system failures and the reasons, if known;
(e) other cost information (capital, installation, etc.).

This information will permit a firm accounting of the long-term recurrent costs associated with operation of the system and will enable the determination of water unit cost in ($/m^{3}xm).

The financial/economic analysis is discussed briefly in Section 2.0 and elsewhere in this Project Paper. Appendix B outlines the site logbook.

4.0 TRAINING

1.0 Introduction

The training required for the water pumping evaluation under this Project has obvious applications beyond the scope of the Project itself. By increasing the number of people trained (which can be done, probabably at marginal costs), a significant contribution can be made to better determination of pumped water costs in various projects and areas of Honduras.

Not only can additional technicians, farmers, etc., be trained, the training component can reach any agricultural extension and/or government agencies related to irrigation. Furthermore, the projects training component will offer the opportunity to participate in appropriate courses to technical representatives of the major importers of diesel and pumps. This will in the long run, improve the services that the manufacturer's representatives can offer to the purchaser/installers of pumping systems. The training program should also solicit contributions of equipment suitable for training from the key importers of equipment and have it installed in the participating training centers.

1.1. Training Requirements

The following training activities are required:

A. Training of engineers to perform short-term intensive testing/evaluation of pumping systems.

This course should cover the following topics:

a. Basic notions of irrigation, water requirements, etc.
b. Review of some simple relevant concepts of hydraulics
c. Survey of pump operation principles and pump types
d. Basic notions of diesel engine operation and coupling to loads (pumps)
e. Principle of operation of the relevant measuring devices/instruments needed in the methodology -- this should include hands on experience of using these instruments, data taking, calibration, etc.
f. Short exposure to errors, error analysis and data reduction
g. Thorough exposure to the water pumping evaluation methodologies, its objectives, assumptions, application, etc., including the long-range testing, logbook keeping data reduction, obtaining results and interpretation of results
h. Basic notions of the associated economic issues with training in life cost cycle computations leading to the determination of unit water costs.

A training course covering the above outline should be stressing hands-on experience and not be an academic-theory oriented course. It will require a training center with appropriate facilities simulating the whole pumping system from the water source to the water distribution point. The course should also include appropriate field trips to familiarize the participants to existing pumping systems with exposure to good and poor systems.

It is estimated that the duration of such a course will be 8-12 weeks.

B. Training of technicians, selective farmers, and operators in the long-term testing to support the water pumping evaluation methodology.

This course should cover the following topics:

a. Simple but comprehensive introudction of the methodology, its principles, objectives, procedure and importance
b. Principles of site operation, management, and record taking
c. Site logbook usage with emphasis on the importance to keep accurate data and the reasons for it
d. Hands-on experience with data taking and loging
e. Observations as the basis to detect malfunctioning and operational problems.

C. The Project will keep the option open of considering ad-hoc courses, as need may arise, to train farmers, operators and technicians in Operation and Maintenance (O&M) of water pumping systems.

It is estimated that the duration of such a course should not exceed 4 weeks and should be implemented in the same training center(s) as the training of part A. However, relatively more on-site training time should be considered for these shorter courses.

This will require one or two participating sites for the training.

4.2. Training Audience and Facilities

The most appropriate trainees for short-term testing training (part A) are graduating engineers prior to their "national duty" assignment in rural areas. Obviously other, more experienced engineers, should not be excluded when appropriate.

The Project management will consider the most appropriate training center(s) and contact appropriate GOH institutions and equipment importers for an early coordination of the necessary activities.

4.3. Implementation

Detailed development of the courses, training material, and the development of the methodology (as outlined in this chapter) into a workable entity could be achieved through the International Institute for Education (IIE) with the help of other appropriate short-term technical assistance. IIE is under contract with the Agency to do all the energy related training world-wide, is primarily funded by Mission buy-ins, and is managed by A.I.D.'s Office of Energy (S&T/EY). Other options should also be considered.

Throughout the training implementation, the Project will make sure that local training capabilities will be developed and institutional support activities will be undertaken to ensure a viable local training capability beyond the life of the Project.

5.0 ORIGIN OF THE WATER PUMPING METHODOLOGY AND ITS FUTURE RELATIONSHIP WITH THE PROJECT

There is a wide recognition of the need for a common basis for assessing water-pumping systems. USAID took the initiative to call for a meeting to discuss a methodology for field testing, and the preparation/distribution of a handbook which would provide a common set of guidelines for conducting comparative analyses of their technical and economic performance.

The USAID initiative resulted in a workshop in West Sussex, England, during January 27-28, 1986 which was held to discuss a common methodology. Water pumping experts from Britain, Canada, FAO, Germany, the Netherland, France and Italy attended as observers.

The intent of the meeting was to reach concensus as to what the methodology should encompass and how the major issues should be addressed in the final document. In practical terms, the workshop was organized to give guidance to smaller work groups which are presently preparing sections of the guide based on the meeting's discussion. These sections will be integrated into a final draft, by the end of 1986, and circulated for review among the workshop participants, and then finally, distributed as an informal joint (participating) donor publication for use in field tests over the next 2-3 years when another meeting will be conviened to evaluate the applicability, success, and experience associated with the methodology.

It is presently planned to present the guideline handbook at an all Africa meetings of ADO's and water pumping experts scheduled for the week of March 23, 1987 in Africa.

Since this Project might be the third* A.I.D. projects to apply the common methodology, it is expected that AID/W as well as other donors will be very interested in sharing experience with the Project in support of a successful application. This will allow the Project to draw, if needed, on a wider range of technical assistance to implement the methodology and its training component.

At the same time, an active interest of the Project in world-wide implication of this common approach to the evaluation of water-pumping system is a major contribution to the Agency's water pumping and irrigation activities.

---

* It is presently applied in Botswana and being introduced in Somalia.

6.0 Other issues to be examined by Project

As the project developes during implementation other issues, related to energy constraints, water availability, economic impact, pricing, and others should be analyzed and documented. Some of these issues are described below:

(1) Using existing water resources data, estimate the accessibility of water to fill the needs estimated by the project paper. Estimate what portion of this water needs pumping and distribution. Based on current costs-estimate the future costs of irrigation.

(2) Assess the availability of electric power, diesel power, and other energy forms (through the grid, decentralized systems, and rural power development). What are viable alternatives to supply power for specific water pumping/irrigation projects in specific locations. How are the power needs related to current and projected availability of power? Consider energy expansion plans and rural electirification plans of A.I.D. and other donors.

(3) Assess fuel availability (and storage & distribution) issues. What are the problems associated with the alternative supply modes considered in (2)? What are cost estimates to remove existing and/or future barriers.

(4) Ascertain what resources can be leveraged and/or directed towards projects involving the improvement or expansion of irrigated land. Consider government resources, other donors, lending institutions, public sector, and private sector.

(5) Estimate the economic impact of expanded irrigation. analyze market conditions for the increase of agricultural produce as a measure for evaluating the economic feasibility of providing power for irrigation. Are there export and foreign earning issues involved?

(6) Assess the effects of agricultural pricing policies towards other key inputs to agriculture production (including energy), the cost of equipment O&M and infrastructure support, access to markets, access to capital, and agricultural practices on the economic feasibility of pumping.

(7) Identify other (than agricultural) policies influencing the choice of pumping/distribution equipment such as import duties, taxes, infrastructural support, availability of financing, cost subsidies for equipment/fuel, government standardized procurement policies.

(8) If significant pumping systems/facilities are required for the expansion of irrigated land-assess the management and operational issues and estimate the role and cost of associated training activities.

(9) Provide an overview on the economics of any existing public and/or private sector water pumping activities.

(10) Assess the competition for power between water pumping for irrigation needs and other rural development needs such as agroprocessing, cottage industries, and community development.

Appendix A SHORT TERM TESTING

This material is based on a draft prepared by ARD and I.T. Power and is still undergoing revisions. The final form will be available prior to the ADO and water pumping experts meeting in Africa during the week of March 23, 1987.

A.1. Diesel/Gasoline/Kerosene Pumping Sytems

Rigorous testing of an internal combustion engine is quite complex and costly. Since there are many types and configurations of pumping systems -- all of which demand different variations in instrumentation. Thus a simplified methodology is essential. It must be limited to a relative simple procedure that does not require the use of complicated and expensive measuring devices. A more sophisticated procedure is technically feasible, but it would probably cost more than any savings that might result from its use. Therefore, the recommended procedure does not permit a detailed technical fault analysis to be carried out, but any significant performance shortcomings should be clearly detected and above all it allows for an agreed upon simplified economic analysis.

A.2. Measurements, Instruments, and Calibration

This section discusses the basic measurements that need to be made, specifies the types of instruments that should be used to achieve acceptable levels of accuracy as given in Table A.1, and discusses the calibration procedures.

Table A.1

Summary of Parameters to be Measured and Accuracy Required

Parameter (units)	Short-Term Test	Long-Term Test	Instrument	Precision Required	Calibration Interval
Volume of water (m^3) in:					
. 10 Min. period	X		see Table A.2	±5%	each test
. daily		X		±5%	3 months
Static Head (m)	X	X	well dipper	±1%	each test
Fuel Consumption					
. 10 min. period	X		fuel flowmeter		
. daily		X			
Time (min. & sec.)	X	X	Stopwatch		
Speed of Rotation (RPM)	X	X	Tachometer		

The following measurements are required:

A.2.1. Water Volume

Fluid flow rate should be measured to an accuracy of ±2 percent. It is recommended that the flow meter be calibrated before each short-term test and at intervals of three months during the long-term test. Calibration can be undertaken with the flow meter in place by diverting the water flow to a vessel and measuring the volume delivered for a specific time period -- the standard bucket and stopwatch method. A container of sufficient volume to hold the water delivered during a 10-minute period is necessary.

Six parameters influence the choice of flow meter. First is the type of flow meter. Under a pulsed flow, as in the case of positive-displacement pumps (wind, hand and animal-traction), a positive-displacement type of flow meter is the best option, although it is susceptible to dirt and thus, may require a filter, depending on the quality of the water. Under these conditions, a turbine-type flow meter is least accurate, but it has the lowest head loss. Since diesel pumps have high constant flow rates, the usual choice is a turbine flow meter. However, under certain circumstances, such as measuring the output of a low-lift ladder pump into a channel, a V-notch weir may have to be used. The operating principles for weirs are available in any standard engineering reference.

Second, the flow range needs to match the flow range of the pump being tested to achieve sufficient accuracy.

Third, for the 10-minute short-term test on pumps of typical size, a resolution of 0.1 percent of the rated daily flow is preferable.

Fourth, an accuracy over the flow range of ±2 percent is desirable. It should be noted that V-notch weirs will only give 10 to 15 percent accuracy.

Fifth, head loss must be as low as possible, preferably less than two percent of the total head, particularly for pumps without stuffing boxes. filters may need to be used where the water is contaminated.

Sixth, the cost is typically from $100 to $400.

Table 4.3 summarizes the properties of the main types of flow meters and the technologies for which they are appropriate. It is essential that the flow meter is fitted so that the flow meter pipe always runs full of water. Flow meters should be installed in a straight run of pipe with a length of at least 10 pipe-diameters on either side.

A.2.2. Fuel Flow

Fuel flow meters need to be accurate at low flow rates (down to 1.0 liters per hour for standard diesels and as low as 0.3 liters per hour for small gasoline motors) with a resolution of one cubic centimeter. Calibration should be carried out by collecting fuel in a calibrated container and comparing the amount to the meter reading. Fuel flow meters that can measure such low flows are difficult to find and can be quite expensive. The main problem is that the pressure drop across such a small, yet accurate, flow meter can be great enough to impede the flow of fuel and chock the engine.

An alternative to using a flow meter is a separate calibrated fuel container attached to the injector inlet. The container has two marks, one that is 100 milliliters above the other, for instance. After the engine is warmed up, the separate fuel container is filled to a pre-marked upper level. The water flow meter reading and RPM are recorded (see elsewhere). Then the engine is run until the fuel level reaches the lower pre-marked level, and the water flow meter reading and RPM are again noted. The engine should be run at a steady RPM during this test so that the load is constant. This procedure is normally replicable to within five percent.

A.2.3. Time

A simple stopwatch is entirely adequate for this purpose.

A.2.4. Static Head

Static head is often difficult to measure where boreholes are deep and enclosed. For open boreholes/wells, a well dipper can be used with ease. A small pipe should be installed in the borehole, if possible, so that the dipper wire will have easy access to the borehole. Alternatively, the water level can be measured by inserting an air pipe into the borehole and a pressure gauge attached to it.

A.2.5. RPM

Engine speed is to be measured by a standard tachometer. It is necessary to know the operational RPM so that the percentage de-rating from the rated full local condition can be determined.

A.3. Procedure

- Calibrate all instruments

- Install the fuel meter between the filter and injection pump on a diesel engine or at the carburetor inlet on a gasoline engine. On diesel engines, disconnect the return from the injectors adn collect the unburned returned fuel in a calibrated container -- often this amount is negligible, but it can be up to five percent of total fuel consumption. Install the water flow meter in a straight run of pipe at the outlet of the pump. Allow at leat 10 pipe-diameters on either side of the flow meter.

- For pumps with electrical transmission, connect the energy meter to the generator output.

- Run the system until it has warmed up fully (at least 30 minutes) and shows steady operating conditions (constant spped, head and water output).

- The test should be carried out over a period of several hours to obtain at least 20 data points. Results should be recorded on the format sheets shown in Tables A.3 and A.4.

- Record meter readings at 10-minute intervals. Engine speed should be recorded from the tachometer. On diesel engines, the fuel returned (if any) should be subtracted from the fuel meter reading. Make sure that the manufacturer's rated conditions for the engine are recorded.

Table A.2

Properties of the Main Types of Flow Meters

Type	Head Loss At 2.7 ls/sec	Particle Resistance	Typical Use
in-line turbine	good, 0.2 m	good	diesel; dirty water for others
Pelton wheel	poor, 2.5 m	medium	
positive displacement	poor, 3 m	poor	wind, animal, hand; clear water
paddle wheel	negligible	good	solar, diesel

Table A.3

Form for Recording Short-Term Diesel/Gasoline Pump Performance

Diesel engine make and rating:

Pump make and rating:

Meter Reading	Meter Reading	Pressure Gauge Reading	Static Head

Table A.4

Form for Presenting Short-Term Diesel/Gasoline Pump Performance

Diesel engine make and rating:

Pump make and rating:

Hydraulic Power (watts)	Power Output (watts)	Fuel Power	Engine/ Generator Efficiency	Motor/ Pump Efficiency	System Efficiency

A.4. Data Analysis

The data should be analyzed and recorded on the format sheets shown in Table A.3 and A.4. The measured values are divided by the time period (10 minutes) and converted into standard units for convenience. For each 10-minute test point, calculate:

- average fuel consumption rate (ls/sec = $q_2-q_1)/600$
- average water flow rate (ls/sec) = $(q_2-q_1)/0.6$
- average static head (meters) = $0.5\ (h_{s1} + h_{s2})$,

where q is the mater flow meter reading in cubic meters, q is the fuel flow meter reading in liters, and h_s is the static head in meters. The subscripts 1 and 2 refer to the readings before and after the 10-minute period, respectively.

Now, calculate hydraulic power using the equation:

hydraulic power (W)L = water flow rate x static head x g,
where g is the gravitational constant (9.81 m/s^2). The power in the fuel is then equal to:

fuel power (W) = fuel flow rae (ls/sec) x c x 3.6 X 10^6,
where c is the calorific value of the fuel at 10.5 kWh per liter for diesel and 8.9 kWh per liter for petrol.

Calculate overall system efficiency as follows:

n_s = (hydraulic power)/(fuel power)

Then, determine average efficiencies for at least twenty 10-minute test points. The overall efficiency of a diesel pumping system is a strong function of the load (measured as a function of RPM) on the engine. When opeating at a rated power, a small (less than 10 kilowatts) direct-drive diesel pumping system should achieve an overall efficiency of 15 to 20 percent. If the measurements indicate that the efficiencies are not in these ranges or do not meet the manufacturer's specifications, either the system is improperly sized for the load, the components are not properly matched (diesel and pump), or the system needs maintenance and/or repair.

Appendix B SITE LOGBOOK

The site logbook is the basis for long-term O&M cost data collection. There are four sections in the logbook and they are spread over two pages. These are to be used for each week of the irrigation season (or water pumping "season") at the end of which a summary sheet is to be used for cost data analysis.

The four parts are:

A. Recurrent cost data, completed each day, or by each event such as whenever a part is replaced or a fuel delivery is received;
B. Water use data from flow meter reading -- time measurement completed each day or whenever irrigation is applied or storage tanks filled;
C. Pump performance data as described in Section _____.
D. Reliability and maintenance report covering a description of failures, routine maintenance, and any other relevant events.

Tables B.1 and B.2 show the format for the logbook. Cost data can be summarized as shown in Table B.3.

These tables are based on the work done by ARD and I.T. Power. While these are undergoing reviews -- no changes in substance are expected. The substance and the relative simple approach have been endorsed by a multi-donor meeting early in 1986.

Table B-2

Format for Site Logbook
(front sheet)

Date:
Site Name and Manager/Operator:

Day:	1	2	3	4	5	6	7

A. Recurrent Costs
Expenditures:
. maintenance
. salaries
. fuel
. other
Revenues:
. water sales
. other

B. Water Use Data
. area irrigated
. diurnal distribution
. crop(s)
. application method
. other

C. Pump Performance Data

See Appendix A for data

Format for Site Logbook
(Reverse Sheet)

D. Reliability and Maintenance Report

- Description of failures; shut down time; repair time; parts replaced, costs, date:
- Labor required; transportation; per diem; skil' levels requied (local or regional or others that are called in):
- Percent of _____ or availability:
- Routine maintenance; time to perform, parts used; costs; date; skill levels:
- Reliability of fuel supply; availability of spare parts; availability of maintenance/repair personnel; extra charges.

Table B.3

Summary Sheet for Cost Data Analysis

Site and Manager/Operator:

Month:	J	F	M	A	M	J	J	O	S	O	N	D

Capital Costs
Break down by components

Installation Costs
. engineering
. labor (skilled/unskilled)
. transportation
. other

Maintenance Costs
. labor (for special skills)
. spare parts
. other

Fuel Costs
. cost
. source
. transportation mode

Operating Costs
Include salary and other benefits