IRRIGATION PROJECTS DOCUMENT REVIEW

APPENDIX A:
THE INDIAN SUBCONTINENT

WATER MANAGEMENT SYNTHESIS PROJECT
WMS REPORT 1

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WMS Report 1

INTRODUCTION

Members of the staff of the USAID-sponsored Water Management Synthesis Project have written this project document review to serve as a resource paper indicating general directions of irrigation project investments in developing countries.

The bulk of the documents obtained were written preliminary to project execution and therefore did not attempt to evaluate either an ongoing or a completed project. It is thus clear that these papers do not purport to represent the projects' actual attainments and shortcomings. For this reason, the reviewers have not attempted to critically assess the merits of executed projects on the basis of this documentation, but rather, have summarized information contained in these documents to arrive at descriptions of individual projects as perceived during the planning stage.

Taking collectively, these summaries afford an overview of methods and strategies used by USAID and IBRD (World Bank) in facing the problems of irrigation development.

METHODOLOGY

Each of the following summaries is divided loosely into three sections. The first section is an outline giving the project's location, approximate area, expected cost and brief entries on the goals of the project and how these goals are to be achieved. Following this outline are more detailed descriptions of selected aspects of the projects. These descriptions come under the headings "Technical," "Environmental," "Social," "Institutional" and "Economic," headings which generally correspond with those used to organize World Bank appraisal reports.

USAID project papers are less standardized in format with the result that individual project papers may not specifically address certain topics, while having extensive coverage of others. Also, aspects which may sensibly be viewed as one type of factor by the authors of some project papers may legitimately be classified under another heading by other authors. These judgments are reflected in the summaries.

Environmental aspects are not consistently addressed in either USAID or IBRD papers, although in general, the later the document, the more attention is paid to environmental questions. The institutional emphasis in the documents of both organizations pertains mainly to the official channels designated for the construction and operation of projects without casting much light on how water is to be managed by the farmers themselves or on the level of rapport anticipated between irrigators and project personnel.

The third section of the summaries is composed of tables usually including an implementation schedule, a cost breakdown and estimates of present and future productivity within the project area. USAID project summaries also include a copy of the project logical framework, whenever this was available.

ACKNOWLEDGMENTS

The permission of FAO and the World Bank (IBRD) to perform this project and their assistance in bringing it to completion are gratefully acknowledged.

Recognition of this cooperation, however, in no way implies the support or endorsement of these bodies for this study.

EXPLANATION OF SYMBOLS

The documents included in this review are organized first by country, then grouped within each country by donor organization, and finally assigned a number within each group. Thus, for example, B-W-1 stands for Bangladesh-World Bank-1.

The full project title may be found in the index of projects. The number in parenthesis after the key word is an indication of the frequency of use of the word or words.

Donor Code

A	USAID
F	FAO
W	World Bank

INDEX OF PROJECTS SUMMARIZED IN APPENDIX A:

THE INDIAN SUBCONTINENT

INDEX APPENDIX A (Continued)

Sri Lanka

TITLE: Central Helmand Drainage (Phase II)

PROJECT NO.: 306-0149

COUNTRY: Afghanistan

KEYWORDS: Open drains (5); drainage research (5)

SUMMARY: (1) the capabilities of the Helmand Arghandab Valley Authority (HAVA) will be expanded; (2) 130 km^2 of land will be adequately drained; (3) farmers' understanding of and participation in the drainage effort will be broadened to include leaching of salts on their land and maintenance of farm drains running through their land; (4) planning for a possible Phase III will be advanced, including the updating of the Master Drainage Plan, development of a Construction Plan, completion of soils maps and a soils handbook; and (5) the establishment of an effective equipment maintenance and supply program for construction equipment.

LOCATION: Central Helmand Valley CLIMATE: BS

CROPS: Wheat, cotton SOILS:

TARGET GROUP: Small farmers (2-6 ha) resettled in the Helmand Valley.

BEGIN: 1977 END: 1980 AREA: 13,000 ha

NUMBER OF FARMS: 2,580

CONTRIBUTION:

	Phase I	Phase II
USAID	$ 985 K	$17,336 K
GOA	282 K	2,400 K
Total	$ 1,267 K	$19,736 K

GOALS: To bring about increases in agricultural productivity, income, and employment of small-scale farmers and farm laborers throughout the project area.

PURPOSE: To reduce the salinity and waterlogging throughout 13,500 ha of farmland.

TYPE OF PROJECT: This is one phase of a long-term reclamation project.

TECHNOLOGY USED: Mostly hand labor for drain construction.

DOCUMENTS REVIEWED: Project Paper (80 p) for Phase I and Project Assistance Paper (240 p) for Phase II.

PROJECT ORIGIN AND BASELINE DATA: The project is a continuation of Phase I of the Helmand Project.

BENEFICIARY INVOLVEMENT: Low

ACTUAL STARTING DATE: N/A COMPLETION DATE: N/A

LOGICAL FRAMEWORK: Consists of 10 pages, attached to reviewed documents.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

U.S. assistance for irrigation in the Helmand Valley has existed over many years, and development for this drainage project is a continuation of this support. Phase I (Project No. 306-0146) will be described briefly in this report, and Phase II will be described in detail.

The very limited Phase I ($1.801 M) was designed as a laboratory in which to establish a working relationship between the U.S. and GOA prior to proceeding with a Phase II proposal for the requested longer-term effort. Where Phase I has fallen short is in terms of physical accomplishments. Original construction targets called for completion of 70 kms of farm drains and 50 kms of main drains by September 1976. At the time of the evaluation, 4.1 km of farm drains and 8.6 km of main drains had been completed. As of this writing (November 1976), 15 km of farm and 19 km of main drains are complete. Phase I also developed a base of solid farm economic data to assist in planning and measuring the impact of drainage in the project areas.

Phase III, if undertaken, would concentrate on improved irrigation practices, better water allocation and water use charges, and improvements to the irrigation system.

TECHNICAL

Drainage. The system will involve on-farm drains and main drains to conduct the water back to the Helmand River. Both open and tile drains were considered for use on this project and it was decided to use primarily open drains for both farm and main drains. The seepage from existing canals and drains will be controlled by the use of parallel interceptor drains which will prevent the seepage water from entering the cultivated areas. This procedure will be a quicker and less costly means of seepage control than canal lining. In some areas, the seepage waters from the interceptor canals will be mixed with other irrigation water to provide additional flows while also reducing the flow in existing drainage channels. In total, 130 km^2 of land will be drained, with the completion of 1,260 km of farm drains and 278 km of main drains.

The existing methods of irrigation which result in over-irrigation and resultant inefficient use of water and overloading of the drainage system will be the subject of a farmer information and education program. The farms with newly-built farm drain systems will be used as demonstration plots for the introduction of methods of efficient water use.

Leaching Program. In order to reduce the soil salinity levels that are presently a constraint to agriculture, a program of controlled application of leaching water over a period of six to 24

months will be developed. The success of this program will depend on developing the farmer information and education program mentioned above.

Land Smoothing. Where drains are provided to lands with small hummocks and irregularities there must be some smoothing work done. This work will be done by machine to assist the farmers in getting the land under cultivation. A total of 2,430 ha of land will be smoothed.

Irrigation Structures. Some modifications of irrigation supply structures will be necessary in certain areas. This is due to differences in farmers' property sizes and shapes and the variation in drain spacings as determined by the soil characteristics.

Technical Standards. During Phase I, detailed design criteria have been drafted, field tested and put into use. Other than some minor customizing from contract to contract, these documents are adequate for use in Phase II.

Land lost in drains will average an estimated six to 10 percent of total land.

A detailed construction plan is given in Annex D, and an Equipment Plan is given in Annex E.

INSTITUTIONAL

The Ministry of Water and Power will be the responsible agency for the project. Implementation of the project will be the responsibility of the Helmand Arghandab Valley Authority (HAVA) servicing as the project Directorate and the Afghan contractor, the Helmand Construction Company (HCC). U.S. assistance will be confined to advice, review, training, the development grant financing of construction on the basis of 75 percent reimbursement of actual costs, and the capital grant financing of new construction equipment.

One-hundred-and-four engineers, planners and technicians will receive training. This is detailed in Annex F.

SOCIAL

Farm labor will increase from 130K man-days to 250K man-days per year in the project area.

The area has been used for resettlement over the last 20 years. In the period 1974-1976, 4,976 families were settled in the Helmand Valley.

ECONOMIC

Phase I inputs from USAID are given on page 18 (attached) of the Phase I Project Paper, and the Phase II Financial Plan is given on Page 74 (attached) of the Phase II PAP.

Net farm income will increase from a 1975 base of $350 annually to $490 by 1981 and to $940 by 1983.

When foreign exchange is shadow-priced, the IRR for the project is 37%.

HAVA collects a negligible $0.20 per year per acre for water. HAVA could increase its revenues and provide better services if it made a more realistic charge, although there would be resistance to charging for water in this Moslem country. A joint U.S./Afghan study team will attempt to define a desirable experimental program in this area.

USAID Phase I Inputs
($ US 000)

Component	Fiscal Year 75	76	76 IQ	Total
Personnel:				
Direct-hire Project Manager	$ 4 (1 mm)	$ 48 (12 mm)	$ 12 (3 mm)	$ 64 (16 mm)
PASA Group:				
Drainage Design Engr. (2)	$ 20	$ 112 (24 mm)	$ 26 (6 mm)	$ 158 (15 mm)
Design Engr. (Short Term)		$ 24 (6 mm)		$ 24 (6 mm)
Trainer for Soil and Water Data Collection (S-T)		$ 16 (4 mm)		$ 16 (4 mm)
Soils Lab Tech (S-T)		$ 36 (9 mm)		$ 36 (9 mm)
PASA Subtotal	$ 20	$ 188	$ 26	$ 234
Contract (Personnel Service);				
Master Mechanic	$ 65 (7/75 through 9/76)			$ 65
Warehouseman	$ 65 (7/75 through 9/76)			$ 65
3rd Ctry Engineer for Construction Monitor		$ 35		$ 35
Contracts Subtotal	$ 130	$ 35		$ 165
Personnel Subtotal	$ 154	$ 271	$ 38	$ 463
Commodities: spare parts, shop tools and equipment	$ 250			$ 250
Other Costs:				
Fixed cost reimbursement for farm drains @ 70 percent of the total		$ 154		$ 154
Fixed cost reimbursement for major drains @ 70 percent of the total	$ 118			$ 118
Other Costs Subtotal	$ 118	$ 154		$ 272
TOTALS	$ 522	$ 425	$ 38	$ 985

C. PROJECT FINANCIAL IMPLEMENTATION PLAN

Title: Central Helmand Drainage (Phase II)

Project No.: 306-51-120-149

	PROJECTED EXPENDITURES ($000)							
	Prior Years' Actual Expenditures	FISCAL YEAR 1977 1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	FY 1978	FY 1979	All Future Years	Total All Years
Project Specific Inputs:									
1. Technicians					293	976	887	842	2,998
2. Participant Training						110	151	207	468
3. Capital Commodities:									
Equipment							6,335		6,335
Supplies						3	332		335
4. Actual Cost Reimbursement (75%)						1,145	1,750	4,305	7,200
Total PFIP					293	2,234	9,455	5,354	17,336

TITLE: Development of Winter Crops in the Northwest of Bangladesh Through Improved Water Use

PROJECT NO.: FAO/UNDP BGD/73/042/8/01/12

COUNTRY: Bangladesh

REGION: Northwest

KEYWORDS: Water management (5); irrigated cropping systems (5); tubewell utilization (3); basin irrigation (3).

SUMMARY: The project was designed to assist the GOB in its development for increasing the utilization of presently developed groundwater irrigation facilities in the northwest region, principally through the introduction of irrigated wheat in the dry season. The immediate objectives of the project were oriented to three broad sectors: strengthening of applied research; training; and institution building. Overall, the project made considerable progress in achieving its objectives although the degree of success varied in each sector - the applied research being the most successful.

LOCATION: Bogra and Rangpur

CLIMATE: Monsoon, SE Asian.

CROPS: Wheat, rice.

SOILS: Sandy loam and clay loam.

TARGET GROUP: Small farmers (average landholding 1/2 acre).

BEGIN: September 1976 END: March 1980

AREA: 200 ac (pilot); 400,000 ac (all)

NO. OF FARMS: 400 (pilot) 800,000 (all)

CONTRIBUTION: UNDB - $ 931 K
GOB - 1,910 K (in kind - nil in cash).

GOALS: To increase overall crop production and nutritional self sufficiency at the village level in northwest Bangladesh.

PURPOSE: To develop and demonstrate methods for the introduction of acceptable irrigated cropping systems and water distribution systems which maximize the utilization of the available irrigation facilities.

TYPE OF PROJECT: Applied research and demonstration.

TECHNOLOGY USED: Traditional irrigation methods and water conveyance systems.

DOCUMENTS REVIEWED: Project Contract (15 p); Evaluation Mission Report, June 1979 (34 p); Final Report - Water Management Aspects of Deep Tubewell Development by C. W. Houghton, August 1979 (28 p); and Irrigation in Bangladesh by Edwards, Biggs and Griffith, Development Studies Discussion Paper No. 22, February 1978, University of East Anglia, Northwich NR4 TTJ England (58 p).

PROJECT ORIGIN AND BASE LINE DATA: Since there are a large number (7,000) of deep well and other pumps in the area, it was assumed that these were functioning well; the idea was to develop and demonstrate cropping programs to make better use of the irrigation water during the winter season.

BENEFICIARY INVOLVEMENT: Farmer demonstration systems.

ACTUAL STARTING DATE: In schedule.

COMPLETION DATE: In schedule.

PERT CHART: Follows orderly process of locating sites, studying region, selecting strategy of cropping program and setting up demonstration. The project was allowed to generate its own speed of development.

PROJECT DESCRIPTION

The Winter Crops Project was designed to assist the GOB in its development program for increasing the utilization of presently developed groundwater irrigation facilities in the northwest region, principally through the introduction of irrigated wheat in the dry season. As mentioned earlier, the immediate objectives of the project were oriented to three broad sectors: strengthening of applied research, training and institute building.

In order to carry out the strengthening of the applied research portion of the program, the project was deliberately restricted to two trial areas not exceeding 20 acres each and two pilot areas of 100 acres each where a deep tubewell or shallow tubewell and hand tube well are already commissioned. The trial farms included areas which had the two major soil types of the region, namely, clay loam which was suitable for rice and other crops, and sandy loam, which is not as suitable for irrigated rice, but well suited for other cereals, legumes, vegetables and tobacco.

The trial farms were used to carry out experimentation on types of crops, cropping systems and intensities to evaluate correct crop husbandry procedures. This agronomic work was carried out in conjunction with experimentation on water management and application so that an overall irrigated cropping procedure could be assembled. The assembled procedures were then applied to pilot areas which were operated by existing farmers. The idea was that care would be taken in the selection of the pilot areas in order that the project would start out dealing with farmers most likely to respond to the objectives of the project. The project relied on existing institutions to provide the essential logistic support. The placement of the project in the production areas was to create opportunities for in-field training of government staff in the related disciplines. Because of the shortages of qualified individuals, the training aspects of the project, and also the institutional building aspects of the project, were somewhat limited.

It was assumed that, with an area having over 700 deep and shallow tubewells, the irrigation facilities were in place and that the main need was to demonstrate ways to use the water during the winter season. The original concept of the project was that these tubewells were being adequately utilized, and thus little attention was paid to the on-farm irrigation works. During the implementation of the project it was found that this was not true. Much work needed to be done on the two pilot farms (which comprised approximately 100 acres, each served by a deep tubewell) in order to deliver the water adequately to the farmers so they could benefit from the new irrigation practices. It is important to note that the winter wheat irrigation program required reliable and accurate applications of water for its success. Thus, it became obvious that the hit and miss type of irrigation available was not adequate and work needed to be done in order to improve the water delivery systems under the tubewells.

The demonstration that a winter wheat cropping program was viable is probably the most successful aspect of the project. Farmers actually were picking up on the practices quicker than the project was ready to deliver them. What was noted, however, is the fact that only 25 to 50 percent of the potential command areas of the 3,000 recently installed deep tubewells is presently being irrigated. The reasons for this low level of utilization are varied, and include complex social, economic and technical constraints. Nevertheless, it is clearly evident that the water course improvement and water management play a key role in extending the command area, as well as increasing crop yields. The GOB therefore requested the assistance of UNDP/FAO in the implementation of an applied research/training project to demonstrate methods for increasing yields from winter crops through improved water management and cropping patterns. Under a pilot scheme, the GOB proposed to sink 30 new tubewells utilizing both deep and shallow wells. In addition, this new program will assist in developing and constructing the water distribution system on 100 existing wells where they are now being under-utilized due to various constraints.

The important thing here is the fact that the winter wheat program was successful. In addition to developing winter wheat irrigated cropping packages, it also resulted in the development of better water distribution systems under the two tubewells which were used in the pilot phase of the project. This pointed out the need and also gave some of the base data, for the recommended new project mentioned above.

TECHNICAL

Since no government agency has the responsibility for developing the water distribution system, the farmers are often left to themselves to resolve the building of the canal system. Such an approach has been partially responsible for the low level of tubewell utilization since proper channel constructions involve some expertise and planning in order to maximize the command area. While this technical part of watercourse improvement is fundamental, the social component is equally or more difficult to solve.

The project, in conjunction with the research group, BARI and through two trial areas and two pilot areas, has developed tentative recommendations on the needed organizational material and manpower requirements, training and financial inputs for implementation of command area improvement, especially with watercourse improvement for introduction of winter wheat cropping. Particular findings include watercourse construction techniques and the need to obtain equitable distribution of water among farmers. The latter aspect was approached by the project by grouping the farmers' plots into small subplots of three to 10 acres each and providing this grouping with a set rotation for water delivery and equal representation on

the irrigation committee. This avoided many of the organizational problems inherent with the large numbers of farmers, and also lent itself to a more manageable cropping pattern for water use.

As a result of the project, the Mission findings are:

1. Through the trial areas, considerable experience has been gained in the techniques for the design and construction of the water distribution channels. This experience needs to be properly documented to ensure its utilization in follow-up activities.

2. The techniques tried on the pilot and trial areas can only be considered as tentative recommendations and need to be tested on a wider basis to determine their application to large scale development activities. In addition, follow-up activities must also consider alternate methods of water conveyance, including closed pipe systems. For each of the systems, a performance and economic evaluation must be carried out in relation to the proposed cropping system.

3. It has been recommended that a technical writer be employed to prepare illustrated practical field manuals and brochures to demonstrate the practices developed as a result of the project.

The report by Houghton points out the magnitude of the problem of dealing with 4,200 deep tubewells in the northwest of Bangladesh. For example, he points out the following:

1. If 4,200 deep tubewells were pumping for 18 hours per day consuming .75 gallons of diesel per hour, then 56,700 gallons of diesel fuel would be required at the tubewell sites per day. The monthly requirement would be 1,700,000 gallons. This would probably severely strain the existing transport system in the area even if no other pumps were in operation.

2. Meetings would be another problem. In the proposed new project, if 100 tubewells were to be serviced, then only about two meetings per tubewell would be possible in one year. This is based on the fact that there are only about 200 meeting days per year. In addition, it is interesting to note that there are some 200 landowners per the tubewell's command area. Thus, 20,000 people would need to be contacted just to handle the 100 tubewell pilot program.

3. Approximately 7,000 linear feet of channel may be required per tubewell with an average of about 16 cubic feet of earth filled per linear foot. For 100 tubewells, the quantity of earthwork required is 11,000,000 cubic feet. Houghton goes on to describe some other items, but the main point is the fact

that the magnitude of dealing with even 100 tubewells is quite staggering. If only 100 tubewells were improved each year, it would take 42 years to improve the total of 4,200 deep tubewells.

INSTITUTIONAL

Except for the co-manager's support in the project, the absence of counterparts in most disciplines has been a major constraint in the project now having a core of trained subject matter specialists after two years of operation. However, the project has been flexible in this regard by providing assistance through direct hire when critical project objectives would otherwise not have been met. Two nutrition assistants were hired who have been trained by the nutrition expert, and are now capable of carrying on an action program with only periodic supervision. The major drawback to such an arrangement is that these trainees are presently not government staff and will be lost unless hired by the government on termination of the project.

The counterpart problem will not easily be solved. The remote location and often, lack of schools and medical facilities in the tubewell development area, will for some time be a constraint to obtaining adequate numbers of qualified counterparts.

Coordination with responsible agencies becomes a complex task for the project since no lead agency carried responsibility for watercourse and command area improvement. Consequently, the project and research station staff spent considerable time acting as a focal point to accomplish the task at hand. Fundamentally, the government agencies are organized to provide the needed inputs to enable the farmer to utilize a tubewell. However, it is well recognized that most of the agency programs are widely dispersed, and thus cannot concentrate specifically on tubewell command area improvement. As a result, watercourse improvement from the well head to the farmers' plot has traditionally been left to the farmers themselves, thus resulting in a low level of utilization.

The coordination task has been time-consuming for the project and research staff and has lowered their effectiveness. In spite of this constraint, however, it must be said that the project has made notable achievements in agency awareness just by its physical presence in the northwest. The research substation at Bogra and the pilot area at Rainagar have become focal points for agencies involved in command area improvement, and the techniques are being extended. The work in the pilot area has also spurred adjacent farmers into taking their own initiatives, since progress in watercourse improvement and water-cropping systems has been made by the project in spite of social and technical constraints.

With the government's desire to push forward with its command area improvement program, the Mission recommends that UNDP/FAO

activities be concentrated on staff development training. This program must be supported simultaneously be a strong applied research and demonstration program to act not only as a training aid, but take the role of a testing center for new ideas.

The project has had limited success in transferring the watercourse improvement techniques since counterparts have not been available. The Missions feel that any follow-up activities in watercourse improvement should only be started when adequate counterparts are assigned to the project. The existing situation of the expert acting as a technician accomplished a specific task. However, the project must now place emphasis on transferring this experience rather than continuing to implement improvements.

SOCIAL

In spite of the constraints that the project has faced, notable achievements in nutrition and nutrition education have been made. These have contributed directly to the nutritional upgrading of the pilot area villages.

It was found that there were rather difficult social problems associated with water delivery under the tubewell command areas. It seemed that the larger farmers tended to get more than their share of the water and that many or most of the small farmers had no benefits from the existing tubewell. This, coupled with poor maintenance of the pumping facilities and lack of adequate distribution systems, resulted in only a small proportion of the tubewell areas receiving water. It has been estimated that the existing 4,200 tubewells are only irrigating about 25 percent as much land as could be irrigated.

FINANCIAL/ECONOMIC

The project costs are rather modest, being in the neighborhood of $3,000,000. It seems that much was accomplished by the project and the development of the extended project which will deal with many more demonstration areas is now under way. It is estimated that the new project dealing with some 100 tubewell rehabil · :ions will involve approximately one and one half million dollars o. UNDP contribution, and an estimated Bangladesh government contribution of approximately 2.7 million dollars. From a review of the projects, this appears to be money well-spent. This is particularly evident in view of the fact that there are some 4,200 deep tubewells now in existence in the area, and that these tubewells potentially should be irrigating approximately 100 acres each instead of an average of approximately 25 acres each. In addition, the total groundwater potential in the northwest region of the country is said to be in the neighborhood of 2.5 million acres of irrigated land.

TITLE: Agricultural Research

PROJECT NO.: 388-0003

KEYWORDS: Agricultural research (5); non-rice crops (3)

SUMMARY: The Bangladesh Development Assistance Program recommends that U.S. Assistance support agricultural research as a component of improving the productivity of Bangladesh's land resource base. The development model outlined in DAP is firmly based upon the new seeds technology and shifting of the biological production function.

LOCATION: Joydevpur, Ishurdi

CLIMATE: Aw

CROPS: Vegetables, oilseed, pulses, wheat

SOILS: Soil types found throughout Bangladesh.

TARGET GROUP: Farmers and the rural landless.

BEGIN: FY 1975 END: FY 1979

CONTRIBUTION:

USAID grant	US$	2.6M
USAID loan		4.0M
GOB		8.0M
Total	US$	14.6M

GOALS: This project aims at year-round cropping of non-rice crops through full utilization of land where rice farming is not possible. National targets are:

500K ac of fallow land under cultivation
700K ac of HYV wheat introduced
500K ac of vegetables under cultivation
100K ac of improved oilseed under cultivation
200K ac under pulses and legumes.

PURPOSE: The purpose of the project is to establish a functioning BDG-supported and staffed agricultural system for non-rice food crops and cropping systems.

TYPE OF PROJECT: Development of an Agricultural Research Institute

DOCUMENTS REVIEWED: Project proposal (61 pages)

PROJECT ORIGIN AND BASE LINE DATA: The report of the Hesser team (1974) stated that agricultural research for crops other than rice and jute should receive much more than the minimal attention which they are now accorded.

LOGICAL FRAMEWORK: Consists of 3 pages attached to reviewed documents.

GENERAL DESCRIPTION

By the end of the project, the Agricultural Research Institute is expected to have research results utilizable by farmers of Bangladesh and released to the agricultural extension service. Specific targets are four varieties of wheat, two varieties of oilseeds, one improved pulse variety and three released varieties of vegetables.

TECHNICAL

Irrigation is to be one of the crop inputs examined at these experiment stations, however, no description of how water is to be managed at the stations was given.

ENVIRONMENTAL

The impact of the physical facility will be positive. Construction of the administrative and laboratory complex has been started by the BDG and the buildings are now about 80% complete structurally. Site development, landscaping, roads and walks in this area will improve rather than adversely affect the environmental quality of the area. The construction of the new residential units with improved water supply, sanitation and electrical service will offer advantages to ARI personnel.

Development of the farm area also started with land layout, leveling and drainage underway. No forest land will be destroyed since the site is entirely on old paddy fields. Land leveling and improvement in water supply for irrigation and drainage will create a positive impact on the site. The site is on flat gradient land and there will be no detrimental effect from erosion by water. Improved drainage will minimize the danger of flooding during monsoon season. There is no requirement for removal and resettlement of farmers, since the site is on land already owned by the BDG.

Fifty percent of the total project funds will be utilized for technical assistance, equipment and manpower training which will not relate to any physical environment impact.

The impact on the environment stimulated from the adaptive and applied research will be positive. Results of all research conducted are to increase production and intensify land usage. New crop varieties and associated cultural practices must be determined for varied local conditions whether the technique is locally developed or adaptive research on introduced methods is the source of the new technology.

When agronomic research has identified adaptive new varieties which are fertilizer responsive, this will allow extension to know

optimal rates of fertilizer application. Efficient use of fertilizer will, in fact, contribute to minimized use of chemicals in the soil and water. Adaptive research, combined with appropriate technologies, will increase the effective use of available organic compounds for plant nutrition. Genetic improvement through breeding will develop insect and disease resistant varieties thus limiting the use of chemical pesticides.

The project will provide for funds to the Agricultural Research Council for contract research. By strengthening the ARC, all research projects will be carefully designed and evaluated. Research funds can be utilized from ARC through different research institutes for studying the environmental impact of all the research and the results of the research.

SOCIAL

A crucial question in agricultural development is what happens to employment in the agricultural sector and to the agricultural laborers' income as a result of technological innovations. More research on this matter has been conducted in India, but we believe the findings there are suitable proxies for what might occur in Bangladesh. That is, the HYV technology increases the amount of labor required per crop. For example, local rice varieties are cultivated with about 50-60 days of labor per acre while improved rice varieties require 100-110 man-days. Improved wheat requires 70 man-days of labor per acre, improved mung beans require 70 man-days of labor and so on. Agricultural research which identifies varieties or cropping practices which facilitate double or triple-cropping directly contribute to the generation of employment. Planting 2,000,000 ac in new wheat varieties during the boro season will generate a similar number of additional jobs that season.

INSTITUTIONAL

The Agricultural Research Institute is in the process of an internal reorganization to rationalize a multiplicity of divisions based on scientific disciplines into more rational groupings. In addition, the Government of Bangladesh is considering giving ARI autonomous status. Because of these transitions, which were taking place at the time the project paper was being written, it is difficult to predict the present shape of the Institute's management.

ECONOMIC

No significant information given.

TITLE: Small Scale Irrigation I

PROJECT NO.: 388-0019

COUNTRY: Bangladesh

REGION: Asia

KEYWORDS: Pumps (5); credit (5); surface irrigation (3).

SUMMARY: The project will make available 40K irrigation hand pumps per year for sale to farmers. This will be done by providing pumps to the BDG for purchase of pump-manufacturing raw materials; by providing a credit program with minimal stipulations for loans; and by a program for advertising the availability of credit and pumps.

LOCATION: Wherever technically feasible CLIMATE: BWh

CROPS: Rice, wheat. SOILS: Alluvial

TARGET GROUP: Small farmers (one acre or less).

BEGIN: FY 1976 END: FY 1980 AREA: 240K ha NO. OF FARMS: 240K

CONTRIBUTION:

US	$ 14 M loan
BDG	7.6 M
UNICEF	1.04M
TOTAL	$ 22.64M

GOAL: To achieve self-sufficiency in food grain production in Bangladesh by 1980.

PURPOSE: To provide farmers with private ownership of small-scale irrigation equipment.

TYPE OF PROJECT: Large-scale credit for the supply of irrigation equipment.

TECHNOLOGY USED: Hand pumps.

DOCUMENTS REVIEWED: Project paper (100 p).

PROJECT ORIGIN AND BASE LINE DATA: The project is based on the perception that farmers are eager to buy pumps, but do not always have sufficient capital. UNICEF has been conducting a similar program.

BENEFICIARY INVOLVEMENT: Farmers will buy the pumps at cost and operate them.

LOGICAL FRAMEWORK: Consists of 1 page attached to reviewed documents
PERT CHART: Attached to review document.

TECHNICAL

The project will finance the distribution of 240K hand pumps for dry season irrigation to farmers owning one-third to one acre of land, at a cost to the farmer of $70/pump and $3.45 for installation. There is presently a large demand for such pumps, and 135K/year are manufactured at present by local industry.

Assuming a 120-day season, one-third acre of land will require 640 hours of pumping, 5.3 hours per day. The food energy produced will be 20 times the human energy for pumping.

A program of radio advertisements will be prepared to inform the farmer of the program.

INSTITUTIONAL

The Bangladesh Krishi Bank (BKB) will need to add 210-300 loan officers at a cost of $50-75K/year. Also, $1M/year will be needed for credit operations.

In areas where the Integrated Rural Development Program (IRDP) is administering the credit, the farmer must be a village cooperative member to receive credit. Any farmer will be able to buy a pump with cash and, in the future, credit may be extended to non-cooperative members.

SOCIAL

The use of irrigation hand pumps has been widespread and will continue. This project only accelerates the process.

No attempt will be made to organize farmers since pumps will be owned and used individually. Indeed, it is felt that avoidance of organizations will facilitate the process.

The estimated total potential market for pumps is 1.63M farmers, owning one-third to two acres apiece. Larger landowners will probably not be interested in this technology.

The main advertisement for the program will be the farmer who successfully uses a pump. His neighbors will soon follow his example.

ECONOMIC

The annual budget summary is given on pages 26 and 27 (attached). A financial analysis from the farmer's viewpoint was made and, even

with rice prices at an extremely low level, the farmer owning one-third acre or more would show a profit after three years. In general, a small farmer will show a net annual profit of about $70 after the third year.

It is expected that there will be a 13% interest rate on loans, and a 29% default rate, although the latter may improve with the addition of more loan officers. Therefore, the BDG is consciously subsidizing the distribution of these pumps.

The BKB will require $1M/year to maintain credit operations. In the first year, the IRDB will borrow $1.38M worth of pumps from UNICEF, to be repaid in local currency, and in the remaining years, it will borrow about $1M/year from the Bangladesh Bank. The interest and default rates will be the same for the IRDP.

The BDG will absorb all local costs of constructing the 120K additional pumps for which AID is providing raw materials.

Assuming (conservatively) a five-year life for the pumps, the B/C for the project is 2.2 at 15%, and the IRR is 85%.

Terms for farmer loans are: no down payment; repayment in three equal installments after each dry season harvest; 13% interest; and pledging of the farmer's land as collateral.

For each $70 credit pump sale, AID will disburse $113-$43 for raw materials and $70 as credit to the farmer. Cash sales will be estimated and $43 paid for each cash sale.

Farmers' annual costs are given on page B.6.1 (attached).

Annual Budget Summary--Pages 26 and 27

PROJECTED DISBURSEMENTS BY PROJECT COMPONENTS AND SOURCE OF FUNDS - FX AND LC

	FY 77	FY 78	FY 79	FY 80	TOTAL
TOTAL	6.38	6.83	5.74	3.69	22.64
FX	3.51	2.65	2.65	2.63	11.44
LC	2.87	4.18	3.09	1.06	11.20
AID	3.80	3.79	3.78	2.63	14.00
FX	2.65	2.65	2.65	2.63	10.58
LC	1.15	1.14	1.13	-	3.42
BDG	1.54	3.04	1.96	1.06	7.60
FX	-	-	-	-	-
LC	1.54	3.04	1.96	1.06	7.60
UNICEF	1.04	-	-	-	1.04
FX	0.86	-	-	-	0.86
LC	0.18	-	-	-	0.18
CREDIT	1.54	1.97	0.89	-	4.40
FX	-	-	-	-	-
LC	1.54	1.97	0.89	-	4.40
AID	-	-	-	-	-
FX	-	-	-	-	-
LC	-	-	-	-	-
BDG	1.54	1.97	0.89	-	4.40
FX	-	-	-	-	-
LC	1.54	1.97	0.89	-	4.40
UNICEF	-	-	-	-	-
FX	-	-	-	-	-
LC	-	-	-	-	-

Annual Budget Summary--Pages 26 and 27 (Continued)

	FY 77	FY 78	FY 79	FY 80	TOTAL
PROMOTION	0.04	0.03	0.03	-	0.10
FX	-	-	-	-	-
LC	0.04	0.03	0.03	-	0.10
AID	0.04	0.03	0.03	-	0.10
FX	-	-	-	-	-
LC	0.04	0.03	0.03	-	0.10
BDG	-	-	-	-	-
FX	-	-	-	-	-
LC	-	-	-	-	-
UNICEF	-	-	-	-	-
FX	-	-	-	-	-
LC	-	-	-	-	-
PUMPS	4.80	4.83	4.82	3.69	18.14
FX	3.51	2.65	2.65	2.63	11.44
LC	1.29	2.18	2.17	1.06	6.70
AID	3.76	3.76	3.75	2.63	13.90
FX	2.65	2.65	2.65	2.63	10.58
LC	1.11	1.11	1.10	-	3.32
BDG	-	1.06	1.07	1.06	3.20
FX	-	-	-	-	-
LC	-	1.07	1.07	1.06	3.20
UNICEF	1.04	-	-	-	1.04
FX	0.86	-	-	-	0.86
LC	0.18	-	-	-	0.18

I. Analysis of Farmer's Return over Five Years For Using a Hand Pump to Irrigate HYV Boro Rice; One, Two and Three Bigha Farms.

ANNEX B.6

First Year Price of Rice: Tk 120 per maund.[1]

Assumptions:

1. The pump is purchased on credit. Its cost is Tk 1,000. Ten percent down, repayment in three installments (after boro harvests); interest rate 20%.

2. All costs and prices increase 10% per year.

3. Except as noted, all labor will be family labor, requiring no cash outlay.

4. Yield will be nine maunds per bigha (one ton per acre) of rice (paddy with husks removed).[2]

5. The pump will last at least five years.

YEAR 1	1 BIGHA	2 BIGHAS	3 BIGHAS
A. Costs			
1. Down Payment for Pump	Tk 100	Tk 100	Tk 100
2. Installation Cost	50	50	50
3. Seed	40	80	120
4. Fertilizer	115	230	345
5. Pesticide	20	40	60
6. Transplanting[3]	9	18	27
7. Plowing[3]	30	60	90
8. Harvesting[3]	9	18	27
9. Threshing/winnowing[3]	15	30	45
10. Husking[3] (Tk 10/md.)	90	180	270
11. One-third Principal (Tk 1,000 less Tk 100 down payment)	300	300	300
12. 20% interest, half year	90	90	90
13. TOTAL	Tk 868	Tk 1,196	Tk 1,524

[1]This is the price which the Government announced on November 3 it will pay for Aman Rice under the "Aman Rice and Paddy Purchase and Price Support Policy for 1975-76". The yield and rice figures for rice rather than for paddy (unhusked rice) are used because they are comparable to the yield and price of wheat. This project is not aimed at rice production, but at the addition of any income-producing

YEAR 1	1 BIGHA	2 BIGHAS	3 BIGHAS
B. Gross Return			
1. Nine mds rice/bigha @ Tk120	Tk 1,080	Tk 2,160	Tk 3,240
2. Nine mds straw/bigha @ Tk 1	9	18	27
3. TOTAL	Tk 1,089	Tk 2,178	Tk 3,267
C. Net Return (B less A)	Tk 221	Tk 982	Tk 1.743

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food crop. Other crops, e.g., vegetables are likely to generate higher income.

[2]The figures in this analysis are based on the assumption that all production is additive, i.e., that no winter crop was grown before the pump was obtained. Some farmers may, in fact, have been growing small plots of crops requiring little water, e.g., chilies, thereby reducing the increment attributable to the pump. We assume, however, that this reduction is insignificant.

[3]It is assumed that extra help must be hired to complete these items.

TITLE: Muhuri Irrigation Project

REPORT: B-W-1

COUNTRY: Bangladesh

REGION: Asia

KEYWORDS: Flood control (5); drainage (5).

SUMMARY: The proposed project would provide irrigation, improved flood control and drainage, and improved agricultural supporting services to farmers in a net area of about 67,000 ac. The project would enable a major increase in crop yields through the construction of facilities to create favorable conditions for growing HYV rice.

LOCATION: Around the confluence of the Muhuri and Feni Rivers in southeast Bangladesh.

CLIMATE: Aw

CROPS: Paddy, wheat, pulses, jute.

SOIL: Deep older alluvium, mostly silt and clay.

TARGET GROUP: The irrigating farmer.

BEGIN: 1976 END: 1983 AREA: 67K ac

NUMBER OF FARMS: 45,000

CONTRIBUTION:			
	IDA	US$ 21	M
	Canada	9	M
	GOB	22.4	M
	TOTAL	US$ 52.4	M

PURPOSE: The primary national benefit from the project would be increased rice production and the resultant foreign exchange savings. The population of the project would benefit directly from increased farm incomes and an increase in employment opportunities in agriculture, transportation and marketing. The project would also discourage migration to the already overcrowded urban areas of Dacca and Chittagong.

TYPE OF PROJECT: Large-scale irrigation and drainage project

TECHNOLOGY USED: Heavy machinery and labor used in major project works such as the coastal embankment; minor works will be labor-intensive.

DOCUMENTS REVIEWED: Staff Appraisal Report.

PROJECT ORIGIN AND BASE LINE DATA: Report based on the findings of the 1974 Appraisal Mission and has been revised to reflect the developments since the appraisal.

BENEFICIARY INVOLVEMENT: The Government aims to recover O&M costs and costs for the replacement of low-lift pumps from the beneficiaries.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

Irrigation facilities provided by the project would expand the boro rice area from the present 15,000 ac to about 50,000 ac. In the wet season, project works would reduce flooding and allow supplementary irrigation. This would permit a shift from local varieties to HYVs on 10,000 ac. By preventing overland seawater intrusion, 3,000 ac of presently marginal and largely uncropped land would be brought to high productivity. About 1,100 units of five to seven horsepower diesel-powered low-lift pumps, each serving an average of 45 ac, would irrigate the area from an extensive network of natural and project-improved channels. A reservoir formed by a coastal earthfill embankment, a dam across the Feni River Channel and a gated regulator structure would provide a permanent source of fresh water. The rivers would be free of tidal fluctuations and the attendant salinity. Channel excavation would make water available and small-vessel navigation possible throughout the area. The regulator would also improve flood drainage by protecting waterways from tidal surges. This would allow discharge from the project area when tidal levels in the Sandwip Channel drop below reservoir level. In addition to pumps and civil works, the project would provide supporting facilities and equipment, including operation and maintenance facilities.

TECHNICAL

The main components of the project are as follows:

1. Coastal earthfill embankments and a dam across the Feni River Channel, totaling 6.5 miles in length;

2. A reinforced-concrete regulator structure equipped with radial gates and flap gates;

3. One major and 30 minor drainage structures equipped with flap gates, and the improvement of an existing drainage outlet;

4. Improvement of 110 miles of natural khals and the excavation of six miles of new khals;

5. Improvement of nine miles of existing roads and the construction of nine miles of new roads for access to the main project works;

6. About 1,100 diesel-powered, two cusec low-lift pumps to raise water from the khals to adjacent farm lands.

Irrigation facilities provided by the project would expand the boro rice area from the present 15,000 ac to about 50,000 ac. In

the wet season, project works would reduce flooding and allow supplementary irrigation resulting in a shift from local varieties to HYVs on 10,000 ac. By excluding overland seawater intrusion, 3,000 ac presently marginal and largely uncropped, would be brought to high productivity. About 1,000 low-lift pumps, powered by five to seven horsepower diesel engines[1], each serving an average area of 45 ac, would irrigate the area from an extensive network of natural and project-improved khals. These khals, along with the principal rivers, would serve both reservoir (storage) and canal (conveyance) functions with a minimum of water losses. Low-lift pumping has already been adopted on a large scale in areas of Bangladesh where the rivers and khals carry fresh water throughout the dry season. The reservoir formed by the regulator would provide a permanent source of fresh water, the level of which would fluctuate only gradually within a range of four feet. The rivers would be free of tidal fluctuations and the resulting salinity problem. Khal excavation would make water available and small-vessel navigation possible throughout the area. The regulator would also improve flood drainage by freeing waterways from tidal surges. This would allow discharge from the project area when tidal levels in the Sandwip Channel drop below reservoir level. The regulator would be designed to withstand cyclones. However, full seaward protection of the embankment against cyclones and tidal waves is not economically justifiable, and, in the economic and financial analyses, suitable provisions have been made to cover possible rehabilitation needs for these works.

ENVIRONMENTAL

The overall environmental effects of the project are expected to be beneficial. Public health would improve because of the increased availability of fresh water on a year-round basis. Schistosomiasis is not present in Bangladesh. In remaining salt-blighted land along the coast, the project will enhance environmental conditions. Existing fisheries in the area are small and the project would have little adverse effect on them. Major carp, the most important species, can generally be expected to stay in the area even during floodwater discharge through the proposed regulator. The reservoir would have the potential to become an important area for fish production if the planned pilot fish culture facilities on the Halda River are developed and fingerlings of major carp become available. Investigations of the fish habitat in the Muhuri River, including the potential effects of the proposed project and the prospects for future development, are being financed under the Karnafuli Irrigation Project.

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[1]Most of the 330 units currently in the project area will become due for replacement during the project implementation period.

ORGANIZATION AND MANAGEMENT

The Water Development Board (WDB) under the Ministry of Flood Control, Water Resources and Power (MFWP) would have overall responsibility for management and execution of the project works. The WEB would be directly responsible for project preparation, design and construction of all civil works. Responsibility for procurement and distribution of low-lift pumps would rest with BADC (the Bangladesh Agricultural Development Corporation). The IRDP (Integrated Rural Development Program) would be responsible for the formation of farmers' pump groups and their integration into the Thana Central Cooperatives Association (TCCA) structure. The Ministry of Agriculture would be responsible for strengthening extension services to the farmers.

In order to ensure coordination between the various departments and agencies responsible for project implementation, a Project Implementation Committee (PIC) has been established. The PIC is to be chaired by the Project Director and consists of senior officers of the participating agencies and district administration officers. The Project Director would be a senior WDB official. Problems not resolved at this level would be referred to the Central Evaluation Committee (CEC). The CEC was formed for the Barisal Project by a government order, dated December 13, 1974, to periodically review progress and problems on IDA-financed water development projects and would function also for this project. The members of the committee are the secretaries of the various ministries concerned with project implementation and the Chief, Flood Control and Water Resources Division, Planning Commission. Joint Secretary, MFWP, is secretary of the committee. The project director has already been appointed, the members of the PIC designated, and the project has been included in the CEC's portfolio.

As noted above, the PIC/CEC management concept was introduced on the Barisal Project. It was also designated by MFWO to be adopted on the Chandpur and Karnafuli Projects. However, experience-to-date on these projects has shown that, while the concept is viable and has resulted in some improvements in interagency cooperation, the dominant role of WDB, with overall managerial and financial control, has greatly restricted the anticipated benefits of this system of interagency coordination. WDB management is still very construction-oriented with little regard for the key agricultural inputs essential for irrigation development. Staff assigned for other agencies to work with WDB on these projects still believe their prime responsibility is to their own organization and the required project cooperation has not developed. IDA is currently reviewing with DOB the role of WDB in irrigation project development and the problem of poor coordination among the various agencies. GOB, from its own studies, is fully aware of the shortcomings of WDB and it is expected that alternative organizational arrangements for multi-sectoral projects, will be developed. Both IDA and GOB

have agreed that, as and when new arrangements are formulated, IDA would examine the same and would be prepared to consider amending the Credit Agreement to facilitate the introduction of revised organizational arrangements.

SOCIAL

With the project, the net farm income in the project area would typically increase by 30 to 40%. The demand for hired labor would also increase substantially and thereby create additional employment opportunities for landless laborers and submarginal farmers. Although the overall income distribution will remain largely unchanged, the project will substantially reduce the level of absolute poverty in the area and should discourage the migration from this area to Dacca and Chittagong.

ECONOMIC

The project's rate of return is estimated to be about 16%, however, several admittedly risky assumptions were made in arriving at this figure. The proposed regulator structure is large in relation to similar works undertaken in Bangladesh and local contractor capacity for executing large civil works is limited. Attached to this summary are a schedule of project expenditures, the project economic analysis, a summary of cost and benefit streams.

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MUHURI IRRIGATION PROJECT

Schedule of Expenditures

Item	Total Cost	Fiscal Year 1977/78	1978/79	1979/80	1980/81	1981/82
		(Tk Million)				
(a) Land Acquisition						
Base Cost	7.5	3.0	3.0	1.5	-	-
Physical Contingency	1.1	0.4	0.5	0.2	-	-
Price Contingency	1.1	0.2	0.5	0.4	-	-
Subtotal	9.7	3.6	4.0	2.1	-	-
(b) Regulator & Related Works						
Access Roads	13.5	13.5	-	-	-	-
Regulator Channel Excavation	69.5	10.4	20.8	20.8	17.5	-
Regulator & Gates	228.0	53.5	58.0	53.0	53.0	10.5
Transmission Line	4.0	-	1.0	2.0	1.0	-
Base Cost	315.0	77.4	79.8	75.8	71.5	10.5
Physical Contingency	35.9	9.0	9.1	8.7	8.1	1.0
Price Contingency	74.3	5.3	13.3	21.7	28.6	5.4
Subtotal	425.2	91.7	102.2	108.2	16.9	
(c) Cross Dam & Wing Embankments						
Stripping Top Soil	6.3	-	0.1	0.1	0.1	-
Embankment Construction & Compaction	7.0	-	1.4	2.1	2.1	1.4
Dam Construction & Compaction	40.0	-	6.0	14.0	14.0	6.0
Slope Protection & Turfing	23.0	-	3.5	8.0	8.0	3.5
River Diversion	11.4	-	-	-	-	11.4
Base Cost	81.7	-	11.0	24.2	24.2	22.3
Physical Contingency	12.3	-	1.7	3.6	3.6	3.4
Price Contingency	31.3	-	2.0	7.2	10.0	12.1
Subtotal	125.3	-	14.7	35.0	37.8	37.8
(d) Channel Improvements						
Base Cost	26.0	-	1.3	7.8	9.1	7.8
Physical Contingency	3.9	-	0.2	1.2	1.3	1.2
Price Contingency	10.4	-	0.2	2.3	3.7	4.2
Subtotal	40.3	-	1.7	11.3	14.1	13.2

Item	Total Cost	Fiscal Year 1977/78	1978/79	1979/80	1980/81	1981/82
		(Tk Million)				
(f) Drainage Structures						
Base Cost	9.5	-	1.9	3.0	3.0	1.6
Physical Contingency	1.4	-	0.3	0.4	0.5	0.2
Price Contingency	3.3	-	0.3	0.9	1.3	0.8
Subtotal	14.2	-	2.5	4.3	4.8	2.6
(f) Low-Lift Pumps						
Base Cost	33.0	-	-	-	16.5	16.5
Physical Contingency	1.8	-	-	-	0.9	0.9
Price Contingency	11.6	-	-	-	5.0	6.6
Subtotal	46.4	-	-	-	22.4	24.0
(g) O & M Facilities						
Civil Works & Regulator	3.0	-	-	-	-	3.0
Low-Lift Pumps	3.0	-	-	-	1.5	1.5
Base Cost	6.0	-	-	-	1.5	4.5
Physical Contingency	0.9	-	-	-	0.2	0.7
Price Contingency	3.0	-	-	-	0.6	2.4
Subtotal	9.9	-	-	-	2.3	7.6
(h) Vehicles & Agriculture Equipment						
Base Cost	6.0	2.0	0.5	0.5	1.0	2.0
Physical Contingency	0.6	0.2	-	0.1	0.1	0.2
Price Contingency	1.4	0.1	0.1	0.1	0.3	0.8
Subtotal	8.0	2.3	0.6	0.7	1.4	3.0
(I) Consulting Services						
Base Cost	55.0	11.0	13.8	13.7	11.0	5.5
Physical Contingency	5.5	1.1	1.4	1.4	1.1	0.5
Price Contingency	12.1	0.6	2.1	3.3	3.7	2.4
Subtotal	72.6	12.7	17.3	18.4	15.8	8.4
(J) Management & Administration						
Base Cost	23.4	3.4	5.0	5.0	5.0	5.0
Price Contingency	5.0	0.2	0.6	1.0	1.4	1.8
Subtotal	28.4	3.6	5.6	6.0	6.4	6.8
Total Project Cost	780.0	113.9	148.6	184.0	213.2	120.3

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MUHURI IRRIGATION PROJECT

Economic Analysis

Assumptions

The economic analysis is based on the following assumptions:

(a) Prices: The farm gate prices used in the economic analysis are derived from projected 1985 world market prices expressed in early 1977 currency values. Appropriate adjustments have been made for freight, handling and processing. A standard conversion factor of 0.75 is used to reflect the prevailing regime of import taxes and quotas. The price assumptions are discussed in more detail in Annex 10.

(b) Benefits: The direct benefits of the project would be: Increased agricultural production; reduced transport costs through improved navigation possibilities on khals, and increased fish yields. The project would also have substantial secondary employment effects in trade and transport. In this analysis, however, only increased agricultural production due to the project is counted as a project benefit.

(c) Crop Production Costs: Per acre input requirements are shown in Annex 11. Prices for inputs other than farm labor are discussed in Annex 10. Farm labor is evaluated at a seasonally adjusted opportunity cost. The economic cost (in domestic prices) per man-day is estimated at Tk 4.3, which is about 55% of the peak wage rate (for a detailed analysis, see Annex 12). Crop production costs (except irrigation costs) are summarized in Table 2.

(d) Low-Lift Pump Costs: Since about 330 low-lift pumps would be operating in the area even without the project, investment and O&M are based on 770 additional pumps only. It is assumed that the pumps will be replaced every seventh year. The annual O&M cost per pump is shown in Table 3. Out of a total annual cost of Tk 9,000 per pump, about Tk 1,000 would be in taxes and duties (mostly on diesel and spares) and Tk 5,000 in foreign exchange. Deducting taxes and duties and multiplying the local costs with the standard conversion factor, gives an economic O&M cost of Tk 7,250 per pump. For the 770 pumps, the cost would amount to Tk 5.6M (say Tk 6M) per year.

(e) Investment Costs: All investment costs except price contingencies (Tk 153.5M), cost of low-lift pumps (Tk 36.3M) and taxes and duties (Tk 116.8M)[1] are included in the economic analysis. On this basis, the investment costs are estimated at Tk 473.4, of which Tk 200.6M would be in foreign exchange. Using the standard conversion factor of 0.75 for the local costs results in an estimated "economic" cost of Tk 405.2M. The estimated salvage value of the equipment and materials used in the construction of project works, Tk 20M in economic terms, is credited against project cost after project completion. Project facilities are assumed to have a useful life of 40 years. It is assumed that the embankments would require major repairs every 10 years at an estimated economic cost of Tk 5.0M. The regulator gates would be replaced after 20 years at a cost of Tk 40M, and the cross dam would require major repairs at a cost of Tk 35M once during the project life. The replacement/repairs costs are included as investment costs in years 16, 26 and 36 of the project.

(f) Operation and Maintenance: The annual O&M costs for project works and facilities (excluding low-lift pumps) are estimated at Tk 5M, of which 1M would be in foreign exchange. Accordingly, in economic terms, the O&M cost would amount to about Tk 4M per annum. These costs are used as a cost stream against the project benefits.

(g) Development Phasing: Construction would be phased over five years. Some benefits from khal excavations would accrue even before the project is fully complete Although all new low-lift pumps would be delivered by the last year of construction, the formation of pump groups is likely to lag somewhat. Also, it would take a couple of years before the farmers adapt to the new cropping patterns. Consequently, it is assumed that full project benefits would not be achieved for three years after all project construction is completed. On this basis, the overall phasing of the benefits is estimated to be as follows:

Year	0-4	5	6	7	8	9
Net benefits (% of full development benefits)	0	15	60	80	90	100

[1]Taxes and duties in the amount of Tk 30.2M are included in the price contingencies and the cost of low-lift pumps.

Economic Rate of Return

Resulting cost and benefit measures are shown in Table 4. Assuming a 40-year life of the project, the economic rate of return is estimated at 16%.

Sensitivity Analysis

Several tests were made to determine the sensitivity of the rate of return estimates to various alternative assumptions. These reflect the uncertainty in some of the more important factors in the analysis.

		Rate of Return
(a)	Basic Case	16%
(b)	Standard Conversion Factor (SCF)	
	(1) SCF = 1.0	13%
	(2) SCF = 0.6	18%
(c)	Farm labor valued at the peak market wage (Tk 8/man-day)	14%
(d)	Commodity Prices decrease by 15%	13%
(e)	Crop Inputs Prices increase by 15%	15%
(f)	Construction and Replacement Costs increase by 15%	14%
(g)	Fuel and Operating Costs increase by 25%	16%
(h)	Irrigated Area	
	(1) Reduction of the net irrigated area from 50,000 ac to 40,000 ac due to increased water usage upstream of the project area.	13%
	(2) Reduction of the irrigated area per pump from 45 ac to 40 ac.	16%
(i)	Delays	
	(1) Construction completed after seven years instead of five years	14%
	(2) Full agricultural development delayed by two years.	14%

Hence, it may be concluded that the project is moderately sensitive to changes in rice prices, delays, increased upstream water usage and the estimated SCF.

May 1977

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MUHURI IRRIGATION PROJECT

Cost and Benefit Streams

Year	Civil Works			Low-Lift Pumps		Crop Production	
	Construction Cost	Replacement & Repair Cost	O&M Costs	Investment Replacement Costs	O&M Costs	Incremental Gross Benefits	Incremental Crop Production Costs
1	74	0	0	0	0	0	0
2	88	0	0	0	0	0	0
3	101	0	0	0	0	0	0
4	97	0	0	0	0	0	0
5	45	0	0	21	1	22	6
6	(20)	0	4	0	4	88	22
7	0	0	4	0	5	118	30
8	0	0	4	0	6	132	34
9-11	0	0	4	0	6	147	37
12	0	0	4	21	6	147	37
13-15	0	0	4	0	6	147	37
16	0	5	4	0	6	147	37
17-18	0	0	4	0	6	147	37
19	0	0	4	21	6	147	37
20-25	0	0	4	0	6	147	37
26	0	80	4	21	6	147	37
27-32	0	0	4	0	6	147	37
33	0	0	4	21	6	147	37
34-35	0	0	4	0	6	147	37
36	0	5	4	0	6	147	37
37-39	0	0	4	0	6	147	37
40	0	0	4	21	6	147	37
41-45	0	0	4	0	6	147	37

Economic Rate of Return = 16%

TITLE: Bangladesh Shallow Tubewells Project

REPORT NO.: B-W-2

COUNTRY: Bangladesh

REGION: Asia

KEYWORDS: Tubewells (5).

SUMMARY: The proposed project would provide irrigation to about 150,000 ac in the northwest region through the installation of about 10,000 small capacity tubewells. The project would also improve the workshop facilities for maintenance of all irrigation equipment in the northwest region.

LOCATION: Northwest region.

CROPS: Rice, wheat, jute.

SOILS: alluvial soils with the young alluvium of the Tista, Brahmaputra and Ganges flood plains surrounding a block of older material constituting the Barind Tract.

BEGIN: 1977 END: 1981 AREA: 150K ac

NUMBER OF FARMS: 43,000

CONTRIBUTION:

IDA	US$16.0M
Farmers' payments	4.8
Commercial banks	2.5
Farmers' associations	0.2
GOB	1.0
Private sector mechanics	0.9
	US$25.4M

GOALS: To improve the condition of the rural farmer and to benefit the landless laborer.

PURPOSE: The project would assist in reducing Bangladesh's food grain shortages which have been averaging about 1.5M tons per year. At full implementation, the project tubewells would provide irrigation which would increase rice yields by about 40,000 tons and wheat production by about 51,000 tons.

TYPE OF PROJECT: Large-scale irrigation development and improvement of rural institutions.

TECHNOLOGY USED: Equipment, materials and incidentals for the installation of 10,000 hollow tubewells with diesel-powered pumps.

DOCUMENTS REVIEWED: Staff Project Report Appraisal (103 pp), Report and Recommendation of the President of the IDA (46 pp).

PROJECT ORIGIN AND BASE LINE DATA: The feasibility study for the project was prepared by BADC and further preparation was done by IDA missions. The project was appraised in February/March 1976. Negotiations took place in Washington in May 1977.

BENEFICIARY INVOLVEMENT: Except for a part of the indirect O&M costs and possibly the import duties and taxes, all capital and O&M costs for the tubewells would be borne by the users.

GENERAL DESCRIPTION

Tubewells to exploit groundwater offer the best prospects for further expansion of irrigated area in Bangladesh. Conservative estimates based on preliminary investigations indicate that some four million acres could be irrigated by tubewells. Tubewell irrigation, although somewhat costlier than that by LLPs has the advantage that it allows extension of irrigation to many areas where surface water resources have already been exhausted.

TECHNICAL

Design Specifications. The tubewells would be four-inch diameter wells equipped with diesel-powered pump sets. The main criteria in specification of the various tubewell components would be the economy, ruggedness and simplicity of operation. It is expected that the engines would be single cylinder, four-stroke cycle type, developing about six BHP at 1,500 RPM. The engine would have a manual starting system and a forced lubrication system. The pumps would be of centrifugal type with four-inch suction and delivery diameters. The engine and pump would be directly coupled through a flexible flange coupling and would be mounted on a solid base. The wells would have PVC or GI screens and casings, and would average 90 ft in depth.

Siting and Installations. Minimal feasibility criteria for siting of project tubewells would be that:

1. Pre-monsoon water table is expected to be within 15 ft of the surface;

2. Surface clay layers are expected to be less than 20 ft thick;

3. No deep tubewell exists within 2,500 ft of the site; and

4. No shallow tubewell exists within 500 ft of the site.

Installation would be done by local contractors, using locally constructed rigs and locally developed labor-intensive techniques. It is expected that each tubewell would yield about 0.75 cusec from a water table typically 12 to 15 ft below the surface. During installation, particular care would be taken that well depths are kept to the minimum necessary and that the wells are developed properly to exploit their full potential.

Compilation of existing hydrological data and preparation of Thana Irrigation Maps showing feasibility for STW development is underway. Assurances have been obtained from BADC that, in project

thanas where the existing hydrological data are found to be inadequate, it would commission the drilling of test bore holes and other appropriate tests, to determine, before June 30, 1978, the suitability of those thanas for STW development. A lump sum provision of Tk 3.0M has been included under the project for preparing the Thana Irrigation Maps and for undertaking additional investigations where necessary.

ENVIRONMENTAL

The project papers do not contain an environmental assessment.

SOCIAL

No significant information given.

INSTITUTIONAL

Project implementation would principally involve three agencies:

1. BADC, (The Bangladesh Agricultural Development Corporation) for procurement, installation and after sales service of the project-financed STWs. It would also be responsible for strengthening the repair and maintenance services for all irrigation equipment in the northwest;

2. IRDP (The Integrated Rural Development Program), for organizing farmers' cooperatives for credit sales of STWs to groups, and for administering and supervising the credit facilities to the TCCA-KSSs (Cooperative Associations); and

3. CBs (Commercial Banks) (The Sonali and Janata Banks), for providing credit facilities to individual, as well as group buyers. They would have the sole responsibility for administering and supervising the lending to individuals and would help IRDP in this regard for the groups.

In addition, the Ministry of Land Administration, Local Government, Rural Development and Cooperatives (Min LG&RD), would supervise construction/completion of thana workshops, assist in verification of credit records for the borrowers under the project and provide project coordination through the local government administration in the field.

BADC, a semi-autonomous organization, under the Ministry of Agriculture, is the single most important organization in Bangladesh for supply inputs and services to the agricultural sector. It is

responsible for procurement of virtually all agricultural inputs, machinery and equipment and for distribution of seeds (except for jute), fertilizers, diesel and some pesticides. It also manages seed multiplication farms, deploys and maintains low-lift pumps, tractors and power tillers; and sinks and maintains shallow and deep tubewells. The corporation, with some 16,000 employees and a total annual budget in excess of US$100M, is one of the largest organizations in Bangladesh. Most of the BADC's operations so far have been of promotional nature and hence dependent upon heavy subsidies by the Government. In turn, this dependence has meant that, although nominally the corporation enjoys substantial autonomy in its staffing, finances and operating policies, in practice, it has functioned basically like a regular Government department.

For administrative purposes, BADC is organized into four Directorates, each headed by a Director. The Irrigation Directorate, one of the four, is responsible for deployment and maintenance of LLPs, for supervising the installation of DTWs and STWs, and for subsequent maintenance. Three divisions, each headed by a Chief Engineer, are responsible for the LLP, DTW and STW programs of BADC. Each of the three Divisions has a full complement of the field staff generally down to the thana level or sometimes even at sub-thana level. The Directorate employs a total technical staff of about 5,000.

Over the last few years, the activities of BADC have expanded rapidly. For example, during the past decade, the number of LLPs fielded by BADC has increased more than 10 times and the quantity of fertilizer distributed by BADC has more than quadrupled. In addition, BADC has gotten involved in activities for which it is not particularly well-equipped (e.g., agricultural credit through its "hire-purchase" scheme for STWs.) Due to these, as well as the disruptions caused by the civil disturbances during the early 1970s, there has been some deterioration in the management of the various BADC programs. The deterioration has, in turn, affected implementation of two IDA-financed projects - the NW Tubewells Project and the Cereal Seeds Project - for which BADC is the main implementing agencies. Both projects have experienced substantial implementation delays as well as cost overruns. Following intensive supervision and monitoring by IDA and GOB during the past year, both projects are proceeding satisfactorily now. To prevent similar problems to the proposed Shallow Tubewells Project, during appraisal of the project, BADC's existing STWs Program was thoroughly reviewed and institutional changes incorporated as necessary. Also, IDA is currently financing consultants under a technical assistance credit to assist BADC in preparing terms of reference for further studies necessary for improving BADC's management and operations.

IRDP is an agency under the direct administrative control and supervision of the Min. LG&RD, for developing stable, self-reliant

and disciplined cooperatives in rural areas. The IRDP approach is fashioned after the two-tiered cooperative system developed at the Comilla Academy during the 1960s. At the village level, farmers (typically 30 to 100) are encouraged to join together to form Village Agricultural Cooperative Societies (KSSs)[1]. In turn, the KSSs within a thana (100 to 150) are federated into a Thana Central Cooperative Association (TCCA). The TCCAs organize supply of technical services (land use planning, training and extension), farm inputs and machinery, and production-linked supervised credit for the member KSSs. The two-tiered approach enables retaining the village as the natural unit of development while still exploiting economies of scale inherent in organizing and supervising the supply of inputs and services at the thana level. The IRDP, started in 1970, presently covers about 160 thanas and plans are to extend its operations to another 50 thanas during 1977.

The IRDP is headed by a Director-General, who is assisted by five Directors, each looking after one of the five divisions, namely: Administration, Planning and Inspection; Training and Extension; Finance, Accounts and Audit; Cooperatives, Credit and Marketing; and Statistics, Research, Evaluation and Construction. In each District, there is a Project Director assisted by a Deputy Project Director. In each thana, there is a Thana Project Officer, assisted by a Deputy Project Officer and an Accountant. Village Accountants and Inspectors for maintenance and supervision of KSS finances are employed for every six KSS, one Assistant Inspector for every 12 KSS, and one Inspector for every five Assistant Inspectors. The TCCAs and KSSs are largely autonomous organizations, governed by the elected managing committees. Major responsibilities of the IRDP staff are to guide TCCAs in rules and regulations of IRDP, advise them in technical matters, supervise their financial affairs and assist them in bookkeeping and coordination of various programs and services.

Funds for IRDP operations are provided by GOB as grants through annual budgetary appropriations. The accounts are required to be maintained in a manner prescribed by GOB and are subject to audit by the Auditor General of Bangladesh. It is envisaged that, once fully established, TCCAs would cover their operating expenses from commissions and service charges earned in providing various services to the members. For the interim (typically for five years after establishment), TCCAs are being partially supported by annual grants of Tk 100,000 each from IRDP. The TCCA and KSS accounts are kept in a manner prescribed by IRDP and are annually audited by IRDP staff.

---

[1]Krishi Sambaya Samities.

Compared to most other agencies and departments involved in rural development in Bangladesh, IRDP is a relatively strong organization with better than average field staff, a well-conceived work program, and good leadership. IRDP is the main implementing agency for the IDA-financed RD-I project. A substantial amount of technical assistance for improving IRDP's field operations is being provided under that project. Further assistance is likely under future rural development projects proposed for IDA financing.

ECONOMICS

Except for a part of the indirect O&M costs and possibly the import duties and taxes, all capital and O&M costs for the tubewells would be borne by the users. Depending upon the pricing policy for the STWs, the cost recovery on the project, in financial terms, would range from 80-90%. The anticipated economic rate of return of the project is estimated to be about 50%. The high economic returns are essentially a result of two factors - a very low unit investment and the short project gestation period.

Costs and Pricing. A component-wise breakdown of the estimated costs for installing a four-inch diameter tubewell is shown on the following pages.

	Item	Cost in Tks Local	Foreign	Total
(a)	Mechanical Equipment			
	6 hp Diesel Engine	500	4,500	5,000
	4-inch Centrifugal Pump with base and couplings	200	2,200	2,400
(b)	Casing, Screen and Pipework			
	4-inch Pipe (50 ft)	-	1,500	1,500
	4-inch Screen (40 ft)	-	1,600	1,600
	Miscellaneous Fittings Incl. Priming Pump	400	900	1,300
(c)	Installation and Development	2,000	-	2,000
(d)	Physical Contingencies[1]	400	600	1,000
(e)	Taxes and Duties[2]	2,900	-	2,900
(f)	Transport, Handling and Overheads[3]	1,500	300	1,800
	Total Cost per STW	7,900	11,600	19,500
	Cost for 10,000 STWs =	Tk 195.0M		

[1]15% of items (b) and (c).

[2]15% import duties on the foreign cost and 20% sales tax on the landed cost of engine.

[3]10% of other costs.

	P[1]	W (Tk/ac)	W	Increase % Over Present	Increase % Over Future without Project
Cropping Pattern I					
GVP	1,070	1,070	2,260	110	110
Cost of Farm Inputs[2]	740	740	1,570	110	110
Of which Farm Labor	(430)	(430)	(680)	60	60
Animal Labor	(185)	(185)	(190)	5	5
NVP	330	330	690	110	110
Farm Income[3]	765	765	1,330	75	75
Cropping Pattern II					
GVP	1,265	1,460	4,035	220	175
Cost of Farm Inputs[2]	855	920	2,675	215	190
Of which Farm Labor	(590)	(625)	(1,320)	125	110
Animal Labor	(185)	(185)	(335)	80	80
NVP	410	540	1,360	230	150
Farm Income[3]	975	1,135	2,585	165	130
Cropping Pattern III					
GVP[4]	1,670	1.850	3,555	115	80
Cost of Farm Inputs[2]	1,225	1,325	2,380	95	80
Of which Farm Labor	(825)	(895)	(1,280)	55	45
Animal Labor	(260)	(265)	(335)	30	25
NVP	445	625	1,175	165	90
Farm Income[3]	1,235	1,475	2,365	90	60

[1] P = Present, W = Future without Project and W = Future with Project.

[2] Including cost of irrigation (para 7.06).

[3] Farm Income = NVP plus 80% of the cost of farm labor and 50% of the cost of animal labor.

[4] Foodgrain prices discounted by 5% to reflect the food surplus situation in areas with these cropping patterns.

As indicated above, typically, the gross value of production would increase by 100 to 200%, farm labor requirement by 50-100% and the net value of production by 100-200%.

BANGLADESH

SHALLOW TUBEWELLS PROJECT

Estimated Capital and O&M Cost of a 4-inch Dia. Shallow Tubewell

	Item	Cost in Tk
A.	Annualized Capital Costs[1,2]	
	(a) Engine (Tk 7,500)	1,560
	(b) Centrifugal Pump (Tk 3,000)	510
	(c) Tubewell Materials (Tk 6,500)	850
	(d) Installation and Development (Tk 2,500)	330
	Subtotal	3,250
B.	Direct O&M Costs	
	(a) Pay of Operator, annual lump sum	500
	(b) Spare Parts at Tk 500 per annum	500
	(c) Diesel 210 gallons at Tk, 9.50 per gallon[3]	2,000
	(d) Lub. oil 5 gallons at Tk 50 per gallon	250
	Subtotal	3,250
C.	Indirect O&M Costs	
	(a) Salaries and Allowances of BADC Staff[4]	700
	(b) Depreciation of Buildings and Structures[5]	200
	(c) Maintenance of Buildings at 3% of Initial Cost	50
	(d) Depreciation of Workshop Equipment[6]	300
	Subtotal	1,250
	Total O&M Cost (B+C)	4,500
D.	Total Annual Cost (A+B+C) for 700 hrs. Operation	7,750
E.	Total Cost per Hour	11.0
	of which: Capital Cost	(4.6)
	Direct O&M Cost	(4.6)
	Indirect O&M Cost	(1.8)

1 Figures in parentheses refer to the estimated initial cost inclusive of taxes and duties.

2 Assuming a 12% annual interest rate, a useful life of seven years for engine, 10 years for pump and 20 years for the tubewell, and assuming 10% scrap value for the engine, pump and tubewell materials.

3 Assuming 700 hours of operation per year.

4 About Tk 20 M per year for a total of about 30,000 LLP's, DTW's and STW's.

5 Valued at Tk 50 M for 30,000 pumps and tubewells. Assuming useful life of 40 years and an annual interest rate of 12%.

6 Valued at Tk 50 M for 30,000 pumps and tubewells. Assuming useful life of 10 years and an annual interest rate of 12%.

TITLE: Bangladesh Drainage and Flood Control Project

REPORT NO.: B-W-3

COUNTRY: Bangladesh

KEYWORDS: Drainage (5); flood control(5).

SUMMARY: In CCB and KBK, the project would provide flood control and improved drainage to 46,000 ac and 42,000 ac, respectively. In BRE, it would rehabilitate and improve the existing embankment which protects about 180,000 ac against flooding from the Brahmaputra River.

LOCATION: Chenchuri Beel (Jessore District), Kolabashukhali (Khulna) Brahmaputra Right Embankment (Rangpur, Bogra, and Pabna districts.)

CLIMATE: Aw

CROPS: Paddy, wheat, jute.

SOILS: Vary from sands and sandy loams on the natural levees in the north to silt loams in the intermediate positions and clays in the more inland areas.

TARGET GROUP: The irrigating farmer.

BEGIN: 1978 END: 1983 AREA: 268K ac

NUMBER OF FARMS: 100K

CONTRIBUTION:

IDA	US$	19M
GOB		9M
TOTAL	US$	28M

GOALS: The improved drainage and flood protection for some 88,000 ac of cultivated area in CCB and KBK would enable more intensive land use as well as shifts to higher yielding varieties. As a result, the food grain production is estimated to increase by some 19,000 tons over the projected 1988 levels in these areas without the project. In BRE, the project would, besides increasing the current food grain production by 19,000 tons, prevent a decline of 14,000 tons which is likely to follow the collapse of the existing embankment.

TYPE OF PROJECT: Large-scale construction and rehabilitation of drainage and flood control works.

TECHNOLOGY USED: Work would be carried out using simple machines and labor to build earthen embankments and brick-surfaced access roads.

DOCUMENTS REVIEWED: Staff Appraisal Report (69 pages)

PROJECT ORIGIN AND BASE LINE DATA: The proposed project was prepared by the Water Development Board, assisted by consultants NEDCO (Netherlands), and was appraised in January/February 1978 by a mission consisting of Messrs. H. J. Tennant, B. Kanchanalak (Bank), Hpu and J. K. Lee (Consultants).

BENEFICIARY INVOLVEMENT: It is not proposed under this project to impose charges on the beneficiaries.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

During the past five years, Bangladesh has imported an average of 1.5M tons of food grain annually. This severely restricts the resources available for other essential imports. To improve this situation, the Chenchuri Beel and Kolabashukhali projects were identified because they would eliminate salinity and reduce the incidence of flooding, thus resulting in an increase in crop yields and improved cropping patterns. The Brahmaputra Right Embankment project provides a degree of flood control permitting a shift from low yielding broadcast aman to transplanted aman and the greater use of inputs, thereby promoting higher yields and production levels.

TECHNICAL

CCB

1. Sixty miles of embankment with an average height of six and one half feet, a top width of 14 ft and involving about 83M cu ft of earthwork;

2. A drainage network with four new regulators varying from five feet to 10 ft wide, covering a net cultivated area of 46,000 ac; and

3. Twenty-five miles of 18 ft wide access roads with 12 ft wide broken brick surfacing.

KBK

1. Fifty-three miles of embankments with an average height of four and one half feet, a top width of 14 ft and involving about 44M cu ft of earthwork;

2. A drainage network with 13 drainage regulators varying from five feet to 40 ft wide, covering a net cultivated area of 42,000 ac; and

3. Twenty miles of 18 ft wide access roads with 12 ft wide broken brick surfacing.

BRE

1. Rehabilitation and improvement of 106 mi out of 170 mi of existing embankment to an average height of 12 ft and a top width varying from 14 to 24 ft. Earthwork involved is estimated at 135M cu ft;

2. Construction of 36 mi of retired embankments involving about 90M cu ft of earthwork;

3. About 78 cross embankments, involving about 23M cu ft of earthwork, for protection of the main embankment as well as groynes and revetments where required; and

4. Drainage channel improvements including eight drainage regulators.

The project has been planned and designed to feasibility standards by WDB, with the assistance of NEDECO (Netherlands) consultants. A three foot freeboard would be provided for CCB, KBK and the Teesta River section of BRE. There would be a five foot freeboard for the main section of BRE, where more wave and wind action would be encountered. Water levels outside the embankments of CCB and KBK are such that no gravity drainage would be possible between July and September. Accordingly, the drainage systems are designed for a quick drawdown of interior flood waters from mid-October to allow planting of crops in November/December. The systems are also designed to conserve useful rainfall within the area. Compaction would be by labor-intensive methods in keeping with the policy of GOB.

ENVIRONMENTAL

Projects such as the one under consideration necessarily involve substantial ecological changes, not all of which can be fully foreseen. The improved flood protection and drainage should reduce the incidence of malaria and cholera, both of which are endemic to the project areas. The effect on flood levels outside the project areas is likely to be negligible since the flood discharges in the affected rivers are vast compared to changes made under the project. The disturbances in the natural drainage patterns, however, could have some adverse effects on isolated pockets within the project areas (as evidenced by the occasional breaches made by the farmers in similar embankments in other areas). Construction of the embankments could have some adverse impact on the water transport; however, since currently most cargo is transferred from small boats (sampans) to larger boats at the confluence of major rivers and drains, the effect is likely to be small. Some adverse effect should also be expected on the fish production in the project areas. The proposed IDA-assisted Oxbow Lakes Fisheries Project, now under preparation, would include a Central Hatchery within 60 mi of the two subprojects in the southwest. The hatchery would be well-suited for supplying the affected areas with high quality fry and fingerlings. Lastly, there could be some loss in land fertility due to absence of soil deposition during the annual floods. This loss could, however, be readily compensated through the use of chemical fertilizer. On the whole, it is anticipated that the ecological impact of the project should be positive. However, there is a need for close monitoring. Assurances were obtained that for five years after project completion, GOB would undertake an annual

monitoring program commencing in May 1983 for assessing the impact, if any, of the project on water transport and fisheries in the project areas and would take remedial actions as necessary.

SOCIAL

The project would have a pronounced effect on incomes for farms of all sizes. Typically, the net farm incomes would increase by 50-100% over the without-project income levels. These increases are considered to be fully adequate for ensuring active participation and cooperation of the bulk of project area farmers even when account is taken of the risky nature of cultivation in Bangladesh.

INSTITUTIONAL

The Water Development Board will be responsible for surveys, planning, designs, procurement and implementation of all works, except agricultural staff quarters, training centers and related procurement. WDB would carry out the work through its normal channels: planning and design being undertaken in Dacca under the Chief Engineer (CE)(Planning) and CE (Design) and construction and detailed financial control being through the respective regional CEs, Superintending Engineer (SEs) and Executive Engineers (EEs). The Directorate of Agriculture (DOAEM) would be responsible for the introduction of the T&V extension system. They would also arrange construction of extension staff quarters and traning centers and procure equipment and vehicles for agricultural extension.

Overall responsibility for project administration and supervision would rest with the Member, Implementation (WDB). To assist the Member, Implementation in monitoring project progress, coordinating the work of various WDB units, liaising with DOAEM, and in sorting out implementation problems, a small Project Cell headed by a Project Coordinator would be attached to the Member's Office. The Project Coordinator would also be responsible for corresponding with IDA on project-related matters including annual work programs and periodic progress reports. The Project Coordinator will have experience and qualifications satisfactory to IDA. The appointment of the Project Coordinator will be a condition of credit effectiveness. During negotiations, it was agreed that the Director of Programs, assisted by EEs would be designated the Project Coordinator.

At the field level, WDB staff would need to maintain close contact with the respective staff of other agricultural agencies, such as BADC, IRDP and DOAEM. This would be particularly important in the later stages of the project when the project works would enable introduction of substantial changes in prevailing cropping patterns and cultivation practices. Accordingly, in each subproject,

a Project Coordination Committee would be established. The Committees would report to the Project Coordinator and would include appropriate level officials from the concerned agricultural agencies. The committees would meet quarterly or more often, if necessary. Establishment of the three Coordination Committees, with membership and terms of reference satisfactory to IDA, would be a condition of credit effectiveness. During the negotiations, it was agreed that the Chairman of the Project Coordinating Committees would be SE Khulna for CCB and KBK, and CE Northern Zone for BRE. The establishment of these Committees with membership and terms of reference satisfactory to IDA would be a condition of credit effectiveness.

ECONOMIC

The estimated economic rates of return are 28% for CCB, 37% for KBK and 38% for BRE. Attached are cost estimates for the three subprojects, tables of present and projected future cropping patterns, a schedule of projected expenditures, and a project implementation schedule. The exchange rate used in this project is US$1 = Tk 13.3.

Table 3.1: Cost Estimates[a/]

Item	Local	Foreign	Total	Local	Foreign	Total	% of Total
	----Tk million-----			----US$ million-----			
1. Chenchuri Beel (CCB)							
Land Acquisition	12.2	—	12.2	0.81	—	0.81	3
Civil Works	38.5	5.0	43.5	2.57	6.33	2.90	10
Equipment & Vehicles	2.6	2.3	4.9	0.18	0.15	0.33	1
Technical Assistance	0.5	2.0	2.5	0.03	0.14	0.17	1
Engineering & Admin.	8.0	0.3	8.3	0.53	0.02	0.55	2
Base Cost	61.8	9.6	71.4	4.12	0.64	4.76	17
Physical Cont.	12.4	1.9	14.3	0.83	0.13	0.96	3
Price Cont.	22.3	3.0	25.3	1.48	0.20	1.68	6
Total Cost	96.5	14.5	111.0	6.43	0.97	7.40	26
2. Kolabashukhali (KBK)							
Land acquition	6.8	-	6.8	0.45	-	0.45	2
Civil Works	32.4	6.1	38.5	2.16	0.40	2.56	9
Equipment & Vehicles	2.6	2.3	4.9	0.18	0.15	0.33	1
Technical Assistance	0.5	2.0	2.5	0.03	0.14	0.17	1
Engineering & Admin.	7.0	0.3	7.3	0.47	0.02	0.49	2
Base Cost	49.3	10.7	60.0	3.29	0.71	4.00	14
Physical Cont.	9.9	2.1	12.0	0.66	0.14	0.80	3
Price Cont.	17.8	3.2	21.0	1.19	0.21	1.40	5
Total Cost	77.0	16.0	93.0	5.13	1.07	6.20	22
3. Brahmaputra Right Bank (BRE)							
Land Acquisition	19.2	-	19.2	1.28	-	1.28	5
Civil Works	89.2	6.8	96.0	5.95	0.45	6.40	23
Equipment & Vehicles	2.7	2.7	5.4	0.18	0.18	0.36	1
Technical Assistance	0.3	1.5	1.8	0.02	0.10	0.12	—
Engineering & Admin.	12.4	-	12.4	0.83	-	0.83	3
Base Cost	123.8	11.0	134.8	8.26	0.73	8.99	32
Physical Cont.	24.8	2.2	27.0	1.65	0.15	1.80	6
Price Cont.	49.9	4.3	54.2	3.33	0.28	3.61	13
Total Cost	198.5	17.5	216.0	13.24	1.16	14.40	51
Grand Total	372.0	48.0	420.0[b/]	24.80	3.20	28.00[b/]	100

[a/] Small discrepancies due to rounding

[b/] Includes US$1.6 M equivalent in taxes and duties.

BANGLADESH

DRAINAGE AND FLOOD CONTROL PROJECT

Chenchuri Beel Subproject

Present and Projected Future Cropping Patterns, Yields and Production

	Present			Future Without Project[1/]			Future With Project[1/]		
	Area ('000 ac)	Yield (md/ac)	Prod. ('000 Tons)	Area ('000 ac)	Yield (md/ac)	Prod. ('000 Tons)	Area ('000 ac)	Yield (md/ac)	Prod. ('000 Tons)
I. Paddy									
1. Aus	7.5	13(0.48)[2/]	3.6	7.5	14(0.52)	3.9	2.0	16(0.60)	1.2
2. B.Aman	24.0	12(0.45)	10.8	24.0	12(0.45)	10.8	24.0	16(0.60)	14.4
3. T.Aman (local)	12.0	16(0.60)	7.5	10.0	18(0.67)	6.7	5.0	22(0.82)	4.1
4. T.Aman(HYV)	1.0	22(082)	0.8	3.5	25(0.93)	3.3	13.0	30(1.12)	14.6
Subtotal	45.0		22.7	45.0		24.7	44.0		34.3
II. Other Crops									
5. Wheat	1.0	14(0.52)	0.5	3.0	16(0.60)	1.8	5.0	20(0.75)	3.8
6. Jute	2.0	11(0.41)	0.8	2.0	12(0.45)	0.9	2.0	14(0.52)	1.0
7. Pulses	3.5	7(0.26)	0.9	6.0	8(0.30)	1.8	8.0	9(0.33)	2.6
8. Oilseeds	3.5	6(0.22)	0.8	6.0	7(0.26)	1.6	8.0	8(0.30)	2.4
9. Vegetables[3/]	2.0	40(1.49)	3.0	3.0	50(1.87)	5.6	3.0	60(2.24)	6.7
Total Cropped Area	57.0			65.0			70.0		
Net Cultivated Area	48.0			48.0			46.0		
Cropping Intensity	119%			135%			152%		

1/ In 1988 i.e. four years after completion of the proposed project

2/ Figures in parentheses are metric tons/ac.

3/ Composite crop;yield figures are notional.

BANGLADESH

DRAINAGE AND FLOOD CONTROL PROJECT

Kolabashukhali Subproject

Present and Projected Future Cropping Patterns, Yields and Production

	Present			Future Without Project[1]			Future With Project[1]		
	Area ('000 ac)	Yield (md/ac)	Prod. ('000 Tons)	Area ('000 ac)	Yield (md/ac)	Prod. ('000 Tons)	Area ('000 ac)	Yield (md/ac)	Prod. ('000 Tons)
I. Paddy									
1. Aus	3.0	13(0.48)[2]	1.4	3.0	14(0.52)	1.6	-	-	-
2. B.Aman (local)	24.5	12(0.45)	11.0	26.0	12(0.45)	11.7	30.0	16(0.60)	18.0
3. T.Aman (local)	1.0	16(0.60)	0.6	2.0	18(0.67	1.3	7.0	22(0.82)	5.7
4. T.Aman (HYV)	-	--	-	-	--	-	4.0	30(1.12)	4.5
5. Boro	2.0	25(0.93)	1.9	2.0	30(1.12)	2.2	2.0	32(1.19)	2.4
Subtotal	30.5		14.9	33.0		16.8	43.0		30.6
II. Other Crops									
6. Wheat	1.0	14(0.52)	0.5	2.0	16(0.60)	0.6	3.0	20(0.75)	2.2
7. Jute	1.0	11(0.41)	0.4	1.0	12(0.45)	0.4	1.0	14(0.52)	0.5
8. Pulses	1.5	7(0.26)	0.4	3.0	8(0.30)	0.9	6.0	9(0.33)	2.0
9. Oilseeds	1.5	6(0.22)	0.3	3.0	7(0.26)	0.8	6.0	8(0.30)	1.8
10. Vegetables[3]	-	--	-	-	--	-	2.0	60(2.24)	4.5
Total Cropped Area	35.5			41.0			61.0		
Net Cultivated Area	35.5			35.5			42.0		
Cropping Intensity	100%			115%			145%		

1/ In 1988 i.e. four years after completion of the proposed project

2/ Figures in parentheses are metric tons/ac.

3/ Composite crop;yield figures are notional.

BANGLADESH

DRAINAGE AND FLOOD CONTROL PROJECT

Brahmaputra Right Bank Subproject

Present and Projected Future Cropping Patterns, Yields and Production

	Present			Future Without Project[1]			Future With Project[1]		
	Area ('000 ac)	Yield (md/ac)	Prod. ('000 Tons)	Area ('000 ac)	Yield (md/ac)	Prod. ('000 Tons)	Area ('000 ac)	Yield (md/ac)	Prod. ('000 Tons)
I. Paddy									
1. Aus	80	14(0.52)	41.6	70	14(0.52)	36.4	80	16(0.60)	48.0
2. B.Aman (local)	20	14(0.52)	10.4	50	12(0.45)	22.5	20	16(0.60)	12.0
3. T.Aman (local)	90	20(0.75)	67.5	80	18(0.67)	53.6	85	22(0.82)	69.7
4. T.Aman (HYV)	30	26(0.97)	29.1	15	26(0.97)	14.6	35	30(1.12)	39.2
5. Boro	10	30(1.12)	11.2	10	32(1.19)	11.9	10	35(1.30)	13.0
Subtotal	230		159.8	225		139.0	230		131.9
II. Other Crops									
6. Wheat	5	17(0.63)	3.1	5	15(0.56)	2.8	10	20(0.75)	7.5
7. Jute	30	14(0.52)	15.6	30	14(0.52)	15.6	30	14(0.52)	15.6
8. Pulses	15	8(0.30)	4.5	10	8(0.30)	3.0	15	9(0.33)	5.0
9. Oilseeds	15	7(0.26)	3.9	10	7(0.26)	2.6	15	8(0.30)	4.5
10. Vegetables[3]	5	50(1.87)	9.3	5	50(1.87)	9.3	5	60(2.24)	11.2
Total Cropped Area	300			285			305		
Net Cultivated Area	180			185			178		
Cropping Intensity	167%			154%			171%		

1/ In 1993 following complete disablement of the existing embankment.
2/ Figures in parentheses are metric tons/ac.
3/ Composite crop;yield figures are notional.

BANGLADESH

DRAINAGE AND FLOOD CONTROL PROJECT
Estimated Schedule of Expenditures

	Item	Total Cost	Fiscal Year 1979	1980	1981	1982	1983
				(Tk M)			
1.	Land Acquisition						
	Base Cost	38.2	2.2	10.0	13.0	10.0	3.0
	Physical Contingencies	7.7	0.5	2.0	2.6	2.0	0.6
	Price Contingencies	14.1	0.2	2.4	4.7	4.9	1.9
	Subtotal	60.0	2.9	14.4	20.3	16.9	5.5
2.	Civil Works						
	Base Cost	178.0	4.0	40.0	60.0	50.0	24.0
	Physical Contingencies	35.6	0.8	8.0	12.0	10.0	4.8
	Price Contingencies	71.4	0.5	9.1	21.6	24.6	15.6
	Subtotal	285.0	5.3	57.1	93.6	84.6	44.4
3.	Equipment and Vehicles						
	Base Cost	15.2	6.2	8.4	0.6	-	-
	Physical Contingencies	3.0	1.2	1.7	0.1	-	-
	Price Contingencies	2.8	0.7	1.9	0.2	-	-
	Subtotal	21.0	8.1	12.0	0.9	-	-
4.	Technical Assistance						
	Base Cost	6.8	0.5	2.5	2.0	1.0	0.8
	Physical Contingencies	1.4	0.1	0.5	0.4	0.2	0.2
	Price Contingencies	2.4	0.1	0.6	0.7	0.5	0.5
	Subtotal						
5.	Engineering & Administration						
	Base Cost	28.0	4.0	7.0	7.0	7.0	3.0
	Physical Contingencies	5.6	0.8	1.4	1.4	1.4	0.6
	Price Contingencies	9.8	0.4	1.6	2.5	3.4	1.9
	Subtotal	43.4	5.2	10.0	10.9	11.8	5.5
	Total for Entire Project						
	Base Cost	266.2	16.9	67.9	82.6	68.0	30.0
	Physical Contingencies	53.5	3.4	13.6	16.5	13.6	6.2
	Price Contingencies	100.5	1.9	15.6	29.7	33.4	19.9
	Total	420.0	22.2	97.1	128.8	115.0	56.9
	(Say)	420.0	22	97	129	115	57

BANGLADESH

DRAINAGE AND FLOOD CONTROL PROJECT

Project Rent Estimates

Item	1 ac Farm		3 ac Farm		7 ac Farm	
	$\bar{W}$	W	$\bar{W}$	W	$\bar{W}$	W
	(Tk)					
1. CCB						
Gross Value of Prod.	1,930	2,790	4,830	7,150	10,050	15,330
Certainty Equivalent of GVP[2/]	1,540	2,370	3,860	6,080	8,040	13,030
Cost of Farm Inputs[3/]	430	640	1,220	1,900	3,850	5,540
Cost of Family Labor[4/]	670	820	1,700	1,890	2,510	2,860
Management Fee[5/]	40	60	120	190	390	550
Implicit Land Rent	400	850	820	2,100	1,290	4,080
Project Rent (total)		450		1,280		2,790
Project Rent/ac		450		430		400
2. KBK						
Gross Value of Prod.	1,250	2,620	3,080	6,550	6,410	14,180
Certainty Equivalent of GVP[2/]	1,000	2,230	2,460	5,570	5,130	12,050
Cost of Farm Inputs[3/]	320	600	790	1,600	2,290	4,830
Cost of Family Labor[4/]	410	760	1,020	1,580	1,810	2,920
Management Fee[5/]	30	60	80	160	230	480
Implicit Land Rent	240	810	570	2,230	800	3,820
Project Rent (total)		570		1,660		3,020
Project Rent/ac		570		550		430
3. BRE						
Gross Value of Prod.	2,060	2,920	5,730	8,250	12,390	18,010
Certainty Equivalent of GVP[2/]	1,650	2,480	4,580	7,010	9,910	15,310
Cost of Farm Labor[3/]	490	660	1,490	2,370	5,160	7,620
Cost of Family Labor[4/]	770	920	2,060	2,240	2,890	3,000
Management Fee[5/]	50	70	150	240	520	760
Implicit Land Rent	340	830	880	2,160	1,340	3,930
Project Rent (Total)		490		1,280		2,590
Project Rent/ac		490		430		370

1/ $\bar{W}$ = Without Project, W = With Project
2/ 80% of GVP under without project conditions and 83% of GVP with the project due to reduced risk of crop loss
3/ Including hired labor but excluding family labor.
4/ At an imputed cost of Tk 8/manday
5/ 10% of the cost of farm inputs.

TITLE: Low-Lift Pump Project

REPORT NO.: B-W-4

COUNTRY: Bangladesh

REGION: Asia

KEYWORDS: Low-lift pump (5); surface irrigation (3).

SUMMARY: The objective of the project is to furnish a sufficient number of low-lift pumps together with spares and supporting services to enable farmers to exploit the surface water resources of the project area. The project intends to assure 13,500 farming groups of a continued capacity to pump irrigation water.

LOCATION: Comilla, Noakhali, Chittagong, Barisal and Patuakhali districts.

CLIMATE: Aw

CROPS: Paddy, pulses, oilseeds.

SOILS: Alluvial soils, mostly fine to medium in texture and generally suited for paddy cultivation.

TARGET GROUP: The irrigation farmer.

BEGIN: 1980 END: 1984 AREA: 4.7M ha

NUMBER OF FARMS: 1.7M

CONTRIBUTION:

IDA	US$ 37.0M
GOB	11.0M
	US$ 48.0M

GOALS: The proposed project would help maintain present levels of paddy production through a program of pump replacement and rehabilitation increase output through additional LLP fieldings; improve the life of LLPs and their utilization by upgrading BADC's maintenance, repair and storage capabilities; increase cost recovery; promote greater private ownership, sales and service of LLPs, estimate LLP fielding potential; and introduce a monitoring and evaluation program to determine the impact and effectiveness of such programs in meeting future needs.

TYPE OF PROJECT: Large-scale extension and improvement of the existing practice of low head pumping from rivers and ponds for irrigation water.

TECHNOLOGY USED: Diesel-powered engines attached to centrifugal or mixed flow pumps and equipment to install and repair pumps.

DOCUMENTS REVIEWED: Staff Appraisal Report (109 pages) and the Report and Recommendation of the President of the International Development Association (45 pages).

PROJECT ORIGIN AND BASE LINE DATA: The project was appraised by a mission that visited Bangladesh in November/December 1978. Negotiations for the proposed credit were held in Washington, D.C. in January 1980.

BENEFICIARY INVOLVEMENT: Increased pump rental rates will increase capital recovery to around 29%; sales of pumps to be encouraged.

GENERAL DESCRIPTION

For centuries, Bangladesh farmers have used bucket-lift methods for irrigating a dry-season boro crop (January to May) on lands near low-lying ponds and perennial streams. However, it was not until the establishment of the Water Development Board (WDB) in 1959 and the Bangladesh Agricultural Development Corporation (BADC) in 1961 that a major impetus was given to the development of water resources. Currently, irrigation is available for about 2.6M acres; 1.2M acres by low-lift pumps (LLPs), 0.2M acres by gravity supply, and about 1.0M acres by traditional methods.

TECHNICAL

The project would involve:

1. Procurement of 3,000 two-cusec LLPs; each comprised of a 10-12 hp diesel engine attached to a centrifugal or mixed flow pump designed to deliver a two-cusec flow against a total head of 30 ft;

2. Procurement of 5,500 one-cusec (nominal) LLPs; each comprised of a six to eight horsepower diesel engine attached to a centrifugal or mixed flow pump designed to deliver a 1.3 cusec flow against a total head of 30 ft;

3. Procurement of spare parts and ancillary fittings for the 8,500 new LLPs, and spare parts needed to rebuild 5,000 existing but unserviceable LLPs;

4. Rebuilding 5,000 existing but unserviceable LLPs; and

5. Construction and equipment of new BADC workshops and pump storage facilities.

The 3,000 two-cusec LLPs would be required to replace 1,790 condemned two-cusec units and to replace 1,210 unserviceable but repairable units. The new units would be rented out to farmers' groups in the Comilla, Noakhali, and Chittagong Districts where most units operate at a total dynamic head of 28 ft. Existing two-cusec units are designed to pump against a 40 ft head and thus are over-powered and wasteful of fuel. The new units would be designed to pump against a 30 ft head and their 10-12 hp diesel engines would be lower powered than the 16-18 diesels now employed. Engines would be manual starting, four stroke and with forced oil lubrication for all bearings and joints with splash lubrication of piston pins. Pumps would be of mixed flow or centrifugal design and would be flexibly coupled to the engines. The LLP unit would be designed for outdoor operation and mounted on a sturdy trolley. The average cost of a basic two-cusec LLP is estimated at US$1,700 including duties and taxes.

Unserviceable two-cusec LLPs would be replaced by 3,787 new one-cusec LLPs and the remaining 1,713 of the 5,500 new one-cusec units would be provided to new pump groups. All 5,500 LLPs would be sold to individual farmers or farmer groups. The one-cusec LLPs would be sold mostly in the Barisal and Paluakhali districts where the area irrigated by existing LLPs exceeds 25 acres in only 10% of cases and where the average total dynamic pumping head is only 19 ft. The existing two-cusec units are grossly over-powered for such duties. Since some of the one-cusec pumpsets would be used where the pumping head is greater than 19 ft and to provide flexibility for use with longer delivery pipes, the units would be designed for a total dynamic head of 30 ft using six to eight horsepower engines. The general specifications for the one-cusec unit, except for power, would be as for the two-cusec units described above. The average cost of a basic one-cusec LLP is estimated at US$800 including duties and taxes.

ENVIRONMENTAL

The project is expected to have no deleterious effects on the environment. In fact, the proposed water availability survey would assist in water use management by providing a systematic basis for annually determining optimal pump fieldings. This exercise would examine surface water exploitation for irrigation in relation to other uses and factors including fisheries, navigation, and seasonal salinity intrusion.

INSTITUTIONAL

BADC. Primary responsibility for carrying out the project would rest with the Bangladesh Agricultural Development Corporation (BADC). BADC is a semi-autonomous organization under the Ministry of Agriculture, established in 1961. Its purpose when created was to develop agriculture by supplying necessary inputs such as fertilizer, seeds, low-lift pumps and tubewells. It has since grown into an organization employing about 22,000 employees, with an annual budget of US$144M. It administers Government subsidies and its annual deficit is covered by the national budget. This system of budgeting has meant that, although it is a corporation enjoying autonomy in staffing, financing and operating policies, it has tended to function as a Government department. BADC is responsible for three IDA-financed projects: Shallow Tubewells Project; Northwest Tubewells Project (341-BD); and Cereal Seeds Project. Its effectiveness in managing these projects has been mixed. In the case of the seeds project, implementation is three to four years behind schedule but, performance is now adequate; in that of Northwest Tubewells, maintenance was fair but impaired by procurement difficulties early in the life of the project and an inability to

provide support to pump groups formed around the deep tubewells financed under the project. Performance in connection with the Shallow Tubewells Project again has been less than satisfactory because of delays in procurement. For the latter reason, rather specialized procurement arrangements have been designed for this LLP project.

The BADC is organized into five Directorates, each headed by a Member Director. The Directorate of Irrigation is responsible for: deployment and maintenance of LLPs; supervising the installation of both deep (DTWs) and shallow tubewells (STWs); some tubewell operation and maintenance; and for the operation and maintenance of rental farm tractors[1]. The Directorate is divided into three divisions: Mechanization and Pumps (M&P), DTWs, and STWs. Each has its own complement of staff, often down to the subthana level, operating independently, though in some areas, DTWs and STWs are under one executive head. The M&P Division has a total staff of about 6,000.

BADC Organization and Staffing in the Project Area. The operations of the M&P Division in the project area are run by the six executive engineers located at regional level. In all districts, except Barisal, the BADC region corresponds directly to the district boundaries; Barisal District is divided into two regions: Barisal and Bhola.

The executive engineers report to the Chief Engineer M&P at headquarters through a superintending engineer, but are answerable directly to headquarters. There are two superintending engineers responsible for the project area: one at Comilla is responsible for Chittagong Circle, comprising the project area regions of Chittagong, Noakhali and Comilla, plus Sylhet; one at Khulna is responsible for Barisal Circle, comprising the project area regions of Barisal, Bhola and Patuakhali, plus Khulna and Jessore.

The six regions in the project area are divided into 21 zones for which assistant engineers are responsible. Within the zones are 82 units (equivalent to thanas) for which unit officers located at thana headquarters are responsible. These unit headquarters are distribution points for pumps and have maintenance facilities and staff. Where the number of pumps exceeds 200, or the areas are remote, sub-units have been established, headed by sub-unit officers responsible to the unit officer. Including the staff associated with the zonal workshops, the total M&P staff in the project area is 1,308. These are the staff working in the five districts outside the Bank-assisted irrigation projects.

The tubewell divisions function independently of the M&P Division. They have a different geographic spread and have different

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[1]One hundred and fifty-eight were fielded in 1976-77.

boundaries for their organizational units. An executive engineer at Chittagong is responsible for Chittagong and Noakhali Districts, one at Comilla handles Comilla and Sylhet Districts, and another at Faridpur has Faridpur and Barisal Districts. They have 111 staff, complementary to the M&P Division.

PROJECT MANAGEMENT

A project director, of equivalent rank to a deputy chief engineer/superintending engineer, has been appointed and would be responsible for the financial and technical aspects of the project, reporting through the Chief Engineer (Mechanical and Pumps) to the Chairman, BADC. He would be supported by a project unit comprising 15 professional accounting and engineering staff to keep project accounts and be responsible for coordinating implementation. The unit would employ BADC headquarters services, such as the procurement section, for specialist activities. The Project Director would be responsible for all BADC irrigation engineering activities and staff in the project area, both LLP and shallow tubewells, as well as for BADC workshops in the area. He would also supervise the M&E unit to be established under the project. BADC has sufficient numbers of suitably experienced staff in the project area for field operations and, if necessary, would be able to draft in personnel from other areas.

Under the project, improvements would be made in the staffing of BADC's zonal workshops - not least to ensure the success of the LLP rebuilding program. This would mean more than rationalization of use of existing BADC staff than of employing additional personnel. Under the project, staffing of each of the five zonal workshops would be as follows:

One Assistant Mechanical Engineer
Four Unit Officers
Thirty-two Mechanics
Sixteen Ancillary Staff
Eight Storekeepers.

IRDP

IRDP, an agency of the Ministry of Land Administration, Local Government, Rural Development and Cooperatives (MLG & RD), is responsible for promoting and supporting cooperatives. The level of IRDP involvement in rural areas depends upon whether the thana concerned is an IRDP thana or not. About 250, or 60%, of all thanas in Bangladesh are IRDP thanas and about 50 of the 86 in the project area. In IRDP thanas a Thana Apex Cooperative Society (TCCA) is established that acts as a union for its member primary societies,

the KSS, and for which it provides credit (through linkage with the nationalized commercial banks), marketing and input supply services. TCCA received technical and financial aid from IRDP. In non-IRDP thanas, cooperatives exist, but are supported in a much less intensive way by the Cooperative Department of MLG & RD. It is Government's current intention that ultimately the TCCA/KSS system should become the standard for the whole country. In IRDP thanas pump groups can be either TCCA/KSS or TIP/KSS. The TIP/KSS is registered with the thana cooperative officer solely for the season for which the pump is allocated to the group. On the other hand, the TCCA/KSS is a permanent farmers' cooperative that, in practice, is usually engaged in activities in addition to the rental of pumps. As most KSS are organized on a village basis, they may have within them two or more pump groups. TIP/KSS are formed in non-IRDP thanas; there, the role of the TCCA/KSS is undertaken, albeit rather ineffectively, by village multipurpose cooperative societies that are linked through 62 central cooperative banks to the national cooperative bank, SBJB.

No immediate changes are foreseen for the IRDP and MLG & RD cooperative organizations as a consequence of the project. Similarly, no changes are proposed in pump group organization. However, with the proposed change to LLP sales, the adequacy of the present systems of pump group support needs examination, not least to determine their ability to protect the interests of smaller farmers and tenants and to provide credit for those groups that need it.

ECONOMIC

The Bangladesh economy would realize an economic rate of return from total project investment inclusive of physical contingencies of over 100%. A sensitivity test for the case of a simultaneous occurrence of a cost overrun of 25% and 25% shortfall in net benefits shows that the rate of return would still exceed 40%. The economic analysis employs the following basic assumptions.

About 324,000 rural households would have their existing access to irrigation facilities assured through project investments, and a further 106,000 households would be provided with such access for the first time enabling increases in their family incomes of 50% or more. Initiation of private pump ownership would probably allow intensification of use of LLPs and their engines thereby generating incremental output and stimulating additional employment. Private pump ownership is also expected to give impetus to small-scale, village-based servicing industry, enabling better LLP maintenance and producing beneficial effects for users of other small-scale capital equipment (sprayers, tillers, STWs, HTWs, etc.). These secondary benefits, however, have not been included in the economic analysis of the project.

The poverty target group in Bangladesh comprises that segment of the population in the lower 40% per capita GNP percentile. According to recent estimates (1973-77), individuals in the absolute poverty group (rural areas) earn less than US$90 per annum. About 50% of the rural poor are classified as landless or near landless, with the balance operating sub-subsistence holdings. While some tenants and sharecroppers are expected to participate in pump groups under the project, the bulk of project beneficiaries are anticipated to be landowning farmers. Nevertheless, about 30-40% of project beneficiaries would fall within the poverty target group.

To stimulate productivity, GOB has traditionally subsidized the use and maintenance of LLPs while seeking to reduce subsidies on other centrally-controlled inputs, such as fertilizers. Currently, rental charges[1] for LLPs cover only about 15% of capital costs, and maintenance charges amount to 51% of the cost of spares (net of taxes and duties) with no allowance being made for BADC's overhead costs. GOB does, however, recover part of its existing subsidies through taxes and duties levied on diesel and lubricating oils, equivalent to about 16% and 20% of the price of each product, respectively. GOB is cognizant of the need to rationalize its pricing policies in the agricultural sector and, in particular, enhance irrigation water charges in an effort to achieve greater domestic resource mobilization. GOB has therefore prepared proposals for rationalizing rental charges for LLPs. The objective is to move toward the elimination of all subsidies on rental charges on the basis of a phased program. As a first step, GOB will double existing rental rates for LLPs by September 30, 1981. This will increase capital cost recovery to around 29%. The first installment of an increase in rental rates would be implemented in the 1980 planting season.

The proposed one-cause LLP sales program would further enhance GOB's cost recovery efforts. However, to make a sales program viable, the sales price and rental charges must be such that farmers are relatively indifferent to either rental or purchase. Because subsidy on rental rates is likely to continue for some time, some subsidy on pump sale price would be necessary initially. However, annuities and repair costs under pump purchase arrangements do not necessarily have to equal rental and repair charges in view of the additional benefits (such as risk avoidance, elimination of annual pump transportation costs, use of pump/engines for other agricultural and non-agricultural purposes, avoidance of extralegal payments incurred under rental) to be derived from pump ownership, which would make ownership attractive even with annuity and repair

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[1]Rental charges do not include the cost of diesel fuel, which is purchased by farmers from BADC's diesel depots.

costs higher than those incurred under rental. While it is difficult to quantify such benefits, it has been estimated that a maximum level of subsidy of around 40% on the sale price for one-cusec LLPs (based on current rental rates and on accrued aggregated secondary benefits of around Tk 1,200 per pumpset p.a.) would be justified initially. The above sales program would be established not later than June 30, 1980[1].

Under the proposed sales program, GOB would realize an effective cost recovery of over 60%. If taxes and duties on fuel are included, the subsidy would decrease to about 26%. Similarly, allowance for taxes and duties on spares would reduce the subsidy level further to around 20%. The results of the sales program, including review of sales to individuals, and any subsidy on the sales price for one-cusec pumps would be reviewed with IDA semi-annually.

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[1]The rate of exchange used in this summary is US$1 = Tk 15.5.

Estimated Schedule of Expenditures

		Total Cost	1980-1981	1981-1982	1982-1983	1983-1984
		Taka Million				
(a)	Land Acquisition					
	Base cost	2.5	1.0	1.3	0.2	--
	Physical contingencies	0.3	0.1	0.2	--	--
	Price contingencies	0.7	0.2	0.4	0.1	--
	Subtotal	3.5	1.3	1.9	0.3	--
(b)	Pumpsets					
	Base cost	219.8	11.0	88.0	87.9	32.9
	Physical contingencies	17.3	0.9	6.9	6.9	2.6
	Price contingencies	60.0	1.3	18.5	26.8	13.4
	Subtotal	297.1	13.2	113.4	121.6	48.9
(c)	Rebuilding of 5,000 pumps and spares					
	Base cost	47.3	6.2	19.3	17.4	4.4
	Physical contingencies	5.0	0.7	2.0	1.8	0.5
	Price contingencies	13.4	0.9	4.5	5.9	2.1
	Subtotal	65.7	7.8	25.8	25.1	7.0
(d)	Diesel Fuel					
	Base cost	142.6	142.6			
	Physical contingencies	--	--			
	Price contingencies	--	--			
	Subtotal	142.6	142.6			
(e)	Civil Works					
	Base cost	34.0	5.0	12.7	12.8	3.5
	Physical contingencies	5.0	0.7	1.9	1.9	0.5
	Price contingencies	11.3	0.8	3.5	5.1	1.9
	Subtotal	50.3	6.5	18.1	19.8	5.9
(f)	Machinery, Equipment and Tools					
	Base cost	57.3	2.9	25.8	25.8	2.8
	Physical contingencies	3.9	0.2	1.7	1.8	0.2
	Price contingencies	14.6	0.4	5.3	7.8	1.6
	Subtotal	75.8	3.5	32.8	35.4	4.1
(g)	Transport Vehicles and Office Equipment					
	Base cost	36.6	1.8	17.7	14.1	3.0
	Physical contingencies	1.1	0.1	0.5	0.4	0.1
	Price contingencies	9.9	0.2	3.8	4.6	1.3
	Subtotal	47.3	2.1	21.7	19.1	4.4
(h)	Training, Studies and Advisory Services					
	Base cost	44.5	7.8	12.4	12.3	12.0
	Physical contingencies	3.3	0.6	0.9	0.9	0.9
	Price contingencies	12.2	0.8	2.5	3.9	5.0
	Subtotal	60.0	9.2	15.8	17.1	17.9
	Total	746.0	336.1	146.6	166.2	97.1

BANGLADESH

LOW LIFT PUMP PROJECT

Project Pumps, Cusecs, Area Irrigated, and Incremental Production

Project Pump Classification	Type of Pump	Number of Pumps	Number of Cusecs	Area Irrigated[1] ('000 ac)	Net Cultivated Area[2] ('000 ac)	Total Cropped Area (W)[3] ('000 ac)	Net Paddy Production (W-$\bar{W}$)[4] ('000 tons)
A. Replacement Program							
1. New pumps replacing unserviceables in project area	1-cusec	3,787	3,787	75.7	149.0	268.3	88.3
	2-cusec	1,213	2,426	48.5	95.4	171.8	56.5
2. New pumps replacing condemned units in project area	2-cusec	1,787	3,574	71.5	140.6	253.1	83.4
3. Rebuilt pumps replacing unserviceables/condemned units outside project area	2-cusec	3,205	6,410	128.2	252.2	454.1	149.5
Subtotal		9,992	16,197	323.9	637.2	1,147.3	377.7
B. New Pump Fieldings							
1. New pumps in project area	1-cusec	1,713	1,713	34.3	67.4	121.3	39.9
2. Rebuilt pumps outside project area	2-cusec	1,795	3,590	71.8	141.2	254.2	83.7
Subtotal		3,508	5,503	106.1	208.6	375.5	123.6
Total		13,500	21,500	430.0	845.8	1,522.8	501.3

1/ at 20 ac per cusec

2/ Boro covers an average 51% of net cultivated area on project farms

3/ In With Project Case, cropping intensity of 180% assumed

4/ Yields per acre: (a) Boro: 1.38 tons, (b) Aus: 0.52 tons. Aman production remains the same, W to W. For each acre of Boro grown, farmers forego .41 ac Aus; therefore for each ton boro paddy produced, farmers forego 155 tons

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LOW LIFT PUMP PROJECT

Economic Analysis:
Relative Importance of Individual Cost and Benefit Streams
and Switching Values (SV)[1/] of Cost and Benefit Streams

	Percent of Total Present Value of Benefit/Cost Stream (12% p.a.)[2/,3/]	SV (10% p.a.)[2/]	SV (12% p.a.)[2/3/]	SV (14% p.a.)[2/]	SV (16% p.a.)[2/]
	percent				
I. Base Case[4/]					
A. Incremental Project Benefits					
Crop Output	99.3	-52.6	-51.6	-50.7	-49.8
Salvage Value and Unexpired Economic Life	0.7	* [5/]	* [5/]	* [5/]	* [5/]
Total Incremental Project Benefits	100.0	-52.6	-51.2	-50.3	-49.5
B. Incremental Project Costs					
Investment Costs	15.1	765.8	695.1	643.5	597.3
Crop Costs Excluding Labor and Irrigation	31.9	340.2	328.8	319.5	320.5
Crop Labor Costs	40.9	264.4	256.3	249.7	343.3
Direct O&M Costs (Irrigation)	11.1	962.5	942.8	926.1	909.2
Indirect O&M Costs (Irrigation)	0.6	* [5/]	* [5/]	* [5/]	* [5/]
Administrative Costs	0.3	* [5/]	* [5/]	* [5/]	* [5/]
Land Cost	0.1	* [5/]	* [5/]	* [5/]	* [5/]
Total Incremental Project Costs	100.0	109.5	104.9	101.4	98.0

Continued from Previous page

	Percent of Total Present Value of Benefit/Cost Stream (12% p.a.)[2/,3/]	SV (10% p.a.)[2/]	SV (12% p.a.)[2/3/]	SV (14% p.a.)[2/]	SV (16% p.a.)[2/]
	percent				
II. Four-Year Disaster Cycle Case[6/]					
A. Incremental Project Benefits					
Crop Output	99.1	-40.6	-39.4	-38.4	-37.3
Salvage Value and Unexpired Economic Life	0.9	* [5/]	* [5/]	* [5/]	* [5/]
Total Incremental Project Benefits	100.0	-40.2	-39.0	-38.1	-37.1
B. Incremental Project Costs					
Investment Costs	15.1	471.1	424.4	390.6	360.3
Crop Costs Excluding Labor and Irrigation	31.9	209.3	200.7	193.9	187.3
Crop Labor Costs	40.9	162.6	156.5	151.6	146.7
Direct O&M Costs (Irrigation)	11.1	592.1 [5/]	575.7 [5/]	562.1 [5/]	584.4 [5/]
Indirect O&M Costs (Irrigation)	0.6	* [5/]	* [5/]	* [5/]	* [5/]
Administrative Costs	0.3	* [5/]	* [5/]	* [5/]	* [5/]
Land Cost	0.1	* [5/]	* [5/]	* [5/]	* [5/]
Total Incremental Project Costs	100.0	40.4	39.5	38.8	38.0

1/ Switching Value (SV) is the percentage change which reduces the net present value to zero at a specified discount rate, e.g. the opportunity cost of capital.

2/ Economic analysis done on quarterly basis with the following quarterly rates of discount (in percent)

	Quarterly Rate	Equivalent Annual Rate
(a)	2.314	10.0
(b)	2.874	12.0
(c)	3.330	14.0
(d)	3.780	16.0

3/ Assumed Opportunity Cost of Capital

4/ Reference Annex H, Table 3

5/ Greater than 1100% : Costs (+), Benefits (-).

6/ Assumes post-harvest destruction of incremental Boro crop every fourth year beginning with first cropping year under Project, Project Year 2.

Cost Estimate

		Local	Foreign	Total	Local	Foreign	Total	% of Total Cost
		(Taka Million)			(US$ Million)			
(a)	Land Acquisition	2.5	--	2.5	0.2	--	0.2	1
(b)	Pumpsets, complete with trolleys, pipes, fitting and spares	74.7	148.8	223.5	4.8	9.6	14.4	30
(c)	Rebuilding of 5,000 pumps and spares	23.2	24.1	47.3	1.5	1.5	3.0	6
(d)	Diesel fuel	18.6	124.0	142.6	1.2	8.0	9.2	19
(e)	Civil works for Thana workshops and training facilities	24.6	9.4	34.0	1.6	0.6	2.2	5
(f)	Machinery, equipment, tools for workshops, hand tools for mechanics and spares	19.6	37.7	57.3	1.3	2.4	3.7	8
(g)	Transport vehicles for BADC field operation, water availability survey, training program, and office equipment (for training and water availability survey)	18.8	17.5	36.3	1.2	1.1	2.3	5
(h)	Training, studies and advisory services (training specialists, water availability survey specialists, training of pump mechanics and operators, and monitoring	18.0	26.5	44.5	1.1	1.7	2.8	6
	Base Cost	200.0	388.0	588.0	12.9	24.9	37.8	80
Physical Contingencies		9.1	26.8	35.9	0.6	1.7	2.3	5
Price Contingencies		65.3	56.8	122.1	4.2	3.7	7.9	15
Total Project Cost		274.4	471.6	746.0	17.7	30.3	48.0	100

[a] The cost estimates include taxes and duties. Small discrepancies are due to rounding.

TITLE: Small Scale Drainage and Flood Control Project

REPORT NO.: B-W-5

COUNTRY: Bangladesh

REGION: Asia

KEYWORDS: Drainage (5); flood control (5).

SUMMARY: The project would involve the completion, by the provision of permanent structures and improvement of earthworks as necessary, of selected schemes or subprojects constructed under the Food for Work Program.

LOCATION: Throughout Bangladesh, with the exception of the Northwest Region.

CLIMATE: Aw

CROPS: Paddy, wheat, jute.

SOILS: Not given.

TARGET GROUP: The irrigating farmer.

BEGIN: 1979 END: 1984

AREA: 350,000 ac

NUMBER OF FARMS: 130,000.

CONTRIBUTION:

IDA	US$	25M
CIDA		3M
GOB		7M
TOTAL	US$	35M

GOALS: The principal benefit of the project would be increased food grain production, of which paddy is expected to amount to 90%. The anticipated increase in food grain production of 114,000 tons will reduce Bangladesh's dependency on imported grain.

TYPE OF PROJECT: Construction and improvement of a large number of small to medium-sized drainage and flood control projects.

TECHNOLOGY USED: Earthen embankments with steel gates for flow regulation constitute the main construction work. Most of the work will be carried out by labor-intensive methods.

DOCUMENTS REVIEWED: Staff Appraisal Report (87 pages).

PROJECT ORIGIN AND BASE LINE DATA: The project was prepared by the Water Development Board, assisted by a consultant (NEDCO, Netherlands). The project was appraised in February 1979.

BENEFICIARY INVOLVEMENT: It is not proposed to seek the direct recovery of project costs from beneficiaries.

PERT CHART: Attached to reviewed documents

GENERAL DESCRIPTION

The project works will permit more intensive land use and enable shifts from local to high-yielding varieties by providing protection from early flooding and from saltwater intrusion and by reducing flooding depths and durations.

TECHNICAL

Besides the construction and completion of earthworks, the project will also install small steel gates required for the many scattered drainage sluices, regulators and controls. These gates will be designed, ordered and built in the course of appraisal and approval of each individual subproject.

ENVIRONMENTAL

None of the subprojects financed under the project are expected to have any significant impact on public health. In the case of soil fertility, however, there is no doubt that flood control embankments eliminate the benefits of the nutritional effect of soil deposits caused by annual floods. It is considered, however, that on balance the damage of annual flooding to homes, vegetable gardents, fowl and cattle is worse than the benefit of the silt deposition which can be replaced by use of either chemical or organic fertilizers. Disturbance to fish culture by bunds and embankments is a potential hazard and would be specifically investigated and guarded against as part of WBD subproject appraisal and execution.

ORGANIZATION AND MANAGEMENT

The project would be managed by the Water Development Board (WDB). WDB was established in 1972 as a semi-autonomous agency within the Ministry of Power, Water Resources and Flood Control and is responsible for providing surface water irrigation, drainage, flood control, erosion control, town protection and river training throughout Bangladesh. WDB is managed by a Chairman and five Board Members covering planning, implementation, and supply. Under their overall direction, day-to-day management is provided by 11 Chief Engineers (CE), and approximately 50 Superintending Engineers (SE) and Directors. WDB has approximately 2,000 fully professional staff, mainly engineers, of whom 1,100 are in Dacca. Of 6,500 technical and accounting staff, approximately 4,000 are in the field. Ten thousand employees are non-technical.

WDB manages five ongoing IDA-financed projects in the irrigation, drainage and flood control sector. All these projects have been subject to serious delays in implementation. By mid-1977, the extent of delays was such that IDA made strong representations to Government concerning the need to improve the efficiency of WDB. Since that time, Government has taken a number of positive actions

aimed at streamlining WDB's administrative procedures and improving its overall performance. A new chairman of WDB has been appointed; there has been a greater delegation of authority to project directors, thereby enabling them to function more effectively; the WDB project portfolio has been reviewed with a view to eliminating uneconomic projects; and criteria for the selection of future projects have been agreed upon with IDA. There was a noticeable overall improvement in WDB's performance in 1978 as an organization and it is hoped that further improvements will result from the implementation of the recommendations of a joint GOB/Bank Review Mission that completed an in-depth review of WDB and its program earlier in 1979.

WDB's technical performance in the implementation of its five IDA-assisted projects has improved significantly. Chandpur is virtually complete, Barisal is slightly ahead of schedule, and Karnafuli started well but is slipping behind schedule, largely due to lack of local funds. The Muhuri Project is plagued currently by an internal dispute within the principal contracting company and other problems; and the Drainage and Flood Control Project is only now beginning to get underway. Intermittent delays in project implementation continue and increasingly, these are attributable to a lack of adequate counterpart funding by the government. Inadequate Government funding has been a problem common to many development projects and was recently the subject of a special study by the Bank which is being used to improve funding allocation procedures. The proposed project revolving fund should help minimize this problem in the proposed project. Another weakness in WDB's operations has been the delays often experienced in its selection for the award and subsequent administration of large contracts. It is unlikely that this will be an issue in the proposed project as the various works involved comprise small simple structures which are only likely to be of interest to small local contractors and, in some instances, would be undertaken on the basis of force account.

Subprojects for completion would be proposed by WDB ZCE's (Zonal Chief Engineers) acting upon the advice of their SE's and EE's. There are four WDB zones, three of which encompass the project area. Before making his recommendations, the ZCE would consult with the appropriate District Commissioner in charge of Administration in the area involved. Submissions by ZCE would be reviewed by the WDB Flood Control Cell (FCC), its Chief Engineer (CEFCC) and the consultants. Following an initial review to establish the desirability of proceeding further, which would be based largely on the original proposal prepared to obtain FFWP assistance, the CEPCC would commission an appraisal of the subproject. This would be carried out by staff of FCC, the consultants, and the Zone, who would work in close collaboration with the local administration, including thana and union officials, in the case of the social and organizational aspects of the subprojects. A short appraisal report would be prepared. Final design of each subproject would be carried out by the

Design and Research Branch (DRB) of WDB in Dacca in the case of the more complex subprojects, or by Zonal staff for approval by DRB in that of simpler subprojects. Following completion of the design work, cost estimates would be updated and responsibility for execution would pass to the appropriate ZCE. Copies of the appraisal report, designs, and updated cost estimates (direct costs including full-time supervision) would be sent to the Bank's Resident Mission in Dacca for information except in the case of subprojects for which approval of IDA would be required.

CEFCC would be the principal IDA contact and responsible for correspondence with IDA including the submission of quarterly progress reports. These would include the status of subprojects proposed, initially reviewed, appraised, designed, approved, under implementation and completed. CEFCC would also be responsible for the preparation of claims for reimbursement under the IDA credit.

At the Zone, line responsibility runs from the ZCE to SEs and through them to EEs. Each ZCE is responsible for 100 to 400 technical personnel and numerous non-technical supporting staff. Typically, the SE's jurisdiction encompasses a geographic area or a maor project or both. The EEs have geographic responsibilities which may encompass parts of large projects or the whole of small projects. The Zonal organization is well-suited to the implementation of the project. Generally, WDB engineers are underemployed - a situation confirmed by the joint GOB/Bank review. Consequently, there is not a shortage of trained personnel for this type of project. EEs have authority to accept tenders for work costing up to Tk 500,000 and supplies up to Tk 200,000, make local purchases of survey equipment, construction equipment components, spare parts, etc., up to Tk 1,000,000, and rent offices and godown (stores) accommodation up to Tk 2,500/month. Commensurably greater thresholds of authority are delegated to SEs and CEs.

SOCIAL

Since the major result of the project would be to increase the productivity of land, to a large extent, the distribution of direct benefits would follow the land ownership pattern. In establishing the criteria for the project, however, particular attention was paid to ensuring that small farmers would get a fair chance to benefit from the project.

ECONOMIC

An expected project ERR of 35% has been calculated for this project as a whole with individual subproject ERRs ranging from 14% to 78%. Attached are cost estimate tables, and a project implementation schedule. The exchange rate used in this summary is US$1 = Tk 15.5.

BANGLADESH

SMALL SCALE DRAINAGE AND FLOOD CONTROL PROJECT

Bhola West Embankment Scheme
Cost Estimate

Item	Local	T&D[1]	Foreign	Total	% f.e.[2]
	---------- Tk '000 ----------				
A. Project Costs					
Civil Works					
8 regulators, 3 and 4 vent @ Tk 1,800,000	6,900	1,700	5,800	14,400	40
10 regulators, 1 vent @ Tk 700,000	3,200	800	3,000	7,000	40
Closures and related earthworks improvements improvements LS[3]	8,000	--	-	8,000	-
Subtotal	18,100	2,500	8,800	29,400	30
Engineering and Administration					
WDB engineering and administration - 10%	2,650	50	300	3,000	10
Consultants' share of cost - 5%	100	--	1,400	1,500	90
Subtotal	2,750	50	1,700	4,500	
Total Base Cost	10,850	2,550	10,500	33,900	30
Physical Contingencies 15%	2,950	450	1,600	5,000	30
Price Contingencies, 10%, then 8%	2,600	400	1,500	4,500	30
Total Project Cost	26,400	3,400	13,600	43,400	30
B. Sunk Costs					
Land Acquisition -land provided at no cost	--	--	--	--	--
Earthwork					
110 M cu ft @ Tk 375/1,000 cu ft	39,000	--	2,250	41,250	5
Administration and overhead 10%	4,000	--	250	4,250	5
Total Sunk Cost	43,000	--	2,500	45,500	5

1/ T&D = Taxes and duties.
2/ % f.e. = percentage foreign exchange
3/ LS = lump sum

BANGLADESH

SMALL SCALE DRAINAGE AND FLOOD CONTROL PROJECT

Bhola South Reclamation Scheme
Cost Estimate

Item	Local	T&D	Foreign	Total	% f.e.
			Tk '000		
A. Project Costs					
Civil Works					
2 regulators, 10 vent @ Tk 4,000,000	3,900	900	3,200	8,000	40
1 regulators, 1 vent @ Tk 700,000	300	100	300	700	40
Improvements to earthworks LS	3,300	--	--	3,300	--
Subtotal	7,500	1,000	3,500	12,000	30
Engineering and Administration					
WDB engineering and administration - 10%	1,100	--	100	1,200	10
Consultants share - 5%	50	--	550	600	90
Subtotal	1,150	--	650	1,800	
Total Base Project	8,650	1,000	4,150	13,800	30
Physical Contingencies 15%	1,320	150	600	2,070	30
Price Contingencies, 10%, then 8%	1,130	100	500	1,730	30
Total Project Cost	11,100	1,250	5,250	17,600	30
B. Sunk Costs					
Land Acquisition - land provided at no cost	--	--	--	--	
Excavation					
Earthwork closures 55 M cu ft @ Tk 375/1,000 cu f.	19,600	--	1,050	20,650	5
Channel connections LS	2,000	--	--	2,000	-
Materials for closures LS	500	--	--	500	-
Administration and overhead 10%	2,750	--	100	2,850	-
Total Sunk Cost	24,850	--	1,150	26,000	5

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SMALL SCALE DRAINAGE AND FLOOD CONTROL PROJECT

Excavation of Nurania Khal Scheme
Cost Estimate

Item	Local	T & D	Foreign	Total	% f.e.
	Tk '000				
A. Project Cost					
Civil Works					
1 bridge 80 ft span LS	300	100	300	700	40
1 bridge 70 ft span LS	250	50	200	500	40
1 regulator, 4 vent LS	900	200	700	1,800	40
Subtotal	1,450	350	1,200	3,000	40
Engineering and Administration					
WDB engineering and administration - 10%	270	--	30	300	10
Consultants' share - 5%	--	--	150	150	100
Subtotal	270	--	180	450	
Total Base Cost	1,720	350	1,380	3,450	30
Physical Contingencies - 15%	250	50	200	500	40
Price Contingencies - 10%	150	30	120	300	40
Total Project Cost	2,120	430	2,700	4,250	40
B. Sunk Costs					
Land Acquisition					
10 ac @ Tk 15,000	150	--	--	150	-
Excavation					
5.0 M cu ft @ Tk 200/1,000 cu ft	950	--	50	1,000	5
Administration and overhead 10%	100	--	--	100	-
Total Sunk Costs	1,200	--	50	1,250	5

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SMALL SCALE DRAINAGE AND FLOOD CONTROL PROJECT

Harihar River Re-excavation Scheme
Cost Estimate

Item		Local	T & D	Foreign	Total	% f.e.
				Tk '000		
A. Project Costs						
Civil Works						
13 bridges, span 80 ft to 120 ft	LS	3,200	800	2,500	6,500	40
5 regulators, one and two vent	LS	2,100	550	1,800	4,450	40
Cross drainage		780	100	220	1,100	20
	Subtotal	6,080	1,450	4,520	12,050	40
Engineering and Administration						
WDB engineering and administration - 10%		1,080	—	120	1,200	10
Consultants' share - 5%		50	—	550	600	90
	Subtotal	1,130	—	670	1,800	
	Total Base Cost	7,210	1,450	5,190	13,850	
Physical Contingencies - 15%		1,080	200	820	2,100	40
Price Contingencies - 10%, then 8%		800	150	650	1,600	40
	Total Project Cost	9,090	1,800	6,660	17,550	40
B. Sunk Costs						
Land Acquisition (given free)		—	—	—	—	—
Excavation						
43 M cu ft @ Tk 220/1,000 cu ft		9,000	—	460	9,460	5
Administration and overhead, 10%		1,000	—	40	1,040	—
	Total Sunk Costs	10,000	—	500	10,500	5

BANGLADESH

SMALL SCALE DRAINAGE AND FLOOD CONTROL PROJECT

Sanir Haor Submersible Embankment Scheme
Cost Estimate

Item	Local	T & D	Foreign	Total	% f.e.
			Tk '000		
A. Project Costs					
Civil Works					
1 regulator, 8 vent LS	1,900	500	1,600	4,000	30
Embankment and drainage improvements LS	1,000	--	--	1,000	--
Subtotal	2,900	500	1,600	5,000	30
Engineering and Administration					
WDB engineering and administration - 10%	450	--	50	500	10
Consultants' share - 5%	25	--	225	250	90
Subtotal	475	--	275	750	
Total Base Cost	3,375	500	1,875	5,750	
Physical Contingencies - 15%	500	50	300	850	30
Price Contingencies - 10%, then 8%	300	50	150	500	30
Total Project Cost	4,175	600	2,325	7,100	
B. Sunk Costs					
Land Acquisition					
40 ac @ Tk 10,000/ac	400	--	--	400	--
Excavation--embankment and drains					
6.4 M cu ft @ Tk 375/1,000 cu ft	2,275	--	125	2,400	5
Administration and overhead 10%	225	--	25	250	5
Total Sunk Cost	2,900	--	150	3,050	

TITLE: Soil and Water Management -- Uttar Pradesh

PROJECT NO.: 386-0368.2

COUNTRY: India

REGION: Asia

KEYWORDS: Pilot projects (1); manuals (5); water management (5).

SUMMARY: The project was intended to bring together various disciplines to identify soil and physical problems of irrigation in the project area, and to test and demonstrate techniques for improving water management. It also gave training to groups of governmental agricultural workers at different levels, so that they could give technical assistance to cultivators in applying the water management programs.

LOCATION: Punjab, Uttar Pradesh, Mysore.

CLIMATE: A

CROPS: N/A

SOILS: Variable

TARGET GROUPS: Professional workers and extension agents.

BEGIN: 1967 END: 1972 AREA: N/A.

NUMBER OF FARMS: N/A

CONTRIBUTION: USAID $429K

GOALS: Not given.

PURPOSE: Not given.

TYPE OF PROJECT: Pilot projects, research and training.

TECHNOLOGY USED: Not given.

DOCUMENTS REVIEWED: Project Appraisal Report (33 pages).

PROJECT ORIGIN AND BASE LINE DATA: 1966 report by Don Williams.

BENEFICIARY INVOLVEMENT: Not given.

ACTUAL STARTING DATE: 1970. COMPLETION DATE: September 1972.

LOGICAL FRAMEWORK: Not available. PERT CHART: Not available.

GENERAL DESCRIPTION

This summary is based on a 33-page Project Appraisal Report prepared at the end of the project. The type of information normally available for these summaries therefore does not exist in our files. Rather, this summary will be an outline of the PAR.

ACCOMPLISHMENTS

The fundamental purpose of the project was to enable the dissemination of technical data to the level of the extension agent and the farmer. The intent was to build a strong organization patterned after the U.S. Soil Conservation Service, to test and evaluate water management techniques, to establish three pilot projects for such testing, and to publish a series of handbooks with the results.

The PAR lists the accomplishments as follows:

1. Introduced and integrated approach to on-farm water management.

2. Confirmed the hypothesis that increased yields would result.

3. Convinced some cultivators of the value of proper land preparation and water management.

4. Trained a number of technicians in the various technical components of water management and associated practices (283 technicians trained).

5. Impressed some officials with the importance of water management.

6. Published project work plans.

7. Developed technical guides and standard specifications (list attached).

8. Introduced modern land grading techniques.

9. Produced standard detailed soil surveys and evaluated irrigation systems.

10. Completed construction on a number of field trials on farms.

RECOMMENDATIONS

The PAR contains the following recommendations:

1. The three pilot projects should be continued but not duplicated.

2. Water management techniques should be evaluated as to priority and those with highest priority should be applied first. This would allow better concentration of effort on those few techniques. The PAR ranks the techniques from most to least important as: land preparation, on-farm water application and removal systems, modernization and improvement of farm delivery systems, water management assistance, agronomic assistance, credit, and organization advice to cooperatives.

3. Set up state organizations to carry out these programs.

4. Use field work more for research and less for demonstration, since the demonstration work does not seem to be having an effect.

5. Establish better liaison between the highly trained administrative officer and the field worker.

6. Give greater priority to rainfed agriculture, which in practical terms makes up 80% of the cropped area.

7. Begin to introduce better soil conservation and watershed management practices.

APPENDIX IV

List of Handbooks and Guides Prepared by
Center and Project Personnel

1. Land and Water Resources in India, 1964.

2. Need of and Plan for Research on Water Use and Soil Management toward Meeting India's Food Shortages, 1967-68.

3. Water Resources Investigation Program for Upper Gangetic Plain--India, 1967.

4. An Organizational Plan for A Comprehensive Study of the Water Resources of the Narmada River Basin, 1969.

5. Joint Indian-American Team Report, Efficient Water Use and Farm Management Study, 1970.

6. Report to the Government of India on Design Criteria, Construction Guide and Material Standards for Irrigation Pipelines, 1970.

7. A Project Report on the Location of Information Sources Regarding Water Resources in India. Published by Mansinghal Associates, 1968.

8. Soil Survey Manual (Revised), 1970.

9. A Guide for Estimating Irrigation Water Requirements, 1971.

10 Handbook on Water Management (Irrigation), 1971. Details of publications included in Handbook, which were published originally separately.

Part I	Soil Survey and Land Classification
Part II	Soil-Water Plant Relationship
Part III	Scheduling Irrigation to Meet Crop Needs
Part IV	Irrigation Methods
Part V	Irrigation of Principal Crops
Part VI	The On-Farm Irrigation System
Part VII	Land Leveling

11. Rotary Drilling Handbook on Accident Prevention and Safe Operating Practices, 1970-71.

12. Project Work Plan, Bellary Regional Pilot Project, 1969.

13. Project Work Plan, Patiala Regional Pilot Project, 1970.

14. Project Work Plan, Dohrighat Regional Pilot Project, 1971.

15. Technical Guide, Pilot Project for Soil and Water Management (including the Irrigation Guide), Mysore, 1971.

16. Directory for Irrigation Equipment and Related Services, 1970.

17. A Discussion on Design, Construction and Use of Well Screens, 1970.

18. Current Practices Relative to the Design and Placement of Artificial Gravel Packs for Tubewells, 1970-71.

19. Submersible Motor Pumps, 1970-71.

20. Air Injection Equipment for Reverse Circulation Drilling, 1971.

21. Developing and Completing Water Wells, 1971.

22. Water Well Specifications.

23. Development and Demonstration of Recommended Methodology for Delineation and Codification of a Watershed System of India, 1970.

24. Measurement of Irrigation Water, 1971.

25. Analysis of Chauhat Pump Drainage Scheme, Patiala, Regional Pilot Project, 1971.

26. Reconnaissance Soil Survey Report, Patiala Pilot Project, 1971.

27. Small Catchment Hydrology for India, 1970.

28. Handbook of Hydrology, 1972.

29. Handbook of Sedimentation, 1972.

30. Cylinder Infiltrometer Method for Determination of Intake Characteristics of Soils, July 1969.

31. Lining of Small Irrigation Channels, December 1970.

32. Preparing Irrigation Guides, September 1971.

33. Proceedings of Soil Survey Workshops on Classification, Correlation and Interpretations, 1972.

34. Manual and Guide for Rapid Assessment of Soil and Land Resources, 1972.

35. A Justification for Soil and Land Resource Inventories, Resource Inventory Center, Ministry of Food and Agriculture.

36. Soil and Land Resource Inventories for Broad Areas, Agriculture Planning.

37. Use of Land Resource Inventory for Dryland Areas.

TITLE: Gujurat Medium Irrigation

PROJECT NO.: 386-0464

COUNTRY: India

REGION: Asia

KEYWORDS: Dams (3); research (3); canals (5); water management (5).

SUMMARY: The project consists of: (1) the construction of new and the execution of ongoing Medium Irrigation Projects (MIPS); (2) the modernization or rehabilitation of existing MIPS to bring these to standards established for new MIPS; (3) the establishment of a network of automatic discharge measuring stations (for river gaging); and (4) the monitoring and evaluation studies.

LOCATION: Gujurat

CLIMATE: BSh

CROPS: Millet, sorghum, wheat, paddy, maize.

SOILS: Deep black soils

TARGET GROUP: Small, medium and moderately large farmer, and landless agricultural laborer.

BEGIN: June 1978 END: 1983 AREA: 80K ha new, 69K ha improved.

NUMBER OF FARMS: 36K

CONTRIBUTION:

USAID	$ 30M
IDA	85M
GOI	100M
TOTAL	$ 215M

GOALS: (1) To increase level and security of small farmer income; (2) to expand rural employment opportunities; and (3) to increase the availability of food to the rural and urban poor.

PURPOSE: To increase food production in Gujurat and to decrease the risk of drought.

TYPE OF PROJECT: Irrigation sector support project.

TECHNOLOGY USED: Generally labor-intensive.

DOCUMENTS REVIEWED: Project Paper (120 pages).

PROJECT ORIGIN AND BASE LINE DATA: World Bank feasibility studies conducted in 1977.

BENEFICIARY INVOLVEMENT: A pilot program of water user cooperatives will allow some input from farm groups.

ACTUAL STARTING DATE: N/A

COMPLETION DATE: N/A

LOGICAL FRAMEWORK: Consists of one page attached to reviewed documents.

PERT CHART: Not available.

GENERAL DESCRIPTION

The Project is co-sponsored by AID and IDA, with the latter financing the larger portion. The project addresses problems of:

1. Insufficient hydrologic data for dam construction;

2. High water losses in canals;

3. Public canal outlets which are so large (40 ha) that they inhibit farm development; and

4. Poor water management at the farm level.

AID, IDA and GOG will divide proportionately the costs of canal lining and extension. IDA will finance improved hydrologic stations and a reorganization of the extension system.

TECHNICAL

For each medium irrigation project (MIP), the basic data requirements are:

1. A land classification map;

2. An agroeconomic survey;

3. Rainfall records in or near the project area for a minimum of 20 years;

4. A 20-year estimate of monthly runoff; and

5. Sediment samples at or near each dam site.

The design criteria are:

1. The canal system will be fully lined;

2. Regulated outlets with a capacity of about one cubic feet per second to serve an area no larger than eight hectares on the average;

3. Canals designed for rotational irrigation;

4. A canal system designed to provide full irrigation deliveries to all areas when flows are less than 50% of capacity;

5. Structures for flow measurement from the head of the canal down to and including each minor; and

6. An emergency spillway for each reservoir.

A state government program under the Agriculture Department's Soil Conservation Service handles land leveling of farmers' fields and construction of field channels below the government outlet. On new projects, channels to the farm fields will be constructed by contractors under Soil Conservation Service supervision. Farmers must repay the costs incurred at prevailing interest rates, but are given seven years to do so.

The state has a good network of rainfall stations, but stations for measuring runoff are few and have been operated sporadically. Under the project's terms, IDA will finance a stream-gaging network. Velocity and flow cross-sectional area must be measured at runoff stations. Three hundred thousand dollars have been set aside to provide for imported stream-gaging equipment. Under the bank agreement, at least one year of stream-gaging records should be available, and projects submitted for the second and third years should have two and three years' gaging records, respectively.

On-farm water management will be improved by canal lining, by use of holding ponds, and by better scheduling. The World Bank is developing a computerized approach to scheduling. This has some promise for allocating limited water resources more efficiently, and for encouraging changes from tradition.

Although not required, an environmental assessment will be carried out under AID auspices.

INSTITUTIONAL

The direct responsibility for planning, implementation, operation and maintenance rests with the irrigation wing of the GOG's Department of Public Works. It will prepare a proposal for each subproject. Each proposal, after GOG clearance, will be submitted to the GOI's Central Water Commission for final approval. The CWC is India's highest technical authority for water resources development, and has a capable staff of 1,000 engineers. For projects exceeding a cost of $8 million or 12,000 hectares, IDA will retain review and appraisal authority.

The extension agents, or Village Level Workers, are actually agents of the Department of Community Development, and so have considerably more duties than just agriculture. IDA will finance a reorganization of the VLW system that will transfer the VLW's to the Department of Agriculture, strengthen applied agricultural research, establish a better link between research and extension, and increase staff mobility at all levels.

A system of 5,000 farm cooperatives in the state provides services to 80% of the farmers.

SOCIAL

In the short term, there will be increased demands for labor. Irrigated cotton, for instance, will require 140 man-days/ac of labor instead of 40 man-days/ac for rainfed cotton. In the long run, there may be a move to more mechanization. The irrigation construction works will also require large labor inputs (perhaps 1,200 laborers per dam).

ECONOMIC

A summary of costs is given on page 45 (attached).

The IRR for the project, for new MIP's, is 19%, assuming a cost of $1,740 per acre, and for modernization of old MIP's, costing $465/ac, the IRR is estimated at 28%.

The economic criteria for acceptance of individual MIP's requires a B/C ratio exceeding 1.0, assuming an annual interest of 12%.

A sample farm budget for a two hectare farm is given on page 40 (attached). On a one hectare farm, income will increase from $148 to $658 due to the project.

Gross revenues for water charges have not been sufficient to cover project working expenses over time. Cost recovery is supposed to be based on a "betterment levy" which has been set at half the increase in land value due to an individual project, but the levies are seldom collected. Also, application of a uniform water rate (based on crop season) does not take into account the volumes used or the distance from the main canal. Lining canals will provide more reliable supplies and justify higher water charges. Also, increased production will produce more sales tax revenues.

INDIA

Farm Budget for 2.0 ha Farm
(Mainland Gujarat)

	P	FWO	FW
Cropped Area (ha)			
Kharif			
Pearl Millet	0.2	0.2	0.1
Sorghum	0.1	0.1	0.3
Groundnuts	0.1	0.1	0.2
Pulses	0.2	0.2	0.2
Maize	0.1	0.1	0.2
Paddy	0.3	0.3	0.3
Tobacco	0.1	0.1	0.1
Rabi			
Wheat	0.2	0.2	--
Safflower	0.2	0.2	0.4
Biseasonal			
Cotton	0.5	0.5	0.6
Total Cropped Area (ha)	2.0	2.0	2.4
Net Cultivated Area (ha)	2.0	2.0	2.0
Cropping Intensity (%)	100.0	100.0	100.0
Gross Production Value (Rs)	3,106.0	3,859.0	14,151.0
Farm Production Costs (Rs)			
Hired Labor	124.0	142.0	327.0
Animal	385.0	392.0	523.0
Other Inputs	687.0	970.0	2,316.0
Totals	1,196.0	1,504.0	3,166.0
Net Farm Income (Rs)	1,910.0	2,355.0	10,985.0
	($222)	$274)	($1,277)

NOTE:
P = Present
FWO = Future Without Project
FW = Future With Project

TITLE: Rajasthan Medium Irrigation

PROJECT NO.: 386-0467

COUNTRY: India

REGION: Asia

KEYWORDS: Surface irrigation (5).

SUMMARY: The Medium Irrigation Projects (MIPS) encompass cultivable command areas ranging from 2,000 to 12,000 ha. Each MIP would generally be composed of: (1) an earthfill storage dam with gated spillway (possibly with some tank storage); (2) a lined canal network down to the major outlet; and (3) an appropriate drainage network. The average cost of an MIP has been estimated at about $1,500 per ha of cultivable command area.

LOCATION: Rajasthan

CLIMATE: Bwh

CROPS: Not given.

SOILS: Not given.

TARGET GROUP: Small farmers (95% less than 10 ha).

BEGIN: 1980 END: 1985 AREA:

NUMBER OF FARMS:

CONTRIBUTION:	USAID	$35.0M loan
	GOI	25.0M
	TOTAL	$60.0M

GOALS: To increase small farmer income, expand rural employment opportunities, and increase availability of food to rural and urban poor.

PURPOSE: To increase small farm production and decrease the risk of drought to the producer in the State of Rajasthan.

TYPE OF PROJECT: Large-scale; assistance is supplemental to regular government expenditures.

TECHNOLOGY USED: Labor-intensive, by private contractors.

DOCUMENTS REVIEWED: Project Identification Document (eight pages); Trip Report (13 pages); and Appraisal Team Report (100 pages).

PROJECT ORIGIN AND BASE LINE DATA: Not given.

BENEFICIARY INVOLVEMENT: Not given.

ACTUAL STARTING DATE: N/A

COMPLETION DATE: N/A

LOGICAL FRAMEWORK: Not available

PERT CHART: Not available.

GENERAL DESCRIPTION

This WMS summary is taken from a Project Identification Document (PID) describing a potential project. The PID and the summary are necessarily vague, and some of the following is a description of present irrigation practices in Rajasthan, rather than a definite program for the project.

TECHNICAL

The GOR has identified 42 projects that could be called medium irrigation projects, ranging in size from 2,000 to 12,000 ha.

Under previously built projects servicing 40 ha public outlets, it has been difficult to organize the 10 to 20 farmers inhabiting the area to design, build and manage the watercourses to their fields. This has resulted in inefficient use of water plus great unreliability of water supply at the tail of the watercourse. Lined watercourses at the five to eight hectare level will allow the farmers to be greater risk-takers; i.e., to invest in the agricultural inputs necessary to increase production and optimize the benefits of irrigation.

In the northwest, where the Irrigation Department is constructing channel lining below the major outlet, the Department conducts the O&M on the lined or stabilized sections for up to two years. After two years, a committee composed of Irrigation, Agriculture, farmers, and headed by an Irrigation Department engineer, designs a rotational water delivery program according to the area and crops of each farm holder.

INSTITUTIONAL

The direct responsibility for planning, implementation and O&M of the MIP's would rest with the Irrigation Department of the State of Rajasthan. It prepares project reports for each MIP encompassing a full project analysis. The MIP's need to meet certain preestablished technical and economic criteria in order to be eligible for financing under the project. In addition, an agricultural plan will be required specifying cropping patterns and necessary improvements in agricultural supporting services to efficiently use the water developed by the project.

The MIP's would be included in the GOR's annual development plan to be reviewed by the Planning Commission of the GOI. Subsequent to GOI approval of the plan, the selected MIP's would be submitted to the Central Water Commission (CWC) of the GOI for approval. The CWC is the highest technical authority for water resources development in India.

Civil works will be carried out by local contractors using labor-intensive methods under supervision of the Irrigation Department. Support for on-farm development will come primarily through the "Training and Visit" system of extension.

SOCIAL

No significant findings reported.

ECONOMIC

For lining of existing watercourses with large seepages, the B/C ratio is between 2.5 and 3.5.

Loans for the construction of watercourse linings can be secured from the commercial banks and then made to the Rajasthan Development Corporation, which in turn employs the Irrigation Department to construct the lining. There may be 50 to 100 farm holders under each major turnout. The loan agreement is with each farmer and each is expected to pay his proportionate share. For capital costs above the major turnout, the government considers them as sunk costs and makes no attempt to recover them. The betterment levy on the farmer is assumed to help pay for the capital costs.

TITLE: Chambal Command Area Development Project

REPORT NO.: I-W-1

COUNTRY: India

REGION: Asia

KEYWORDS: Command area development (5); surface irrigation (3).

SUMMARY: The project would be the first phase of a 10-year program to provide adequate on-farm and off-farm facilities to achieve maximum benefits from the Chambal Command Area.

LOCATION: Rajasthan State

CLIMATE: Bsh

CROPS: Rice and sorghum in Kharif; wheat in Rabi, sugarcane, oilseeds, and pulses are also grown.

SOILS: Clay loam underlain by heavy clay loam and silty clay.

TARGET FARMER: The irrigating farmer.

BEGIN: 1974 END: 1980 AREA: 229K ha

NUMBER OF FARMS: 60K

CONTRIBUTION:		
	World Bank	US $52.0M
	Local (GOI & GOK)	US $39.5M
	TOTAL	US $91.5M

GOALS: The project will create the equivalent of 20,000 full-time agricultural jobs and an increase in annual gross value of production of US $35 million.

TYPE OF PROJECT: Large-scale irrigation command area development.

TECHNOLOGY USED: Heavy machinery and labor to do land grading, canal lining, road construction and other project works. Labor-intensive methods used wherever possible.

DOCUMENTS REVIEWED: Project Appraisal; Pilot Field Study.

PROJECT ORIGIN AND BASE LINE DATA: It has been unofficially estimated that 10 million ha of recently completed irrigation projects require additional investments of between US$200 and

US$500 per hectare before they become fully productive. Command area development offers a means of making these required investments.

BENEFICIARY INVOLVEMENT: On-farm works, O&M and some capital costs are to be paid by farmers.

GENERAL DESCRIPTION

Agricultural production in the project are of 229,000 ha has not met earlier expectations due to a lack of drainage and on-farm development, inadequate roads, unsatisfactory maintenance, and ineffective supporting services. This project would be the first step in a program to correct these deficiencies.

TECHNICAL

The proposed project will drain 167,000 ha, increase the capacity of 850 km of canals, line 14 km of canals; provide on-farm development of over 50,000 ha including irrigation and drainage ditches, access roads, boundary realignment, and land shaping, construct or improve 250 km of roads; furnish afforestation and erosion control work; and construct 160 control structures.

INSTITUTIONAL

For the administration of this project, the GOR has created a Command Area Development and Water Utilization Department (CAD& WU) at the State Level and the Chambal Command Area Authority (CAA) at the project level. The CAA would be organized into four departments: Agriculture, Irrigation and Land Development, Cooperatives and Colonization, and Revenue. In addition to the Rajasthan Land Development Corporation (RDLC), there would be a statutory corporation, empowered to carry out on-farm development on a compulsory basis. Farmers ineligible for commercial loans for on-farm improvements would receive unsecured loans at higher rates from the RLDC. The project includes the introduction and enforcement of a system of rotational irrigation (warabandi) throughout the area, and also provides for the marketing facilities.

SOCIAL

No significant information given.

FINANCIAL/ECONOMIC

Water charges, intended to cover the O&M cost of the irrigation system, are being levied and a betterment levy of US$27.50/ha for farms over two hectares has been collected in installments to repay part of the capital cost of the Chambal Irrigation Project. An additional lump sum of US$4/ha was levied to pay for watercourse construction.

The project IRR is 19% over 30 years with a seven year grace period.

INDIA

CHAMBAL COMMAND AREA DEVELOPMENT PROJECT (RAJASTHAN)

Schedule of Expenditures

	Total Cost	Bank Fiscal Years 74/75	75/76	76/77	77/78	78/79	79/80
		Rs Million					
1. Irrigation and Drainage	131.2	10.0	24.0	24.0	24.0	24.0	25.0
2. On-Farm Development	84.0	5.0	10.3	14.0	16.7	18.0	20.0
3. Roads	50.0	5.5	6.3	6.3	7.3	10.8	13.8
4. Afforestation	1.2	0.2	0.2	0.3	0.3	0.2	--
5. Supplementary Fertilizer	51.3	51.3	--	--	--	--	--
Subtotal	317.7	72.0	40.8	44.6	48.3	53.0	59.0
Physical Contingencies	32.5	2.5	5.3	5.7	6.0	6.3	6.7
Subtotal	350.2	74.5	46.1	50.3	54.3	59.3	65.7
Expected Price Increases:							
%	47	17	31	42	53	64	75
Rs Million	164.2	12.7	14.3	21.1	28.8	38.0	49.3
Subtotal	514.4	87.2	60.4	71.4	83.1	97.3	115.0
6. Project Administration and Operating Costs	98.0	17.0	14.5	15.0	16.0	17.0	18.5
Expected Price Increases							
$	33	12	22	29	36	43	50
Rs Million	31.6	2.0	3.2	4.4	5.8	7.2	9.0
Subtotal	129.6	19.0	17.7	19.4	21.8	24.2	27.5
Total 1-6	644.0	106.2	78.1	90.8	104.9	121.5	142.5
7. Interest during construction	88.0	2.4	4.8	8.0	12.0	16.0	44.8 1/
Total Project Cost	732.0	108.6	82.9	98.8	116.9	137.5	187.3

1/ Includes interest of Rs24.0 million for the year 1980-81.

TITLE: Rajasthan Canal Command Area Development Project

REPORT NO.: I-W-2

COUNTRY: India

REGION: Asia

KEYWORDS: Command area development (5); surface irrigation (3); resettlement (3).

SUMMARY: Two hundred thousand hectares of a project area of 235,000 ha are suitable for irrigation development and will become part of the command area of the Rahasthan Main Canal.

LOCATION: Rajasthan State.

CLIMATE: Bsh

CROPS: Cotton, wheat principal; also millet, pulses, gram, fodder and mustard.

SOILS: Sodic silty clay and sand overlaying alluvial material.

TARGET GROUP: The irrigating farmer.

BEGIN: 1975 END: 1981 AREA: 200K ha

CONTRIBUTION:

World Bank	US $ 83.0M
GOI and GOR	US $ 91.0M
TOTAL	US $174.0M

GOALS: Upon completion, the project would provide year-round irrigation to 200,000 ha including 92,000 ha of new land developed under the project. It would also bring 35,000 ha of nonirrigable sand dunes surrounding the irrigated areas under controlled pasture development.

TYPE OF PROJECT: Large-scale irrigation command area development.

TECHNOLOGY USED: Heavy machinery and labor to do land grading, canal lining, road construction and other project works. Labor-intensive methods used wherever feasible.

DOCUMENTS REVIEWED: Project appraisal.

PROJECT ORIGIN AND BASE LINE DATA: It has been unofficially estimated that 10 million ha of recently completed irrigation projects require additional investments of between US$200 and

US$500 per hectare before they become fully productive. Command area development offers a means of making these required investments.

BENEFICIARY INVOLVEMENT: On-farm works to be financed mainly by farmers.

GENERAL DESCRIPTION

The Rajasthan Main Canal commands only about 30% of its intended irrigated area because of the lack of assured year-round water supplies caused by a heavy loss of water through the unlined distributary network and because of the poor state of preparation of virgin desert lands. This project would provide all of the necessary physical works and agricultural supporting services to enable full realization of the benefits of the existing Rajasthan Main Canal.

TECHNICAL

Project works include: lining 915 km of canal; construction of 431 km of roads; village water supply construction; lining 5,800 km of watercourses; land shaping on 32,000 ha; reclamation of 12,000 ha of sodic soils and assistance to farmers in shaping a further 26,000 ha and reclaiming an additional 17,000 ha.

INSTITUTIONAL

For the administration of this project, the GOR has created a Command Area Development Water Utilization Department (CAD&WU) at the State level and Rajasthan Canal Command Area Authority (CAA) at the project level. The CAA would be organized into four departments: Agriculture, Irrigation and Land Development, Cooperatives and Colonization, and Revenue. In addition, the Rajasthan Land Development Corporation (RDLC) would be a statutory corporation empowered to carry out on-farm development on a compulsory basis. Farmers ineligible for commercial loans for on-farm improvements would receive unsecured loans at higher rates from the RDLC.

SOCIAL

The process of settling about 33,000 heretofore landless families of 6.32 ha farms in the project area is to have been completed by mid-1974. These families would purchase their farms from the GOR over a 15-year period with an interest-free loan. The project is expected to provide the equivalent of 70,000 additional jobs and to lead to an increase in the net value of production of US$32M/year in 10 years' time and of US$44M at full development in year 21.

FINANCIAL/ECONOMIC

The projected farm budgets show that it is within the capacity of the project area farmers to pay for project O&M, as well

as to repay their loans for land purchase and for on-farm development costs. The GOR also intends to recover about 40% of the canal lining costs from the beneficiaries.

The project ERR is 25% based on a 25-year project evaluation period.

INDIA

RAJASTHAN CANAL COMMAND AREA DEVELOPMENT PROJECT

On-Farm Development Financing Scheme
(Rs Million)

Item	Project Year[a/] 1	2	3	4	5	6	Total
Construction Cost of On-Farm Development							
Rajasthan Canal Project	47.8	63.8	79.7	79.7	47.8	0.0	318.8
Chambal Project	5.7	11.8	16.0	19.0	20.4	22.6	95.5
Subtotal	53.5	75.6	95.7	98.7	68.2	22.6	414.3
Less:							
GOI disadvantaged farmer subsidy	2.3	3.6	4.6	4.8	4.0	1.2	20.5
Total Credit Financing (net of subsidy)	51.2	72.0	91.1	93.9	64.2	21.4	393.8
GOI Special Loans							
20% of Rajasthan Canal Credit Volume	9.6	12.8	15.9	15.9	9.6	0.0	63.8
30% of Chambal credit volume	1.7	3.5	4.8	5.7	6.1	6.8	28.6
Total	11.3	16.3	20.7	21.6	15.7	6.8	92.4

a/ First implementation year to begin October, 1974.
b/ Includes engineering costs, but excludes price contingencies.

INDIA

RAJASTHAN CANAL COMMAND AREA DEVELOPMENT PROJECT

Schedule of Expenditures

Item	Total Cost	IDA Fiscal Years 74/75	75/76	76/77	77/78	78/79	79/80
		Rs Million					
Infrastructural Work							
1. Canal Lining	276.0	22.1	33.1	55.2	55.2	55.2	55.2
2. Roads	61.1	4.9	7.3	12.3	12.2	12.2	12.2
3. Afforestation	45.1	3.6	5.4	9.0	9.0	9.0	9.1
4. Village Water Supply	15.4	1.2	1.9	3.1	3.1	3.1	3.0
Subtotal	397.6	31.8	47.7	79.6	79.5	79.5	79.5
5. Land Development	292.8	43.9	58.6	73.2	73.2	43.9	--
6. Supplementary Fertilizer	157.6	157.6	--	--	--	--	--
Subtotal	848.0	233.3	106.3	152.8	152.7	123.4	79.5
Physical Contingencies	60.0	6.6	9.3	13.3	13.3	10.7	6.8
Subtotal	908.0	239.9	115.6	166.1	166.0	134.1	86.3
Expected Price Increases -%	42	17	31	42	53	64	75
--Rs Million	390.9	42.1	36.5	70.9	89.2	86.8	65.4
Subtotal	1,298.9	282.0	152.1	237.0	255.2	220.9	151.7
7. Operating Cost during implementation	69.6	10.4[1/]	8.9	11.0	12.0	13.2	14.1
Expected Price Increases - %	34	12	22	29	36	43	50
--Rs Million	23.5	1.2	2.0	3.2	4.3	5.7	7.1
Subtotal	93.1	11.6	10.9	14.2	16.3	18.9	21.2
Total Project Cost	1,392.0	293.6	163.0	251.2	271.5	239.8	172.9

1/ This includes vehicle and equipment purchases of Rs4.4 million.

TITLE: Gujarat Irrigation Project

PROJECT NO.: I-W-3

COUNTRY: India

REGION: Asia

KEYWORDS: Irrigation (5).

SUMMARY: This project will finance the construction of about 10 MIP's and the modernization of about 10 more. Each project will contain a source of water, a distribution network and a drainage system.

LOCATION: Gujarat State.

CLIMATE: Bsh

CROPS: Millet, sorghum, wheat, rice, maize, cotton, groundnuts, tobacco.

SOILS: Deep black soils in southern mainland, ranging to sandy alluvium along the Rajasthan border.

BEGIN: 1978 END: 1983 AREA: 118K ha

NUMBER OF FARMS: 29K

CONTRIBUTION:

World Bank	US $ 85.0M
GOI and GOD	US $ 85.5M
TOTAL	US $170.5M

GOALS:

1. Achieve a more economic use of scarce surface water resources.
2. Ensure a reliable irrigation supply to individual farmers.
3. Spread irrigation to areas where large-scale development is not feasible.
4. Strengthen GOG's project preparation.
5. Further build up and consolidate GOI's capability to appraise irrigation projects.

TYPE OF PROJECT: Medium irrigation.

TECHNOLOGY USED: Construction of reservoirs, canals and appurtenances by the use of machinery and labor.

DOCUMENTS REVIEWED: Staff Appraisal Report.

PROJECT ORIGIN AND BASE LINE DATA: Expansion of irrigated area is one of the cornerstones in Gujarat's agricultural development strategy. Because of the limited scope for groundwater development, GOG gives high priority to surface irrigation.

BENEFICIARY INVOLVEMENT: The farmers would pay annual O&M costs and, to the extent possible, the cost of infrastructure investments.

GENERAL DESCRIPTION

Medium irrigation projects encompassing cultivable areas of 2,000 to 30,000 ha increase the production of food grains, oilseeds and long staple cotton while providing additional year-round employment to landless laborers and to small farmers.

TECHNICAL

The Medium Irrigation Project includes:

1. Construction of new medium irrigation works covering about 63,000 ha throughout the State;

2. Modernization of existing medium irrigation projects covering another 55,000 ha;

3. Developing a network of automatic discharge measuring stations to improve the hydrological data base for the planning of future major and medium projects; and

4. Monitoring and evaluation studies.

INSTITUTIONAL

The direct responsibility for planning, implementation, operation and maintenance of the MIP's rests with the Irrigation Wing of the Public Works Department (PWD). This department already has sufficient staff to meet the increased workload imposed by the project. The Central Water Commission (CWC) of GOI is responsible for appraising and reviewing the progress of MIP's financed from the credit.

SOCIAL

Most of the benefits of the modernization of MIP's would go to farmers on the tailend of existing systems. This would lead to a more equitable distribution of income within the project area.

FINANCIAL/ECONOMIC

The investment cost for MIP's would amount to about US$1,750/ha ana annual O&M costs are escimated at US$8/ha. Considering all the water and water-related charges collected from beneficiaries, GOG expects to recover about 16% of the annual capital and O&M costs. The average ERR of MIP's is anticipated to be around 19% for new constructions and about 26% for modernized systems.

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GUJARAT MEDIUM IRRIGATION SECTOR CREDIT

Proposed Allocation of the Credit

Category	Allocation (US$ equivalent)	% of Expenditures to be Financed
1. Civil Works		
(a) Construction of MIPs	67,000,000	60%
(b) Modernization of MIPs	16,000,000	60%
2. Equipment	300,000	
(a) Directly Imported Goods		100% of foreign expenditures
(b) Locally procured Goods		100% of ex-factory cost or 70%
3. Technical Services	200,000	100%
4. Unallocated	1,500,000	
Total	85,000,000	

INDIA

GUJARAT MEDIUM IRRIGATION SECTOR CREDIT

Estimated Schedule of Disbursements

Bank Fiscal Year and Semester		Disbursements (US $ M) Semester	Cumulative
1979	1st	0.0	0.0
	2nd	3.0	3.0
1980	1st	6.0	9.0
	2nd	7.0	16.0
1981	1st	8.0	24.0
	2nd	9.0	33.0
1982	1st	9.5	42.5
	2nd	10.0	52.5
1983	1st	10.0	62.5
	2nd	10.0	72.5
1984	1st	10.0	82.5
	2nd	2.5	85.0

TITLE: Maharastra Irrigation Project

REPORT NO.: I-W-4

COUNTRY: India

REGION: Asia

KEYWORDS: Command Area Development (CAD) (5); water management (2).

SUMMARY: The proposed project would complete the next slice, comprising about four years of infrastructural investment in Maharashtra's largest irrigation scheme, the Jayakwadi irrigation scheme, and initiate modernization of the adjacent Purna irrigation project. It would also be the first step in a 10 to 15 year command area development (CAD) program, designed ultimately to cover over one million hectares in the State, including about 277,000 hectares in the Jayakwadi and about 60,000 hectares in the Purna commands. It would also strengthen the extension service in both areas and provide a monitoring and evaluation system for generating a data base for planning future irrigation and command area development projects in similar drought-prone areas.

LOCATION: Maharastra State.

CLIMATE: Aw

CROPS: Sorghum, wheat, pulses, cotton, sugarcane.

SOILS: Deep, calcareous, expansive clay loams.

TARGET GROUP: The irrigating farmer.

BEGIN: September 1978 END: 1982 AREA: 170K ha

NUMBER OF FARMS: 26K

CONTRIBUTION: The proposed credit of US$70M would finance about 50% of the total project cost covering the foreign exchange component of US$38M and 31% of local costs. The credit would be made to GOI. All capital investments would be financed by GOM from its development budget, which would include a GOI contribution. Operation and maintenance costs would be financed by GOM from its development budget, which would include a GOI contribution. Operation and maintenance costs would be financed by GOM from its regular budget.

GOALS: The project objectives would be compatible with those of the Fifth Five-Year Plan. They would be to increase the production of food grains, provide employment opportunities to

landless laborers, and part-time small farmers, and improve the welfare of the low income families in the project area.

At full development, the Jayakwadi project would have the following impact on the economy:

1. Increase the annual production of food grains by 111,000 tons;

2. Provide the equivalent of 38,000 man-years of additional employment in agriculture, mainly to the advantage of landless laborers;

3. Increase the annual average net incomes of the 14,500 families on project lands by approximately five times; and

4. Produce an annual incremental net value of production (economic) of Rs 219 million M (US$24.3M).

PURPOSE: The transformation of the 95,000 ha in the Jayakwadi Project from rainfed agriculture in a drought-prone area to fully irrigated land would result in an increase in cropping intensity (95% to 127%) and in crop yields from some of the lowest in India to a reasonable level. These changes would in turn result in significant increases in the production of food grains, cotton and sugarcane. Increases would be significantly greater in the area on which on-farm development would be carried out than in the area which would benefit only from irrigation infrastructure. At Purna, the improved production levels presently being reached under CADA guidance would be consolidated and progressively improved and extended to the whole 60,000 ha area. In all cases, the strengthened agricultural extension service would play a major role in achieving and sustaining agricultural output.

TYPE OF PROJECT: Large-scale command area development.

TECHNOLOGY USED: Labor-intensive construction methods would be used for most project construction work. Canal structures, except for span portions, would be masonry. The stone would be hand-quarried from the nearby basalt deposits which underlie most of the project area. Coarse aggregate for reinforced concrete would be produced by manual labor from excavated rock.

DOCUMENTS REVIEWED: Project Appraisal (160 pages), Report and Recommendation of the President of IDA.

PROJECT ORIGIN AND BASE LINE DATA: The project was prepared with assistance from the FAO/IBRD Cooperative Program and appraised by the Bank in September and October of 1976.

BENEFICIARY INVOLVEMENT: The 1972 GOI Irrigation Commission concluded that irrigation projects would not impose any burden on the general revenue. The Bank supports that policy and, during project preparation, GOM agreed that the fullest measure of cost recovery compatible with the farmers' ability to repay would be instituted. Maharashtra already imposed comparatively heavy taxes on the farming community, including some of the highest current irrigation charges in India. These have been increased threefold in the past decade. At full project development, with CAD fully implemented and with current irrigation and related charges, the average project beneficiary in the CAD area would pay annual charges and assessments totaling Rs 664/ha. This charge, which would be equivalent to about 31% of the net incremental farm income per ha, represents 47% of the project rent and would recover 35-40% of total project costs amortized over 30 years at 10% interest.

GENERAL DESCRIPTION

The Jayakwadi and Purna Irrigation Systems, two adjacent schemes covered by the project, are located in the drought-prone central western Deccan. In this area, more than in other parts of India where water resources are more plentiful, strictly enforced water discipline and measures for saving water in conveyance are essential in project design. Such measures are:

1. Water conservation through water allocation planning and irrigation system management techniques and the construction of a lined canal network to minimize seepage losses; and

2. Increasing the cropping intensity of the large farms, which are characteristic of the project area, by a comprehensive program of on-farm development and strengthening of agricultural supporting services.

The project introduces these measures in the Jayakwadi and Purna commands. It contains the following components: irrigation works, command area development and a village road network within the planned 183,000 ha Jayakwadi Stage I command area; and modernization of canal structures and provision of drainage works in 30,000 ha of the Purna command area. The project is limited to works that are planned to be completed within about four years.

TECHNICAL

The project would include:

1. Completion of the Jayakwadi LBC between km 100-208; the RBC between km 20-132;

2. Provision of a distributary canal system for an irrigation and drainage canal network to serve about 57,000 ha of the LBC command and about 38,000 ha of the RBC. All the irrigation network would be lined;

3. Rehabilitation, upgrading and construction of 385 km of district and village link roads in Jayakwadi and Purna;

4. Rehabilitation of irrigation distribution works and provision of drainage serving about 30,000 ha of the Purna scheme;

5. On-farm development (CAD) in the Jayakwadi area comprising land shaping and field channels, covering 25,000 ha of LBC and 20,000 ha of RBC areas;

6. Eleven market centers in Jayakwadi and Purna; and

7. Provision of monitoring facilities in Jayakwadi to help determine the efficiency of the irrigation system and to evaluate operation and seepage losses; and a system to evaluate project benefits in Jayakwadi.

SOCIAL

No significant information given.

ORGANIZATION AND MANAGEMENT

The Jayakwadi/Purna Command Area Development Authority

The construction of the project and its subsequent management and operation would be the responsiblity of the Jayakwadi/Purna Command Area Development Authority.

The Authority was created in 1974 and is one of the five established in Maharashtra. The Authority's principal executive is an Administrator resident in Aurangabad who is responsible to an Executive Committee (EC) comprised of Regional Heads of Departments, Members of the Legislative Assembly and Cultivators. The EC, through its composition, permits the participation of elected officials in planning and policy-making. The Authority falls within the purview of the Marathwada Region CAD Board which is chaired by a State Minister and composed of elected and appointed officials. The Regional Board acts as a filter between the Regional CADA and the State Cabinet Subcommittee which directs CAD policy. The Cabinet Subcommittee is chaired by the Chief Minister of the State and includes the Ministers of Agriculture, Irrigation and Power, and Finance. The chain of command reflects both GOM's desire to involve the people's representatives in planning and decision-making at regional and scheme levels and the substantial powers that it has provided to the Authority's Administrator who, unlike even the heads of line departments, has, through the Subcommittee, a very close link with the State's Chief Executive. The Secretary of the Subcommittee is the CAD Commissioner and he is responsible for preparing annual development and financial plans for each CAD scheme. Such plans are prepared in conjunction with the Secretaries for Finance, Agriculture, Irrigation and Power, Public Works and such other Ministries as are involved in CAD schemes. Administratively, the CAD Commissioner is located in the Ministry of Agriculture and CAD affairs are part of that Ministry's portfolio.

The Administrator of the Jayakwadi/Purna CADA has two deputies; one is responsible for operation and maintenance services (engineering) and the other for production support services (agriculture). These three officials, together with a very small staff, would

direct and coordinate the work in the scheme areas, of the following State agencies and departments:

1. Irrigation and Power Department. Planning and construction (down to the chak outlet) of the drainage and irrigation systems and O&M of principal reservoirs. Additional Chief Engineer Aurangabad, in charge.

2. Agriculture Department. Agricultural extension, including on-farm water management and other farmer support services, coordination of farm input and short-term credit supply, crop production recording and agricultural statistics, Superintending Agricultural Officer, Aurangabad, in charge.

3. Public Works Department. Planning, design, construction and maintenance of PWD roads and buildings. Superintending Engineer, Aurangabad, in charge.

4. Revenue Department. Land revenue administration. Collectors of the four administrative divisions of the scheme areas in charge.

5. Maharashtra Land Development Corporation. Design and execution of on-farm development works. Project Manager in charge.

The administrator and his deputies would manage directly the O&M of the canal system including irrigation water allocation and maintenance of farm access roads. The Assistant Administrator (Engineering) would supervise a team of engineers provided by the Irrigation and Public Works Departments for these purposes. Importantly, the Authority would also be involved in promoting farmers' organizations and for handling subjects such as credit, input supplies, and water management.

On-Farm Development

On-farm development would be compulsory for all farmers in a chak where 67% of the farmers or holders of 67% of the land agree to the preliminary plan and cost estimates drawn up by MLDC. The works would involve land shaping and construction of watercourses and drains. Experience indicates that the great majority of farmers would opt to have their land shaped by MLDC and that all would wish to have the "common" work constructed by MLDC. Farmers would be eligible for credit for such works from CB's and the SLDB which would divide the scheme area between them for this purpose. A standard condition of eligibility for credit would be evidence of clear land title and no arrears in repayment of credit advances. Currently, it is believed that more than 75% of the project participants would be eligible. To cover non-eligible farmers and thus to ensure that there would be no financial obstacles to farmer

participation, ARDC has agreed with GOI and GOM to establish a Special Fund to refinance loans to non-eligible farmers.

ECONOMIC

In the Jayakwadi command area, the project would complete the infrastructure needed to irrigate, for the first time, 95,000 ha; it would line all canals and would cover 45,000 ha under a first stage CAD program. The annual increase in production, including 110,000 tons of food grains, expected at full development, is valued at US$24 million. At full development, under the intensified cropping pattern, the project would annually provide 38,000 man-years of additional employment in agriculture, mainly that of landless laborers. The annual net income of 14,500 farm families would increase roughly five times. The economic rate of return is 17%, or 14% for the irrigation infrastructure area alone and 19% for the full CAD area. The benefits include the quantifiable benefits of the net value of increased production and the value of water saved by canal lining. The costs include those of the infrastructure (excluding sunk costs), canal lining and CAD components. Including sunk costs, the rate of return decreases to 10% and 12%, respectively. These calculations do not make allowance for the fact that unemployment (and poverty) in the project is severe and that, therefore, the real economic cost of labor employed in this project is below the market wage. If construction labor were shadow-priced at half its market wage, the rate of return would be 12.5% with sunk costs and 21.5% without. Furthermore, no attempt has been made to quantify the benefits, which, in addition to agricultural production, the local population would derive from some parts of the CAD component, such as roads.

In the Purna area, modernization of infrastructure will have costs and benefits relatively similar to those for the Jayakwadi project components. For drainage construction, which would save at least 8,000 hectares from severe production losses due to waterlogging, the rate of return would be about 13%. Since the economic rate of return is 17% for the Jayakwadi component of the project, which represents 94% of project base costs, and since the return on the Purna component (accounting for 6% of project cost) is about 13%, the overall economic rate of return for the total project is 16.8%.

Net annual farm incomes in the project areas, presently averaging Rs 1,600 per family, would increase under the project with full CAD to an average Rs 12,300. At full project development, with CAD fully implemented, the average beneficiary would pay annual charges totaling Rs 664/ha. This would be sufficient to ensure recovery of 35-40% of total project cost, including O&M and capital cost, within 30 years at 10% interest. As this would represent 31%

of the net incremental benefits generated by the project, it would not be practicable at present to increase water charges further. However, Maharashtra would, in the future, review and, if necessary, increase water and water-related charges in the Project Area from time to time to collect full operational and maintenance cost and, to the extent possible, cost of infrastructure investment. For on-farm development works, investment costs would be fully repaid by the farmers as payments on loans. Given the extreme poverty of the area and recognizing that average farm income at full development of the project would still lag behind average farm income in other irrigated areas of India, GOM's current policy with regard to cost recovery is a satisfactory basis for proceeding with the project.

Attached are economic tables included in the project proposal which give information on anticipated cost recovery, farm income, value of incremental production, and a project cost breakdown.

	Local	Foreign	Total	Local	Foreign	Total	Percent of Base Cost
	---Rs Million---			---US$ Million---			%
(a) Jayakwadi							
1. Paithan Left Bank and Right Bank Network	414.7	170.0	584.7	46.1	18.9	65.0	65.5
2. Equipment for Operation and Maintenance	7.7	12.1	19.8	0.9	1.3	2.2	2.2
3. Lining of Distributaries and Minors	49.0	15.8	64.8	5.5	1.7	7.2	7.3
4. CAD	78.0	17.1	95.1	8.7	1.9	10.6	10.7
5. Road Program	37.8	7.3	45.1	4.1	0.9	5.0	5.0
6. Extension Services	10.3	1.4	11.7	1.1	0.2	1.3	1.3
7. Monitoring Program	7.6	8.7	16.3	0.8	1.0	1.8	1.8
8. Market Yard Construction	2.1	0.7	2.8	0.2	0.1	0.3	0.3
Subtotal	607.2	233.1	840.3	67.4	26.0	93.4	94.1
(b) Purna							
9. Purna Modernization	26.0	8.7	34.7	2.9	1.0	3.9	3.9
10. Road Program	10.2	2.0	12.2	1.2	0.1	1.3	1.3
11. Extension Services	3.4	0.1	3.5	0.4	0	0.4	0.4
12. Market Yard Construction	1.1	0.1	1.2	0.1	0	0.1	0.1
Subtotal	40.7	10.9	51.6	4.6	1.1	5.7	5.7
(c) Project Preparation							
13. GOM Project Preparation	1.8	0	1.8	0.2	0	0.2	0.2
BASE COST	649.7	244.0	893.7	72.2	27.1	99.3	100.0
Physical Contingencies	79.0	29.5	108.5	8.8	3.3	12.1	
Price Contingencies	190.2	67.2	257.4	21.1	7.5	28.6	
TOTAL PROJECT COST	918.2	340.7	1,259.6	102.1	37.9	140.0	

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MAHARASHTRA IRRIGATION PROJECT

Cost Recovery

Items	Full Package Area	Irrigation Infrastructure Area
	Rs/ha/yr	
Annual Financial Requirement		
Irrigation Infrastructure[1]	1,080[5]	1,080
On-Farm Development	396[5]	-
O&M	75	75
Total	1,551	1,155
Cost Recovery Under Existing Charges		
Water Charges	150	150
Employment Cess	25	25
Education Cess	27	27
Sugarcane Crushing Tax	66	66
Subtotal	268[5]	268
On-Farm Development	396[2]	--[2]
Total	664[2]	268[2]
Project Rent (full development)[3]	1,425	850
Annual Benefits (full development)	2,860	1,810
Incremental Net Farm Income[4]	2,143	1,376
	%	
Cost Recovery Under Existing Charges as % of:		
Project Rent	47	32
Annual Benefit	22	13
Incremental Net Farm Income	31	19
Proportion of Total Cost Recovered Under Existing Charges (%)	37	23

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1/ Includes share of sunk costs.
2/ Assuming present price differentials, farmers would also contribute about 40 Rs/ha through the food grain procurement program.
3/ Weighted average.
4/ Over future without development.
5/ For 10 years only, thereafter same as for irrigation infrastructure area.

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MAHARASHTRA IRRIGATION PROJECT

Farm Income

Farm Size[1/]	Gross Value of Production	Production Cost	Net Farm Income
	---------- Rs ----------		
2 ha Farm			
P	1,439	636	803
$\bar{W}_1$	2,026	987	1,039
W_2^1	7,997	3,614	4,383
W^2	10,963	4,547	6,416
Increase: (%)			
W_2^1 over $\bar{W}$	295	--	322
W^2 over $\bar{W}$	441	--	518
5 ha Farm			
P	3,134	1,413	1,721
$\bar{W}_1$	4,510	2,152	2,358
W_2^1	17,108	7,842	9,266
W^2	23,238	9,862	13,376
Increase:			
W_2^1 over $\bar{W}$	279	--	293
W^2 over $\bar{W}$	415	--	467
8 ha Farm			
P	4,620	2,080	2,540
$\bar{W}_1$	6,442	3,210	3,232
W_2^1	25,283	12,743	12,540
W^2	34,413	16,243	18,170
Increase:			
W_2^1 over $\bar{W}$	292	--	288
W^2 over $\bar{W}$	434	--	462

[1/] P = present; $\bar{W}$ = Future without project; W^1 = Future with irrigation infrastructure, and W^2 = Future with full-package development.

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MAHARASHTRA IRRIGATION PROJECT

Value of Incremental Production (Economic)
(Total Project - 95,000 ha)

Crops	Production F-W/O[1/] ('000 tons)	Production F-W[1/] ('000 tons)	Increase ('000 tons)	Price (Rs/ton)	Value Incremental Production (Rs '000)
Kharif					
Paddy	0.81	17.20	16.39	1,710	28,027
Sorghum	7.01	48.60	41.59	990	41,174
Cotton	5.49	34.00	28.51	4,230	120,597
Pearl Millet	2.79	5.62	2.86	1,215	3,475
Pulses	4.86	4.50	-0.38	1,575	- 599
Chilies	0.00	1.02	1.02	9,900	10,098
Rabi					
Wheat	3.74	43.01	39.27	1,665	65,385
Sorghum	17.42	33.37	15.95	1,215	19,379
Gram	1.73	3.30	1.57	1,575	2,473
Oilseeds	2.80	3.12	0.32	2,790	893
Perennial					
Sugarcane	115.82	380.00	264.18	108	28,531
Total	--	--	--	--	319,433
Incremental farm economic cost			--	--	100,191
Net Balance	--	--	--	--	219,242

1/ F - W/O = Future without project
F - W = Fugure with project

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MAHARASHTRA IRRIGATION PROJECT

Value of Incremental Production (Economic)

(Full Package Area-45,000 ha)

Crops	Production			Price	Value of Incremental Production
	F-W/O[1/]	F-W[1/]	Increase	(Rs/ton)	(Rs '000)
	('000 tons)				
Kharif					
Paddy	0.39	10.80	10.41	1,710	17,801
Sorghum	3.35	27.00	23.65	990	23,414
Cotton	2,62	18.0	15.38	4,230	65,057
Pearl Millet	1.32	2.03	0.71	1,215	863
Pulses	2.33	2.25	-0.08	1,575	- 126
Chilies	0.00	0.54	0.54	9,900	5,346
Rabi					
Wheat	1.79	26.91	25.12	1,665	41,825
Sorghum	8.34	19.13	10.79	1,215	13,110
Gram	0.83	1.80	0.97	1,575	1,528
Oilseeds	1.34	1.62	0.28	2,790	781
Perennial					
Sugarcane	55.40	180.00	124.60	108	13,457
Total	--	--	--	--	183,056
Incremental Farm Economic Cost			--	--	54,396
Net Balance	--	--	--	--	128,660

1/ F-W/O = Future without project
F-W = Future with project

TITLE: Maharastra Irrigation II Project

REPORT NO.: I-W-5

COUNTRY: India

REGION: Asia

KEYWORDS: Canal (3); surface irrigation (3).

SUMMARY: This project will aid in the development of irrigated agriculture in the drought-prone Deccan plateau by assisting in the construction of six major irrigation schemes and in the modernization of two more.

LOCATION: Maharastra State.

CLIMATE: Bsh

CROPS: Sorghum, maize, wheat, rice, sugarcane, vegetables, cotton, groundnuts.

SOILS: Shallow to deep clay loam over basalt.

TARGET GROUPS: Farmers and the rural landless.

BEGIN: October 1979 END: September 1984 AREA: 147K ha after five years, 620K ha ultimately.

NUMBER OF FARMS: 40K after five years, 145K ultimately.

CONTRIBUTION:

GOI and GOM	US $ 291.0M
World Bank credit	210.0M
IFAD Financing of Bhima Irrigation Scheme	50.0M
TOTAL	$ 551.0M

GOALS: To increase agricultural production by improving availability and distribution of irrigation water. This would, thereby, generate additional year-round employment for landless laborers and small farmers. Also, organizational improvements introduced under the operation would strengthen local capabilities for the planning, design, monitoring and evaluation of irrigation schemes.

TYPE OF PROJECT: Large-scale construction and rehabilitation of canals, dams and roads.

TECHNOLOGY USED: Dams, roads and canals built in part by machines, but primarily by labor.

DOCUMENTS REVIEWED: Staff Appraisal Report (210 pages, in two volumes).

PROJECT ORIGIN AND BASE LINE DATA: GOI and IDA selected this region because of the area's as yet unfulfilled potential as irrigated farmland and because of Maharastra's strong administration and sound financial position.

BENEFICIARY INVOLVEMENT: Farmers will repay the cost of construction of watercourses leading from the eight hectare turnout to the farmgate.

TECHNICAL

1. Construction work on 11 dams, construction of about 900 km of main and branch canals together with construction of distribution canals (down to the farmgate); drains to serve an area of 95,000 ha; and about 620 km of new and improved link roads to serve an area of 85,500 ha in the five new irrigation schemes. (The IFAD-financed Bhima scheme includes construction of a dam, 175 km of main and branch canals to serve an area of 52,000 ha and 301 km of roads to cover an area of 45,000 ha).

2. Modernization of canals and drains in the Mula and Girna irrigation schemes.

3. Strengthening of the Command Area Development Organization (CAD), including reorganization of agricultural extension and applied research and water management services and operation and maintenance on all eight schemes.

4. Procurement of vehicles and equipment for project construction and for operation and maintenance.

INSTITUTIONAL

The Irrigation Department will be responsible for the planning, survey, design and construction supervision of the project's dams, canals and drainage works. Completed segments of the system will be handed over to the Command Area Development Authority (CADA) wing of the Irrigation Department which will be responsible for the system's operation and maintenance. The Agricultural Department, in conjunction with CADA, will direct agricultural planning and extension, while the Public Works and Housing Department will be in charge of road construction and repair. Because of the scope of this project, the Government of Maharastra will reinstitute the Quality Control Unit of the Irrigation Department to provide systematic inspection of field construction.

SOCIAL

This project aims to provide work opportunities for both the rural landed and landless. In addition, the project's water management scheme is designed to provide an assured, equitable and timely delivery of water so that farmers may harvest the maximum benefit from this resource.

FINANCIAL/ECONOMIC

The construction costs for each watercourse are financed by the Agricultural Refinance and Development Corporation through loans made to individual farmers. Field channel construction between present 40 ha outlets and new eight hectare outlets will be paid for by the State budget with full recovery from cultivators probably being received through the imposition of a land revenue charge.

The ERR for the project is 15% discounting costs and benefits over a 50-year period at either 10% or 12% interest rates.

The project will add an anticipated $317M to the local economy.

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MAHARASHTRA IRRIGATION II PROJECT

Project Cost Estimates

	Rs Million			US$ Million			
	Local	Foreign	Total	Local	Foreign	Total	% of (A)
1. Dams	570	241	811	66.2	28.0	94.2	35.3
2. Main Canal & Branches (Lined)	669	119	788	77.9	13.8	91.7	34.3
3. Distribution (below 100 cusecs) Network (Unlined)	56	6	62	6.5	0.9	7.4	2.8
4. Lining Distribution Network down to minor canal outlet (40 ha)	29	7	36	3.4	0.9	4.3	1.6
5. Lining subminor canals (40 ha to 8 ha level)	27	7	34	3.1	0.8	3.9	1.5
6. Subminors, Field Channels and Field Drains	48	6	54	5.7	0.5	6.2	2.3
7. Roads in Command Area	102	18	120	11.8	2.1	13.9	5.2
8. O&M (Bldgs. & Equipment)	12	4	16	1.2	0.6	1.8	0.6
9. Extension & Land Development Agency (bldgs. & equipment)	15	1	16	1.7	0.1	1.8	0.7
10. Drainage	4	--	4	0.5	--	0.5	0.2
11. Training in Water Management	21	4	25	2.4	0.5	2.9	1.1
12. Agricultural Training and Research	6	1	7	0.7	0.1	0.8	0.3
13. Monitoring & Evaluation	3	--	3	0.3	--	0.3	0.1
14. Pilot Water Management	12	--	12	1.4	--	1.4	0.5
15. Land Acquisition & Rehabilitation	310	--	310	36.1	--	36.1	13.5
Total (A)	1,884	414	2,298	218.9	48.3	267.2	100.0

	Rs Million			US$ Million			%
	Local	Foreign	Total	Local	Foreign	Total	of (A)
16. Modernizing Irrigation Systems of Girna & Mula Irrigation Schemes	63	11	74	7.3	1.3	8.6	
17. Engineering and Administration	378	--	378	43.9	--	43.9	
Total (B) Base Cost	2,325	425	2,750	270.1	49.6	319.7	
Physical Contingencies	349	61	410	40.6	7.1	47.7	
Total (C)	2,674	486	3,160	310.7	56.7	367.4	
Expected Price Increases	599	120	719	69.6	14.0	83.6	
TOTAL	3,273	606	3,879	380.3	70.7	451.0	

NOTES: 1) Price increases are taken at 7% on works, 5% on establishment--average 6.7%.
2) US$1 = Rs 8.6.

TITLE: Resource Conservation and Utilization Project

PROJECT NO.: 367-0132

COUNTRY: Nepal

REGION: Asia

KEYWORDS: Soil conservation (5); water management (3).

SUMMARY: The Resource Conservation and Utilization Project is a multifaceted and integrated project that will attempt to halt the rapid degradation of Nepal's environment. Reforestation, better range management, development of alternative sources of energy other than open wood fires, improvement of agricultural methods and watershed management are resource conservation procedures that will be implemented in an attempt to control this degradation. In order to obtain the necessary personnel to carry out the project, a multitiered training program will be developed.

LOCATION: Kulekhani area, Gorkha area, Mustang area, Mydagdi area, Jumla area.

CLIMATE: Aw.

CROPS: Maize, millet, barley, paddy, wheat, and fruit.

SOILS: Not given.

TARGET GROUP: Nepalese hill people.

BEGIN: 1980 END: 1985 AREA: 185K ha.

TARGET GROUP POPULATION: 700K.

CONTRIBUTION:

AID	$41,015,000
HMG/N	6,442,500
TOTAL	$47,457,600

GOALS: To improve the standard of living of the rural poor through increased agricultural production, raise the nutritional level of the rural population and to develop employment opportunities in rural areas.

PURPOSE: To assist HMG/N in the protection and restoration of the soil, water and plant resource base upon which the rural population is totally dependent.

TYPE OF PROJECT: Large-scale, multifaceted rural development and environmental protection project.

TECHNOLOGY USED: Nonconventional energy technologies, rural road and bridge construction, introduction of improved agricultural techniques (none of the methods to be used in these phases of the project have been specified in the report).

DOCUMENTS REVIEWED: Project Paper (63 pp).

PROJECT ORIGIN AND BASE LINE DATA: The Southeast Consortium for International Development (SECID), a Title XII institution, was selected to assist HMG/N in designing the RCU project. Also, a 1977 AID Consultant's Report (D.B. Thorud, et al.) discussed the present status of land use practices and offered a basis for the formulation of the project paper for the design state of the RCUP program.

BENEFICIARY INVOLVEMENT: Not specified in the project papers.

LOGICAL FRAMEWORK: Attached to reviewed documents.

GENERAL DESCRIPTION

All of the literature on the Himalayan ecosystem illustrates the staggering range of environmental problems that affect Nepal. This project paper suggests an integration of major components that will exert an influence on the entire system of socioeconomic and ecological interdependence that exists in the hills. This project is to proceed simultaneously in two directions. One is to promptly implement the planned resource and social actions to begin the reversal of the environmental degradation process. The second is strengthening the in-country educational and technical training capabilities so that resource management is developed as rapidly as possible.

TECHNICAL

In order to complement the agricultural component of the project, it is intended that early attention will be directed to upgrading existing irrigation systems in the region as well as undertaking the building of new irrigation projects. Only eight percent of the cultivated land in Kulekhani, Gorkha and Mustang is served by irrigation systems. Yet, it is recognized that a successful irrigation program will substantially reduce pressure to cultivate steep slopes, prevent further soil erosion and assist in efforts to bring additional land under productive cultivation.

A total of 19 new projects and 19 rehabilitation projects have been identified in Kulekhani, Gorkha, and Mustang/Myagdi. The planned multipurpose impoundment for Gorkha includes an irrigation benefit in addition to micro-hydrodevelopment, fisheries propagation and water storage.

The project papers do not specify either how the existing irrigation projects are to be improved or how the new projects are to be constructed.

ENVIRONMENTAL

The primary purpose of RCUP is to make land more productive through instituting sound land-use practices appropriate to the control of soil erosion, flooding, deforestation and overall environmental degradation. An Initial Environmental Examination (IEE) was prepared for the RCUP design project paper and it recommended a negative determination. This was approved July 28, 1978.

The project's field operations focus on four selected areas representative of hill and mountain conditions in Nepal, especially with respect to combinations and/or intensities of typical soil and

water conservation problems. Within these four ecological zones, discrete but complementary activities will center on the application of practical methods to reverse existing environmental degradation by advocating and demonstrating practices which allow a better balance between people and nature.

At the national level, the project will assist in the training of individuals in the appropriate fields related to resource conservation. RCUP will also support existing and developing institutions which will be involved in resource-related activities. It is projected that these activities will lead to the protection, improvement and use of natural resources in ways which promote the highest possible economic and social benefits for the nation.

There are no controversial environmental issues within the proposed actions. The project is unique in that its whole purpose is to identify and correct the existing environmental degradation. It will establish an environmental correction procedure, based upon project activity, that is anticipated to diffuse far beyond the designated sites. During project implementation, environmental examinations will be conducted before any infrastructure is constructed in the project areas.

INSTITUTIONAL

The main objective of this set of activities is to increase the capacity of the Nepalese people to provide the technical and administrative skills required to carry out resource conservation management, while continuing to serve the needs of the target population. Staff requirements, both in Kathmandu and at the project sites, will be expanded to meet program goals and to ensure that villagers are fully involved in the design, implementation, and evaluation of proposed program approaches. This will occur through training of program personnel either in Nepal or out-of-country depending on the specialized needs of the project and access to and availability of, training facilities.

Participant training outside Nepal will be done primarily in the U.S. and will lead to academic degrees. In addition, short-term study tours will be provided in order to introduce trainees to subjects not warranting degrees.

The Ministry of Forest, Department of Soil and Water Conservation will be the coordinating HMG/N agency for the RCUP.

SOCIAL

Project activities, for which it is estimated that at least 25% and up to 100% of the target population will be directly benefited, include forest management and tree plantation of various kinds, drinking water, animal health, and provision of improved crop varieties. This is followed by another group of project activities which are estimated to directly benefit between five percent and 25% of the population in the particular areas in which they are implemented. These include water source protection, irrigation, range and pasture development, agricultural credit and other agronomic inputs, and horticulture.

ECONOMIC

Through the prudent application and implementation of RCUP inputs, discernible benefits will accrue to people living within the four districts and secondary benefits to most of the people living in neighboring districts. Tertiary benefits should be realized in Nepal's terai due to a decrease in migration from the hills to that area, and in India and Bangladesh because of the decrease of sediment and flooding in the Ganges River system. These latter two economic externalities impacting on areas outside the project, while not quantified in this analysis, will be important, actual benefits attributable to the project. Total population of the target group is approximately 700,000 people, representing five percent of Nepal's population.

During the proposed 15-year span of the RCUP, specific and quantifiable incremental benefits will flow as a result of the following project inputs:

1. Forest Management programs and the establishment of new forests will produce an increase in fuelwood, timber, fodder, forage and decreases in soil loss, soil erosion, and flood peaks as well as lower crop losses from a reduction in sediment deposition. Net benefits will begin in year three with an estimated $1.8 million and, after year five, should average $3.6 million per year.

2. Range Management programs will assist to increase forage production, improve pasture management and introduce more efficient uses of animal manure. Benefits will be an increase in the production of milk, meat, eggs, wool, and other animal products which should generate $354,500 starting in year two and average $4 million per year over the life of the project.

3. Irrigation and Agronomy programs consisting of improved farming practices, as well as new and improved irrigation

systems, should stabilize the agricultural/ecological systems, resulting in increased land conservation and agricultural production. Modest benefits of $329,700 are estimated in the initial year of the project and should average $3.2 million per year during the project's life.

4. Horticulture programs will include the distribution of approximately one million saplings, kitchen garden vegetable production and development of eight fruit nurseries. Major benefits for these activities will not materialize until year 10 because newly planted tree crops require several years to produce marketable yields. In the last five years of the project, benefits are estimated at $3.3 million per year.

5. Watershed Management will include, among other items, terrace improvements (1,330 hectares) and trail improvements (75 kilometers), major gully control (28 gullies) on range lands, landslide rehabilitation (15 sites) and slope stabilization for roads. These activities will increase crop yields, decrease river and reservoir sedimentation and improve the productive capacity of the land, forest and water resources. Estimated average annual benefits of $110,000 are low, due to substantial amounts of expensive structural construction work. Thus, some of the suggested costly structural work may need to be further analyzed and alternative approaches considered during the implementation stage of the project.

6. Drinking Water projects (82) will be undertaken to increase dependable water supplies for villages. Benefits will be derived from unquantifiable health improvements and measurable village labor time-savings resulting from a decrease in time required to carry daily water supplies to households. Initial benefit of $77,000 will occur in year three and average annual returns for the project are estimated at $254,300.

7. Energy programs consist of stove improvement, solar and bio-gas demonstration and installations, design and construction of small micro-hydroplants and multipurpose water impoundments. The immediate objective is to introduce improved stoves, thereby making more efficient use of fuelwood.

Additional energy activities are a combination of experimental undertakings and operational installations of energy conservation units. Although benefits will be realized from all of these activities, only the benefits from introducing 590 new, more efficient, wood-burning stoves are included in this analysis. In the first year, benefits are estimated at $1,500 and should average $15,500 per year over the project's life.

RCUP will provide other inputs, such as inventory and monitoring, training programs, technical advisors, consultants, construction components and fisheries development. The latter activity is experimental and the former project components are support functions to ensure that the production-related programs are adequately equipped and supported to realize RCUP objectives. Actual benefits are not measured for these inputs, but all financial costs incurred in providing these items are included in the total project cost. Additionally, economic costs, such as forage production for livestock development and a 10% financial contingency, are included in the annual economic costs. Expected increase in land value as a result of improvements to forest areas has been excluded from estimated benefits. Consequently, the economic analysis reflects a conservative treatment of recording costs and benefits for the project.

After discounting and comparing the annual flow of the project's estimated economic benefits with costs, it is evident that the project is economically viable, producing a positive net present value (NPV) of $8,429,800 at a 15% discount rate over 15 years.

Sensitivity analysis has been conducted to measure the effects which unfavorable variables would have on the project. Using the same discount rate, project costs were increased by 10% and benefits decreased by 10%, resulting in a net present value of ($143,700). Therefore, the project remains viable even after introducing adverse economic conditions. A positive NPV indicates that capital, recurrent and economic costs are recovered and a surplus accrues to the project. The 15% discount rate was selected because that rate represents the estimated average opportunity cost of capital in Nepal. Presently long-term cost of capital varies from 10% for small industries to 20% for commercial activities; agro-based industries average 12%.

In addition to computing NPV, an internal rate of return (IRR) calculation was conducted. The IRR to the economy is estimated at 21.5% for a project duration of 15 years. When the previously mentioned sensitivity analysis is employed, the IRR drops to 14.9%.

Attached are calculations of net present value and internal rate of return for the project.

CALCULATION OF NET PRESENT VALUE AND INTERNAL RATE OF RETURN
FOR RCUP, BENEFITS AND COSTS, 1981-1995
($ 000)

End of Year	Total Cost	Total Benefits	Net Benefits	Dis-counted 15%	Dis-counted 20%	Dis-counted 25%
July 1981	7790	323	(7467)	(6496.3)	(6220.0)	(5973.6)
July 1982	9014	2253	(7861)	(5942.9)	(5455.5)	(5031.0)
July 1983	8789	4066	(4723)	(3107.7)	(2734.6)	(2418.2)
July 1984	7493	6909	(584)	(334.1)	(281.5)	(239.4)
July 1985	5952	8065	2113	1050.2	849.1	693.1
July 1986	4664	11168	6504	2809.7	2178.8	1704.1
July 1987	4664	11168	6504	2445.5	1814.6	1365.8
July 1988	4664	11168	6504	2126.8	1515.4	1092.7
July 1989	4664	11168	6504	1847.1	1261.8	871.5
July 1990	4664	11168	6504	1606.5	1053.7	695.9
July 1991	5143	20131	14988	322.4	2023.4	1289.0
July 1992	5143	20131	14988	2802.8	1678.7	1034.2
July 1993	5143	20131	14988	2443.0	1393.9	824.3
July 1994	5143	20131	14988	2113.3	1169.1	659.5
July 1995	5143	20131	14988	1843.5	974.2	524.6
				8429.8	1221.4	(2907.5)

Note: The internal rate of return (by interpolation) is 21.5 percent.

TITLE: Birganj Irrigation Project

REPORT NO.: N-W-1

COUNTRY: Nepal

REGION: Asia

KEYWORDS: Canal irrigation (3); tubewell irrigation (3).

SUMMARY: The project would complete the canal distributary network of the Birganj surface-water irrigation project.

LOCATION: In the Bara and Parsa districts of the Narayani Zone.

CLIMATE: Aw.

CROPS: Rice, wheat, sugarcane, pulses.

SOILS: Medium to fine-textured alluvium.

TARGET GROUP: The rural poor.

BEGIN: 1973 END: 1978 AREA: 31,500 ha.

NUMBER OF FARMS: 20,000.

CONTRIBUTION:

IDA	US$ 6.0M
HMGN	3.1M
Farmers	1.0M
TOTAL	US$10.1M

PURPOSE: The major benefit from the project would be the substantial increase in food grain production in the project area, mainly rice and wheat, which would lead to an increased agricultural income and employment opportunities for some 20,000 farm families.

TYPE OF PROJECT: Large-scale surface irrigation project with tubewell irrigation provided to adjoining land.

TECHNOLOGY USED: Electric pumps for the tubewells, machinery for the construction and compaction of major civil works, labor for smaller tasks.

DOCUMENTS REVIEWED: Staff Appraisal Report (130 pp).

PROJECT ORIGIN AND BASE LINE DATA: Feasibility study by Nippon-Koei (Japan). The appraisal report is based on the feasibility study and the findings of an appraisal mission which visited Nepal during November and December 1971.

BENEFICIARY INVOLVEMENT: All beneficiaries would pay the full operation and maintenance cost, as well as a portion of the capital cost.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

The project would complete the construction of a canal distributary system to irrigate 28,700 ha with water supplied from a barrage on the Gandak River on the India-Nepal Border and a main canal constructed by the Government of India, and a tubewell irrigation scheme to irrigate a net area of 2,700 ha in an adjoining area. It includes drainage, on-farm development, service roads, agricultural extension, research and cooperative services.

TECHNICAL

Project works would include:

1. Surface-Water Irrigation.

   a. Improvement of the Nepal Eastern Canal including the construction of additional control structures and the improvement of existing structures.

   b. Improvement of about 50 km of secondary canals above $0.57 m^3/sec$ including the addition of control structures.

   c. Construction of about 1,150 km of secondary and tertiary canals with control structures and field turnouts.

   d. Construction of about 800 km of drainage networks.

   e. Construction of about 290 km of canal service roads and surfacing of about 110 km of these roads to link project area with Kathmandu-Biranj road and with cooperative stores.

2. Groundwater Irrigation.

   a. Testing of existing tubewells and replacement of inadequate pumps, motors, and control devices.

   b. Drilling and equipping of about 14 new tubewells.

   c. Construction of about 18 km of 11 kV transmission lines to serve existing and new tubewells.

   d. Construction of related storage tanks and irrigation distribution systems, consisting of lined main canals and unlined secondary canals to the turnouts commanding 30-40 ha service units each, and drainage networks in the command of each tubewell.

INSTITUTIONAL

Irrigation projects are generally planned, designed, constructed, operated and maintained by the Department of Irrigation, Hydrology and Meteorology of the Ministry of Food, Agriculture and Irrigation. Because this would be the single largest integrated agricultural development project to be undertaken in Nepal, HMGN has established the Narayani Zone Irrigation Development Board (NZIDB) under the Development Board Act of 1956, to be responsible for its execution, management, operation and maintenance. This would ensure efficient coordination of the various activities necessary for such development in one organization instead of being spread over several departments and institutions. The Board will be responsible for irrigation development throughout the Narayani Zone, one of the 14 zones into which Nepal is divided. The zone includes five districts. NZIDB will be funded by an annual budget allocation which would be sufficient to cover all estimated project costs except on-farm development. Its powers are vested in an eight-member Board of Directors appointed by HMGN, consisting of the Secretary, Ministry of Food, Agriculture and Irrigation (Chairman), six members representing government agencies and the Project General Manager. The Board would determine policy; its appointed General Manager would be the chief administrative officer responsible for staff appointment, dismissals and assignment of duties within the general rules of the Nepal Public Service Commission. Consultants would be engaged under the project to assist NZIDB in project implementation. Since NZIDB is a new and untried agency, drawing its key staff from several ministries, its success in implementing and managing the project will depend on strong support from HMGN, as well as on the assistance and training of NZIDB staff by consultants.

ENVIRONMENTAL

The project would not require resettlement of any farmers nor construction of new villages. It would provide drainage which would help in reducing floods and soil erosion and minimizing waterlogging. In addition, increased production, particularly of pulses and vegetables, would improve the quality of human nutrition.

There is no schistosomiasis in Nepal, but the perennial irrigation may increase the incidence of malaria and other water-associated diseases, insect pests, weeds and rodents which affect high-yielding plants and man. There is a campaign for the eradication of malaria over the whole of Terai and NZIDB, through its Extension Services Section, would train farmers in the proper use of chemicals to control pests and rodents.

Currently the growing of marijuana, or "ganja", is licensed by the Government. HMGN has, however, expressed intention to restrict the production and distribution of all narcotic drugs in Nepal. They also assured the Association that the cultivation of narcotic plants would be prohibited in the project area.

SOCIAL

The major benefits from the project would be the substantial increase in agricultural production and the resulting increased incomes and employment opportunities of some 20,000 farm families in the area, about two-thirds of whom are small farmers owning less than one hectare.

ECONOMIC

The anticipated ERR for this project is 24% for the surface irrigated component and 14% for the tubewell component. Attached are tables explaining the ERR, giving typical farm budgets, and showing the implementation schedule.[1]

[1] US$1.00 = Nepalese Rupees (NRs) 10.125 for the figures given in this report.

NEPAL

BIRGANJ IRRIGATION PROJECT

Economic Rate of Return and Sensitivity Analysis

A. Economic Rate of Return

The economic rate of return from the project is estimated at 21.4%. The investment costs and incremental net benefit streams are presented in Table 1. The rates of return from the two subprojects, surface and groundwater irrigation, are estimated at 24% and 14%, respectively. If sunk costs without interest are included in first project year expenditure, the project rate of return would be 14%, and for the subprojects 14% and 11%, respectively. Assumptions and bases of the economic rate of return calculation include:

(a) A 50-year life for the surface irrigation works and a 30-year life for the groundwater installations;

(b) The investment cost stream includes capital investment, physical contingencies, land acquisition for construction and on-farm development works by farmers (estimated cost US$1 million), together with the operation and maintenance costs of the irrigation system which are estimated at NRs 80/ha for the surface system and NRs 160/ha for the groundwater system;

(c) Because of the existing caste system, a part of the potential labor force is unavailable for agricultural employment. On the average, the available labor force is estimated to be about 50 man-days/farm family per month. For the project area as a whole, the monthly labor supply is about one million man-days. The estimated monthly demand for agricultural labor in the project area under "with" and "without" project conditions is given in Table 2. Clearly the available supply is considerably more than the existing requirements for much of the year and would continue to be so even after the completion of the project works. Full employment conditions prevail only during the month of June under "without" project conditions and in June and July under "with project" conditions. Accordingly, all labor inputs were priced at the going market wage rate of NRs 5.00 per man-day during the above peak periods and at a shadow rate of NRs. 1.00 per man-day during the rest of the year;

(d) Economic benefits from the agricultural output (Table 3) were evaluated at 1980 world market prices, produced by the IBRD Economics Department, adjusted to farmgate values as follows:

	NRs/Ton
Paddy	650
Wheat	700
Sugarcane	100
Oilseeds	1,000
Pulses	1,000
Vegetables	800

(e) Yields under the without project conditions are assumed to increase by 1% per year, a rate equivalent to that prevailing in the area during recent years. This increase would take place up to full development (year 15) of the project and yields in ton/ha for individual crops are presented in Annex 3.

B. Results of Sensitivity Tests

	Assumptions	Economic Rate of Return
(a)	The basic run excluding sunk costs	21.4[1/]
(b)	Including sunk costs of US$5 million (without interest) in the first year investment	14.0[2/]
(c)	20% increase in construction costs	18.0
(d)	Two-year delay in project completion	19.0
(e)	Combination of (c) and (d)	16.0
(f)	20% of reduction in benefits	17.0
(g)	Combination of (c), (d) and (f)	14.0
(h)	Replace increased wheat area of 6,200 ha with oilseeds and pulses (paras 6.02 and 7.05)	18.0
(i)	All labor costed at zero	26.0
(j)	All labor costed at NRs 5 per man-day	16.0

1/ 24% for surface irrigation and 14% for groundwater irrigation
2/ 14% for surface irrigation and 11% for groundwater irrigation.

NEPAL
BIRGANJ IRRIGATION PROJECT

Farm Budget for Typical 2.0 ha Farms with Tubewell Irrigation[1/]

	Without Project				With Project			
	Area (ha)	Yield (kg/ha)	Production (kg)	GVP (NRs)	Area (ha)	Yield (kg/ha)	Production (kg)	GVP (NRs)
Wet Season Crops								
Paddy - Local	1.8	1,700	3,060	2,295	0.7	2,700	1,890	1,420
Paddy - HYV					1.0	3,500	3,500	2,625
Sugarcane	0.1				0.2			
Dry Season Crops								
Wheat	0.6	1,200	720	650	1.0	3,300	3,300	2,970
Oilseeds	0.1	400	40	65	0.1	750	75	120
Pulses	0.1	500	50	50	0.1	850	85	85
Vegetables	0.1	6,000	600	480	0.1	12,000	1,200	960
Sugarcane	0.1	18,000	1,800	235	0.2	40,000	8,000	1,040
Total Farm Income				3,775				9,220
Production Costs				NRs				
Seed			185				320	
Fertilizers			170				960	
Plant Protection			5				545	
Bullock Expenses			250				350	
Hired Labor[2/]			200				1,250	
Land Tax			140					
Other			150				335	
Total			1,100	1,100			3,700	
Net Income				2,675				5,460
Incremental Income								2,785
Project Charges								640
Net Incremental Income								2,135
Project Charges as % of Incremental Income								23

1/ Farm production valued at farmgate price
2/ Based on monthly labor requirements shown in Table 5, assuming labor supplies 50 man days per month.

NEPAL
BIRGANJ IRRIGATION PROJECT
Farm Budget for Typical 5.0 ha farms[1/]

	Without Project				With Project			
	Area (ha)	Yield (kg/ha)	Production (kg)	GVP (NRs)	Area (ha)	Yield (kg/ha)	Production (kg)	GVP (NRs)
Wet Season Crops								
Paddy - Local	4.0	1,650	6,600	4,950	2.5	2,600	6,500	4,875
Paddy - HYV					1.0	3,400	3,400	2,550
Sugarcane	0.5				1.0			
Dry Season Crops								
Wheat	1.0	1,100	1,100	990	2.0	2,800	5,600	5,040
Oilseeds	0.3	400	120	190	0.3	750	225	360
Pulses	0.3	500	150	150	0.3	850	255	225
Vegetables	0.1	6,000	600	420	0.1	10,000	1,000	800
Sugarcane	0.5	18,000	9,000	1,170	1.0	40,000	40,000	5,200
Total Farm Income				7,870				19,050
Production Costs	---------- NRs ----------							
Seed			500				760	
Fertilizers			470				2,130	
Plant Protection			150				1,175	
Bullock Expenses and Tractors			1,300				1,700	
Hired Labor[2/]			1,410				3,430	
Land Tax			350				405	
Other			400				765	
Total			4,580	4,580			10,365	10,365
Net Income				3,290				8,685
Incremental Income								5,395
Project Charges								1,200
Net Incremental Income								4,195
Project Charges as % of Incremental Income								22

1/ Farm production valued at farmgate price
2/ Based on monthly labor requirements shown in Table 5, assuming family labor supplied 50 man-days per month.

TITLE: Bhairawa-Lumbini Groundwater Project

REPORT NO.: N-W-2

COUNTRY: Nepal

REGION: Asia

KEYWORDS: Tubewells (5); surface irrigation (3).

SUMMARY: The proposed project would be the first stage of a groundwater development program to provide irrigation for the Western Terai.

LOCATION: Rupandehi District in the Western Terai.

CLIMATE: Aw.

CROPS: Wheat, paddy, maize, jute, pulses.

SOILS: Alluvial, moderately fine-textured silty loams, silty clay loams and silty clays. The soils are not saline, but are moderately alkaline.

TARGET GROUP: The rural poor.

BEGIN: 1981. END: 1985. AREA: 7,500 ha

NUMBER OF FARMS: 4,500.

CONTRIBUTION:		
	IDA	US$ 9.0M
	HMGN	4.7M
	TOTAL	US$13.7M

GOALS: Most of the present production of paddy in the project area is used locally for food and seed. It is anticipated that, after full development of the project, 3,400 tons of rice and 14,000 tons of wheat would be available annually for export to India.

PURPOSE: The project would improve the incomes of those farmers and their families in the project area who are now living in conditions substantially below the project level.

TYPE OF PROJECT: Medium-sized groundwater irrigation.

TECHNOLOGY USED: Drilling rigs will install tubewells, electric pumps and earthen reservoirs and canals will pump, store, and deliver irrigation water.

DOCUMENTS REVIEWED: Project Appraisal Report (106 pages).

PROJECT ORIGIN AND BASE LINE DATA: A feasibility study of this project, originally identified by IDA, was completed by Tahal Engineers, Ltd. (Israel) in October 1975. Project appraisal was completed in December 1975 by a Bank Group Mission.

BENEFICIARY INVOLVEMENT: Beneficiaries will provide labor for the maintenance of irrigation and drainage ditches and will pay for operation and maintenance of the pumps.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

One of the major problems encountered in the development of groundwater projects is that of organizing the farmers using each well and the management of the individual well systems. The Birganj and Bhairawa Groundwater Projects would serve as pilot developments under each of the two major ethnic groups inhabiting the Terai. The Bhairawa is the second of these two projects as well as being the second Bank Group irrigation project to be built in Nepal.

TECHNICAL

1. Project Works.

a. Installation of 63 deep tubewells varying in depth from 120 to 200 m, equipped with electric-powered pumps capable of discharging 300 m^3/hour with 30 m lift;

b. Construction of 63 storage reservoirs, each with 2,000 m^3 capacity for receiving discharges from the tubewells;

c. Construction of irrigation and drainage networks equipped with control structures to serve 120 ha under each well;

d. Construction of approximately 75 km of 11 kV transmission lines and stepdown transformers from 11 kV to 0.4 kV through which power would be delivered from the existing 33 kV Bhairawa-Butwal grid to the project pumps;

e. Construction of approximately 70 km of village roads linking the major villages to the existing blacktop road network;

f. Construction of a 1,000 ton grain storage facility, enlargement of the existing offices of the Department of Irrigation, Hydrology and Meteorology (DIHM) and of the Department of Agriculture at (DA) Bhairawa, and construction of a small training facility and simple residential housing accommodations at the Bhairawa Research Farm.

2. Tubewells, Pumps and Motors. Motor starters on the tubewells would be activated automatically through electrical relays in response to variations in the reservoir water levels and an override control would be provided to shut the pumps off during periods of peak power demand (maximum five hours/day). The tubewells, pumps and motors for individual wells would be housed in a single brick building.

3. Distribution and Drainage Networks. The canal and drainage system serving the 120 ha under each tubewell would be built with select fill materials and provided with both water control and crossing structures. The irrigation channels would lead from the storage reservoir down to five hectare block turnouts. The drainage network would connect each block to the outfalls connecting with the natural north-south rivers and streams. Within each five hectare block, farmers would construct their own small water distribution and drainage channels and prepare the fields for irrigation under the technical guidance provided by the project office.

4. Village Roads. The village roads would be gravel-surfaced to a width of three-and-one-half meters and would be located mainly in a north-south direction to minimize stream crossings. So far as possible, existing tracks and established rights-of-way would be utilized for these roads.

5. Water Supply, Demand and Quality. Groundwater balance studies indicate an annual average recharge for the project area of about 150 Mm^3. Water requirements derived by the Blaney-Criddle method, using project area data and experience in other Terai irrigation projects, amount to 12,000 m^3/ha/year in a dry year and 9,000 m^3/ha/year in an average year. At year eight, when all the wells would operate at full capacity and at full development, the extraction would amount to about 90 Mm^3 in a dry year and 70 Mm^3 in an average year, well within the annual recharge for the project area. Hence it is assured that there will not be any mining of groundwater. Also, because of the location of the project area, there is no possibility that future developments, either surface or groundwater, might adversely affect the groundwater supply. The presently irrigated lands immediately to the north of the proposed tubewell area act as a spreading ground for the recharge of the aquifers, hence any increase in diversions to that area, particularly in the dry season, would improve the groundwater supply.

6. Well Field and Well Design. Wells are required at a spacing of 1,300 m. This would incur well interference, particularly in the artesian area. The additional drawdown accruing from interference, and the drawdown with time which would occur as the piezometry adjusts to the new water balance, have been allowed for in the well design which permits pump setting of 40 to 50 m.

7. Night Storage Reservoir. The tubewell would pump directly into a 2,000 m^3 capacity clay-lined earth reservoir which would fill automatically under the control of a non-float system attached to the electric prime mover of the turbine pump.

A pre-set time relay would cut out pumping during peak electricity system demand hours.

8. Irrigation and Drainage Networks. From the night storage reservoir, each typical 120 ha tubewell command area would be served by distributary canals built of selected earthfill material and earth drains, down to each five hectare block. Within the five hectare blocks, farmers would, under the guidance of the project authority, improve their existing small ditch network (which was constructed to distribute and remove natural rainfall) to enable better distribution to each plot as well as for more effective drainage. The project distributaries would have a conveyance capacity of 1.3 l/s/ha to facilitate rotational irrigation. The drains which would have a 4 l/s/ha discharge capacity would remove excess monsoon flooding to the existing north-south rivers and streams and create conditions more suitable for higher paddy yields and for planting wheat after paddy. The average channel network density would be about 100 m/ha for distributaries and 60 m/ha for drains. The main distributary channels would be flanked by a 1.5 m wide access path suitable for bicycles to enable operation and maintenance supervision. The drains would be provided with appropriate checks, falls, division, drainage, water control structures and cattle crossings constructed of masonry and reinforced concrete.

INSTITUTIONAL

The implementation of the project would be carried out by existing line agencies of HMGN, with special arrangements to ensure coordination among these agencies. The Department of Irrigation, Hydrology and Meteorology (DIHM) of the Ministry of Food, Agriculture and Irrigation (MFAI) would be responsible for the topographic survey of the project area, the design and construction of tubewells, associated irrigation and drainage networks, the village roads, the grain storage and project buildings. It is crucial to the success of the project that the water users accept the responsibility for the operation and maintenance (O&M) of the irrigation and drainage networks and for repayment. Prior to the initiation of the drilling of any individual, the beneficiaries shall be signed up in a Water User group and agree to pay water charges. If drilling and well installation work were given out to contractors, this requirement could occasion delays in the drilling of some tubewells and thus provide a basis for contractors' claims. To avoid this possibility, it is necessary that the drilling and installation of wells be carried out under force account. The DIHM has had considerable experience in this kind of work; with the assistance of USAID, over the last decade, it has carried out a groundwater investigation on over 300,000 ha in the Western Terai. Assurances

were obtained from HMGN that drilling of any individual tubewell would not begin until the potential beneficiaries representing two-thirds of the service area had signed up in a Water Users Group and agreed to pay water charges.

The construction of the electrical transmission system would be carried out by the Nepal Electricity Corporation (NEC) of the Ministry of Water and Power (MWP). The agricultural, extension and education components of the project would be carried out by the Department of Agriculture (DA). The agricultural production credit component of the project would be managed by the Agricultural Development Bank of Nepal (ADBN). The mobilization of inputs would be the duty of the Agricultural Inputs Corporation (AC). The DIHM would establish the Bhairawa-Lumbini Groundwater Project Office (BLGPO) in the project area, headed by a Project Manager (PM), to carry out DIHM's responsibility for the project and coordinate all the other project components with other line agencies. A condition of credit effectiveness would be that the PM, with qualifications and experience acceptable to IDA, shall have been appointed.

Coordination of the various project components would be achieved at two levels by two coordinating committees. The existing Groundwater Resources Development Board (GRDB), at the national level, would advise and coordinate on policy matters including programming, budgeting and finance. The present membership of the Board includes the Secretary of the MFAI, who serves as Chairman, and representatives of the Ministries of Finance (MF) and MWP, the National Planning Commission, the DA, the Director General of the DIHM and the Project Manager of GRDB, who serves as Secretary. There is provision in the order establishing the Board for the addition of other members as appropriate. For purposes of implementing the project, HMGN agreed that representatives of NEC and the Ministry of Home and Panchayat (MHP) would be added to the Board.

At the project level, a Project Coordinating Committee (PCC), under the Chairmanship of the Chief District Officer (CDO) and including the district level officers and representatives of participating agencies as members or associate members, would advise and assist the Project Manager in the coordination of various components of the project, in particular in the siting of wells and the organization of Water Users groups which as the most crucial factors for the success of the project. Members of PCC would include the Assistant District Agricultural Development Officer (ADADO), a representative of NEC, and the PM as member and secretary. Associate members of PCC, to be called when needed, would include heads of the Bhairawa Agriculture Research Station, District Officers of the AIC and of the Food and Agriculture Marketing Service Department (FAMSD), District Manager of ADBN, and a representative of the Soil Survey Division of DA. The project

organization chart is presented at the end of this report. A condition of credit effectiveness would be that the PCC, with the chairman, members and associate members as described above, will have been established. Judging from the working relationships among Government Agencies, there is good reason to be optimistic that the above organizational plan would work satisfactorily.

ENVIRONMENTAL

Gastrointestinal diseases, resulting from polluted water used by the villagers, are the most common public health problem occurring in the proposed project area. Water from tubewells in the project area is potable and the development would definitely help in reducing the incidence of these diseases. At one time, malaria was very common in the area, but with the advent of DDT, this disease was brought under control in the mid-1950's. Since both DDT and pyrethrum are available for the control of mosquitoes, it is not anticipated that any serious water-related diseases would result from the project.

SOCIAL

No significant information given.

ECONOMIC

The estimated project rate of return is 19%. Attached are a table of project costs, a schedule of expenditures.

	Local	Foreign	Total	Local	Foreign	Total	% of Total
	---(NRs Million)---			---(US$ Million)---			
1. Land Acquisition	3.7	--	3.7	0.3	--	0.3	2
2. Civil Works							
Irrigation and Drainage Networks	20.0	5.0	25.0	1.6	0.4	2.0	
Village Road Improvement	7.5	1.2	8.7	0.6	0.1	0.7	
Tubewell Drilling	5.0	1.3	6.3	0.4	0.1	0.5	
11 kV Transmission Line	2.5	1.2	3.7	0.2	0.1	0.3	
Buildings	1.2	1.3	2.5	0.1	0.1	0.2	
Subtotal	36.2	10.0	46.2	2.9	0.8	3.7	27
3. Equipment, Vehicles and Imported materials							
Tubewell Equipment	2.5	26.3	28.8	0.2	2.1	2.3	
Other Equipment and Vehicles	1.2	2.5	3.7	0.1	0.2	0.3	
Imported Materials and Equipment for							
Transmission Line	--	3.7	3.7	--	0.3	0.3	
Roads	--	1.3	1.3	---	0.1	0.1	
Subtotal	3.7	33.8	37.5	0.3	2.7	3.0	22
4. Consulting Services	1.3	17.5	18.8	0.1	1.4	1.5	11
5. Project Services							
Agricultural Supporting Services	2.5	--	2.5	0.2	--	0.2	
Engineering and Administration	5.0	1.0	6.0	0.4	0.1	0.5	
Subtotal	7.5	1.0	8.5	0.6	0.1	0.7	5
Subtotal Items 1-5	52.4	62.3	114.7	4.2	5.0	9.2	
6. Agricultural Credit to Farmers	12.5	--	12.5	1.0	--	1.0	7
Base Cost	64.9	62.3	127.2	5.2	5.0	10.2	
Physical Contingencies	5.0	6.2	11.2	0.4	0.5	0.9	7
Expected Price Increases	16.3	16.2	32.5	1.3	1.3	2.6	19
TOTAL PROJECT COST	86.2	84.7	170.9	6.9	6.8	13.7	100

NEPAL

BWATAWA-LUMBINI GROUNDWATER PROJECT

Detailed Cost Estimate and Expenditure Schedule

	Unit	Quantity	Unit Cost US$	Foreign	Local Costs	Total	Year 1	Year 2	Year 3	Year 4
				US$ million						
1. Land Acquisition	LS				0.30	0.30	0.10	0.10	0.10	
Civil Works										
2. Irrigation and Drainage Network										
Wellhead reservoirs	No	63		0.01	0.11	0.12	0.01	0.04	0.04	0.03
Canal earthworks	m^3	2,000,000	0.5	0.10	0.90	1.00	0.12	0.32	0.32	0.24
Canal structures	LS		930,000	0.31	0.62	0.93	0.11	0.30	0.30	0.22
3. Village Road Network Improvement (Table 5)										
Roads including culverts	km	70	10,000	0.24	0.56	0.80	0.08	0.27	0.27	0.18
4. Tubewells										
Well drilling and installation (Table 2)	No	63	24,920	0.10	0.40	0.50	0.05	0.15	0.20	0.10
Pumphouses	No	63	2,063	0.02	0.11	0.13	0.02	0.04	0.07	--
11 kV line with transformers	LS			0.40	0.15	0.55	0.05	0.30	0.20	--
5. Buildings										
1,000 ton Grain Store	LS	--	90,000	0.02	0.07	0.09	--	0.09		--
Agriculture supporting services buildings		--	30,000	0.01	0.02	0.03	--	0.03		--
O&M Workshop and Store	LS	--	20,000	0.01	0.01	0.02	--	0.02	--	--
Engineering and Administrative Office extensions	LS	--	10,000	--	0.01	0.01	--	0.01	--	--
Subtotal				1.22	2.96	4.18	0.44	1.57	1.40	0.77

	Unit	Quantity	Unit Cost US$	Foreign	Local Costs	Total	Year 1	Year 2	Year 3	Year 4
							US$ million			
Physical Contingencies (10%)				0.12	0.03	0.42	0.04	0.16	0.14	0.08
Civil Works Subtotal Items 2, 3, 4, 5,				1.34	3.26	4.60	0.48	1.73	1.54	0.85
Expected Price Increases (%)							(14)	(26)	(38)	(50)
Cost				0.44	1.08	1.52	0.07	0.45	0.58	0.42
Civil Works Cost (Items 2-5)				1.78	4.34	6.12	0.55	2.18	2.12	1.27
6. Tubewell Equipment (Table 3)				2.10	0.21	2.31	0.70	0.81	0.80	--
7. Equipment and Vehicles										
Table 4										
Project Vehicles				0.13	0.02	0.15	0.05	0.10	--	--
Workshop and miscellaneous equipment				0.09	0.01	0.10	0.05	0.05	--	--
Subtotal Item 7				0.22	0.03	0.25	0.10	0.15	--	--
8. Project Services										
Agricultural Supporting Services				--	0.16	0.16	0.02	0.04	0.05	0.05
Engineering and Administration				0.14	0.41	0.55	0.08	0.17	0.17	0.13
Consultants: Project Implementation				1.00	0.10	1.10	0.20	0.40	0.40	0.10
(Table 6) Feasibility Studies				0.34	0.06	0.40	--	0.20	0.20	--
Subtotal Item 8				1.48	0.73	2.21	0.30	0.81	0.82	0.28
Subtotal Items 6,7,8				3.80	0.97	4.77	1.10	1.77	1.62	0.28
Physical Contingencies (10%)				0.30	0.10	0.48	0.11	0.18	0.16	0.03
Subtotal				4.18	1.07	5.25	1.21	1.95	1.78	0.31
Expected Price Increase (%) Cost:				0.83	0.21	1.04	0.12	0.35	0.46	0.11
Subtotal Items 6, 7, 8				5.01	1.28	6.29	1.33	2.30	2.24	0.42
Total Cost Items 1-8				6.79	5.92	12.71	1.98	4.58	4.46	1.69
Production Credit						1.00				
Grand Total Cost of Project						13.71				

TITLE: Sunsari-Morang Irrigation and Drainage Development Stage I Project

REPORT NO.: N-W-3

COUNTRY: Nepal

REGION: Asia

KEYWORDS: Surface irrigation (3); drainage (3); micro-hydro (5).

SUMMARY: The proposed project would rehabilitate the Chatra Main Canal, the largest existing irrigation scheme in Nepal with the objectives of:

1. Restoring the system to its original scope and capability;

2. Improving the reliability of water deliveries, and therefore to increase farmers' confidence in the system; and

3. Accelerating agricultural development.

LOCATION: Sunsari and Morang Administrative Districts on the left bank of the Kosi River.

CLIMATE: Aw.

CROPS: Rice, wheat, pulses, jute, sugarcane.

SOILS: Alluvial loams, clay loams and coarse loams; moderately to well-drained; low in organic matter, nitrogen and phosphate; wide range in water-holding capacity.

BEGIN: 1978 END: 1983 AREA: 66,000 ha.

NUMBER OF FARMS: 44,000.

CONTRIBUTION:		
	IDA	US$ 30.0M
	HMGN	7.2M
	Farmers	0.3M
	TOTAL	US$ 37.5M

GOALS: The project should produce a US$2M increase in net foreign exchange earnings, generate 10,000 jobs on-farm and an additional 6,000 nonfarm jobs.

PURPOSE: The project would improve canal conveyance capacity, reduce distribution losses, improve the reliability of water deliveries and improve agricultural supporting services.

TYPE OF PROJECT: Rehabilitation of a medium-scale irrigation and drainage project.

TECHNOLOGY USED: Stone and concrete structures, wet or heavy earthworks built by machine with other works would be labor-intensive, prefab control structures, small-scale hydro-electric units.

DOCUMENTS REVIEWED: Staff Appraisal Report (83 pp).

PROJECT ORIGIN AND BASE LINE DATA: The proposal is based on the findings of a Bank mission which visited Nepal in September 1977.

BENEFICIARY INVOLVEMENT: Beneficiaries will pay the full cost of operation and maintenance of the system as well as a reasonable part of the capital costs.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

Nepal has abundant water resources, however, there are only about 1.3M ha of land suitable for surface irrigation by canal in the country. Exploitable groundwater resources, concentrated in the Terai, could provide tubewell irrigation for an additional 0.5M ha. In line with HMGN's objectives of upgrading and exploiting existing irrigation schemes, this project would rehabilitate the largest existing irrigation scheme in Nepal.

TECHNICAL:

The main components of the project would be:

1. River Control Works. To prevent further restriction of the subsidiary supply channel on the left side of the Kosi River, it is tentatively proposed that a guide island would be constructed at the upstream tip of the shoal. The island would stabilize both the river approach and the shoal, by fixing the point of bifurcation between the main channel and the subsidiary channel supplying the project, so that about 20% of the river discharge would always flow towards the CMC intake. With the construction, proper operation and maintenance of a gated sluice bay, as well as the guide island, ample dry season water supplies for the project would be secured. The most effective configuration of the guide island and the sluice bay would be fixed by consultants, following hydraulic model tests. To prevent the possibility of inundation of the CMC headreach during floods, and consequent widespread damage to the project, a protective embankment would be built on the left bank of the Kosi near the intake.

2. Sediment Control. The control and disposal of excess sediment entering the Chatra Main Canal (CMC) from the Kosi River would be achieved by three measures, depending upon the findings of surveys, model tests and designs:

   a. By constructing a sluice bay in the river to reduce sediment inflow;

   b. By dredging coarse sediment from a settling basin; and

   c. By extracting a medium-grained material through a sediment ejector in the canal bed.

The sluice bay, consisting of a gated weir and a training wall, would be located on the Kosi River supply channel. The settling basin, located a short distance below the intake, would enable inflowing sand and gravel to be excavated by a

dredger. Sand and silt would largely be discharged through a slotted conduit (vortex ejector), installed across the bed of the canal headreach, and returned back to the river through a nala. Excavation of the existing 100,000 m^3 of deep deposits in the first 15 km of CMC would be carried out as soon as possible. Remaining deposits (about 200,000 m^3) would be cleared after completion of the new sediment control arrangements and low-level sluices for rapid dewatering of the main canal. These works would restore canal capacity, reduce the number and duration of supply interruptions by 80-90% and shorten the annual maintenance closure period from four months to four weeks.

3. Restoration and Improvements. The works would include:

a. Strengthening CMC embankments to prevent frequent breaches and canal closures;

b. Repair of reconstruction, where necessary, of about 70 main canal structures to prevent leakage and improve flow control;

c. Strengthening embankments of all secondary and tertiary canals to avoid overflow; and

d. Repairing 200 existing regulating structures and constructing about 35 new secondary canal regulators and 1,000 tertiary outlets to control water flows.

In addition, improved protection of the system against storm drainage would be provided by construction of about 20 cross-drainage structures and 14 escape spillways on the secondary canals.

4. Drainage Improvements. To ensure proper drainage of the 6,400 ha selected for Farm Group Development, natural drains serving that area would be improved where necessary, starting from their outfalls near the lower boundary of the project and covering about 12,000 ha. Works would include straightening and increasing the capacities of natural channels, excavation of new secondary and tertiary drains, and control structures. Other priority drainage works would be constructed to reclaim about 3,000 ha of low-lying areas which are subject to inundation. Limited works would also be constructed to protect canals from flood damage by minor rivers crossing the project area. Road drainage would be improved where necessary by construction of culverts, using labor organized by the panchayats and with materials supplied under the project.

5. Pilot Tubewells. The project would install and operate 25 tubewells, energized from the existing 33 kV transmission system, to test the technical, economic, and organizational feasibility of supplementing surface water supplies with groundwater, in areas such as in the tail of the canal system where irrigation water supplies are limited. Five deep wells, located along the East-West Highway, would test the aquifer characteristics under production pumping. Of 20 proposed shallow tubewells, 10 would test their effectiveness in subsurface drainage and the control of waterlogging in low-lying areas, and 10 would provide reliable irrigation supplies to farmers in selected tail areas, to test the application of improved water management practices. Three small hydroelectric plants would be installed at canal falls, to test the feasibility of generating local power in remote areas.

INSTITUTIONAL

In accordance with HMGN's established policy, organization experience gained from Narayana Zone 1, and for effective implementation, a governing board would be created for executing the proposed project under the Development Board Act of 1956. The Sunsari-Morang Irrigation and Drainage Development Board (the Board) would be a semiautonomous agency. It would be chaired by the Secretary to Government, Ministry of Food, Agriculture and Irrigation with Members including representatives from the Ministries of Finance, Water and Power, Land Reform, the Planning Commission, the Directors-General of the Department of Agriculture (DA) and Department of Irrigation, Hydrology and Meteorology (DIHM), Regional Directors of DIHM and DA, (Eastern Region), and the Project Manager (Secretary). The Board's functions would include:

1. Approval of annual budget proposals for executing the project;

2. Staff appointments;

3. Approval of award of large contracts and consultants' agreements;

4. Semi-annual review of implementation programs and progress; and

5. Coordination of policy matters on programming, budgeting and finance.

The Board would be funded by an annual budget allocation sufficient to cover all estimated project engineering, agriculture and administrative costs. The Board would channel funds to field management, headed by the Project Manager, who would then allocate the budgeted

funds to three wings under his supervision. The establishment of the Board would be a condition of credit effectiveness. The Board may invite the World Bank's Resident Representative to its meetings when matters concerning IDA are on its agenda.

The Project Manager, located at Biratnagar, would have overall responsibility for:

1. Preparation of annual project work programs, budget and staffing schedules to present to the Board;

2. Administration of project staff, including consultants;

3. Authorization of works constructed by force account, as well as civil works and equipment contracts below authorized cost ceilings; and

4. Coordination with agricultural activities at Regional and District levels.

The Project Manager would be a senior technical officer of high caliber and appropriate experience. He would be assisted by a team of consultants throughout project implementation. Appointment of the PM, with qualifications and experience satisfactory to IDA, and with appropriate terms of reference, would be a condition of credit effectiveness.

Under the PM, three wings would be established. The Planning and Control Wing (PCW), headed by a senior Superintending Engineer, who would also be the Deputy Project Manager, would comprise five divisions to be responsible for:

1. Overall planning of engineering and agricultural activities, coordination, training and evaluation;

2. Surveys and designs;

3. Procurement and contract matters;

4. Monitoring progress and costs and testing the quality of constructions carried out by force account and by contractors; and

5. Administration and finance.

The Engineering Wing (EW), headed by a Superintending Engineer, would comprise six divisions mainly responsible for all irrigation construction, operation and maintenance work, including the use of mechanical equipment, and the development of groups of farms of about 10 ha beyond the field canal outlets. The Agriculture Wing

(AW), headed by a Senior Agricultural Officer, (SAO), would have two divisions responsible for extension activities and one division for applied research, training, and monitoring of agricultural progress. The SAO would have overall responsibility for extension activities in both Sunsari and Morang Districts and supervise adaptive research conducted in the project area in collaboration with various agriculture stations in Nepal. He would report on technical matters to the Regional Director of Agriculture, Eastern Region. However, he would be primarily responsible to the PM on administrative matters, such as work performance of staff and budget. In view of imperative needs for effective extension activities, appointment of the SAO, with qualifications, and experience satisfactory to IDA, would be a condition of credit effectiveness. Extension services in Sunsari and Morang Districts would continue to operate under the project until the proposed national agricultural extension service has been established, staffed and become fully effective. At such time, HMGN, in agreement with IDA, would incorporate the extension activities related to both Districts into the national extension services organization.

District and regional level coordination between the project and various agencies would be through existing coordination committees (DCC) in Sunsari and Morang. This coordination provides opportunities to confer on rural development, road construction or improvement, agricultural input and credit supplies, marketing, and power supplies. Coordinating committees would co-opt a project representative when matters of direct concern to the project are on the meeting agenda.

ENVIRONMENTAL

With the redistribution of irrigation supplies which the project is designed to achieve, there will be less ponding of waste water in the upper reaches of the distribution system. In addition, drainage of low-lying areas would be improved. As a result, some of these areas would be brought under cultivation and there would be a reduction in locations which are malaria-prone.

SOCIAL

No significant information given.

ECONOMIC

The ERR for this project is estimated to be 28%. Attached are a summary of project costs, a table of estimated annual expenditures.

NEPAL

APPRAISAL OF
SUNSARI-MORANG IRRIGATION & DRAINAGE DEVELOPMENT STAGE I PROJECT

Summary of Estimated Project Cost
(NRs12.00 = US$1.00)

Project Item	Local	Foreign	Total	% of Total	% Foreign Exchange
	US$ Million				
1. Civil Works and Buildings:[1/]					
(a) Kosi river control and CMC flood protection (30%)	0.60	0.88	1.48		
(b) CMC sediment control structures (15%)	0.48	0.68	1.16		
Subtotal	1.08	1.56	2.64	7	59
(c) CMC restoration and additional structures (15%)	2.92	4.21	7.13		
(d) Secondary and tertiary canal restoration (20%)	1.96	1.26	3.22		
Subtotal	4.88	5.47	10.35	28	53
(e) Drainage improvement and flood protection (20%)	1.46	0.98	2.44		
(f) Field canals and drains (Farm Group Dev't) (15%)	1.03	0.43	1.46		
(g) On-farm development (15%)	0.31	--	0.31		
Subtotal	2.80	1.41	4.21	11	33
(h) Pilot groundwater development (30%)	0.02	0.11	0.13		
(i) Pilot development of improved irrigation and drainage, and canal micro-hydels (20%)	0.13	0.68	0.81		
Subtotal	0.15	0.79	0.94	3	84
(j) Buildings for project engineering operations (10$)	0.50	0.12	0.62		
(k) Buildings for project agricultural operations and supporting services (10%)	0.18	0.04	0.22		
Subtotal	0.68	0.16	0.84	2	19
Subtotal Civil Works and Buildings	9.59	9.39	18.98	51	49
2. Equipment:					
(a) Engineering construction, operation and maintenance equipment and spare parts	--	3.40	3.40		
(b) Agricultural operation equipment and spare parts	--	0.10	0.10		
(c) Survey, laboratory, office and communications equipment and spare parts	--	0.24	0.24		
Subtotal, Equipment	--	3.74	3.74	10	100

Summary of Estimated Project Cost (Continued)

Project Item	Local	Foreign	Total	% of Total	% Foreign Exchange
3. Technical Services:					
(a) Project operations consultants	0.14	0.77	0.91		
(b) Air photography and mapping 1/	0.05	0.25	0.30		
(c) Feasibility studies	0.08	0.08	0.16		
Subtotal, Technical Services	0.27	1.10	1.37	4	80
4. Project Establishment: 3/					
(a) Engineering	1.25	0.96	2.21		
(b) Agriculture	0.42	0.02	0.44		
(c) Administration	0.08	0.02	0.10		
Subtotal, Establishment	1.75	1.00	2.75	7	36
5. Contingencies:					
(a) Physical contingencies	1.78	1.59	3.37		
(b) Price contingencies	13.39	3.68	6.79		
PROJECT COST	26.78	20.50	37.00	99	55
6. Land Acquisition	0.30	—	0.30		
7. Taxes and Duties	0.20	--	0.20		
8. TOTAL PROJECT COST	17.00	20.50	37.50	100	55

1/ Physical contingency percentages provided for works are shown in parentheses, and accumulated in item 5(a).
2/ $100,000 for the project, and $200,000 for preparatory mapping for future project(s).
3/ Including operation and maintenance during project construction period FY79 through FY 83.

NEPAL

APPRAISAL OF
SUNSARI-MORANG IRRIGATION & DRAINAGE DEVELOPMENT ST[illegible] I PROJECT
Estimated Annual Expenditure

Project Item	Total Estimated Cost, US$M	Estimated Annual Expenditure, US$M equiv. Year (1) 1978/79	Year (2) 1979/80	Year (3) 1980/81	Year (4) 1981/82	Year (5) 1982/83
1. Civil Works and Buildings:[1/]						
(a) Kosi river control and CMC flood protection	1.5	--	--	0.9	0.6	--
(b) CMC sediment control structures	1.2	0.1	0.5	0.6	--	--
(c) CMC restoration and additional structures	7.1	1.9	2.1	1.6	1.5	--
(d) Secondary and tertiary canal restoration	3.2	--	0.7	0.7	1.5	0.3
(e) Drainage system improvement and flood protection	2.4	0.5	1.0	0.3	--	0.6
(f) Field canal and drain (Block) development	1.5	0.1	0.3	0.4	0.7	--
(g) On-farm development	0.3	--	--	0.1	0.1	0.1
(h) Pilot groundwater development	0.1	--	--	0.1	--	--
(i) Pilot development of improved irrigation & drainage	0.8	--	--	0.2	0.6	--
(j) Bldgs. for project engineering operations	0.7	0.1	0.3	0.3	--	--
(k) Bldgs. for project agricultural supporting services	0.2	--	--	0.1	0.1	--
	19.0	2.7	4.9	5.3	5.1	1.0
2. Technical Services:[1/]						
(a) Project operations consultants	0.9	0.3	0.2	0.1	0.2	0.1
(b) Air photography and mapping	0.3	--	0.2	0.1	--	--
(c) Feasibility studies	0.2	--	--	0.1	0.1	--
	1.4	0.3	0.4	0.3	0.3	0.1

Estimated Annual Expenditures (Continued)

Project Item	Total Estimated Cost, US$M	Estimated Annual Expenditures, US$M equiv. Year (1) 1978/79	Year (2) 1979/80	Year (3) 1980/81	Year (4) 1981/82	Year (5) 1982/83
3. Project Establishment:						
(a) Engineering and Administration	2.3	0.2	0.4	0.5	0.6	0.6
(b) Agriculture	0.4	--	0.1	0.1	0.1	0.1
	2.7	0.2	0.5	0.6	0.7	0.7
Subtotal, Items 1, 2, and 3	23.1	3.2	5.8	6.2	6.1	1.8
4. Contingencies, (i):						
(a) Physical contingencies[1/,2/]	3.4	0.5	0.7	0.7	0.8	0.7
(i) Subtotal (A), works and services, Items 1 thru 4	26.5	3.7	6.5	6.9	6.9	2.5
5. Equipment:[3/]						
(a) Engineering construction O&M equip. & Spare parts	3.4	0.6	2.2	0.6	--	--
(b) Agricultural operation equipment and spare parts	0.1	0.1	--	--	--	--
(c) Survey, Lab, office & Communic. equip. & spare parts	0.2	0.1	0.1	--	--	--
Subtotal (B), equipment	3.7	0.8	2.3	0.6	--	--
Subtotal (C), project cost excluding price contingencies	30.2	4.5	8.8	7.5	6.9	2.5
6. Contingencies, (i), (ii), and (iii):						
(b) Price contingencies[1/,3/]						
(i) Escalation factors[1/], works and services		(0.08)	(0.161)	(0.242)	(0.329)	(0.422)
Escalation on subtotal (A), works and services[1/]	6.3	0.3	1.0	1.7	2.3	1.0
(ii) Escalation factors[3/], equipment		(0.07)	(0.139)	(0.208)	(0.280)	(0.357)
Escalation on subtotal (B) equipment[3/]	0.5	0.1	0.3	0.1	--	--
(iii) Subtotal (D), price contingencies, (i) and (ii)	6.8	0.4	1.3	1.8	2.3	1.0
Project Cost, subtotals (C) and (D)	37.0	4.9	10.1	9.3	9.2	3.5
7. Land acquisition, Customs duties and taxes	0.5	0.2	0.1	0.1	0.1	--

Estimated Annual Expenditures (Continued)

Project Item	Total Estimated Cost, US$M	Estimated Annual Expenditures, US$M Equiv. Year (1) 1978/79	Year (2) 1979/80	Year (3) 1980/81	Year (4) 1981/82	Year (5) 1982/83
8. Total Project Cost	37.5	5.1	10.2	9.4	9.3	3.5

1/ Items with an escalation factor of 8% in 1978/79, 7½% in 1979/80, then 7%.
2/ Physical contingencies vary from 10% to 30% depending upon state of preparation, with weighted average of 18%, see Table 4.1
3/ Items with an escalation factor of 7% in 1978/79, 6.5% in 1979/80, then 6%.

TITLE: Narayani Zone Irrigation Development Stage II Project

REPORT NO.: N-W-4

COUNTRY: Nepal

REGION: Asia

KEYWORDS: Surface irrigation (3); tubewell irrigation (5); micro-hydroelectric (3).

SUMMARY: The proposed project would upgrade the existing Nepal Eastern Canal and extend the development of its command area so that water deliveries become more reliable, drainage is improved, and agricultural development accelerates in the project area.

LOCATION: Along the Nepal Eastern Canal from Pipra to the Bagmati River.

CLIMATE: Aw.

CROPS: Paddy, wheat, sugarcane, pulses.

SOILS: Alluvial silty to clay loams and some coarser sandy soils.

TARGET GROUP: The rural poor.

BEGIN: 1978 END: 1982. AREA: 13,500 ha.

NUMBER OF FARMS: 12,600.

CONTRIBUTION:

IDA	US$ 14.0M
HMGN	2.6M
Ag. Development Bank of Nepal	0.1M
Farmers	0.3M
TOTAL	US$ 17.0M

GOALS: The annual production increase, due to the project, is estimated at 20,200 tons of foodgrains, 14,800 tons of sugarcane, 300 tons of oilseeds and 4,300 tons of vegetables.

PURPOSE: The project would reduce dependence on rainfall and simultaneously accelerate agricultural development in the area through the provision of a reliable water supply.

TYPE OF PROJECT: Medium-scale surface irrigation development coupled with the development of groundwater resources.

TECHNOLOGY USED: Electric pumps on tubewells, small hydrogenerators, labor-intensive construction with mechanical compaction of earthwork.

DOCUMENTS REVIEWED: Staff Appraisal Report (89 pp).

PROJECT ORIGIN AND BASE LINE DATA: The proposed project was formulated to develop the remaining 12,700 ha from the original Birganj Irrigation Project.

BENEFICIARY INVOLVEMENT: Beneficiaries will carry the costs of operation and maintenance of the system as well as a portion of the capital costs.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

As a result of experience gained from implementing and operating the first stage of the Narayni Zone Project, this project would not only extend the area of the Narayani Zone under irrigation, but would also upgrade irrigation and drainage infrastructure in areas of Stage I. It would also introduce a pilot private community tubewell scheme aimed at relieving the strain on public funds for irrigation development.

TECHNICAL

The main components of the project would be:

1. Construction of additional structures for improved water supply control, cross-drainage, protection against floods along about 52 km of the NEC between Birganj and the Bagmati River, and improvement of the NEC service road between Pipra and the Bagmati River;

2. Construction of the irrigation distribution and drainage systems down to farm level and canal service roads in about 12,700 ha of the NEC command area between Birganj and the Arwa River;

3. Upgrading of surface drainage systems, irrigation facilities, and canal service roads in about 16,000 ha of the NEC command area between Pipra and Birganj;

4. Installation of about 25 wells and pumps, irrigation channels, access roads and support to the Agriculture Development Bank of Nepal for providing loans for an 800 ha pilot, privately-owned community tubewell scheme; and

5. Construction and operation of field trials for waterlogging control, low cost roads, and a pilot micro-hydroelectric station.

6. Improvement of NEC. The works would include:

   a. Construction of 13 additional regulating structures to control flows in both wet and dry seasons throughout 52 km of the NEC (from middle to tail reaches);

   b. Strengthening of 10 km of embankments on the NEC left bank and provision of 10 additional drainage inlets and culverts to prevent breaches and ensuing canal closures; and

c. Construction of protective works, including three escapes and conveyance channels, as well as an eight kilometer long flood embankment near the Bagmati River, to prevent recurrence of damage caused by monsoon flooding.

7. Development of Irrigation System. Southward flowing rivers, streams and natural drains divide the Stage II irrigation command of the NEC into six, operationally separate distribution units, Blocks VII through XII, each planned to include a secondary and tertiary distribution canal system. Existing reaches of secondary canals, totalling about 40 km, each with a capacity exceeding 0.6 m^3/sec, would be improved under the project, mainly by the addition of control structures. The distribution system would be extended down to canals serving groups of farms covering seven-and-one-half hectares to 10 ha throughout the six blocks enclosing a total of 12,700 ha. Works include about 360 km of main, secondary and tertiary canals, with about 6,500 control structures, and about 360 km of service roads. In addition, structural improvements would be made throughout the Stage I distribution area.

8. Drainage Improvement. To create conditions more suitable for obtaining higher paddy yields by controlling monsoon flooding, and for planting wheat and other upland crops after paddy, drainage systems including about 250 km of drains, and over 2,000 structures would be constructed to link farm group development areas of about 10 ha to natural drains throughout 12,700 ha.

9. Community Tubewells Scheme. Towards reducing the investment burden on HMGN for groundwater development, the project would install up to five deep, privately-owned community tubewells to irrigate about 10 ha each, in the vicinity of the Stage I groundwater pilot development area where surface irrigation development is not feasible.

10. Micro-Hydroelectric Development. Nepal has considerable scope for micro-hydroelectric development. A major advantage of micro-hydroelectric stations would be their speedy construction, while major hydropower projects take many years to develop. The microstations would be particularly useful for rural electrification and groundwater development, and, possibly for small-scale fertilizer production.

ENVIRONMENTAL

With the extension of the irrigation distribution and drainage system down to the farm level and provision of appropriate regulation structures, there will be less ponding of waste water in the area.

In addition, the drainage network would be greatly improved to reduce inundation and to minimize waterlogging. As a result, there would be a reduction in locations which are malaria-prone.

SOCIAL

In eased labor requirements would be generated primarily by a more intensive use of land in the Stage II area. Taking into account the growth in farm employment that would probably occur without the project, about 2,000 additional full-time agricultural jobs would be created under the project.

INSTITUTIONAL

In accordance with the HMGN's established policy and for effective project implementation, the Narayani Irrigation Development Board (NZIDB) was created in 1973 for executing the Birganj Irrigation Project (Narayani Zone) or Stage I. The NZIDB is a semi-autonomous agency located in Kathmandu. It is chaired by the Secretary to the Government's Ministry of Food, Agriculture and Irrigation, with members including representatives from the Ministries of Finance, Water and Power and Land Reform, the Planning Commission, the Directors-General of the Department of Agriculture (DA) and the Department of Irrigation, Hydrology and Meteorology (DIHM), Regional Directors of DIHM and DA, (Central Region), and the General Manager (Secretary) of the Birganj Irrigation Project. The NZIDB's functions include:

1. Approval of annual budget proposals for executing the project;

2. Staff appointments;

3. Approval of award of large contracts and consultants' agreements;

4. Semi-annual reviews of implementation programs and progress; and

5. Coordination of policy matters on programming, budgeting and finance.

The NZIDB has become increasingly effective in carrying out Stage I, and it would also be responsible for implementing the proposed Stage II project.

To implement the agricultural extension and training components which would be financed under the project, and in continuation

of the successful organizational arrangements made in Stage I, the DA would delegate authority and depute staff for providing these services throughout six districts in the Terai to the project Boards concerned. Extension activities would be administered in Parsa, Bara and Rautahat Districts by NZIDB; in Rupandehi District by the IDA-financed Bhairawa-Lumbini Groundwater Project (BLGP) through the Groundwater Development Board; and in Sunsari and Morang Districts by the Sunsari-Morang Irrigation and Drainage Development Board (SMIDDB).

Coordination between the project and the various agencies concerned would be through existing District and Regional Coordination Committees. These committees provide opportunities for various agencies to confer on rural development, road construction or improvement, agricultural input and credit supplies, marketing and power supplies. Coordination committees would invite a project representative when matters of direct concern to the project are on the meeting agenda. Executive action would subsequently be taken by the agencies' local representatives in consultation with project management.

Project and Agriculture Development Bank of Nepal staff have carried out preliminary surveys to locate communities of farmers who would be willing to take loans under the proposed pilot, privately-owned, community tubewells schemes. The cost of a deep tubewell installation to supply 120 ha is estimated at NRs 988,000; a shallow tubewell for supplying 10 ha would cost approximately NRs 105,000. Each farmer in a tubewell command area would obtain a loan from ADBN for 90% of his share of the cost, in proportion to the size of this holding under the command of the tubewell. Loans for deep tubewell installations would bear an interest rate of 11%, with 20 years for repayment including a two-year grace period; loand for shallow tubewells would also carry 11% interest, with repayment in seven years, including an 18-month grace period.

Farmers would participate in the implementation, operation and maintenance of the project through Water Users' Groups, organized by project staff. In the surface irrigation area, each WUG would be established within a tertiary outlet command, serving groups of farms of about 40 to 50 ha, before water is delivered. Under the pilot community tubewell scheme, each tubewell would have its own WUG.

ECONOMIC

The project has an anticipated ERR of 22%. Attached are charts giving the estimated project cost, the estimated annual expenditures, and a Farm Budget Analysis. For the figures given in this report, US$1.00 = Nepalese Rupees (NRs) 12.0.

NEPAL

APPRAISAL OF
NARAYANI ZONE IRRIGATION DEVELOPMENT STAGE II PROJECT
Estimated Project Cost
(NRs 12 = US$1)

Project Item	Local	Foreign	Total	% of Total	% Foreign Exchange
	US$ million				
1. Civil Works and Buildings[1/]					
(a) Nepal Eastern Canal Improvements (12.5%)					
(i) Stage II area	0.60	0.65	1.25		
(ii) Additional works, Stage I area	0.07	0.08	0.15		
Subtotal	0.67	0.73	1.40	8	50
(b) Surface irrigation and drainage (15%)					
(i) Stage II area	1.90	1.30	3.20		
(ii) Additional works, Stage I area	0.65	0.45	1.10		
(iii) On-farm development	0.35	0.05	0.40		
(iv) Waterlogging control trials & monitoring	0.20	0.20	0.40		
Subtotal	3.10	2.00	5.10	30	38
(c) Community groundwater development (15%)	0.10	0.20	0.30	2	67
(d) Buildings (10%)					
(i) Canal operation bldgs.	0.20	0.05	0.25		
(ii) Input Stores	0.04	0.01	0.05		
(iii) Agricultural Extension buildings	0.30	0.10	0.40		
Subtotal, Bldgs.	0.54	0.16	0.70	4	29
Subtotal, Civil Works and Bldgs.	4.41	3.09	7.50		41
2. Equipment					
(a) Construction and O&M equipment & spare parts	—	2.05	2.05		
(b) Pumps, motors, tubewell casing	--	0.50	0.50		
(c) Survey and laboratory equipment	--	0.05	0.05		
(d) Agricultural vehicles and equipment	--	0.20	0.20		
Subtotal	—	2.80	2.80	16	100

Estimated Project Cost (Continued)

Project Item	Local	Foreign	Total	% of Total	% Foreign Exchange
	---- US$ million-------				
3. Technical Services					
(a) Consultants	0.15	0.70	0.85		
(b) Air photo and mapping 2/	0.03	0.12	0.15		
(c) Training	0.01	0.09	0.10		
Subtotal	0.19	0.91	1.10	6	82
4. Project Establishment					
(a) Engineering and Administration 3/	0.70	0.20	0.90		
(b) Agricultural operating cost	0.20	0.10	0.30		
Subtotal	0.90	0.30	1.20	7	25
5. Contingencies					
(a) Physical contingencies	0.60	0.60	1.20	7	50
Subtotal, Items 1 thru 5(a)	6.10	7.70	13.80		56
(b) Price contingencies	1.10	1.50	2.60	15	58
Project Cost	7.20	9.20	16.40		56
6. Land Acquisition	0.50	--	0.50	4	--
7. Taxes and Duties	0.10	—	0.10	1	--
TOTAL PROJECT COST	7.80	9.20	17.00	100	52

1/ Physical contingency percentages provided for work items are shown in parentheses, and accumulated in item 5(a).
2/ $150,000 for preparatory mapping for future project(s).
3/ Including operation and maintenance during project construction period FY79 through FY 8.

NEPAL

APPRAISAL OF
NARAYANI ZONE IRRIGATION DEVELOPMENT, STAGE II PROJECT

Estimated Annual Expenditure

Project Item	Estimated Cost, US$M	Estimated Annual Expenditure, US$M Equivalent			
		Year (1) 1978/79	Year (2) 1979/80	Year (3) 1980/81	Year (4) 1981/82
1. Civil Works and Buildings					
(a) Nepal Eastern Canal	1.4	0.2	0.5	0.6	0.1
(b) Surface irrigation and drainage	3.1	0.9	1.7	1.7	0.8
(c) Community groundwater development	0.3	--	0.1	0.2	--
(d) Buildings	0.7	0.2	0.4	0.1	--
Subtotal	7.5	1.3	2.7	2.6	0.9
2. Technical Services					
(a) Consultants	0.8	0.3	0.2	0.2	0.1
(b) Air photography and mapping	0.2	--	--	0.2	--
(c) Training	0.1	--	0.1	--	--
Subtotal	1.1	0.3	0.3	0.4	0.1
3. Project Establishment					
(a) Engineering and Administration	0.9	0.2	0.2	0.2	0.3
(b) Agricultural operating cost	0.3	0.1	0.2	--	--
Subtotal	1.2	0.3	0.4	0.2	0.3
4. Contingencies, (1)					
(a) Physical contingencies	1.2	0.3	0.3	0.4	0.2
Subtotal (A), works and services, Items 1 through 4	11.4	2.2	3.7	3.6	1.5
5. Equipment					
(a) Engineering vehicles, equipment and spares	2.6	0.8	0.8	0.6	0.4
(b) Agricultural vehicles and equipment	0.2	0.1	0.1	--	--
Subtotal (B), equipment	2.8	0.9	0.9	0.6	0.4
Subtotal (C), project cost excluding price contingencies	14.2	3.1	4.6	4.2	1.9

Estimated Annual Expenditures
(Continued)

Project Item	Estimated Cost, US$M	Estimated Annual Expenditure, US$M Equivalent Year (1) 1978/79	Year (2) 1979/80	Year (3) 1980/81	Year (4) 1981/82
6. Contingencies (ii)					
(b) Price contingencies					
(i) Escalation factors, works and services		(0.08)	(0.161)	(0.242)	(0.329)
Escalation on Subtotal (A), Works and Services	2.2	0.2	0.6	0.9	0.5
(ii) Escalation factors, equipment		(0.07)	(0.139)	(0.208)	(0.280)
Escalation on Subtotal (B), Equipment	0.4	0.1	0.1	0.1	0.1
(iii) Subtotal (D), price contingencies (i) and (ii)	2.6	0.3	0.7	1.0	0.6
Project Cost, Subtotal (C) and (D)	16.4	3.4	5.3	5.2	2.5
7. Land Acquisition	0.4	0.1	0.2	0.1	--
8. Duties and Taxes	0.2	0.1	0.1	--	--
TOTAL PROJECT COST	17.0	3.6	5.6	5.3	2.5

NEPAL

NARAYANI ZONE IRRIGATION DEVELOPMENT STAGE 1 PROJECT

Farm Budget Analysis

		Unit											
1.	Farm Size	ha	0.67	2.0	5.0	0.67	2.0	5.0	0.67	2.0	5.0	0.67	2.0	5.0
2.	Cropped Area	ha	1.10	3.24	8.0	1.10	3.24	8.0	1.27	3.04	8.65	1.33	3.90	9.25
3.	Cropping Intensity	%	167	165	162	167	165	162	190	182	175	198	195	185
4.	Gross Value of Production	NRs	2,900	8,600	21,400	3,400	10,000	25,200	5,800	16,700	40,900	6,500	18,700	44,500
5.	Farm Production Cost													
	Hired Labor	NRs	60	440	1,550	65	470	1,650	120	670	2,200	120	740	2,300
	Animal	NRs	430	1,300	3,180	450	1,470	3,390	530	1,560	3,750	550	1,690	3,900
	Other Inputs	NRs	580	2,200	5,500	855	2,720	6,970	1,620	4,340	11,620	1,700	4,790	11,000
	Subtotal	NRs	1,070	3,940	10,230	1,370	4,660	12,010	2,270	6,570	17,570	2,370	7,220	17,200
6.	Irrigation Cost 1/	NRs	--	--	--	--	--	--	130	300	860	480	1,440	3,600
7.	Net Value of Production (4) - (5) - (6)	NRs	1,830	4,660	11,170	2,030	5,340	13,190	3,400	9,830	22,470	3,650	10,040	23,700
8.	Nonfarm Incomes 2/	NRs	600	600	800	600	600	800	600	600	800	600	600	800
9.	Land Taxes 3/	NRs	50	150	370	50	150	370	50	150	370	50	150	370
10.	Net Family Incomes (7) + (8) - (9)	NRs	2,380	5,110	11,600	2,580	5,790	13,620	3,950	10,280	22,900	4,200	10,490	24,130

1/ This cost is estimated at NRs 100 per ha per crop, representing a full recovery of O&M and about 10% of capital cost in surface area (amortized over 50 years at 10% rate of interest). In groundwater area, the charge covers O&M cost and repayment of loans (at 11% over a period fo 20 years for deep tubewells and 7 years for shallow tubewells).

2/ These estimates are based on a survey carried out by the ADBN in the Terai. Non-farm incomes were estimated at NRs 370, NRs 500, and NRs 1,020 for small (less than 2.71 ha), medium (2.71 - 5.42 ha) and large (above 5.42 ha) farmers, respectively in 1969-70 prices and subsequently inflated to 1977 price level. For farm budget analysis, NRs 600 and NRs 800 are assumed for the respective non-farm incomes of 0.67 and 2.0 ha, and 5.0 ha farm households. Furthermore, due to the lack of data on consumption patterns and on the supply of migrant labor, it is assumed that non-farm incomes would remain unchanged in the future.

3/ Land taxes vary in accordance with land grade. In the project area, land taxes amount to NRs 75 per ha. Since in other parts of Nepal irrigation has not affected the land taxes, this rate is assumed to remain constant.

September 1978.

TITLE: On-Farm Water Management

PROJECT NO.: 391-0413

COUNTRY: Pakistan

REGION: Asia

KEYWORDS: Canals (5); watercourses (5); land leveling (5); water management (3).

SUMMARY: Three approaches will be combined in a pilot program to increase crop production. Rehabilitation of on-farm irrigation ditches and structures will decrease conveyance losses; precision land leveling will improve application efficiency; and instruction to farmers in improved irrigation scheduling and cropping techniques will pr vide more practical use of water. The related government and private sector services will be established.

LOCATION: All provinces.

CLIMATE: BS-BW.

CROPS: Sugarcane, wheat, cotton, rice.

TARGET GROUP: Low-income farmers (owners of less than 25 ac, sharecroppers and tenant farmers).

BEGIN: June 1976 END: FY 1981 AREA: 424.5K ac leveled.

NUMBER OF FARMS: 60-100K

CONTRIBUTION:		
	USAID	$22.4M (40 year loan) 14-15 technicians
	GOP	16.2M (11.4M direct costs, 4.8M credits)
	Farmers	1.8M (watercourse labor) 3.9M (land leveling)
	TOTAL	$44.3M

GOALS: Increased agricultural production and improved income for the low-income farmers in Pakistan. On-Farm Water Management concept is fully appreciated and taken account of by the Government of Pakistan in agricultural planning and the project is replicated.

PURPOSE: Public and private sector capability is established to plan and deliver on-farm water management services to farms at economic costs.

TYPE OF PROJECT: Large-scale pilot project.

TECHNOLOGY USED: Earth-lined channels, land leveling.

DOCUMENTS REVIEWED: Project Paper (160 pp).

PROJECT ORIGIN AND BASE LINE DATA: Results from a CSU study of watercourse efficiencies, some CSU trials at the Mona Project, interviews with farmers, and success of the SCS land leveling project in Pakistan.

BENEFICIARY INVOLVEMENT: Farmers will assist in planning (interviews conducted), construction, operation and maintenance.

ACTUAL STARTING DATE: September 15, 1976 (first monetary advance)

LOGICAL FRAMEWORK: Not available.

PERT CHART: Not available.

GENERAL DESCRIPTION

The AID loan is to be made in two parts: $7.5M for the first three years of project funding, and $22.5M for the last two years. This reflects the acceleration in work rate and magnitude as the project proceeds. The figures given in this summary are for the full five years of the pilot project.

TECHNICAL

Recent studies by a CSU research team have shown that conveyance efficiency at the farm level is as low as 60%, giving an overall water efficiency of 15%-25% (water used by plants divided by water diverted). This had not been realized before, although farmers named inadequate water supplies as their primary problem in crop production. By showing farmers how to repair the farm supply ditches, by lining them with clay, soil-cement or concrete (necessary in about 5% of cases), available water will be increased considerably. The project will provide 1,500 watercourse systems with compacted earth ditches and masonry control structures.

A rough land surface forces the farmer to either divide his land into very small plots for basin irrigation, or to over-irrigate so as to cover the high spots. This causes a low application efficiency, overwatering of the low spots, and reductions in yield If the field can be leveled to within three centimeters, as has been proven in pilot programs, farmers will achieve better yields using less water. The project will level 424.5K ac of land.

Most farmers are unaware of concepts of consumptive use as related to climate, soil moisture storage and depletion, and other components of irrigation scheduling. New extension agents will be trained and assigned to groups of 300-500 farmers to teach water management and other modern farming techniques. The project will train 1,380 government workers and 188 bankers and contractors.

Watercourse improvement sites will be chosen on the basis of farmer interest, potential for increased acreage, availability of credits and input, conveyance efficiency, and farm size (average size on the watercourse less than 25 ac).

The project will be considered successful if, out of 60-100K farmers, 50% will have doubled efficiency, adopted improved technology, and increased agricultural output by 50%.

INSTITUTIONAL

The government of Pakistan will set up teams to survey, prepare and supervise construction of the watercourse improvement. This

will require the following labor input over five years, including extension agents to be left on site:

	1977	1978	1979	1980	1981	Total
Team Leaders	3	27	48	84	138	300
Watercourse Engineers	6	54	96	168	276	600
Land Development Officers	15	135	240	420	690	1,500
Agricultural Officers	3	27	48	84	138	300
Field Assistants	3	30	78	162	300	573
						3,273

The last year will see 1,542 men employed by the government.

The farmers will organize themselves into informal or formal groups of 60-100 men for each watercourse, as a requirement for any government assistance. This group will work together for construction, operation and continued maintenance of the watercourse. It is anticipated that they will hire a full-time watchman to tend and repair the system.

In the private sector, demand will cause the establishment of 875 tractor land-leveling teams, employing 3,500 people. Similar secondary efforts will be felt throughout the economy (hiring of masons, purchase of tools and fertilizer, etc.).

An aggressive radio publicity campaign will be aimed at convincing farmers of the value of the program.

Pakistani banks will enter into a new field of agricultural lending, and training will be provided for those that are interested.

SOCIAL

Social benefits are indirect. They include increased employment (a fully managed irrigated farm requires a labor input of 80 man-days/ac/year, which is double the input for a low-yielding irrigated system), and, in the long term, improved health and lower birthrate.

A particular effort is being made to reach the low-income farmer. This is done by choosing watercourses where the average farm size is less than 25 acres.

FINANCIAL/ECONOMIC

Achievements and yearly costs are shown on the annexed sheet.

The IRR is calculated to be 45%, assuming that 50% of the water saved is applied to presently underirrigated land, and the rest to unirrigated land, and that farmers will achieve 50% of the difference between their present yields and those at the experimental stations.

Some unit prices are given as follows:

Ditch structures	$20/each
Concrete or brick lining	$3/ft
Earthmoving (leveling)	$0.30/$m^3$
Farm labor	$0.15/hr

Disbursement of the AID loan is to be on a FAR (Fixed Amount Reimbursement) system, whereby the Pakistani government is reimbursed for verified costs of the program. Some advances will be made, however, for startup of the land-leveling teams. In each province, no disbursements will be made until there is an assurance of staff, approved budget, and private land-leveling contractors in adequate numbers.

Table 3
Page 1 of 2
ON-FARM WATER MANAGEMENT
PROGRAM ACHIEVEMENTS, COSTS & SOURCES OF FUNDING

		1977 1st Year	1978 2nd Year	1979 3rd Year	(3 Year Total	1980 4th Year	(4 Year Total	1981 5th Year	(5 Year Total
I.	Teams in field	3	27	48	(78)	84	(162)	138	(300)
II.	Watercourse (WC) Improved (No.)	15	135	240	390	420	810	690	1,500
III.	Precisely Leveled Acres	4,245	38,205	67,920	(110,370)	118,860	(229,230)	195,270	(424,500)
	283 acres per WC (150 acres per WC directly adjacent/133 acres per WC off WC)								
IV.	Costs of Program (in 000's Rupees)		Direct Costs, Extension and Management						
	WCI - Structures & Install.	271	2,437	4,332	(7,040)	7,581	(14,621)	12,454	(27,075)
	Concrete Lining	360	3,240	5,760	9,360	10,080	19,440	16,560	36,000
	Labor of Farmers	180	1,620	2,880	4,680	5,040	9,720	8,280	18,000
	Extension & Mgmt.[1/]	700	4,356	5,648	10,704	9,206	19,910	14,551	34,461
	PLL - Cost @ Rs 600/acre	2,547	22,923	40,752	66,222	71,316	137,538	117,162	254,700
	Extension & Mgmt.[1/]	1,395	8,685	11,263	21,343	18,358	39,701	29,016	68,717
		5,453	43,261	70,635	(119,349)	121,581	(240,930)	198,023	(438,953)

1/ These costs, which together equal the total of "Provincial Overhead" and Direct Team Costs" in Table 2, have, for this breakdown, been divided 1/3 WCI and 2/3 PLL; in fact, a good deal, but undeterminable amount, of these costs should be related to the third element of the project: Improved Crop and Water Management.

Table 3
Page 2 of 2

	1977 1st Year	1978 2nd Year	1979 3rd Year	(3 Year Total	1980 4th Year	(4 Year Total	1981 5th Year	(5 Year Total
V. Costs of Program (in 000's Rupees) - to Pakistani participants								
Government Budget - mgmt.	3,745	17,888	43,334	(74,967)	73,751	(148,718)	119,446	(268,164)
-- Credit	1,146	10,315	18,316	29,777	32,093	61,870	52,723	114,593
Farmers:								
1. Labor - WC	180	1,620	2,880	4,680	5,040	9,720	8,280	18,000
2. Cash Contribution for PLL	382	3,438	6,105	9,925	10,697	20,622	17,574	38,196
Total:	5,453	43,261	70,635	(119,349)	121,581	(240,930)	198,023	(438,953)
VI. AID Disbursement Plan - Fixed Amount Reimbursements (in 000's Rupees)								
WCI - Structures	270 1/	2,430	4,320	(7,020)	7,560	(14,580)	12,420	(27,000)
Concrete Lining	360 2/	3,240	5,760	9,360	10,080	20,440	16,560	37,000
Installation	240 3/	2,160	3,840	6,240	6,720	12,960	11,040	24,000
PLL - Earthmoving	1,910 4/	17,192	30,564	49,666	53,487	103,153	87,853	191,006
Total FAR Entitlement	2,780	25,022	44,484	(72,286)	77,847	(151,133)	(279,006) 7/	(279,006) 1/
Advances to GOP - 1st Loan 5/	1,500	12,000 6/	10,500 6/	(24,000)	--	(24,000)	--	(24,000)
FAR Payts. less Adv. Liq.	1,280 6/	13,022 6/	33,983 6/	48,286	1,964 6/	50,250	--	50,250
1st Loan Disbursement	2,780	25,022	44,484	(72,286)	1,964	(74,250)	--	(74,250)
2nd Loan - FAR Payts.	--	--	--	--	75,883	(75,883)	72,617	(148,500)
Total Loan Disbursements	2,780	25,022	44,484	(72,286)	77,847	(150,133)	72,617	(222,750)

Footnotes

1/ @ Rs 200 per divers. struc. with approx. 80 per WC; buffalo wallow, one per WC at Rs 2,000
2/ @ Rs 30 per ft. (No. of WC x 16,000 ft x 5% x 30 Rs.)
3/ Engineering; @ one rupee per ft. of earth lined WC
4/ @ Rs 450 per acre (75% x 200 m^3 x Rs x no. of acres)
5/ @ Rs 500,000 per Field Team
6/ Balances of FAR payments after advances liquidated.
7/ Loan funds will be exhausted in 5th year, at Rs 222,750,000 (equiv. $22.5 million, total of the 2 loans).

TITLE: Mahaweli Ganga Irrigation

PROJECT NO.: 383-0042

COUNTRY: Sri Lanka

REGION: Asia

KEYWORDS: Research (3); demonstration (3); resettlement (5); land clearing (5); and land leveling (3).

SUMMARY: The full project, sponsored by a donor consortium, provides for a transbasin diversion and major irrigation system, land clearing and resettlement of 15.3K families, and associated infrastructure (schools, roads, wells, storage and processing facilities). The AID component will establish two farms, for research and demonstration, study of cultivation practices and irrigation scheduling, and training of extension agents and farmers. AID will also finance a part of the local (GSL) costs.

LOCATION: North Central (Anuradhapura, Kurunegala, Matale).

CLIMATE: Aw.

CROPS: Rice, cereals.

SOILS: Upland, paddy.

TARGET GROUP: All farmers living in or willing to move to the project area.

BEGIN: June 1977 END: FY 1982 AREA: 104K ac.

NUMBER OF FARMS: 41K

CONTRIBUTION:

USAID	$ 5.2M	loan
	0.8M	grant
World Bank	19.0M	
Netherlands	5.0M	
UK	7.2M	
Canada	6.0M	
GSL	28.3M	
Banks, farmers	9.7M	
TOTAL	$81.2M	($1 billion over 30 years).

GOALS: To increase domestic food production, to expand employment opportunity, and to improve the small farmer's standard of living.

PURPOSE: To enable irrigated agricultural production on 106K acres of land along the Mahaweli River.

TYPE OF PROJECT: Large-scale irrigation installation.

TECHNOLOGY USED: Hand labor for on-farm works, introduction of farm tractors.

DOCUMENTS REVIEWED: Project Paper (100 pp).

PROJECT ORIGIN AND BASE LINE DATA: The project began with a water resources planning program financed by the US (1958) and includes studies by UNDP, BIRD, and previous GSL experience with other projects.

BENEFICIARY INVOLVEMENT: Farmers will be paid to complete the on-farm irrigation works. Eleven farmers on demonstration farm. It is expected that eventually farmers will take over operation and maintenance of system.

LOGICAL FRAMEWORK: Attached to reviewed documents.

PERT CHART: Not available.

GENERAL DESCRIPTION

The project is divided into three stages. Stage I, nearly complete, involved the construction of dams, canals, tunnels, and a 40 MW power station, for a transbasin diversion of water to the area of Stage II. Stage II will use the water to irrigate new land and is the subject of the project described here. Stage III will initiate irrigation in sparsely populated areas of Central Sri Lanka.

The full project is funded by a consortium of donor organizations. To simplify funding and reporting, each organization is subsidizing a separate component of the project. In addition, each of the sponsors has agreed that 25% of its contribution will be used for local (host country) project costs. Thus, AID will be directly funding the research/extension portion of the project.

TECHNICAL

The project proposes:

1. Construction of irrigation, drainage, and roads on 40.3K ac;

2. Clearing of jungle and preparation of 40.3K ac for cultivation, with settlement of 15.3K families on two-and-one-half acre plots;

3. Construction of operation and maintenance facilities for 71K ac;

4. Production support in the form of farm equipment, marketing, transport and processing facilities for 71K ac;

5. Improved agricultural extension services for 106K ac (the full project area);

6. Social infrastructure: well, schools, medical and community development facilities for 64.9K ac; and

7. Technical assistance and monitoring.

The AID-funded research component will be carried out on two farms (30 ac each). The Experimental Farm will be used to test a number of terracing, cropping and field irrigation methods. After one year, the best of these will be installed at the Demonstration Farm, where 11 farmers will operate the system. The Demonstration Farm will be used to train local extension agents, and eventually farmers for the larger system. In the last two years of the project,

results from the Demonstration Farm will be tested on several adjacent field systems.

INSTITUTIONAL

Primary project administration is by the Mahaweli Development Board (MDB). Resettlement is apparently an accepted practice in Sri Lanka, and the government has the necessary organizations to carry it out. The number of extension agents in the area will be increased, to achieve a ratio of one per 250 farmers. There is no discussion of farmer organizations.

SOCIAL

A total of 15.3K families will be resettled. These farmers will be selected on the basis of agricultural experience, tenurial status, age, marital status, and family size. The usual government services infrastructure will be provided.

FINANCIAL/ECONOMIC

Project budget given on page 47 (attached).

IRR is equal to 21%.

Institutional credit is provided by the Bank of Ceylon and the People's Bank, although in the past about 85% of short- and medium-term credit has been provided by private sources.

Farmers will buy the land at a value that will reimburse approximately 60¢ of clearing/reclamation costs. Also, land betterment charges will reflect, in part, the value of the water provided. This will avoid complicated water measurement and pricing requirements.

TABLE 3
OVERALL PROJECT BUDGET

	Local	Foreign	Total	Local	Foreign	Total[a]	Percent of Base Cost
	(Rs million)			(US$ million)			
Irrigation and Land Development							
Land Acquisition	2.6	0.0	2.6	0.36	0.00	0.36	0.5
Irrigation Infrastructure	73.1	22.5	95.6	10.04	3.09	13.13	18.4
On-farm Works	88.6	24.8	113.4	12.16	3.41	15.57	21.8
Construction Equipment	31.8	39.2	71.0	4.37	5.38	9.75	13.6
O&M Facilities and Equipment	10.5	10.5	21.0	1.44	1.44	2.88	4.0
Subtotal	206.6	97.0	303.6	28.37	13.32	41.69	58.3
Production Support							
Agricultural Extension	8.0	5.6	13.6	1.10	0.77	1.87	2.6
Farm Equipment	27.0	43.4	70.4	3.71	5.96	9.67	13.5
Storage, Marketing and Processing	14.5	10.4	24.9	1.99	1.43	3.42	4.8
Market Roads	2.7	1.1	3.8	0.37	0.16	0.53	0.8
Subtotal	52.2	60.5	112.7	7.17	8.32	15.49	21.7
Social Infrastructure							
Schools	16.3	4.2	20.5	2.24	0.57	2.81	3.9
Medical Facilities	2.2	1.0	3.2	0.31	0.13	0.44	0.6
Community Development Facilities	5.6	1.5	7.1	0.77	0.21	0.98	1.4
Village Wells	4.3	0.9	5.2	0.59	0.12	0.71	1.0
Roads in New Villages	7.1	3.2	10.3	0.98	0.44	1.42	2.0
Subtotal	35.5	10.8	46.3	4.89	1.47	6.36	8.9
Settlement	13.1	3.6	16.7	1.80	0.49	2.29	3.2
Technical Assistance	0.6	3.4	4.0	0.08	0.47	0.55	0.8
Monitoring Project Performance	2.6	1.8	4.4	0.36	0.25	0.61	0.8
Engineering, Supervision and Administration	32.6	0.0	32.6	4.48	0.00	4.48	6.3
BASE COST	343.2	177.1	520.3	47.15	24.32	71.47	100.0
Physical Contingencies	38.4	11.0	49.4	5.27	1.52	6.79	9.5
Expected Price Increases	112.7	49.2	161.9	15.48	6.76	22.24	31.1
Total PROJECT COST[b]	494.3	237.3	731.6	67.90	32.60	100.50	140.6
PROJECT COST LESS TAXES AND DUTIES	345.1	237.3	582.4	47.40	32.60	80.00	n.a.

a/ Discrepancies in currency conversions due to rounding

b/ To these costs should be added an additional Fx cost of $700,000 for technical assistance, training and equipment not included in the above budget. Above table does include approximately $100,000 for equipment for the research project.

TITLE: Mahaweli Basin Development Phase I (Maduru Oyo-System B)

PROJECT NO.: 383-0056

COUNTRY: Sri Lanka

REGION: Asia

KEYWORDS: Surface irrigation (5); water management (5); resettlement (5); micro-hydroelectric (3).

SUMMARY: Under the System B project, 31,900 hectares will be developed as irrigated one hectare lowland farms and 5,500 hectares will be developed as two hectare irrigated upland farms. Of the total project area, 22,000 hectares will be utilized for settlements. Settler families will come primarily from outside the project area.

LOCATION: Central eastern Sri Lanka in the Polonnaruwa and Batticaloa districts.

CLIMATE: A.

CROPS: Paddy, maize, sugarcane, groundnuts, green gram.

SOILS: Relatively shallow, somewhat acidic upland soils and alluvial lowland deposits.

TARGET GROUP: The irrigating farmer.

BEGIN: 1979 END: 1986 AREA: 130,000 ha.

NUMBER OF FARMS: 43,300

CONTRIBUTION: New regulations restrict the release of this information.

GOALS: This project should quintuple the production of rice in the valley, as well as contribute to the production of livestock, fish and power in the region.

PURPOSE: The direct benefits resulting primarily from irrigation in the form of increased food production, greater and more productive employment and resulting higher agricultural income to the settlers.

TYPE OF PROJECT: Large-scale irrigation development.

TECHNOLOGY USED: Major concrete arch and rockfill dams, link tunnels and large canals to be built with heavy machinery. Smaller structures will be built largely by labor-intensive methods.

DOCUMENTS REVIEWED: Project Paper (106 pp and eight annexes).

PROJECT ORIGIN AND BASE LINE DATA: A review of the accelerated Mahaweli project was carried out by the Dutch firm of Nedeco. A feasibility study of System B is being undertaken by the Canadian firm of ACRES International Limited.

BENEFICIARY INVOLVEMENT: The structure for water charges has not been decided.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

The proposed design and supervision project of irrigation delivery systems for the Mahaweli Ganga System B/Maduru Oya Basin is the first and essential component for the implementation of a program of irrigation, settlement and rural development of Maduru Oya area.

TECHNICAL

Before System B can be fully operational, the following elements must be in place: Victoria Dam, Minipe Weir, Right Bank Canal, Ulhitiya Dam, Ratkinda Dam, Link Tunnel, Maduru Oya Dam, and System B Irrigation and Drainage Works. These are briefly described as follows:

1. The Victoria Dam will be a 110 m high concrete arch dam on the Mahaweli Ganga which will store 720 million cubic meters of water and have the capability to provide 210 MW of power. The reservoir will yield sufficient flow to irrigate 53,000 ha in a normal flow year.

Irrigated areas amounting to 16,300 ha in System B and 35,000 ha in System A will be dependent upon Victoria Reservoir flows.

2. The Minipe Weir will be a new weir, replacing a lower existing one, which will divert Mahaweli Ganga flow into the Right Bank Canal for irrigating Systems B and C.

3. The Right Bank Canal will be a new canal which will transport the flow diverted by the Minipe Weir to Ulhitiya Reservoir. The Canal will have a capacity of 64 cms and will require several large structures including siphons and level crossings.

4. The Ulhitiya and Ratkinda Reservoirs will be earthfill dams with heights of 25 m and 27.5 m, respectively, which will form the headworks for irrigating the 21,400 ha of irrigable land in System C. They will also serve as level crossings for System B flow. Flow from the Right Bank Canal for System B and C will enter Ulhitiya Pass through the connecting channel into Ratkinda Reservoir. System C will be serviced from both reservoirs and System B flow will go on from Ratkinda Reservoir to Maduru Oya Reservoir via the Link Tunnel.

5. The Link Tunnel will be a 5.9 km tunnel through the ridge separating the Ulhitiya and Maduru Oya Basins, with canal sections at each end, which will divert the flow for System B from Ratkinda Reservoir to the Maduru Oya Reservoir.

The tunnel will have a capacity of 34 cms and a diameter of 5.1 m.

6. The Maduru Oya Reservoir will be a concrete gravity or rockfill dam with a height of nearly 42 m and a storage capacity of 439 million cubic meters. It will receive flow from the Mahaweli Ganga via the Right Bank Canal as well as from the Maduru Oya Basin and will form the headworks for System B. It will also have three small hydropower turbines which will be able to produce about seven megawatts of secondary electric power. The breakdown of the source of water supply during average flow years for the 52,300 ha of irrigable area in System B is as follows:

a. Maduru Oya flow - 16,000 ha;

b. Mahaweli Ganga flow - 20,000 ha (natural flow, no storage) via the Right Bank Canal;

c. Mahaweli Ganga flow - 16,300 ha additional because of the storage in Victoria Reservoir via the Right Bank Canal.

In addition to the 52,000 ha total area, water supplies to the existing Pimburettewa (1,260 ha), Vakaneri (3,120 ha) and Punanai (410 ha) tanks will be augmented with flow from the Maduru Oya Reservoir.

7. The System B Irrigation and Drainage Works will have both right and left bank canals serving the system with 232 km of main and major branch canals. Because much of the soil is porous, all of the major canals, except where they are in rock excavation, and some of the smaller canals will need to be lined.

A number of structures will be required including turnouts, drop structures, level crossings, siphons, and road and rail crossings. Many kilometers of tertiary and farm delivery canals will also be required, along with their appurtenant structures. Extensive drainage works will be required as well. They will range in size from small ditches to carry excess water from individual fields to large interceptor drains. The natural drainage ways will be used as much as possible and, where required, will be deepened and widened.

EFFICIENCY ASSUMPTIONS

The ACRES Report uses a conveyance efficiency in lined canals of 95%. This percentage takes into consideration evaporation and seepage from canals. A distribution efficiency of approximately

75% was used. This percentage accounts for losses in operation of the canal system. Combined conveyance and distribution efficiencies are estimated at 70%. For non-paddy areas, a field efficiency of 50% was assumed which indicates that, for two acre-feet of water applied to the soil, only one acre-foot is beneficially used by the crop. Thus, overall efficiency would be on the order of 35%. The NEDECO Report estimates upland system efficiency at 30%. They state that their efficiency predictions (and consequently their water use requirements) are more conservative than studies made by other consultants, but optimistic when compared to present-day actual practices. An efficiency figure of 30%-35% for surface irrigation on light-textured upland soils is, in our judgment, realistic.

SEEPAGE AND PERCOLATION LOSSES

For irrigation on puddled paddy soils, generally accepted practice is to estimate daily losses due to seepage and percolation (S&P). Both consultants originally used a value three mm/day on the LHG soils (generally sandy clay loams or sandy loams), a rate they say is adopted from UNDP/FAO figures. The current version of the ACRES Report uses a value of six mm/day on Class II R soils and three mm/day on Class I R soils. It is unclear whether this figure includes seepage (through bunds) as well as deep percolation.

Because project soils are generally light in texture and the farms small in size, there is the possibility that S&P losses may exceed the values estimated by the consultants. Field tests at several System B locations will be made to verify the magnitude of these potential losses.

IRRIGATION REQUIREMENTS

Irrigation requirements are calculated from crop water requirements as modified by efficiency assumptions with, in the case of paddy, allowances made for S&P and land preparation. ACRES estimates reveal that, for a Maha crop of paddy, some 600 mm of supplimental irrigation water will be required; for Yala, the figure is approximately 1,500 mm. In our estimation, these figures may have to be increased to account for additional losses due to S&) plus requirements in land preparation. Clearly there is room for improvement in water management, especially so during the Maha season.

WATER MANAGEMENT

Eighty-five percent of the agricultural land to be developed in System B is most suitable for the cultivation of paddy, the crop

farmers prefer, and the crop which has usually caused excessive water requirements when planted on unsuitable soils. Only 15% of the area is designated for upland crops. These upland areas will be served by a different set of field canals from those serving the paddy areas which will insure water deliveries suitable for these crops but not paddy. Thus the situation in Area H, where water use is excessive because farmers plant paddy on upland soils served by the same canals as the paddy fields, is not expected to arise.

A program to organize farmers in turnout groups (15-20 families) in Area H has thus far been quite successful. Each group elects one farmer who deals with project administrators on agricultural support, and another who is responsible for irrigation system operation. The Authority plans to extend this program to System B. Turnout groups may be further organized at successive levels of the irrigation system, though this has not been decided. Farmers will also assist in the construction of the tertiary system and will be represented on the subzonal boards of the Corporation administering the developed project.

The Authority plans to institute a computerized system operation and to train staff to operate it at all levels. The Mission continues to urge IBRD to become involved in such a program. Currently, it remains in the conceptual stage though systems do operate here on the basis of local decisions regarding cropping area, tank levels, etc. This area will require more attention in the future.

A comprehensive Water Resources Act is currently under preparation which should have direct impact on project implementation. This Act, as currently drafted, will do the following:

1. Put ownership and control of all water in the country under the Government;

2. Create a Water Resources Council for advice and on policy formulation and coordination of water;

3. Set up a system of water allocation and water management to include the conditions and procedures for use of water;

4. Provide a general policy of water pricing;

5. Establish the water courts as an additional and preferential function of the primary courts to resolve disputes and try cases for destruction and related problems; and

6. Provide the legal authority for the farmer organizations or irrigation councils.

INSTITUTIONAL

The Mahaweli Authority of Sri Lanka, within the Ministry for Mahaweli Development is responsible for planning and implementing the Accelerated Mahaweli program. The Authority was legally established in February 1979. It has wide powers to carry out, under its own auspices, all actions necessary to implement the program including the authority to establish corporations.

When first established, the staff of the Authority was essentially the staff of the Ministry. Subsequently, the Authority has begun to hire its own staff and has been successful in attracting high caliber people for key positions. Many of these people held important positions in the private sector. The hiring process continues as the work of the Authority expands.

The three major organizations within the Authority which will have primary responsibility for implementing the System B Project are the Central Engineering Consulting Bureau (CECB), the Mahaweli Development Board (MDB) and the Management and Investment Corporation.

The CECB is responsible for headworks construction for the AMP. For System B, CECB is responsible for the construction of the Maduru Oya Dam and link tunnel. CECB will be assisted in this role by Canadian consultants who will supervise construction of the dam and tunnel and by the Canadian contractor who will construct the dam and tunnel. The CECB will be able to perform its function with the assistance of these contractors.

The Mahaweli Development Board will be responsible for designing and constructing the physical infrastructure for System B, including the irrigation system, infrastructure buildings, and land clearing. The Board has been in existence for about ten years and its staff has considerable experience in these activities, primarily gained from the development of the 100,000 acres in System H. The Board's resources will be transferred from Area H to Areas B and C and augmented as necessary. The staffing requirements are now being analyzed and will be further described in USAID's subsequent project peper for the Mahaweli program.

The Management and Investment Corporation will be set up under the Powers provided in the Act establishing the Mahaweli Authority. The Corporation is a new concept for Sri Lanka and will have the power to participate and invest in subsidiary or nonsubsidiary companies which will carry out functions of marketing, processing, plantation management, ranching, transport, plant maintenance, or any other appropriate industrial or commercial venture in any part of the Mahaweli area.

SOCIAL

The project is socially and culturally feasible. The relocation of indigenous villagers within the project area is minimal and a number of special design features in the project are directed towards reducing, if not eliminating, most of the psychological, sociological, and psychological stress which some settlers may experience. Chief among these special features is the settler-worker plan ("advance alienation") whereby settlers will come first to the area to work on construction of the tertiary irrigation systems. This concept, which has worked successfully in earlier Sri Lankan settlement projects, facilitates adjustment by giving the settlers an opportunity to become familiar with their new environment before actually settling there. Also, a number of training courses designed to prepare the settlers for their new lives are planned.

ENVIRONMENTAL

The Mahaweli program will have a beneficial impact on the human environment and can be implemented to minimize such problems as land erosion, but many feel that, since a sizable portion of the downstream area is virgin jungle, the program will have a negative effect on wildlife. Given the concern of U.S. wildlife groups and the Department of the Interior over the impact of the current Mahaweli Irrigation Project, which even wildlife interests here admit has, at worst, a marginal impact on wildlife, can AID participate in this project? It should be noted that CSL has accepted AID's offer of assistance to carry out a thorough environmental study of the program's impact. USAID believes AID's participation in the program will enhance environmental concerns and diminish, though not eliminate, negative impact on wildlife. USAID believes AID/W should air this issue and discuss it with U.S. environmental interests, if necessary.

ECONOMIC

The anticipated ERR for the project is 10.7% over a 40-year period. The main beneficiaries of the Maduru Oya project will be the new farm settlers. A table of cash flow and benefit projections for the average paddy farm are attached.

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AVERAGE PADDY FARM

CASH FLOW AND BENEFIT PROJECTIONS

YEARS 1 through 5

TABLE 11

	Year 1	Year 2	Year 3	Year 4	Year 5
CASH SOURCES					
Beginning Cash Balance	$ —	$ 65	$ 65	$ 65	$ 65
Loan Proceeds	250	300	400	450	500
Crop Sales	616	718	820	923	1,026
Total Cash Sources	866	1,083	1,285	1,438	1,591
CASH USES					
Production Costs:					
Fertilizer	--	—	45	52	57
Crop Protection	10	10	42	48	53
Farm Power	144	168	192	216	240
Labor	19	22	26	29	32
Miscellaneous	69	81	92	103	116
Finance Charges					
Interest	25	30	40	45	50
Loan Amortization	250	300	400	450	500
Total Cash Uses	517	611	837	943	1,048
Ending Cash Balance	349	472	448	495	543
Add: Home Production	255	255	255	255	255
Financial Benefits Realized 1/	604	727	703	750	798
Less: Cash Carryover to following year	(65)	(65)	(65)	(65)	(65)
Consumed Benefits	539	662	638	685	733
Per Capita Financial Benefits	121	145	141	150	160

1/ Note: The ACRES Report estimates a basic cost of living requirement of $387.000 per year (Rs. 500/MO) for a family of five. See assumptions Table 12, Page 2 of 2.

TITLE: Water Management Project

PROJECT NO.: 383-0057

COUNTRY: Sri Lanka

REGION: Asia

KEYWORDS: System rehabilitation (3); water management (5).

SUMMARY: The present status of on-farm water use indicates that vast improvements need to be achieved in the shortest possible time. The Gal Oya Left Bank settlement and Ude Walwae project have been selected for development assistance with these considerations in mind.

LOCATION: Ude Walawe in the southern part of the country and Gal Oya located in Amparai and Batticaloa Districts on the eastern coast of Sri Lanka.

CLIMATE: A.

CROPS: Paddy

TARGET GROUP: The irrigating farmer.

BEGIN: 1980 END: 1985 AREA: 180k ac

NUMBER OF FARMS: 60,000

CONTRIBUTION: Under new USAID rules, this information is classified.

GOALS: Increase production of paddy by 7.5 million bushels in year 20 of the project.

PURPOSE: The purpose of this project is to develop an institutional capacity in the GSL Irrigation Department which will enable it to manage large irrigation schemes in a more effective and efficient manner.

TYPE OF PROJECT: Large-scale improvement and modernization of irrigation schemes through technical and institutional innovation.

TECHNOLOGY USED: Heavy equipment will be needed on the major canals and brarches, while hand labor will be used for work on the smaller distributaries, and field channels.

DOCUMENTS REVIEWED: Project Paper (81 pp with 13 annexes).

PROJECT ORIGIN AND BASE LINE DATA: The PID was submitted to AID/W on May 2, 1978 and approved for PP development on July 19, 1978. AID commissioned CH2M Hill to define details of the program.

BENEFICIARY INVOLVEMENT: Steps have been taken to introduce water charges under 1979 legislation. Farmer participation and involvement in water management will be ensured.

GENERAL DESCRIPTION

The Water Management Project will directly increase production in the Gal Oya area by improving water management and will, through its training, extension research and planning components, improve water management and increase agricultural, especially rice production and small farmer incomes in other parts of the country.

TECHNICAL

1. Master Planning. The purpose of the master plan program is to conduct the necessary investigations and planning for three major areas:

a. Return flow reuse. Better reuse is a major requirement if both the Uda Walawe and Gal Oya irrigation schemes are going to achieve their original design objectives. This project will fund a master planning effort for this purpose and will include planning teams which will be equipped and staffed to conduct return flow measurements and to develop a master reuse plan.

b. Main canal system. A master plan for operation of the main canal and tank system is needed for both Gal Oya and Uda Walawe systems. For Uda Walawe, the plan will include an evaluation of ways to improve operational storage at Chandrikawewa. The other aspects of both plans will include identification of operational deficiencies along the main canal, development of operational criteria to reduce water losses, maximize diversions, and ensure equitable distribution of flows to all reaches of the main canal.

c. Domestic water. A master plan for domestic water is required for the following reasons:

i. Domestic water runs cause major problems with canal operation and maintenance;

ii. Canals used for domestic use present health hazards; and

iii. The loss of water for the amount which is beneficially used is extremely high.

The plan will investigate domestic water requirements, groundwater quantities and quality, and will develop and evaluate alternative plans for domestic water service. The plan will be developed concurrently with the return flow reuse plan.

GENERAL DESCRIPTION

The Water Management Project will directly increase production in the Gal Oya area by improving water management and will, through it training, extension research and planning components, improve water management and increase agricultural, especially rice, production and small farmer incomes in other parts of the country.

TECHNICAL

1. Master Planning. The purpose of the master plan program is to conduct the necessary investigations and planning for three major areas:

a. Return flow reuse;

b. Main canal; and

c. Domestic water.

The master plans will provide the basis for future program implementation including technical details, design cost and related material for both the Gal Oya and Uda Walase systems.

a. Return Flow Reuse. Better reuse is a major requirement if both the Uda Walawe and Gal Oya irrigation schemes are going to achieve their original design objectives. This project will fund a master planning effort for this purpose and will include planning teams which will be equipped and staffed to conduct return flow measurements and to develop a master reuse plan.

b. Canal System. A master plan for operation of the main canal and tank system is needed for both Gal Oya and Uda Walawe systems. For Uda Walawe, the plan will include an evaluation of ways to improve operational storage at Chandrikrwewa. The other aspects of both plans will include identification of operational deficiencies along the main canal, development of operation criteria to reduce water losses, maximize diversions, and ensure equiable distribution of flows to all reaches of the main canal.

c. Domestic Water. A master plan for domestic water is required for the following reasons:

i. Domestic water runs cause major problems with canal operation and maintenance;

2. On-Farm Water Management Research. The on-farm water management (OFWM) research is a program designed to evaluate revised and improved field channel layout with on-farm land levelling and water management features which will permit return flows to re-enter the field channels. The intent of the research is to show the farmers how they can help themselves through their own organizations by improving their field channels and land topography.

a. Field Channel Improvement. On a pilot basis, field channels will be improved with farmer help through an irrigation organization to do the following:

i. Improve and revise the field channel layouts;

ii. Provide partial masonry or concrete lining if required and compact the earth lining for the remainder of the channel;

iii. Construct masonry or concrete control structures and outlets; and

iv. Make other improvements such as scheduling and rotation as deemed necessary.

Equipment, personnel, and technical assistance will be provided by the project to reuse water efficiently on farms in the area starting in Tract 3 of the Right Bank of Uda Walawe and in Left Bank Unit 21 of Gal Oya. These will serve as demonstrations to control and make available water in field channels which at present are not capable of serving farmers at the lower ends. These demonstrations will continue for the life of the project and will provide continuous feedback into the operational program at Gal Oya and to the Master Planning effort of both the Gal Oya and Uda Walawe. Several other tracts (units) may undertake similar field work if there is sufficient personnel, funds and time.

b. Land Improvement. Extension agents, professional technicians, or engineers working under the River Valley Development Board in Uda Walawe and under the Irrigation Department in Gal Oya will be in charge of teams of surveyors and land leveling units which will lay out model farms for best utilization of water from the improved field channel and/or drainageways in the respective irrigation systems. Objectives of the work will be to devise systems to retrieve and reuse water by returning it to the field channel and/or drain by leveling fields and constructing farm ditches and drains with sufficient precision to have this kind of control. The planning of

technical aspects will be done by a committee of Sri Lankan engineers and agriculturists assisted by an expatriate agricultural engineer who is trained in on-farm irrigation development. They will utilize the best known technology for water control compatible to the country and to design systems to fully utilize available rainfall.

INSTITUTIONAL

The Irrigation Department will be the principal implementing agency for this project. In Sri Lanka, the Irrigation Department has the responsibility for most major irrigation systems. A few major systems which are still under development are in the hands of special area development authorities like the Mahaweli Development Board and the River Valley Development Board. Minor irrigation projects, defined as those with a command area of less than 200 acres, are under the Department of Agrarian Services, Ministry of Agricultural Development and Research. This Department has the ability to select, award and administer contracts with both local and foreign firms and is currently doing so. As part of this project, a Water Resource Development Staff Office and a Central Support Office will be established in Colombo. The Water Resource Officer will report directly to the Secretary, Lands and Land Development and will have a deputy for Water Management and a deputy for Institutional Development. The Central Support Office will be established in the Irrigation Department to include special offices of Operation and Maintenance, Training, Extension and Planning. The Gal Oya Project field organization will be upgraded, and Master Planning and Research Units will be established at both Gal Oya and Uda Walawe. The Irrigation Deaprtment will establish a water management training school at the Galgamuwa Training Complex.

In order to give more emphasis to the important area of water management, the Secretary of the Ministry of Lands and Land Development has decided to establish a special staff office headed by a Director of Water Resource Development. This officer will be on equal status with the Director of the Irrigation Department and, while performing special functions and actions for the Secretary, will also help coordinate and facilitate activities of the Project with other relevant Departments and Agencies. Two special Deputy Directors will also be established to assist the Director: the first will be for Water Resources Management, primarily to coordinate water management activities countrywide, and the second will be for Institutional Development to help coordinate the organization of farmers and the socioeconomic research conducted by the Agricultural Research and Training Institute. The Deputy Director will also assist in law enforcement and institutional coordination.

ENVIRONMENTAL

The project is directed at improved operations and maintenance of the Gal Oya irrigation system, training, extension, master planning and field research, farmer organizations and social research. The project objectives are aimed at bringing the levels of management organization, operations and distribution maintenance in the project areas to acceptable and replicable levels. This can only have an overall positive impact over what is presently occurring in the Gal Oya project area and in other parts of the country. The following relevant and specific issues were focused upon in the final environmental analysis and were taken in part from the CH2M Report.

1. Incidence of Malaria. There may be a possible effect on the incidence of malaria by the project's implementation due to planned wider distribution of water. This has the potential of increasing the number of mosquito breeding places. However, it can be expected to be offset by the removal of excessive water in the upper areas of the system. As a further counterbalance, the extension and expansion of the GSL Anti-Malaria Campaign with USAID project assistance in Malaria Control will focus on the major irrigation schemes.

2. Waterborne Diseases. There will be no major expected population density increases related to the project. The project will, however, decrease the risk of waterborne gastrointestinal disease problems, partly as a result of improved nutrition made possible by higher real incomes. Concurrently, domestic water improvement (expected to start around mid-project after "domestic plans" have been developed) will have a positive effect in reducing the incidence of waterborne disease because of the availability of higher quality water.

SOCIAL

A major objective of the project will be the organization of farmers along the minor systems to participate in determining the allocation of water, to reconstruct and, when necessary, rehabilitate field channels, and then to operate and maintain them.

ECONOMIC

The economic analysis of this project indicates that it should command high priority on economic grounds.[1] Based on the best

[1]The following analysis draws on the Economic Evaluation Section, pp. 9-12 to 9-18 of the Hill Report, op cit. It also draws on several other sources of information as explained later in the analysis.

available data supplemented by informed judgments on the most likely future values for such parameters as cropping intensities, yields, and prices, the Gal Oya (Left Bank) Modernization component of the project yields an internal rate of return (IRR) of 23%.[2] This "base case" IRR may be compared against a 10% opportunity cost of capital employed by the Central Bank of Ceylon and a 13% opportunity cost of capital estimated for Sri Lanka by Economist Deepak Lal of the World Bank. When somewhat more optimistic assumptions concerning future parameter values are employed than those assumed for the "base case", the IRR increases to 32%. When the most pessimistic assumptions are employed, the IRR drops to 13%. The latter is still above the 10% opportunity cost of capital estimated by the Central Bank. The nature of these assumptions and alternatives will be explained in the following sections. The reason for the relatively high rate of return follows basically from the fact that this project focuses on improving the efficiency of already existing irrigation systems rather than the creation of an entirely new system.

The Gal Oya Modernization component represents the largest cost element of the total project (86%) and lends itself more easily to quantification of benefits. The training, central support, socio-economic research and Uda Walawe master planning and research elements of the overall project are also expected to make important contributions to improved water management and to small farmer production and incomes in other major irrigation schemes in Sri Lanka, but the benefits of these other elements are extremely difficult to quantify. Even if only the costs and not the benefits of these components are added to the Gal Oya costs and benefits, the "base case" IRR drops by only three percentage points. If the benefits of the non-Gal Oya components could be quantified and added to the analysis, the resulting IRR for the entire project would be undoubtedly higher than 20%.

The following detailed explanation of the economic analysis is organized into three sections: land use and production benefits, evaluation of costs and rate of return and sensitivity analysis. Final sections discuss cost per beneficiary and the need for concessional resources.

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[2]All rates of return are stated in 1978 prices. This reflects the standard assumption that inflation affects benefits and costs in the same way, so that inflation can be ignored.

PADDY PRODUCTION, LEFT BANK GAL OYA -- WITHOUT PROJECT

Year	Gross Sown Acreage (ac)	Average[a] Yield (bu/ac)	Production[a] (1,000 bu)
1	67,000	52.5	2,840
2	67,000	53.0	2,867
3	67,000	53.5	2,894
4 - 20	67,000	54 - 63.4	2,921 - 3,430

[a]Average yield and production are assumed to increase by 1% a year as explained in the text. Since yield figures are on a net harvested acreage basis, production is obtained by multiplying yields by net harvested acreage. The following conversion factors based on observed relationships have been employed: gross harvested acreage equal to 95% of gross sown acreage and net harvested acreage equal to 85% of gross harvested acreage.

PADDY PRODUCTION, LEFT BANK GAL OYA -- WITH PROJECT

Year	Irrigable Paddy (ac)	Cropping Intensity (%)	Gross Sown (ac)	Average Yield (bu/ac)[a]	Production (1,000 bu)
1	52,600	129	67,000	52.5	2,840
2	52,000	129	67,000	53.0	2,867
3	53,000	139	73,700	53.5	3,183
4	54,000	150	81,000	54.0	3,532
5	55,000	162	89,100	55.6	4,000
6	56,000	175	98,000	58.4	4,622
7	57,000	189	107,700	62.5	5,436
8 - 20	57,000	189	107,700	66.9 - 85.4 (see note a below)	5,818 - 7,427

[a]From year 7 to year 20, yields and production increase at the following annual percentage rates: 7%, 5%, 3%, 2%, 2%, 2%, 2%, 2%, 2%, 2%, 1%, 1%, 1%, respectively. See text for explanation.

TITLE: Mahaweli-Ganga Development Project, Stage 1

REPORT NO.: SL-W-1

COUNTRY: Sri Lanka

REGION: Asia

KEYWORDS: Irrigation rehabilitation (3); population or settlement (5); surface irrigation (3); hydropower (3).

SUMMARY: The project, which would be implemented over a five-year period, is Stage I of the first scheme in the Mahaweli Ganga Development Program. It includes:

1. Improved water supply to 126,700 ac of irrigated land;

2. Installation of 40 MW of hydropower; and

3. Additional capacity for 104,500 ac to be put under irrigation in a subsequent project.

LOCATION: Central Sri Lanka

CLIMATE: A

CROPS: Rice, sugarcane.

SOILS: No salinity or alkalinity problems.

TARGET GROUP: The irrigating farmer.

BEGIN: 1969 END: 1979 AREA: 302K ac

NUMBER OF FARMS: 225,000

CONTRIBUTION:

IDA	US$ 3.0M
EEC	2.0M
GOSL	1.0M
TOTAL	US$ 6.0M

GOALS: After construction, about 225,000 farmer families will be settled, and over a million people will be gainfully employed in agricultural and allied pursuits. The output of these people will significantly reduce the need to import rice, wheat, flour, sugar and other food items.

TYPE OF PROJECT: Large-scale rehabilitation and resettlement of irrigated land.

TECHNOLOGY USED: Tunnels, reservoirs, canals and appurtenances required for a large-scale transbasin diversion for irrigation water and for hydropower.

DOCUMENTS REVIEWED: Staff Appraisal Report (29 pp and five annexes); Report and Recommendation of the President of the IDA (30 pp).

PROJECT ORIGIN AND BASE LINE DATA: Data gathered by a four-year FAO/UNDP study and by a Bank Appraisal Mission which visited Sri Lanka in February and March of 1969. NEDCO (Netherlands) reviewed and reevaluated the FAO/UNDP plan in 1977-1979.

BENEFICIARY INVOLVEMENT: Water charges are to cover the full costs of operation and maintenance as well as a reasonable portion of the capital invested.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

The proposed project would support the Government's efforts to accelerate the implementation of the Mahaweli Ganga Development Program. It would provide for:

1. Preparation of a reconnaissance-level study of plans for conveying and utilizing surplus Mahaweli Ganga water to develop land in any of three alternative areas;

2. Ongoing review of designs and tender documents for construction of civil works and social infrastructures; and

3. Support of other studies and designs of projects in the Mahaweli Program to be undertaken by the Mahaweli Development Authority (MDA) during implementation of the program.

TECHNICAL

1. Construction of the Polgolla complex consisting of a low diversion dam on the Mahaweli Ganga at Polgolla, a five-mile long diversion tunnel and a 40 MW hydroelectric plant;

2. Construction of training works and channel improvements on the Dhun Oya and Sudu Ganga;

3. Construction of the Bowatenna complex consisting of a high diversion dam on the Amban Ganga at Bowatenna, a tunnel five miles long and a five-mile-long canal to feed the Kalawewa and Kandalama tanks;

4. Remodeling of the existing Elahera weir and the 38-mile-long Elahera-Minneri-Kantalai canal to carry 1,500 cusecs; and

5. The redesigning of the irrigation system, the construction of drainage systems, land leveling and subsoiling on 4,000 ac planted to sugarcane in the northeastern area.

The Polgolla hydroelectric plant with an installed capacity of 40 MW, would be an integral part of the Polgolla complex. It would be a run-of-river plant with little storage capacity to regulate the river flows at the diversion point. If it were to operate as an isolated plant, the amount of firm or continuous power would be less than 10 MW in an average water year and, in a dry year, would be almost zero. However, Polgolla would be an integral part of the national power system and must be evaluated as such. The operation of the power plants (most with major storage features) in other watersheds with different regimes, and the thermal capacity at Colombo can be coordinated with Polgolla to develop

maximum contribution to the system. It has been demonstrated by computer studies, based on simulation models taking into account these factors, that Polgolla's dependable peaking capability is 20 MW.

On completion, the power assets would be transferred to the Ceylon Electricity Board. This Board and its predecessor, the Department of Government Electrical Undertakings, were appraised in connection with the Maskeliya Oya Project. The power plant would be interconnected with the Board's system at the Iriyagama switching station, which is located a short distance from Polgolla.

WATER SUPPLY

The project works would control the surface water supply from three natural sources, namely: runoff from local streams feeding the existing tanks, and the flows in the Mahaweli Ganga and the Amban Ganga River. These sources would be operated as an integrated water supply system to meet the total 1.7M ac-ft of yearly irrigation demands when fully developed.

The runoff from local streams into the tanks would contribute only 0.55M ac-ft (32%) to the total demands. Other requirements would be met from the Mahaweli Ganga River through the Polgolla tunnel release, and the Amban Ganga River. The long-term discharge data of the rivers, covering a 20-year period (1944-1964), indicates that the total yearly available flow during the irrigation season is more than the demands in 16 years out of 20. In the remaining four years, a shortage of less than 30%, which can be tolerated, has been taken into consideration in evaluating the benefits of the project.

After analyzing the effect of several alternate sizes of tunnel at Polgolla and Bowatenna, the Elahera Canal and storage capacities of the tanks in the project areas, with a view to meeting the gross annual water requirements of 1.7 million acre feet, the Bank found that a 2,500 cusecs tunnel may be required at Polgolla, a 1,500 cusecs tunnel at Bowatenna, and 1,500 cusecs canal at Elahera. These capacities are larger than those originally proposed by the Government.

INSTITUTIONAL

The Mahaweli Development Board would be created by legislation and would be responsible to the Ministry of Land, Irrigation and Power. The Project would be coordinated at the Ministerial level by the Cabinet Planning Subcommittee. The draft legislation was commented on and agreed to by the Bank prior to it being sent to the Legislature.

The Board would comprise three appointed voting members, of whom one would be the Chairman, four ex-officio voting members, representing the Ministries concerned, namely Land, Irrigation and Power, Agriculture and Food, Finance and Planning, and two ex-officio non-voting members representing the Departments of Irrigation and Agriculture and a voting representative of the Ceylon Electricity Board. Close liaison would be obtained with the Ministries concerned through their representatives on the Board who would be of the rank of permanent secretary.

The Board would be responsible for promoting, operating and coordinating irrigation, drainage, land, agricultural and economic development in the declared special areas. This would include, but not be limited to, planning, programming, progress control, coordinating the project, procurement, budget, finance, and accounting. It would be financed by regular subventions from the annual government budget. It would make its own rules and regulations, recruit its own staff and determine their emoluments.

The chief executive of the Board, who would be directly responsible to the Chairman, would be the General Manager. He would be assisted by two deputies, one of whom would be an experienced irrigation engineer, and the other an experienced agriculturist. These, in turn, would be assisted by professional and technical staff, as well as supporting accounting and clerical staff at headquarters. The headquarters staff, which would be small, would be hired directly or seconded from the Government service. The work of the Board would be carried out by divisions, specially created, in the Irrigation, Agricultural and other related departments, to deal exclusively with the Mahaweli Project. To ensure coordination at the field level, "special project" units would be established.

The following steps with respect to organization and management would be conditions of effectiveness:

1. The enactment and coming into force of legislation acceptable to the Bank, establishing the Board, and defining its powers;

2. Notification, by the responsible Minister, that the establishment of the Board, the appointments of its chairman and members shall have been published in the Ceylon Government Gazette;

3. The publication in the Ceylon Government Gazette of the Minister's order declaring the project area to be a "special area" under the jurisdiction of the Board;

4. The setting up of an organization structure of the Board, acceptable to the Bank, and the filling of senior positions on the Board's staff; and

5. The appointment of the general manager and deputy general managers satisfactory to the Bank Group.

To ensure effective coordination, meetings of the cabinet subcommittee should be held twice a year, with the Board meeting at least once a month, and more frequently, if the need arises, particularly during the construction period.

ECONOMIC

In calculating the project's rate of return to the economy, the following assumptions were used:

1. A useful life of the project of 50 years;

2. A price equivalent to US$100 per m ton for valuation of rice output of the project and US$0.5 per pound of sugar;

3. An effective exchange rate of Rs 9.23 to US$1; and

4. Cost of family labor equivalent to prevailing wage rates.

Using these assumptions, the rate of return to the economy would be about 12%, whereas the return on a single purpose project, constructed at Polgalla for irrigation only, would be about nine percent and, similarly, a single purpose project for power only would be about 11%. The estimated rate of return to the economy for all stages of development of the first scheme of the Mahaweli Ganga Development Program is 12%, and for agriculture separately is 11%.

Appended to this summary are a table of cost estimates, and a table of gross water requirements for the irrigated areas.

COST ESTIMATES[1/]

	Million Rupees			US$ million Equivalent		
	Local	Foreign	Total	Local	Foreign	Total
1. Polgolla Complex	43.9	65.5	109.4	7.4	11.0	18.4[2/]
2. Bowatenna Complex	30.9	27.7	58.6	5.2	4.6	9.8
3. Sudu Ganga Training Works	5.7	5.2	10.9	0.9	0.9	1.8
4. Elahera Weir & Canal	5.1	1.9	7.0	0.9	0.3	1.2
5. Buildings & Camps	3.1	1.3	4.4	0.5	0.2	0.7
6. Agricultural Land Development	0.3	0.4	0.7	0.1	0.1	0.2
7. Investigations & Extension	2.3	1.0	3.3	0.4	0.2	0.6
8. Equip. & Vehicles.	—	11.5	11.5	—	1.9	1.9
Subtotal	91.3	114.5	205.8	15.4	19.2	34.6
9. Engineering & Consultant Services						
(a) Consultant Serv.	6.0	13.4	19.4	1.0	2.2	3.2
(b) Engineering & Overheads	6.5	1.5	8.0	1.1	0.3	1.4
Subtotal	12.5	14.9	27.4	2.1	2.5	4.6
10. Contingencies						
Physical 15%	15.8	19.2	35.0	2.6	3.2	5.8
Price Increases 5%	5.3	6.4	11.7	0.9	1.1	2.0
Subtotal	21.1	25.6	46.7	3.5	4.3	7.8
Total	124.9	155.0	279.9	21.0	26.0	47.0
11. Interest & Commitment Charges during construction[3/]	—	17.6	17.6	—	3.0	3.0
Grand Total	124.9	172.6	297.5	21.0	29.0	50.0

1/ Discrepancies are due to rounding.
2/ Including cost of power facilities.
3/ Interest at 7% on Bank Loan and 3/4 of 1% commitment charge on the undisbursed portion of the Bank Loan.

GROSS WATER REQUIREMENTS OF AREAS H, IH, D_1 AND G AT THE TANKS

	Cropping Patterns 1	2	3	4	Total
Areas (1000 acres) - H and IH					
H - Existing	46.2				46.2
H - New	14.2	5.6	37.1		56.9
IH - Existing	10.0				10.0
Subtotal	70.4	5.6	37.1		113.1
Percent	62	5	33		100
Annual Duty at Tank (feet)	8.5	5.5	4.5	7.2	
Annual Water Requirements (1000 acre feet)	598.4	30.8	166.9		796.1
Areas (1000 acres) - D_1 and G					
D_1 - Existing	43.5			4.0	47.5
D_1 - New	20.0	4.0	13.1	3.0	40.1
G - Existing	4.8				4.8
G - New	3.7	1.0	2.8		7.5
Subtotal	72.0	5.0	15.9	7.0	99.9
Annual Duty at Tanks (feet)	8.5	5.5	4.5	7.2	
Annual Water Requirements (1000 acre feet)	612.0	27.5	71.6	50.4	761.5

Note: Cropping Patterns: (1) Paddy-paddy legume; (2) Paddy-high value crops - Legume; (3) High value crop rotation of cotton, groundnut, vegetables, etc. (4) sugarcane.

TITLE: Lift Irrigation Project

REPORT NO.: SL-W-2

COUNTRY: Sri Lanka

REGION: Asia

KEYWORDS: Settlement (5); low-lift pumping (5); surface irrigation (3); youth settlement (3).

SUMMARY: The proposed lift irrigation project would be part of an ongoing Government program aimed at increasing the production of subsidiary food crops under which some 40,000 acres devoted to chillies and onions are expected to be provided with irrigation during the next five years.

LOCATION: North Central Sri Lanka.

CLIMATE: A.

CROPS: Chillies, and onions.

SOILS: Good to medium depth and moderate water holding capacity.

BEGIN: 1969 END: 1972 AREA: 6,500 ac.

NUMBER OF FARMS: 2,000.

CONTRIBUTION:

AID	US$ 2.0M
GOSL	3.1M
TOTAL	US$ 5.1M

GOALS: The incremental net value of production would be about US$1.4 million.

PURPOSE: To diversify agricultural activities on the colonist schemes and to increase farm incomes. In addition, the project would contribute to Ceylon's balance of payments position by reducing import needs.

TYPE OF PROJECT: Settlement and low-lift irrigation project.

TECHNOLOGY USED: Low-lift pumps, concrete, burned clay or brick-lined canals; open drainage ditches.

DOCUMENTS REVIEWED: Staff Appraisal Report (12 pp and eight annexes); Project Performance Audit Report (58 pp).

PROJECT ORIGIN AND BASE LINE DATA: An FAO mission visited Sri Lanka in June and July of 1966. In September of 1967, a Bank Group appraisal mission visited Sri Lanka. These two teams provided the base line data for the project.

BENEFICIARY INVOLVEMENT: Water charges would recover all operation and maintenance costs.

ACTUAL STARTING DATE: 1970 COMPLETION DATE: 1978.

GENERAL DESCRIPTION

The proposed project lands would consist of four noncontiguous areas in the dry zone of Sri Lanka, where colonist paddy irrigation schemes have been in operation for several years. Three criteria were used in selecting the areas: availability of water, proximity to existing irrigation canals, and suitability of the soils for the production of subsidiary food crops. All these areas are above the existing gravity irrigation canals. Each of the four schemes are made up of a number of separate blocks varying in size from 100 to 500 ac of land, of which from 50 to 250 ac would be irrigated by pumping out of the canals. The unit area to be irrigated under the project within each block is one acre in the case of colonists and two acres in the youth settlement scheme. Net acreage to be developed at each scheme would be as follows:

Scheme	Net Irrigated Area (ac)
Vavunikulam	500
Mahakandarawa	1,000
Rajangana	3,500
Polonnaruwa	1,500
TOTAL	6,500

About 6,100 ac of the proposed project lands would be on four colonists' schemes and 400 ac on Polonnaruwa would be for youth settlement. Under the colonist schemes, each family is allotted about five acres by the Government. Three acres are devoted to paddy cultivation under gravity irrigation and the remaining two acres are on lands above the irrigation canals where the colonists have their homes and produce subsidiary crops under dry farming conditions. Although the colonists on these schemes have long association with paddy irrigation, they have no previous experience in producing subsidiary food crops under irrigation. In most instances, the colonists receive only a limited return from their paddy fields and are unable to fully develop their dry land house lots due to lack of irrigation. The proposed project would enable the colonist to supplement his income from paddy cultivation by growing chillies and onions on the one acre of his dry land lot to be provided with irrigation.

The youth settlement scheme would be part of a Government program started in 1965 under which the Government hopes to provide employment opportunity in agriculture to unemployed educated single youths in the 17-21 age group. These schemes, which are largely untried and mainly experimental, contain a large risk element. However, if proven successful, they would contribute to solving the Sri Lankan unemployment problems.

TECHNICAL

1. Irrigation and Drainage. On each of the four areas, several independent irrigation blocks would be developed ranging in size from 50 to 250 ac. Water would be pumped from existing gravity irrigation canals serving paddy fields to elevations varying between 15 to 50 ft above the canals. A small pumping station equipped with one or more single stage centrifugal pumps, driven by a diesel engine, would be constructed at each block. Pumps would vary in size from four to eight inches and the size and number of pumps to be installed at each block would depend upon the area to be served. The discharge lines would be of rigid polyvinyl chloride (PVC) emptying into a concrete-lined forebay on the high point of the block. From this point, lined canals would deliver the water to each landholding with a turnout to be provided at the high point of each holding. Lining would generally be on concrete cast in place, although bricks, either of cement mortar or burned clay, would be used in areas where they are found to be more economical. Surface drainage would be provided by excavating small open channels to remove excess water. Subsurface drainage is not considered necessary.

2. Land Development. Land leveling and grading would be carried out over the entire project area. In addition, mechanized jungle clearing would be carried out on the 400 ac youth settlement scheme, along with the construction of 200 cottages for the youths.

3. Water Supply. Irrigation water would come from existing storage dams. The water is of good to excellent quality in each of the project areas for use on the crops proposed. In an average year, the existing storage facilities could meet the irrigation requirements of the proposed lift areas during the wet season (October-April) without impinging upon paddy irrigation. There would be, however, competition over water use during the dry season (May-September) when water supply is normally limited to that carried over in storage in the reservoirs from the wet season. Except for the Polonnuruwa Scheme, where the storage capacity is sufficient to allow year-round paddy cultivation on the entire area, water supply on the three other schemes generally dictates a reduction in paddy acreage from about 25,000 ac in the wet season to about 11,000 ac during the dry season. The introduction of the lift irrigation project would necessitate a further reduction in dry season paddy acreage. Water consuptive use calculations indicate a necessity to reduce the paddy area of 11,000 ac by about 800 ac in order to ensure adequate water supply for the 6,500 ac of the lift irrigation project. Such a reduction would represent only a small fraction of the total paddy area

on the schemes and would be highly profitable since returns from an acre of chillies and onions would be at least four times greater than those from paddy.

At the beginning of the dry season, the Irrigation Department makes an assessment of the water available in the reservoirs and informs the Government Agent of the extent of paddy lands which could be provided with irrigation on each scheme. The Government Agent, in turn, informs a Cultivation Committee composed of colonists and the Committee decides what proportion of each holding would be irrigated. Water for the lift irrigation project would be pumped out of the canals serving the paddy fields and, in order to ensure that adequate water would be available for the project, assurances were obtained from the Government that it would guarantee the priority of water for lift irrigation.

SOCIAL

Unlike the colonists who would rely exclusively on family labor, participants in the youth settlement scheme would have to resort to hiring outside labor. This, in turn, would bring about a substantial increase in production costs and a corresponding reduction in net earnings. However, at the prevailing GPS prices, even with the higher production costs, annual net income in the fifth year from a two acre plot on the youth settlement scheme would be about Rs 3,000. This level of income should provide sufficient incentive to attract and maintain the youths on the project.

INSTITUTIONAL

Responsibility for planning, design and construction of the irrigation and drainage works would rest with the Irrigation Department, an agency within the Ministry of Land, Irrigation and Power. The Irrigation Department, which is staffed with experienced personnel, and had previous experience with similar works, would be competent to implement the project. Preparation of designs and overall supervision of the works would be done from the Department's headquarters in Colombo. Field supervision would be assigned to the Division Engineer within whose jurisdiction the specific project area lies and he, in turn, would assign a Resident Engineer to execute the work in the field.

OPERATION AND MAINTENANCE

The colonist schemes are organized into cooperatives and the youth settlement scheme would also be organized along similar lines.

It is the Government's intention to eventually turn over responsibility for the operation and maintenance to these cooperatives. Until such as this can be done, responsibility for operation and maintenance activities would rest with the Department of Irrigation, using its existing facilities established for the paddy schemes. Assurances were obtained from the Government that the Irrigation Department would operate and maintain the irrigation facilities until such time as they could safely be turned over to the cooperatives or other satisfactory organizations.

LAND DEVELOPMENT

Land leveling and smoothing would be done by the Lands Department of the Ministry of Land, Irrigation and Power, with equipment to be purchased under the credit. The Department would also carry out the mechanized jungle clearing on the youth settlement scheme. Land development works to be implemented under the project are small in scope and relatively simple, and would be within the competence of the Department.

ECONOMIC

The prime benefits to be derived from the project would be diversification of agricultural activities on the colonist schemes and a substantial increase in farm income. In addition, the project would contribute to Sri Lanka's balance of payments position by reducing import needs. At maximum production, the project would enable the country to save about Rs 14 million (US$2.3 million annually in imports, based on 1963/66 average import prices valued at the current exchange rate). The project would also provide the experience on which to plan the development of subsequent stages.

At full agricultural development, the annual gross value of production from project lands is expected to increase from the present negligible level to around Rs 14 million per annum. These figures are based on chillie and onion prices corresponding to the average 1963/66 import prices valued at the current exchange rate. After deducting production costs (family labor used on the farm was valued at zero cost), the foregoing of paddy production on some 800 ac and annual operation and maintenance charges, the annual direct benefits to the economy, at full development, would be about Rs 9.5 million. Assuming a useful life of 30 years for all irrigation facilities, except for pumps and engines which would require replacement after 15 years, the rate of return to the economy would exceed 25%.

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PROJECT COMPLETION REPORT

TABLE 3

SRI LANKA: LIFT IRRIGATION PROJECT (CREDIT 121-CE)

Estimated and Actual Expenditures

	Appraisal Estimate			Actual		
	Local	FE	Total	Local	FE	Total
		US$ '000			S.L. Rs '000	
1. Pump and installation	160	450	610	750	3,600	4,350
2. Distribution	620	285	905	11,000	8,100	19,100
3. Land Development	650	30	680	6,259	50	6,309
4. Housing for Youth	60	—	60	--	--	--
5. Engineering & Administration	110	50	160	600	50	650
6. O&M for Four Years	120	70	190	800	300	1,100
7. Contingency on #1-4	300	195	495	1,053	478	1,531
Total	2,020	1,280	3,300	20,462	14,878	35,340
Total[1/] (US$ '000)	2,020	1,280	3,300	3,704	1,443	5,147

S.L. Rs were converted to US$ approximately[2/] as follows:

Rates of Exchange:

1968-71	=	Rs 5.95
1972-74	=	Rs 6.65
1975	=	Rs 7.50
1976	=	Rs 7.70
1977	=	Rs 15.50

1/ Recalculated based on above exchange rates.

2/ Only approximations can be used because it was not possible to establish the dates when local expenditures occurred and relate them to the dates of the frequent exchange rate alterations.

TITLE: Drainage and Reclamation Project

REPORT NO.: SL-W-1

COUNTRY: Sri Lanka

REGION: Asia

KEYWORDS: Land reclamation (5); coastal drainage (3); saline intrusion (3).

SUMMARY: The project is the reclamation by drainage and flood control of six separate, physically independent land units. The project would be part of an ongoing program conducted by the Government to increase paddy production by drainage and flood control so low-lying coastal areas can be used to grow HYV rice.

LOCATION: Southwest coast of Sri Lanka.

CLIMATE: A.

CROPS: Rice.

SOILS: Range from alluvium to boggy peats.

TARGET GROUP: The irrigating farmer.

BEGIN: 1970 END: 1974. AREA: 13,200 ac.

NUMBER OF FARMS: 10,000.

CONTRIBUTION:		
	IDA	US$ 2.5M
	GSL	2.5M
	TOTAL	US$ 5.0M

GOALS: At full development, the annual gross value of rice production from the project is expected to be nearly triple the present level. Of this, the incremental net value of production would be about US$ 840,000 per year resulting from an additional output of 10,900 metric tons of milled rice.

PURPOSE: To increase rice production and farm incomes in the project area.

TYPE OF PROJECT: Drainage and reclamation of coastal marshlands.

TECHNOLOGY USED: Machinery and labor used to construct canals and groynes to remove floodwater and prevent saltwater intrusion.

DOCUMENTS REVIEWED: Staff Appraisal Report (17 pp and eight annexes); Project Performance Audit Report (37 pp).

PROJECT ORIGIN AND BASE LINE DATA: The credit request was prepared by the Irrigation Department following an FAO/IBRD mission in June and July, 1966. An appraisal mission visited Sri Lanka in September 1967.

BENEFICIARY INVOLVEMENT: Beneficiaries will be charged annual operation and maintanance costs of the project and an appropriate share of the capital costs.

ACTUAL STARTING DATE: 1970. COMPLETION DATE: 1978.

GENERAL DESCRIPTION

The aim of the project was to increase rice production on 13,200 ac in the six deltaic areas by controlling internal flooding and saline intrusion from the sea. It included the procurement of suitable dredging equipment, and trucks, tractors and trailers for transporting gravel and laterite. Civil works, the major part of the project, were:

1. The construction of sea groynes to regulate the flow of the rivers;

2. Dredging the main internal waterways to speed up the river flow, and build levees with the spoil to contain the rivers which would otherwise overflow their banks and inundate the rice fields;

3. Topping the embankments with gravel and laterite to ensure that the banks maintain their height and cross section; and

4. Building water-regulating structures, to prevent inflows of saline water into the rice fields.

TECHNICAL

1. Drains. The existing open channel drainage system (some of which dates back to the Dutch period of 1815) has been neglected for many years. All the drains need cleaning and, in most cases, enlargement to effectively remove surplus rainfall and floodwaters from upstream areas. New drains would be constructed to extend and make effective drainage over the entire project area. Regulators with gates would be constructed at appropriate places so saltwater may be excluded at high tide conditions, and to control discharge of the drains.

2. Drainage Outlets. Wave action and littoral drift form a continuous sandbar along the southwest coast. Under low flow conditions in the streams, the sandbar forms across the mouth of the stream to an elevation of about five feet above sea level, which persists until stream discharge becomes great enough to overtop the sandbar and erode a channel through the bar to sea level. Appropriately constructed groynes of heavy rock material in the sea have been found effective in altering the wave pattern to allow a sea level outlet to remain open at the mouth of the stream. Two such groynes would be part of the project. Minor periodic dredging would be required to maintain the open channel.

Rock outcrops occur in some of the stream channels near the sea and serve to restrict the discharge capacity of the

channel under flood conditions. By removing these constrictions, the water surface in the stream through the project areas would be lowered and the overflow of floodwaters onto the lands reduced. Necessary channel improvements of this nature would be part of the project.

3. Flood Control and Supporting Works. Levees to an elevation of three-and-one-half feet with gate structures at drainage channels would be constructed along the stream channels and on the periphery of lagoons to permit isolation of tracts and control of water levels within tracts. They will also serve to protect the lands from inundation by high tides and minor floods. In major floods, the levees would be overtopped with resultant partial damage to crops from flooding. The damage will depend on depth and duration of inundation. Such floods would occur on the average of one every 10 years. This is considered a reasonable risk. To provide a greater degree of protection would involve steeply rising costs. Access roads would be constructed or improved as necessary to reach structure sites. Temporary housing facilities would be constructed for guards and stores during construction. In some of the larger areas, permanent housing and offices would be provided for operation and maintenance personnel.

The project would also include a water sampling program to monitor salinity at selective points in the streams and lagoons. With improved outlet conditions to the sea, salinity intrusion will be a greater hazard. Observations would allow early detection of increased salinity levels so corrective action can be taken before a serious problem develops.

Construction of the above works would improve growing conditions for paddy and, for areas lying above an elevation of two feet, would allow dependable double season cropping except for major floods which might inundate paddy fields for about five days once in 10 years. Thus, one crop in 20 might experience some damage. Areas between one and two feet of elevation would not be drained as adequately as the higher areas and would have somewhat poorer growing or cultivation conditions. This is reflected in the yield projections.

At the request of the Government, Engineering Consultants Incorporated (USA) prepared a report concerning flood problems on three basins along the southwest coast. The concept of that report was to provide essentially complete flood protection by storage and a series of high levees along the stream channels. Such levees could induce much higher peak flows downstream than now occur. Although the likelihood of such development taking place is remote, an assurance was obtained from the Government during negotiations that no

major works which would have an adverse effect on areas included in the project would be constructed upstream without agreement of the Association.

ENVIRONMENTAL

The project's reclamation and drainage activities in the coastal area involved control of tidal action to prevent salinity intrusion. In the estuarial areas where an interface mixing of sea and fresh water takes place, project works interfered with natural cycles and adversely affected the ecological balance.

The project areas, on Sri Lanka's west coast, are strung out along about 20% of the country's total coastline. Along this coast, where several rivers and creeks drain into the sea, numerous fish varieties and shrimp find their feeding and breeding grounds. By impeding the free flowing and mixing of sea with fresh water, as well as by limiting the previous access to the frequently flooded marshy areas, the aquatic life suffered. Fishermen complain about reduced catches since construction of project works.

The audit mission did not succeed in obtaining details on the volume and value of lost catches. However, bearing in mind the substantial length of the coastal area covered by the project, the coastal fishermen's losses could be substantial. These losses are all the more important to a nation like Sri Lanka relying heavily on fishing for the protein supply of its population and for exports.

The project contributed to a change of the area's ecology. With the benefit of hindsight, it can be said that consideration should have been given to the project's negative impact on marine life. A lesson learned from the adverse developments of fisheries, following project implementation is that any interference with the free flow of coastal brackish waters may lead to unwarranted changes in the ecology, and to reduced aquatic life.

INSTITUTIONAL

1. Construction. The Irrigation Department, an agency within the Ministry of Land, Irrigation and Power, would be responsible for the planning, design and construction of the flood control, drainage and reclamation facilities of the project.

The Irrigation Department is staffed with experienced personnel, has had previous experience with similar works and would be competent to implement the works included in the project.

Preparation of design and overall supervision of works would be carried out by its Headquarters staff at Colombo. Field supervision would be carried out by the Divisional Engineer within whose jurisdiction the specific work unit is located. He would station a Resident Engineer to execute the work in the field.

2. Agriculture Development. The Agriculture Department, an agency of the Ministry of Food and Agriculture, would provide Research and Extension Services to ensure successful paddy cultivation within the project area by organizing farmers into about 70 Cultivation Committees and providing "Production Overseers" who would each supervise about 860 ac of paddy land cultivation. There would be a total of six Agricultural Instructors, and at least 16 Extension Overseers located within the project area. The Department will also be responsible for supply of improved seeds.

The Agrarian Services Department would, with assistance from the members of the Cooperative Department, ensure purchase of paddy output of the project area, and make provision for supply of fertilizers, pesticides, weedicides and other inputs and cooperate with the Agricultural Department in supervising the work of "Cultivation Committees." The People's Bank would supply production credit to farmers through their cooperatives.

Assurances were obtained from the Government during negotiation that a special Agricultural Development Program for the Project Area with annual targets would be formulated and implemented by the Ministry of Food and Agriculture, incorporating, with full staff and budgetary support from the Government, the activities mentioned above. This should ensure production increases as construction brings subsequent portions of the Project Area under protection each year, with full development being reached shortly after the completion of construction.

3. Coordinating Machinery. In order to ensure the necessary degree of coordination between Departments under the Ministry of Land, Irrigation and Power and the Ministry of Food and Agriculture, particularly between the Irrigation, Agriculture, and Agrarian Services Departments, the Government intends to establish a coordinating committee consisting of senior level representatives of these Departments and the Commissioner of Cooperatives. The Committee would be concerned with the project areas and similar areas on the southwest coast. It would convene at the request of any member to discuss problems which may arise during implementation and meet periodically to review progress, and coordinate the construction and agricultural development. During negotiations, an assurance was

obtained from the Government that such a committee would be established within six months of the date credit becomes effective.

4. Operation and Maintenance. After construction has been completed, operation and maintenance of the project works would be carried out by the Irrigation Department. The Department has, in recent years, paid more attention to the problems of the southwest coast. Most of the existing drainage facilities were originally constructed many years ago and were not considered as part of the Irrigation Department's normal maintenance program. However, recently the Department has taken on this responsibility and has embarked on a limited drain maintenance program pending the accomplishment of work as outlined for this project. The Department is capable of adequately maintaining the facilities. The Department should also look into the merits of attempting control of water weeds by use of herbicides.

Costs of operation and maintenance, estimated at US$4.00 per acre per year for benefited area, are based on actual expenditures experienced on similar works in Sri Lanka. The estimates include charges for wages and salaries, fuel and lubricants, materials and replacement of parts, together with charges for administration which would be incurred by the Irrigation Department.

SOCIAL:

As a result of the project, farm employment opportunities have increased substantially. In addition to job opportunities during the construction period, the crop budgets show increased employment opportunities on the newly reclaimed areas: additional labor requirements with the project are expected to be five man-days per acre. Since the project will have increased the cropped area from 4,000 to 17,500 acres, total employment is expected to be 630,000 man- and woman-days combined, against 120,000 before the project.

ECONOMIC

In 1977, the year when the project works were completed, the project area produced an estimated 10,720 tons of paddy, or about 7,000 tons of rice. GSL now estimates that, in 1969, only 1,900 tons of paddy, i.e., 1,250 tons of rice were, in fact, produced. Based on this information, and on a review of project development and achievements to date, the present economic analysis is based on the following assumptions, which are compared with those employed at appraisal:

1. Project life would be 30 years (at appraisal, 50 years);

2. The total annually harvested area would rise to 17,500 ac (20,000) i.e., an actual cropping intensity of 133% would be achieved (150% at appraisal);

3. Yields will average 37.5 bu of paddy per harvested acre: (70 bu);

4. O&M costs would be about US$13.00 per acre per annum;

5. Family labor was shadow priced by the factor of 0.67, compared to standard labor rates (full cost in appraisal estimate);

6. Foreign exchange was not shadow priced (shadow priced for offshore items in appraisal estimate); and

7. No benefits to areas below +1 ft MSL were taken (same as appraisal.

In addition, the present estimate assumes that the manual on the operation of the gates excluding the saline water would be developed. The border price of fertilizer was derived from the average actual CIF prices at the time of the mission's visit (July 1978), adjusted by internal handling and transport charges. They were close to the Bank's projected price. The project costs were net of taxes, and converted to 1978 constant prices adjusted by the average of domestic and international price deflators. With these assumptions, the economic rate of return was estimated at 19%, compared to 25% estimated at appraisal.

Attached are a summary of the Project Performance Audit, a comparison of pre-project, expected and actual cropped area and production, and a comparison of appraisal cost estimates and actual costs.

SUMMARY

The Drainage and Land Reclamation Project (Credit 168-CE) was designed to increase the area available for rice growing in six noncontiguous areas along the east and south coast of Sri Lanka. These areas were swamps which at high tide were partly inundated. Such cultivation which did take place was fraught with the risk of frequent crop failure and yields were low. As a result of the project, 13,200 ac have been protected against inundation and brought under controlled cultivation. About 1,000 ac were double-cropped in 1978. So far, yields per acre have increased by about 60%. It is expected that, when the full development is reached in about

1985, the double-cropped area will be about 4,300 ac and the total cropped area will be about 17,500 ac. Average yields are about 0.75 tons of paddy per acre and crop which is about 60% above the pre-project level.

The project was prepared in 1967 and appraised in 1968. The Credit Agreement was signed in 1969 and became effective, as planned, in February 1970. However, the scheduled completion date of September 1974 could not be met. There was a two-year delay brought about by political events and subsequent civil strife in 1971-72. A further year was lost in 1976 due to budgetary constraints. The 1977 elections and subsequent communal strife also caused delays and project works were not completed until the end of 1977.

At appraisal, project costs were estimated to be US$4.1 million equivalent (Rs 24.4 million); cost at completion was US$5.0 million equivalent (Rs 36.9 million). In terms of the US dollar, costs increased by 22%; in terms of the Sri Lankan rupee, which was devalued in comparison with the US dollar, by 51%. Cost increases were borne by the Government of Sri Lanka.

Due to a reduction in the assumed project life, lower paddy yields and higher than expected operation and maintenance costs (O&M costs), the economic rate of return of the project is now estimated to be 19%, against the appraisal estimate of 25%.

Under the Credit Agreement, the Government of Sri Lanka had agreed to collect O&M costs from benefiting farmers, and to conduct a study to determine whether part of the capital costs could also be recovered. Currently, steps are under way to collect the O&M costs. The Government recently has contracted the study to the Agrarian Research and Training Institute and it is expected to be completed in the summer of 1980.

SRI LANKA: DRAINAGE AND LAND RECLAMATION PROJECT (CREDIT 168-CE)

Preproject, Expected and Actual Cropped Area and Production

	Pre-Project		Expected		Actual (1977)	
	Harvested Area[a/] (acre)	Production (tons)	Harvested Area[a/] (acre)	Production (tons)	Harvested Area[a/] (acre)	Production (tons)
Iranavilu	40	18	774	969	593	239
Bolgoda	600	301	9,180	8,434	5,902	5,690
Bentota RB	650	587	3,920	3,700	1,790	1,258
Dedduwa Rantotuwila	950	477	2,640	2,343	758	398
Madampe	150	90	5,608	5,387	1,813	916
Kiralakelle	1,660	1,167	4,278	2,303	3,394	2,220
TOTAL	4,050	2,640	26,400	23,136	14,250	10,721

a/ Total of Maha and Yala cultivations.

SRI LANKA: DRAINAGE AND LAND RECLAMATION PROJECT (CREDIT 168-CE)

Appraisal Cost Estimates and Actual Costs

	Appraisal		Actual	
	SL rs '000	US$ '000	SL Rs '000	US$ '000
Iranuvillu	3,960	660	4,000	554
Bolgoda	8,840	1,480	15,900	2,166
Bentota RB	5,950	1,000	7,900	1,058
Dedduwa Rantotuwila	1,619	270	2,600	353
Madampe	1,815	310	2,800	403
Kiralakele	2,220	380	3,650	504
Total	24,404	4,100	36,850	5,038
of which: Local	14,292	2,400 [a/]	26,447	3,410 [b/]
FE	10,112 [a/]	1,700 [a/]	10,403 [b/]	1,628 [b/]
IDA Contribution	US$2.5 M or 61%		US$2.48 M [c/] or 49%	

a/ Inclusive of indirect FE.

b/ Excluding indirect FE.

c/ US$18,000 was cancelled.

NOTE: SL Rs were converted to US$ approximately [1/] as follows:

Rates of Exchange, 1968-71 = Rs 5.95
1972-74 = Rs 6.65
1975 = Rs 7.50
1976 = Rs 7.70
1977 = Rs 15.50

1/ Only approximations can be used because it was not possible to establish the dates when local expenditures occured and relate them to the dates of the frequent exchange rate alterations.

TITLE: Tank Irrigation Modernization Project

REPORT NO.: SL-W-4

COUNTRY: Sri Lanka

REGION: Asia

KEYWORDS: Tank irrigation (5); system rehabilitation (3); canal lining (3)

SUMMARY: The project would cover five tank schemes, serving a total cultivated area of 31,500 ac. The project would include:

1. Construction works for improving irrigation and drainage facilities;

2. Improvement of farm roads; and

3. Provision of farm equipment for land preparation and plant protection.

LOCATION: Anuradhapura, Vavuniya and Mannar Districts.

CLIMATE: A.

CROPS: Paddy, maize, sorghum and pulses.

SOILS: Moderately coarse, highly permeable upland soils, slightly finer, moderately permeable soils in intermediate locations, and poorly drained, moderately fine soils in the lowlands.

BEGIN: 1976 END: 1980 AREA: 31,500 ac.

NUMBER OF FARMS: 10,000.

CONTRIBUTION:			
	IDA	US$	5.0M
	UK		6.0M
	GSL		13.0M
	Commercial banks		6.0M
	TOTAL	US$	30.0M

GOALS: As a result of the project, food grain production in the project area is expected to reach 46,000 tons compared to a projected 23,700 tons without the project. The project-related increase of 22,300 tons would represent an annual net foreign exchange savings of about US$4.0 million.

PURPOSE: Present income levels in the project area are substantially below the national average. At full development, the project would raise them to the national level.

TYPE OF PROJECT: Prototypical project for modernization and rehabilitation of tank irrigation systems.

TECHNOLOGY USED: Machinery used to repair and construct canals, tanks and roads.

DOCUMENTS REVIEWED: Staff appraisal report (114 pp).

PROJECT ORIGIN AND BASE LINE DATA: An appraisal mission visited the country in April and May 1975. A followup appraisal mission subsequently visited Sri Lanka in January and February of 1976.

BENEFICIARY INVOLVEMENT: The Government will collect charges adequate to cover O&M and a portion of the construction costs.

PERT CHART: Attached to reviewed documents.

GENERAL DESCRIPTION

The dry zone of Sri Lanka has some 180 major tank irrigation schemes, serving a total cultivated area of about 400,000 ac. Deterioration of irrigation systems, poor water management and inadequate agricultural supporting services, are the prime constraints limiting agricultural production in the schemes. The proposed project would be a prototype for bringing these schemes up to their full potential.

TECHNICAL

1. Desilting and enlarging the entire water conveyance system (main and branch canals, 120 miles; distributaries, 180 miles; and field channels, about 500 miles) to provide sufficient capacity for a seven-day rotation with only daylight irrigation (estimated earthwork: 0.6M cubic yards).

2. Repairing, enlarging and surfacing with gravel the embankments used as farm roads (estimated earthwork: 1.3M cubic yards; gravel work: 0.4M cubic yards).

3. Excavating some 300 miles of drains to improve the drainage (estimated earthwork: 1.6M cubic yards).

4. Where necessary, brick lining of the conveyance system to reduce excessive seepage or erosion, and to provide the necessary degree of water control. In addition, all irrigation canals and field channels under the Mahawilachchiya tank would be lined, with different kinds of lining, as a pilot program for determining the effect on seepage losses, and capital and maintenance costs (estimated lining requirements for main and branch canals: about six miles; for distributaries: about seven miles; and for field channels: about 50 miles).

5. Repairing and modifying the existing structures in the irrigation system to enable daylight irrigation for each farm on a seven day rotation schedule.

6. Installation of some 170 new regulators in the main and branch canals to increase water control in the conveyance system. Similar regulating structures would also be installed in distributaries and field channels.

7. Installation of devices to measure releases from the tanks and water flows at various points in the system.

ENVIRONMENTAL

The only known water-related disease in the area is malaria. Schistosomiasis and other similar diseases common in some tropical parts of the world do not occur in Sri Lanka. At one time, malaria was practically eliminated, but, in recent years, the incidence of the disease has been increasing. This has been due to a variety of factors including development of resistance by the vectors to DDT and a general slackening of control measures due to inadequate staffing and budgeting. To combat the problem, the Government's Anti-Malaria Organization is seeking aid from various bilateral agencies to help finance the purchase of Malathion (a DDT substitute), vehicles and equipment, and spare parts.

The implementation of the tank program would extend the time during which storage water would be held in the tanks and run in the canals and thus would increase the breeding potential for the mosquitoes. On the other hand, the opening of the natural drains would remove the tailwater from the fields which stagnates in burrow areas and low spots. The Government has agreed, as a precautionary measure, to institute a malaria monitoring system, and if necessary, to take appropriate preventive and remedial measures in the project area.

The extension of the irrigation season into the dry season would improve the recharge of village wells and thus improve the domestic water supply. On balance, the net effect of the project on public health and environment would be positive.

SOCIAL

The project would ensure equitable water distribution through strictly enforced rotational delivery schedules in keeping with the Government emphasis on equitable income distribution.

INSTITUTIONAL

The Irrigation Department (ID) would be responsible for implementing the civil works proposed under the project. It would prepare final plans and designs, procure the necessary construction materials, and undertake all irrigation and drainage improvements, including the construction of necessary farm roads along the embankments of canals, distributaries and field channels. Procurement of construction machinery and equipment for the ID would be through the Sri Lanka Land Trading Corporation (SLTC) which is the sole authorized agency for such work in Sri Lanka. Responsibility for the maintenance of the construction machinery and equipment would be with the Department of Machinery and Equipment (DME), which operates a regional workshop at Anuradhapura.

The ID's current program includes several irrigation, drainage and reclamation projects. Its permanent staff of about 1,200 is well-qualified to carry out the program. However, together with its sister organization, its operations suffer from a severe shortage of adequate equipment and vehicles. With the necessary equipment and vehicles to be provided under the project, the ID staff should have no problem in implementing the project civil works.

Preparation of final plans and designs and overall supervision of the works would be done from the Department's headquarters in Colombo. The field organization would be headed by a Chief Project Engineer with overall responsibility for the management and supervision of the construction program. Construction would be done by two field units, each capable of modernizing about 6,000 ac per construction season. Each unit would be headed by a Project Engineer. A Chief Project Engineer with the necessary experience and qualifications acceptable to IDA has already been appointed.

The Department of Agriculture (DA), under the Ministry of Agriculture and Lands (MAL), would be responsible for the reorganization and strengthening of the extension service and for the procurement of vehicles, equipment and supplies for the extension service. The motorcycles and bicycles to be used by the extension staff would be sold to the staff by the DA on terms and conditions which are satisfactory to IDA. Agreement was obtained that, in Anuradhapura District, the Government would establish an extension organization by March 1, 1977 to implement a work program which is acceptable to IDA.

The Sri Lanka Trading Corporation would be responsible for the procurement of the farm tractors and equipment and for their distribution to its dealers for resale within the project area. In line with the Government policy, the Agricultural Productivity Committees (APCs) area would be encouraged to buy and operate the farm equipment on a cooperative basis. However, as the APCs are relatively new organizations, inexperienced in running efficient commercial operations, it is expected that private custom operators would continue to play a major role in providing farm equipment on a rental basis. To ensure availability of farm equipment in the project area on a priority basis, and to ensure reasonable rental rates, the private operators would be approved and supervised by the APCs and COs. Also, a condition of sale to the private operators would be that they agree to do custom work within the project areas, during the peak cultivation periods, as specified by the concerned APCs. Credit facilities for the purchase of farm equipment would be provided by the Bank of Ceylon and the People's Bank. Terms of lending would be up to 100% financing for APCs and up to 80% financing for private operators at prevailing interest rates (currently 8.5% annually), with repayment over five years. Refinancing for up to 75% of the total loans for farm equipment would be made

available by the Central Bank of Sri Lanka to the Bank of Ceylon and the People's Bank. These terms and conditions are considered satisfactory to IDA.

PROJECT COORDINATION

Committees have been established at the Central, District and Tank levels to facilitate interagency coordination. The committee at the Central level is chaired by the Secretary, MIPH, and includes senior representatives from the concerned departments and agencies. The Director of Irrigation is the member secretary of the committee. The committee is responsible for overall project execution and coordination. It would meet quarterly, or more often if necessary, and would make policy decisions, review the work program and approve budgets for the various agencies.

ECONOMIC

Based on the following assumptions, the project's economic rate of return is estimated to be about 23%:

1. A five year project implementation and a 30-year project life;

2. Full agricultural development five years after project completion;

3. Projected 1985 world market prices in terms of 1976 dollars for crops, fuel, fertilizers and pesticides;

4. Allowance for the shortage of foreign exchange by using a shadow rate of US$1=Rs12;

5. All farm labor valued at about 70% of the average market wage rate of Rs8 per man-day and construction labor at the market wage.

Only the project-related increase in crop production in the five tank areas is included in the benefits. Benefits from improved farm roads, and strengthened extension service in the rest of Anuradhapura District are not included in the analysis.

Attached are a project budget summary, a summary of present and estimated future production and a summary of water supply to the five tanks.

Item	Local	Foreign	Total	Local	Foreign	Total[a]	% of Total
	(Rs million)			(US$ million)			
I. Civil Works							
Main and branch canals	9.5	1.5	11.0	1.3	0.2	1.5	5
Distributaries	8.7	2.3	11.0	1.2	0.3	1.5	5
Field channels	26.2	6.8	33.0	3.5	0.9	4.4	15
Drains	8.1	0.7	8.8	1.1	0.1	1.2	4
Buildings	1.1	--	1.1	0.1	--	0.1	--
Subtotal	53.6	11.3	64.9	7.2	1.5	8.7	29
II. Construction Equipment and Vehicles	22.5	19.5	42.0	3.0	2.6	5.6	19
III. Agricultural Equipment and Supplies for Extension							
Farming equipment	16.5	20.2	36.7	2.2	2.7	4.9	16
Extension vehicles and supplies	3.0	2.3	5.3	0.4	0.3	0.7	2
Subtotal	19.5	22.5	42.0	2.6	3.0	5.6	19
IV. Technical Assistance[b]	1.3	0.7	2.0	0.2	0.1	0.3	1
V. Engineering and Administration (15% of I)	9.7	--	9.7	1.3	--	1.3	4
Basic Project Cost	106.6	54.0	160.6	14.3	7.2	21.5	71
VI. Physical Contingencies	10.7	2.3	13.0	1.4	0.3	1.7	6
Subtotal	117.3	56.3	173.6	15.7	7.5	23.2	77
VII. Price Contingencies	37.8	13.6	51.4	5.0	1.8	6.8	23
Total Project Cost	155.1	69.9	225.0	20.7	9.3	30.0	100

a/ Figures may not agree exactly due to rounding.
b/ Includes Rs 0.8 M for the project evaluation and for the proposed study on maize and sorghum (para 6.04)

SRI LANKA

TANK IRRIGATION MODERNIZATION PROJECT

Water Supply, Demand and Quality

Water Supply

1. Water for the project is regulated by five separate tanks (Map 11749). The principal water supply features of the tanks are summarized as follows:

Feature	Maha-kanadarawa	Maha-wilachchiya	Pavatkulam	Vavunikulam	Padaviya
Tank capacity (ac ft)	34,000	32,500	27,000	35,000	85,000
Tank surface area (acres)	4,000	3,200	3,000	3,150	6,480
Head on outlet at full supply level (FSL)	19.0	22.0	19.0	24.0	24.0
Catchment area (sq. mi)	126	141	115	88	206
Irrigated area (acres)	6,000	2,600	4,400	6,000	12,500
Area irrigated per sq mi of catchment (ac)	47.6	18	38	68	60