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DEPARTMENT OF STATE

AGENCY FOR INTERNATIONAL DEVELOPMENT

WASHINGTON, D.C. 20523

PROJECT PAPER

INDIA

HILL AREAS

LAND AND WATER DEVELOPMENT

(386-0489)

USAID/INDIA

JULY 27, 1984

UNCLASSIFIED

HILL AREAS LAND AND WATER DEVELOPMENT

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INDEX OF KEY TERMS AND ACRONYMS

AD	- Agricultural Department
AD/SC	- Soil Conservation Wing of the Agricultural Department
A.I.D.	- Agency for International Development
Block Irrigation Unit	- Irrigation Service Area of about eight hectares served by a single outlet
CCA	- Culturable Command Area
CCF	- Construction Cost Factor
CDSS	- Country Development Strategy Statement
Chak	- Irrigation Service Area of about 40 hectares served by a single canal outlet
Dhauladhar Area	- Mountain Range in Himachal Pradesh
EOPS	- End of Project Status
ERR	- Economic Rate of Return
FIRR	- Financial Internal Rate of Return
FIS	- Flow Irrigation Scheme
GOHP	- Government of Himachal Pradesh
GOI	- Government of India
IBRD	- International Bank for Reconstruction & Development (World Bank)
ICAR	- Indian Council of Agricultural Research
ID	- Irrigation Department
Kharif	- Monsoon Crops (Rainy Season), June to October
Khud	- Perennial Stream
Kuhli	- One who operates a flow irrigation scheme called Kuhl
Kuhl	- Flow Irrigation Scheme receiving water from stream
LIS	- Lift Irrigation Schemes
Medium Irrigation	- Schemes between 2,000 and 10,000 hectares
Major Irrigation	- Schemes above 10,000 hectares

NGO	- Non-Government Organization
Nullah	- Non-Perennial Stream
O&M	- Operation and Maintenance
PACD	- Project Assistance Completion Date
Panchayat	- Village Level Government Body (elected)
PH	- Public Health
PW	- Present Worth
PVO	- Private Voluntary Organization
Rabi	- Winter Season Crop, November to February
RD	- Rural Development Department
SLIC	- State Level Implementing Committee
T&V	- Training and Visit
USAID	- A.I.D. Field Mission
Village Motivator	- Influential person in village who promotes Development activities
Warabundi	- Rotational system of water distribution
W/P	- With Project
WOP	- Without Project
Water Harvesting	- Creation of a small tank or pond by building a barrier across a catchment area.

AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON D C 20523

VI

PROJECT AUTHORIZATION

INDIA

Hill Areas Land and Water Development
Project No. 386-0489
A.I.D. Loan No. 386-T-

1. Pursuant to Section 103 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Hill Areas Land and Water Development Project for India (the "Cooperating Country"), involving planned obligations of Fifty Million United States Dollars ($50,000,000) in loan funds and Four Million United States Dollars ($4,000,000) in grant funds over a seven year period from date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing foreign exchange and local currency costs for the project.

2. The project will support the design and construction of minor and smaller-scale irrigation schemes; emphasize development at the chak level (lower-end) of such schemes; introduce afforestation and systems design and management; establish coordination among state agencies involved in the sector; encourage human resource and institutional development; and commit an important research and technology adaptation effort to the hill areas.

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

a. Interest Rate and terms of Repayment

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

b. Source and Origin of Commodities, Nationality of Services

Commodities financed by A.I.D. under the project shall have their source and origin in the Cooperating Country or the United States in the case of grant funds and in the Cooperating Country or countries included in A.I.D. Geographic Code 941 in the case of loan funds, except as A.I.D. may otherwise agree in writing. Except for ocean shipping, the suppliers of commodities or services shall have the Cooperating Country or the United States as their place of nationality in the case of grant funds and the Cooperating Country or countries included in Code 941 in the case of loan funds except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the project shall be financed only on flag vessels of the United States or the Cooperating Country, except as A.I.D. may otherwise agree in writing.

c. Condition Precedent to Disbursement

Prior to the first disbursement of loan funds under the project, or to the issuance of commitment documents with respect thereto, the Cooperating Country shall, except as A.I.D. may otherwise agree in writing, furnish to A.I.D., in form and substance satisfactory to A.I.D., documentary evidence of the establishment of a State Level Implementing Committee which shall review policies for implementation of the project, review and approve subprojects financed under the project and which shall have the responsibility to promptly

a. establish and adequately staff a project cell to provide technical support to the project;

b. prepare a plan for training, technical assistance, field studies, research and evaluation for the first year of project operations; and

c. submit a staffing plan for additional personnel for all cooperating departments to implement the project.

d. Covenants

1. The Cooperating Country shall take appropriate measures to ensure adequate provision of counterpart financial and staff resources, at the state level, for expeditious implementation of the project;

2. The Cooperating Country shall introduce community-based management systems on project financed irrigation schemes;

3. The Cooperating Country shall explore ways to share more fully the costs of project financed schemes with their beneficiaries;

4. The Cooperating Country agrees that responsibility for Schedule II (community) schemes rehabilitated or upgraded under the project will not be transferred to Schedule I under the Minor Canals Act of 1976, except under extraordinary circumstances.

Signature Frank B Kimball
for M. Peter McPherson
Administrator

July 16, 1984
Date

Clearances:	Date	Initial
Charles W. Greenleaf, AA/ASIA	7/6	CG
Richard A. Derham, AA/PPC		7/12
Howard M. Fry, GC	7/11	

GC/ASIA:STisa:hp:6/28/84

1X

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

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

DOCUMENT CODE: 3

2. COUNTRY/ENTITY: India

3. PROJECT NUMBER: 386-0489

4. BUREAU/OFFICE: Asia — 04

5. PROJECT TITLE (maximum 40 characters): Hill Areas Land and Water Development

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 09 DD 30 YY 91

7. ESTIMATED DATE OF OBLIGATION (Under 'B.' below, enter 1, 2, 3, or 4)
A. Initial FY 84 B. Quarter 4 C. Final FY 86

8. COSTS ($000 OR EQUIVALENT $1 = Rs.11.00)

A. FUNDING SOURCE	FIRST FY 1984 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	550	14,950	15,500	2,070	51,930	54,000
(Grant)	(550)	(450)	(1,000)	(2,070)	(1,930)	(4,000)
(Loan)	(-)	(14,500)	(14,500)	(-)	(50,000)	(50,000)
Other U.S. 1.						
Other U.S. 2.						
Host Country	-	1,190	1,190	-	25,000	25,000
Other Donor(s)						
TOTALS	550	16,140	16,690	2,070	76,930	79,000

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) FN	B213	064	064	-	-	1,000	14,500	4,000	50,000
(2)									
(3)									
(4)									
TOTALS				-	-	1,000	14,500	4,000	50,000

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 022 | 050 | 091

11. SECONDARY PURPOSE CODE

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

13. PROJECT PURPOSE (maximum 480 characters)

To increase irrigation efficiencies and expand the area under irrigation.

14. SCHEDULED EVALUATIONS
Interim MM 09 YY 88 | MM YY | Final MM 09 YY 91

15. SOURCE/ORIGIN OF GOODS AND SERVICES
[X] 000 [ ] 941 [ ] Local [ ] Other (Specify) _____

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

17. APPROVED BY
Signature: [signature]
Title: Director, USAID/India
Date Signed: MM 06 DD 11 YY 84

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

AID 1330-4 (8-79)

I. Project Summary, Rationale and Detailed Description

A. Project Summary

The proposed Hill Areas Land and Water Development project will be located in the state of Himachal Pradesh (HP). It is intended to introduce new approaches to land and water management, as well as to support state initiative in developing its land and water resources.

The project will support the design and construction of minor and smaller-scale irrigation schemes; emphasize development at the chak level (lower-end) of such schemes; introduce afforestation and erosion control; initiate community-based approaches to irrigation systems design and management; establish coordination among state agencies involved in the sector; encourage human resource and institutional development; and commit an important research and technology adaptation effort to the hill areas.

B. Rationale

1. A.I.D.'s Irrigation Strategy

A.I.D.'s approved assistance strategy for irrigation in India is based on the sector's key role in accelerated agricultural growth and poverty alleviation, and the high priority attached to it by the Government of India (GOI). A summary statement may be found at Annex I.

Attention to major irrigation, indeed even to medium systems, with their complex engineering works, enormous budgets and very visible organizational setups has tended to under-estimate the widespread importance of minor and smaller-scale irrigation. Evidence shows, however, that small systems are important in India both in terms of area commanded and in their persistence over time.

A.I.D. irrigation strategy has turned its focus increasingly to minor and smaller irrigation systems. Investment in these sectors reduces the gestation period between project initiation and system operation. Secondly, minor or smaller-scale irrigation systems allow state resources to be dispersed rather than concentrated in a few locations. Third, small irrigation systems are more likely to reach and engage marginal and small cultivators.

2. Project Premise

An important priority in Himachal Pradesh is to create high performance irrigation systems that will protect the hills environment while allowing cultivators to increase their production of food

grain and other agricultural and horticultural crops. Minor and smaller-scale irrigation is the key in an environment characterized by small, narrow valleys, steep hillsides and intensive farm terracing. Communities have an important role in the development of smaller-scale irrigation works in the hill areas (accounting today for more than half of total irrigated area), but not without complication. Design problems in the community sector occur because of limited knowledge, materials or both. Community systems also encounter difficulties because of environmental change such as shifting watercourses or changes in run-off patterns due to watershed deterioration. There often are problems in mobilizing resources either because their availability, such as labor, changes sharply or because natural disasters destroy works that have been developed over a period of time. One of the most difficult problems faced by community systems is interacting effectively with government agencies and departments without compromising their capacity to be self-sustaining.

Himachal Pradesh has responded with an aggressive and far-reaching minor irrigation program; and while the major effort to develop widespread and small-scale irrigation systems has been an effective means to the expansion of irrigated area and increases in food production and cultivators' incomes, certain difficulties repeatedly occur in the state sector as well. The technical design of these systems is complex. Moreover once designed and built, operations, management and maintenance have been a problem -- in part because of the difficulties state agencies have experienced in attempting to motivate community participation. Finally, an increasingly serious issue is that of the level of recurring costs for operating small systems.

On a worldwide basis, there is considerable foment and experimentation as to the best approach to small-scale irrigation development and management. At one extreme, some technical agencies are assuming greater responsibilities for control over these small works. A minority are proceeding in exactly the opposite direction. In fact, among the most critical, and admittedly ambiguous, issues for irrigation policy at this time may be to reach a better balance between states and localities for creating and sustaining small-scale irrigation systems.

In the hill areas, most irrigation systems will of necessity be small and dispersed. These two fundamental features of irrigation development in Himachal Pradesh create both the need and opportunity for a strategy in which local groups assume greater control and responsibility for irrigation schemes, while selective assistance is provided by the state. The small scale of the systems, for example, means that the relatively more limited investments needed for routine maintenance and management may be compatible with local experience, resources and capacities.

Environmental deterioration, particularly erosion and deforestation, is a particularly serious issue in the hill areas. Irrigation systems need not be a negative or passive factor in the environmental equation. Afforestation and erosion control interventions can be associated with small-scale irrigation and positively enhance the environmental prospects for the command and adjacent watersheds. Such interventions are also probably best rooted in community participation and responsibility.

3. The Opportunity

There are three principal agencies charged by the state with responsibility for irrigation in Himachal Pradesh: the Irrigation and Public Health Department (ID), the Soil Conservation Wing of the Agricultural Department (AD) and the Rural Development Department (RD). These three agencies, while carrying out somewhat different irrigation-related activities, also employ different strategies with regard to community participation and post-construction responsibility. The AD and RD typically implement schemes of smaller scope and leave the post-development management responsibility with the user or community. There is cost-sharing, but no water charges are assessed. In contrast, the ID typically undertakes larger schemes and after completion assumes responsibility for management. There is no cost-sharing, but a water charge is usually assessed.

These different approaches to irrigation development and management provide a laboratory for the consideration of alternative approaches to land and water development and management. Lessons learned should have wide applicability in the hill areas of the sub-Himalayan range. The moment is appropriate because the state has committed itself to a rigorous and critical assessment of alternative approaches. This is evident in their enthusiastic engagement of USAID in the planning and design of the proposed project. It is evident in their willingness to commit an important research and technology adaptation effort to the hill areas. It is evident in their initiative to subsume virtually the entire scope of the Seventh Five Year Plan for minor irrigation in the state under the purview of the proposed project, to appoint a State Level Implementing Committee (SLIC) chaired by the Agricultural Production Commissioner (the second highest administrative official in the state), to bring together into a Land and Water Development Cell all state agencies touching on the sector and to chart an ambitious human resource and institutional development agenda for the project period.

These initiatives alone do not, however, adequately capture the commitment of the state. Three further developments define the real opportunity for this project. The state has put chak development at the forefront of program planning. That means a concern for development at the lower-end of irrigation systems. It means a concern for cultivators and agricultural production. Second, while

practice to date has been to construct and manage, the state itself has recently initiated community experiments in system management, and it has agreed to continue that experimentation into the project. Third, where ID had acted (albeit only in limited situations) under the Himachal Pradesh Minor Canals Act, 1976, to assume responsibility for community-based systems judged "detrimental to the public benefit", it has agreed that no community irrigation works or chak development on community systems financed under the project will be transferred, except under extraordinary circumstances. Indeed, the openness to explore and provoke new approaches is the premise, opportunity and rationale for the proposed A.I.D. investment.

4. Himachal Pradesh

Himachal Pradesh came into being in its present form with the creation of an independent state in 1972. It is essentially a mountain state, encompassing the transition zone from the plains to the high Himalayas and, in the trans Himalayan region, actually crossing to the Tibetan plateau. The population of the state is estimated at 4.2 million, its area is 55,538 sq. kms., its main languages are Hindi and Pahari, and its capital is at Simla. The state is comprised of 12 districts with 46 towns, and there are more than 17,000 villages of which some 12,000 are villages with populations of less than 200 persons. Almost 80 percent of the population is engaged in agriculture.

Agriculture dominates the economy of the state although because of the mountainous terrain only a little over 10 percent of the total land area is cultivated. Population pressure on cultivated land is high, and the land holdings of most cultivators are very small (i.e. 70 percent of holdings are less than one hectare, about 16 percent range from one to two hectares, with the remaining 14 percent more than two hectares in size). Most holdings are self cultivated; and of the some 550,000 hectares net sown area, about 375,000 hectares are sown more than once in a year giving an average crop intensity of 165 percent. Many cultivators obtain three crops in a year, and some even four. Cereals, pulses, vegetables and horticulture crops dominate the regime.

Four main tributaries of the Indus originate or pass through Himachal Pradesh, although these are either tapped by the plains states of Punjab, Haryana and Rajasthan, or by the national hydro-electricity grid. Most of the state's productive water resources for agriculture come from the smaller perennial or seasonal monsoon-fed streams. There are two rainy seasons. About 25 percent of the precipitation occurs during the period December to March, with the remaining 75 percent during the monsoon months from June to October.

Pressure on watersheds in the low and mid-hill regions of the state for fodder, fuel and timber is high, and consequently soil erosion problems in most watersheds are a cause for serious concern. Indeed, the concern is of national scope with excess Himalaya run-off contributing significantly to the annual $250 million flood and erosion-related crop loss in the Gangetic plain. The GOI alone allocates $40 million annually to Himachal Pradesh to address related soil erosion problems, and is looking to this project to help alleviate such problems.

The state estimates almost 136,000 hectares to be under irrigation, with about 55 percent of the area served by community systems. Indeed, state irrigation legislation takes account of both systems although they have operated in different spheres. Both state and community systems are small. There are only a few state systems, extant or planned, with commands in excess of 2,000 hectares, and the total command of these systems is less than 20,000 hectares. Smaller schemes are typically flow (known in HP as kuhls) and lift. Communities have largely confined themselves to flow, although the state finances both. The water source for kuhls is either perennial or seasonal springs or streams. Lift schemes use both surface and groundwater sources.

Several state agencies are engaged in irrigation development and management. They are involved in creating new commands, repairing and remodeling existing schemes and intensifying facilities at the chak (i.e. watercourse and land development level). The major agency is the Irrigation and Public Health Wing of the Department of Public Works, followed by the Soil Conservation Wing of the Agriculture Department. The Rural Development Department mostly carries out repairs, maintenance and construction of small community schemes. In addition to these three mainline irrigation organizations, there are other important resource institutions, including the Agricultural University, polytechnic institutes, the Agricultural Extension Service and Soil Conservation Wings of the Agriculture Department, the Department of Horticulture, the Forestry Department, the civil administration and the three tier panchayati raj systems at the local level.

5. Other Donor Activity

An ambitious program was undertaken in the Kangra District of Himachal Pradesh under an Indo-German agricultural project during the period 1966-1977. The project area included the entire district, and the program involved a broad range of agricultural extension and development activities including soil fertility, plant cultivation, fruit and vegetable growing, plant protection, soil conservation, land leveling, terracing and rural water supply. The main objective of the project was rapid increase in agricultural production through improved production techniques and appropriate incentives to farmers.

Project activities included demonstration and training, construction of storage and processing facilities, installation of tubewells and construction of flow and lift irrigation systems. A recent evaluation using sample survey data showed yields significantly higher for most crops in the project area. Fertilizer use also increased and gross farm income per hectare rose substantially. Under the A.I.D. project, a number of irrigation schemes in the Kangra District will be supported. It is anticipated that these schemes will benefit from improved agricultural practices already adopted and provide useful feedback on ways to increase agricultural productivity.

A second German project in the Dhauladhar area of Kangra District trained "village motivators" in a wide variety of community oriented activities. These ranged from social forestry, soil and water conservation to horticulture and animal husbandry. This project is still in the implementation stage and is deemed to be reasonably successful. Lessons learned will be incorporated in this project.

In addition, the International Bank for Reconstruction and Development (IBRD) is discussing with state officials the possibility of introducing the Training and Visit (T&V) system as part of the Agricultural Department's extension program, and a major watershed management project. This system is quite effective throughout India.

Since 1978, the A.I.D. Mission to India has developed a strong collaborative relationship with other bilateral and multilateral donors, and particularly in the irrigation sector. The experience gained under various donor projects in Himachal Pradesh will provide useful knowledge in implementing this project, particularly at the community level. Moreover, the proposed IBRD project should greatly enhance the impact of irrigation on productivity due to the strong complementaries that exist between irrigation and other agro-inputs, especially information as provided under the T&V system.

C. Project Description

1. Design Approach

There are few subjects more debated on the Indian irrigation scene than water distribution to the farm. It is a topic which spans engineering technology to sociology, and it has exercised the interest and imaginations of a wide range of professional experts. The subject has also acquired an extensive literature, particularly on the socio-economic aspects of the problem. Much less has been written from the technical viewpoint, and there still remains no comparative treatment of the subject which could serve as a reference in evaluation of various systems at the management level.

Apart from a few generalizations with regard to the objectives of irrigation, there is scarcely any statement on the subject which cannot be challenged in some respect. It is a subject which inevitably involves trade-offs of one objective against another (e.g. operational simplicity against end use efficiency), with consequent scope for differences in approach by various agencies or practitioners; indeed there are even different schools of thought on the subject. Furthermore technical and institutional factors can vary widely from one locality to another, calling for significantly different design approaches. What can be achieved in one location with a particular system may not be achievable in another.

The design approach taken for this project is based on USAID's experience in India. The approach is premised on the understanding that end-of-project status cannot be assured at the inception of project activity (and, in many instances, can hardly be anticipated). What can be achieved at the beginning is some agreement on principles and a reinforcing implementation plan.

2. Design Principles

Despite an impressive national commitment and achievement in the irrigation and agricultural sectors over the past thirty years, production in most irrigated areas remains well below the design targets used to justify investments, and this gap is of increasing concern to the GOI and the states -- particularly in the face of financial resource constraints. The reasons for the performance gap are varied and often interlinked, but they can be classifiedas follows:

a) a design gap prevents optimum system performance. This could be improved with more precise tools to measure seepage losses, assess river hydrology, design control structures, estimate field losses, determine crop water requirements, refine the accuracy of surveying and system layout, and improve the frequency and content of communications.

In formulating a small-scale irrigation development program, then, a key programmatic issue is the nature of the technical design process to be used. There is growing evidence to support the proposition that the design process is enhanced when research is fedback to technology adaptation, ground verification is assured and when local knowledge, experience and preferences are incorporated along with modern engineering skills. In this project, provision is made for modifying design procedures and training staff needed to develop, gather, analyse and utilize new, ground-verified, research-tested, local and locally-provided information in the design of minor and small-scale irrigation systems.

b) the operations gap is the inability to exploit the full potential of existing schemes. This has been caused by imperfect match between scheduled water deliveries and crop needs, uncertainty among farmers of the times and amounts of water supply, inequitable distribution of water between channels and among cultivators, and uncertainty among cultivators and state officials of their rights, duties and responsibilities. Lower-end investment and increased community participation in systems operation are the currently accepted prescription.

With the realization that a watercourse system one kilometer long and serving 50 to 100 cultivators unfamiliar with irrigation and unaccustomed to community effort is unlikely to survive in the form intended, the GOI has tended to encourage subdivision of the outlet command into smaller units and the upgrading of the channel delivering to those units, both technically and administratively. In this project the ID will bring the outlet closer to the farm, albeit from a more abbreviated watercourse system, but probably lined and subject to some degree of government supervision and maintenance. Distribution to individual holdings will then be by more conventional field channels probably unlined, with the expectation that operation and maintenance will be by a smaller community or user group. Water application in the hill areas is also confounded by steep slopes with consequent low efficiencies. To maximize the returns to below-the-outlet works and cultivator inputs, as well as to check run-off and soil erosion, field bunding, terracing and land shaping are also considered an integral element of irrigation development in Himachal Pradesh. Together these concepts represent chak development.

Nearly without exception, planning for programs of small-scale irrigation development have anticipated some irrigation responsibilities being assumed by local groups, but there appear to be several issues that repeatedly arise. Since in most instances the role of a local irrigation group is conceptualized primarily as that of being responsible for the civil works once completed, understandably little or no attention is given to the local group until something has been constructed which needs to be maintained. This approach does not work well because the users are not involved at the outset; because as a result the facilities may be inappropriate; because community conflict within the command may be exacerbated by the construction process itself; because the best opportunity for group organization undoubtedly has been lost; because the time-frame for group action after construction is usually yesterday; and because passive involvement often leads to alienation.

The project encourages the involvement of cultivators or localities in the design and management of project-financed schemes. While for any given scheme, localities themselves will have to agree upon the level and formality of organization, it is agreed that the principle of engagement or participation will be adhered to

and that wide experimentation will be encouraged. In addition, it is agreed that action studies and other work under the research and technology adaptation component of the project will be related to locality issues. Designated schemes, for example, will be identified to test community responsibility for operations and maintenance. It is also important to note that confirmation of the status of community organization or association will be required for final disbursement.

c) the departmental gap is the need for government departments (e.g. irrigation, agriculture, rural development, extension, horticulture, seeds and fertilizer, credit and marketing etc.) to align their operations, strategies and perceptions of local situations; to share responsibilities among themselves or with localities; and to coordinate activities to assure that they are mutually supportive and timely for the needs of cultivators and the community.

The state has identified and engaged a broad range of state agencies and institutions to participate in the proposed project. Rural Development, Forestry, Horticulture and Extension have been brought formally into the project with the Irrigation Department, and an even broader range of state academic, research and management institutions will participate in implementation. While the style of implementation cannot be totally predicted, there is agreement on design principles and commitment to improve coordination, to put the cultivator at the center of the process, to engage the community, to invest in development below the outlet, to undertake human resource and institutional development initiatives which will affect the operating cultures of the participating agencies and to undertake various analyses, reviews and action studies of alternative approaches. Significantly, the state has also agreed to establish a State Level Implementing Committee and a Land and Water Development Cell (project cell) involving the concerned agencies in the full range of project activity. Even at this early stage, organizational configuration is on the table.

d) the financial gap is escalating as government assumes increased responsibility for small and scattered irrigation commands. Today the dominant mode of state investment in minor irrigation works takes the form of what might be called direct investment. That is, the state, acting through one of its technical agencies, acts directly, using its own budget and staff to design, construct and operate irrigation facilities (e.g. the ID model). Though fewer in number, there also have been some interesting government programs that are based on an indirect investment strategy - that is, a strategy in which the state makes some resources available to the community sector (in the form of grants, loans, technical assistance) for the local sector itself to implement community irrigation development works which the community then owns and controls (e.g. the AD model).

A strategy by which government can induce local groups to invest in works below the outlet, thus leveraging the initial state input and reducing the need for substantial repeated or recurrent investments, must be the goal of financial and irrigation establishments alike. This project will begin a dialogue and the testing of approaches to this issue. It has been agreed that the focus will be on the chak, the lower-end, on operations, management and maintenance of the system and on the engagement and participation of community initiative. That focus is, in itself, essentially an approach to recurrent costs. It is agreed, as noted earlier, that the state will not exercise its option except under extraordinary circumstances, to assume new responsibility for the management of existing community systems developed under the project. Most importantly, it is also agreed that the best features of the ID and AD approaches will be adapted for finance of land development with both cost-sharing and assessment of water charges as applicable. Admittedly, direct investment is increased by the relocation of the outlet, but the rationale for that movement seems rooted in rational public policy which has been endorsed broadly by the professional and donor community throughout India.

3. Project Purpose

The purpose of this project is to initiate new approaches to hill areas minor and small-scale irrigation development incorporating both state and community responsibilities and to support state initiative in developing its land and water resources. To this end, the state will emphasize chak development in the design and construction of minor and small-scale schemes, initiate community-based approaches to irrigation system design and management, introduce environmental control, establish coordination among state agencies involved in the sector, facilitate staff and institutional development, and commit a research and technology adaptation effort to the hill areas.

4. Project Components

a) Design and Construction of Minor Schemes

The project will provide financing for the design and construction of minor and small-scale irrigation schemes throughout the state. The proposed seven-year project will develop up to 75 flow and 75 lift schemes covering 15,000 hectares, and will support development of additional micro and water harvesting schemes on 7,700 hectares. Rehabilitation of up to 15 flow and 15 lift schemes may be included. The development of the proposed schemes contemplates:

i. plans. Design criteria were agreed during project negotiations (Annex II). Designs will be rooted in ground-verified and research-tested data, and community involvement in plans will be required for every scheme in order to be eligible for financing. Creation of a Land and Water Development Cell should facilitate feed-

back and technology adaptation from analyses, studies and research, and a comprehensive training program will be developed for design engineers.

ii. construction. Minor irrigation works will include headworks, distribution systems and watercourses. They will be scattered and carried out largely by force-account of implementing agencies but also with local labor. Minimal contracting is anticipated, but will follow standard government regulations which are considered acceptable.

b) Chak Development

Chak development refers to a sub-division of the command and the training and organization of cultivators to use delivered water more productively. This entails construction of watercourses from the minor canals, layout of field channels to individual fields, land shaping, bunding and terracing to facilitate efficient distribution of water to crops and to minimize runoff and erosion, provision of field drainage for removing excess water, and the introduction of access roads, if required. Some 31,000 hectares of chak development on minor schemes, an additional 7,700 hectares on smaller-scale and water harvesting schemes as well as rehabilitation on 2,000 hectares by the Rural Development are included under the project. Detailed plans will be prepared at the same time with headworks and distribution systems for new schemes. Chak development contemplates:

i. field works. Construction of field channels and drainage, in addition to more conventional watercourses, will be included as an integral, new element of system development. Indeed, the introduction of watercourses themselves will be a new element on many schemes.

ii. water management & maintenance. The project will seek to place responsibility for operations (i.e. equitable and timely distribution) with user associations consisting of community beneficiaries. These groups could also be made responsible for all maintenance works. Irrigation Department staff will devote part of their time to forming such groups as well as in community run systems (whose engagement will be required prior to approval of proposed schemes and whose status will have to be confirmed prior to final disbursement) and, together with Agricultural Extension, to training cultivators in simple maintenance techniques and effective water utilization.

iii. land shaping, field bunding and terracing. Water application in the hill areas is confounded by steep slopes with consequent low efficiencies. To maximize the returns to below-the-outlet works and cultivator inputs, as well as to check run-off and soil erosion, land development is included as an integral element of chak development.

iv. agricultural extension. By support for incremental staff costs and training, the Agricultural Extension service will be able to provide better information to individual cultivators, communities and user organizations about rotational water supply, operations, management and maintenance of field channels, water application and water crop requirements. This component will be coordinated with other training and workshops supported under the project.

c) Afforestation and Erosion Control

Work in scheme areas will be largely confined to afforestation and erosion control, although more localized environmental and agricultural work will also be undertaken by the Horticultural Department. The development of this component contemplates:

i) watershed treatment. Where vegetative cover can be established, the Forest Department will undertake afforestation and construction of small check-dams, constructed from brush and other local but readily available material, to control gully erosion and protect downstream structures. In deciding treatment on the culturable command area (CCA) of watersheds, first priority will be given to satisfying local needs for fodder and fuel. Some experimentation with controlled grazing may also be included.

ii) horticulture development. This component will include improvement of wild fruit groves, development of private and community orchards and an increase in the number of nurseries to supply fruit tree seedlings to project areas that are within the gross command area (GCA) but are not part of the CCA.

d) Community-based Management Systems

This component is at the very heart of the project. The state is committed to scheme definition likely to engage cultivator and community participation (namely, chak development). The project should facilitate community awareness, interest and participation; elicit their engagement in the design of schemes; encourage placement of operations and maintenance responsibilities with the localities (including associated costs) and actually test several models for doing so. While obviously easier said than done, and while cultivators and communities themselves will have to agree upon the level and formality of any organization, it is agreed that the principle will be adhered to and incorporated in design and disbursement criteria, and that wide experimentation will be encouraged. A major allocation to agricultural extension for this purpose is included under project costs.

e) Coordination

An essential component to the project is the organization and management of agency support on a broader sectoral basis. Organizational orientation and coordination, together with alignment of agency strategies, is the principal objective. The major elements are:

i) State Level Implementing Committee. The Committee, under the charge of the Agricultural Production Commissioner, will comprise Secretaries of Finance, Planning, Irrigation and any other Secretaries or invitees and heads of participating departments. The Committee will be responsible for formal approval of projects, ensuring a coordinated approach to project implementation and adequate staff deployment, reviewing progress of implementation and resolving problems of execution. A Chief Project Officer of the Irrigation Department responsible for coordinating all actions, will act as Member/Secretary of the Committee and will head the Land and Water Development Cell, which is described below:

ii. Land and Water Development Cell. The Cell will comprise specialists in irrigation, forestry, horticulture, extension, soil conservation and relevant support staff. The Cell will have defined and separately staffed units for scheme preparation and planning, training, research and technology adaptation, monitoring and evaluation.

iii. District-Level Committees. Committees will be organized at the district level to coordinate development activities at this level.

iv. Sub-project Committees. Committees will be organized at the block level to prepare and oversee implementation of schemes.

f) Human Resource and Institutional Development

Training and institutional development are integral to the project and distinguish it from more typical investment programs. The component includes:

i. training. Special staff development and training programs will be organized for personnel drawn from the various state departments and agencies involved with the project. In general, staff development and training will be directed toward improving knowledge and skill to plan and design irrigation facilities; to understand and analyze irrigation systems in an integrated manner; and to involve communities in the planning, operations, management and maintenance of systems.

ii. analyses, review and field studies. Three broad types of work will be implemented throughout the project life. These might include, among others, agronomic, irrigation management or institutional analyses. Review activity is intended to develop information and data, analyze technical or institutional options, assess trends and assure feedback to project planning and operations. Action studies will foster collaborative learning among cultivators, researchers and project staff. They are intended to be iterative and will involve interventions such as changes in water scheduling, introduction of other management procedures and minor infrastructural improvements, subsequently moving to system improvement, changes in agricultural production practices, consideration of cultivators' incentives, introduction of user associations, application of incentives for departmental activity and ultimately testing alternative institutional configurations.

g) Research & Technology Adaptation

A key issue in a project of this type is that of clearly identifying which particular components of a land and water development program will have the most effective impact at the lowest possible cost. Research under this project will include, among others:

i) new technologies. There appear to be a number of opportunities to introduce new irrigation technologies in Himachal Pradesh. The principal ones visualized are sprinkle, trickle and hose basin irrigation. A pilot testing program will be included.

ii) land development. Data on water run-off and soil loss as a result of outward sloping bench terraces are neither readily available nor adequately analyzed. This component will assess the content of run-off and soil loss from cultivated terraces; costs of controlling terrace erosion by various measures; the extent to which cultivators using their own labor and equipment and adapting new tillage practices can bring about the reshaping of their land over a two to three year period so that the terraces become inward sloping, and expected increases in farm production as a result of land shaping.

iii) waterharvesting. The objective of this component will be to test alternative integrated water harvesting schemes with maximum user participation and responsibility.

iv) development-cum-demonstration of irrigation and chak development schemes. A limited but representative set of flow and lift irrigation schemes having appropriate geographic distribution will be selected to test and demonstrate various development and management approaches. A mix of new and rehabilitated schemes will be included. These sites will also be used for analyses, review and field studies. Chak development is a major activity of the project, and demonstrations will be included but not limited to test or research sites.

II. Cost Estimate, Financial Plan, Disbursement Procedures

A. Cost Estimates and Financial Plan

The total cost to complete the proposed schemes during the seven-year life of the project is estimated to be $75 million (Rs. 825 million). The A.I.D. Loan will provide $50 million (approximately Rs.550 million). The state will provide $25 million (approximately Rs. 275 million) towards planning and construction costs of the schemes. A summary of cost estimates and the financial plan is presented in Table 1.

A.I.D. will also provide a Grant of $4 million to cover the human resource and institutional development and the research and technology adaptation components of the project, as well as the cost of monitoring and evaluation. An illustrative breakdown of grant funded activities and estimated costs is set out in Table 2.

Table 3 provides details of construction costs by estimated area, number and type of schemes proposed under the loan by the participating state departments, with contributions by A.I.D. and the GOHP*/.

Training will be intensively programmed during the first three years of the project. Analyses, review and field studies will begin towards the end of the first year and continue thereafter to the Project Assistance Completion Date (PACD). Useful feedback and information will be generated after one or two years. Development-cum-demonstration schemes will continue for the major part of the project. In general, technical consultations will be concentrated in the first half of the project life. Liaison and coordination will continue throughout the project.

Appraisal, approval and construction of schemes will begin during the second year to benefit from the training provided the first year in system design and improved technical standards for schemes. All schemes will be completed by the PACD. It is antici- pated that all proposed schemes will be approved by the end of the fourth year. Table 4 gives the expenditure and disbursement plan by GOI and U.S. fiscal years. Counterpart financial commitments for the GOHP are shown along with corresponding disbursements by A.I.D.

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*/Chapter II, Section E, Chapter III, Sections E,F,G and Chapter VII, Section B 2a and b, Volume II provide details on the grant and loan funded activities.

D. Disbursement Procedures

1. Loan Funds

A new performance-based, fixed-percentage reimbursement method to finance construction costs is proposed for this project. The large number of irrigation schemes involved in the project and the relatively small size of each argued for Fixed Amount Reimbursement, in some variation of established FAR procedures. FAR, however, requires that each separate project be sufficiently similar to all the others that a standard unit-reimbursement amount applicable to all can be developed. This is not the case with the systems involved in this project. Individual system costs vary from Rs.100,000 for very small watershed schemes to Rs.8,000,000 for large, flow irrigation surface catchment schemes. Similarly, the cost per irrigated hectare varies widely and thus is not a suitable unit for FAR financing.

There are, however, certain key actions, common to all irrigation schemes, representing the essence of the innovations to be introduced by the project. It is proposed to use these actions as trigger points for reimbursement of fixed percentages for A.I.D.'s share of the construction cost of each subproject.*/ The trigger points represent important stages in the planning, design and construction process.

The first trigger point for a given subproject will be the approval of the initial subproject appraisal report by the State Level Implementing Committee. This report will have to incorporate the project feasibility criteria shown in Annex III. Where the criteria are inapplicable or otherwise not adopted, justification will have to be provided.

The second trigger point will be the approval by SLIC of the detailed subproject design, from water source to chak development. This is necessary to lay the groundwork for integrated system planning. The detailed design will also include designation of responsibility among the state departments participating in the project. For example, the roles of the Irrigation, Agriculture, Horticulture, Forestry and Rural Development Departments will be spelled out. Furthermore, certification of the availability of funds for the

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*/ Because of extremely wide variations in the cost of land and the inability of A.I.D. to finance land and identifiable taxes and tariffs, these items are not included in the project figures contained in this paper. They are, however, valid project costs which will have to be budgeted for and carried by the GOHP.

complete works, specified separately for each participating department, will assure timely completion. Finally, formal concurrence in the detailed project design by an authorized community representative -- the panchayat, the head of the water user organization, or some other appropriate representative -- will assure engagement of the community in the design process.

The third trigger point will be the completion of all system construction to the outlet, in accordance with the detailed design.

The fourth and final trigger point will be the completion of all chak development, including confirmation of the status of community organization or association.

Experience with performance-based financing in other projects has demonstrated the potent influence this type of financing can have in highlighting key project objectives and supporting design outcomes consistent with institutional development objectives. In order to work, however, funds proportionate to the importance placed on the objective must be assigned to the trigger points. Except for conduct of socio-economic and other on-site baseline and design studies, relatively small proportions of project costs are involved in initial appraisal and feasibility studies, and virtually no actual expenditure of funds is associated with assigning departmental responsibility for project activities or with sanctioning and certifying budget allocations. Similarly, very little expenditure should be required to achieve community concurrence in detailed plans if the community has been involved throughout the design process. Nevertheless, these actions are vitally important to the successful completion and effective operation of these schemes, especially at the chak level. It is therefore proposed that monetary value be assigned to these steps to assure that each receives due attention. Performance-based, fixed-percentage reimbursement is accordingly proposed as follows:

Performance Indicators	Disbursement Percentage*/
I. Institutional	
a) Approval of appraisal report using improved project feasibility criteria	10

*/Applied to the A.I.D. share of the pre-agreed, fixed, overall cost developed for each scheme during the detailed subproject design, i.e, Step I. b) above. The ten percent reserved for Step I. a) will be based on estimates developed for the appraisal report. Any adjustments in the absolute amount arising from changes in overall costs at the detailed design stage will be made at the time of the second disbursement.

Performance Indicators	Disbursement Percentage
b) Approval of detailed subproject design, including chak development plans based on detailed topographic and soil surveys; assignment of agency responsibility; certification of budget provision; concurrence of community	30
II. Construction:	
a) completion of distribution system down to outlet	40
b) completion of chak development	20

The following example will illustrate how this financing will work. An appraisal report is prepared and forwarded to SLIC for a subproject estimated to cost Rs.1,000,000, or roughly $90,910, excluding land and identifiable taxes and similar charges. A.I.D. loan financing is available for two-thirds of construction costs; the Cooperating Country will bear the remaining one-third. Thus, two-thirds of the estimated cost becomes the preliminary figure for the total amount to be reimbursed by A.I.D., or $60,610. Upon notification that the project feasibility criteria have been applied and the appraisal report approved by SLIC, A.I.D. will release ten percent of this sum, or $6,060 to the Ministry of Finance through standard local currency financing procedures. In the event no further progress is made toward project completion within one year, this sum will be applied against reimbursements due on other projects or refunded to A.I.D.

When the detailed design for the subproject has been approved, including chak development, departmental responsibilities assigned, budgets allocated and certified and the formal concurrence of the community obtained, an additional thirty percent, or $18,180 will be released. Adjustment will be made at this stage to accommodate any change in overall cost, and the total A.I.D. contribution will be fixed for the subproject by the SLIC. Upon completion of the subproject to the outlets (i.e., the entire system except for field development) an additional forty percent, or $24,240, will be released. At this stage, actual expenditures will have outstripped the sums released, reaching approximately 80 to 85 percent of total subproject costs. Completion of field development, representing fifteen to twenty percent of overall project costs and confirmation of the status of communty organization or association will trigger release of the final instalment of the agreed fixed amount, totaling twenty percent of the overall sum, or $12,120.

In addition to the schemes to be constructed by the Irrigation Department, the project also includes small irrigation and water harvesting schemes to be undertaken by the Soil Conservation Wing of the Agriculture Department. A total of approximately 7,700 hectares will be irrigated through this program. Also, the Rural Development Department will repair or rehabilitate existing flow schemes totaling approximately 2,000 hectares. Similar financing procedures will be used for these activities also, except that the appraisal report and detailed design are combined.

The project also includes chak development by the Irrigation Department for 16,000 hectares on schemes already completed but for which no chak development has heretofore been done. Financing for this work will likewise be provided in stages, although only three trigger points will be used:

a. Detailed design, for chak development, including designation of all departmental responsibilities, certification of budgetary allocations and formal concurrence of community:	40 percent
b. Completion of water courses:	20 percent
c. Completion of all works:	40 percent

The percentages for each trigger point will remain fixed for each type of scheme construction and rehabilitation irrespective of the absolute cost or agreed total reimbursement amount for each subproject. The same trigger points will be used for each subproject regardless of size, cost or design. One possible result might be that A.I.D. disbursements could exceed actual expenditures by the state on some subprojects, although it is more likely that A.I.D. disbursements will lag behind construction because of the reimbursement process. These disbursements will, however, directly result in carefully prepared, fully integrated plans, clear designation of responsibility, adequate budgetary provisions and the active involvement of the beneficiaries early on in the development of individual projects. This will serve to assure the completion of well designed and well run individual schemes two to four years earlier than would otherwise be the case. Furthermore, it enables USAID, with a very small staff, to implement and effectively monitor a potentially very complicated and widely dispersed project.

Evaluation will focus on the impact of these new procedures in facilitating the adoption of improved planning and better feasibility criteria, integration of chak planning in overall system design, clear assignment of responsibility for system construction and operation, provision of adequate budgetary resources and involvement of communities. If it appears these procedures are not producing the desired results, they will be adjusted accordingly.

2. Grant Funds

A.I.D. grant funds will be used for direct financing of agreed local currency and foreign exchange costs as detailed in Table 2. To provide for local currency expenses, A.I.D. will release the dollar equivalent of planned costs for each activity to DEA through established transfer procedures. DEA will then arrange to have the equivalent rupee amount credited to the current budget for Himachal Pradesh, for use by the participating departments.

To facilitate implementation of grant funded local currency activities, an advance of grant funds equivalent to the initial three months of projected expenditures will be provided upon completion of conditions precedent. This amount is estimated to be approximately $50,000 (Rs. 550,000). Every three months thereafter, the state will report on actual expenditures for the previous quarter and estimated requirements for the ensuing quarter. USAID will liquidate the previous advance on this basis, and advance requested funds for the next quarter.

C. Recurrent Costs

Approximately 12.5 percent of ID's annual irrigation budget is allocated to repairs and maintenance of existing schemes. Expenditures on salaries, supplies, vehicles, etc. are covered under the state's General Operating Fund and meeting such costs is not expected to be a problem for the state. In addition, when natural calamities occur, additional funds are provided for repair and rehabilitation. Thus, Himachal Pradesh does not appear to have a critical recurring cost problem in irrigation in the sense that "finance is lacking for variable inputs even when they are more economically profitable than for new capital inputs, either public or private."*/

USAID's Irrigation Office estimates that ten percent of the total budgeted for capital costs should generally be budgeted annually thereafter for operation and maintenance. Thus, the provisions made by the state appear to be sufficient.

D. Construction and Chak Development Cost Estimates

Although the specific schemes to be supported by this project are yet to be identified, the overall cost estimates in Tables 1, 3 and 4 are considered reasonably accurate. Escalation is calculated at 10% per year. Above-the-outlet costs in particular are well developed and are based on per hectare estimates used by the state ID.

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*/A.I.D. Policy Paper on Recurrent Costs, May 1982, p. 1

Chak development costs can likewise be calculated on a per hectare basis based on prior experience in Himachal Pradesh and elsewhere. USAID's irrigation staff has reviewed these figures in detail and finds that an overall cost of about Rs. 7,000 per hectare will cover construction of watercourses and field channels, land leveling and some terracing. Costs may vary plus or minus 30 percent from chak to chak, but on the average this figure is reasonable for arriving at overall project levels.

E. Budget and Financial Plan Tables

Table 1

SUMMARY COST ESTIMATES AND FINANCIAL PLAN
($000)

	A. I. D.								PROJECT GRAND TOTAL
	LOAN			GRANT					
	LC	FX	Total	LC	FX	Total	TOTAL	GOHP	
1. Design and construction of irrigation schemes	24,885	-	24,885	-	-	-	24,885	12,995	37,880
2. Chak development	17,115	-	17,115	-	-	-	17,115	8,005	25,120
3. Irrigated agricultural extension support	2,000	-	2,000	-	-	-	2,000	1,000	3,000
4. Forest Dept. activities	3,000		3,000	-	-	-	3,000	1,500	4,500
5. Horticulture Dept. activities	3,000		3,000	-	-	-	3,000	1,500	4,500
6. Professional & institutional development:									
a) Training & education of staff	-	-	-	440	817	1,257	1,257	-	1,257
b) Analysis, review and field studies	-	-	-	868	934	1,802	1,802	-	1,802
c) Research and technology adaptation	-	-	-	622	319	941	941	-	941
T O T A L	50,000	-	50,000	1,930	2,070	4,000	54,000	25,000	79,000

Variations up to 10% may occur between line items, subject to the availability of funds, without format agreement between the GOI and A.I.D.

Table 2

ILLUSTRATIVE GRANT BUDGET
($ 000)

DESCRIPTION	Local Costs	Foreign Exchange Costs				Grand Total
		TR	TA	Equip.	Total	
1. Training						
a. Initial Design and Implementation	15	-	30	-	30	45
b. Conveyance and Distribution	6	-	15	-	15	21
c. Planning, Design of Lift Facilities	15	-	-	-	-	15
d. Hydrology, Water Requirements, Water Budget	15	8	30	18	56	71
e. Planning and Design Water Harvesting Schemes	10	-	15	-	15	25
f. Chak Development	35	30	30	10	70	105
g. Watershed Treatment and Maintenance	15	-	8	-	8	23
h. O&M of FIS and LIS Schemes	15	-	15	-	15	30
i. Small Watershed Hydrology	15	24	25	10	59	74
j. Quality Control	20	-	-	-	-	20
k. User Organization and Community Participation	35	51	30	-	81	116
l. Irr. Water Management/Soil-Water-Plant Relationship	60	45	60	18	123	183
m. Integrated Project Planning and Management	120	60	60	15	135	255
n. Economic Analysis	10	-	-	-	-	10
o. Diagnostic Analysis	40	-	90	10	100	140
p. High Lift Systems	4	-	40	-	40	44
q. P.G. Training in Water Resource Planning and Management	10	-	-	-	-	10
r. Audio-Visual, Reference Books, Special Equipment etc.	-	-	-	70	70	70
SUB-TOTAL	440	218	448	151	817	1257
2. Analyses, Review and Field Studies						
a. Small Watershed Hydrology	15	-	15	5	20	35
b. Integrated Action Research on Conveyance, Distribution and Utilization	180	24	70	16	110	290
c. Crop Water Requirements	10	-	10	5	15	25
d. Soil Survey Unit	30	-	-	-	-	30
e. Crops Research	90	24	10	-	34	124
f. Action Research on User Participation/ Social Aspects						
- Water Scheduling and Distribution	35	-	15	-	15	50
- Farmer Involvement in Kuhl Management	100	-	30	-	30	130
- Nature and level of Farmer Participation	25	-	15	-	15	40
- Pump Groups for Small and Marginal Farmers	30	-	15	-	15	45
- Alternative Forms of Water User Organizations	35	-	30	-	30	65
- Involvement of Women	25	-	8	-	8	33
g. Socio-Economic Baseline Surveys	25	-	15	-	15	40
h. Environmental Monitoring	50	-	15	-	15	65
i. Development of Technical Handbooks	20	-	90	-	90	110
SUB -TOTAL	670	48	338	26	412	1082

Contd.....

DESCRIPTION	Local Costs	Foreign Exchange Costs				Grand Total
		TR	TA	Equip.	Total	
3. Research and Technology Adaptation						
a. New Irrigation Technology	90	24	60	55	139	229
b. Agricultural Land Studies	90	-	-	-	-	90
c. Development of Integrated Water Harvesting Schemes	190	-	90	-	90	280
d. Development cum Demonstration FIS and LIS Systems inc. Chak Development	252	-	90	-	90	342
SUB-TOTAL	622	24	240	55	319	941
4. Liaison & Coordination	140	-	480	-	480	620
5. End of Project Evaluation	58	-	42	-	42	100
GRAND TOTAL (1 to 5)	1930	290	1548	232	2070	4000

Topics and figures on this table are illustrative and estimates and may be modified.

Table 3

DETAILS OF LOAN BUDGET
($ 000)

D E S C R I P T I O N	A.I.D. (LC)	GOHP	TOTAL
A. Irrigation Department			
1. Construction			
(a) Lift Irrigation Schemes (up to 75) (10,000 ha @ $1,900/ha)	12,285	6,715	19,000
(b) Flow Irrigation Schemes (up to 75) (5,000 ha @ $1,300/ha)	4,200	2,300	6,500
Sub Total item (A1)	16,485	9,015	25,500
2. Chak development (31,000 ha including 16,000 on completed schemes)			
(a) Survey, planning, design @ $62.5/ha	1,285	715	2,000
(b) Field channels and allied structures @ $125/ha	2,600	1,250	3,850
(c) Land development @ $400/ha	8,600	3,800	12,400
(d) Field drains and access road @ $62.5/ha	1,270	600	1,870
Sub Total (A2)	13,755	6,365	20,120
B. Agriculture Department/Soil Cons. Wing			
1. Construction			
(a) Small lift Irrigation Schemes from ground water resources (3,500 ha @ $1,400/ha)	3,300	1,600	4,900
(b) Water Harvesting Tank Schemes (2,100 ha @ $1,400/ha)	1,900	1,000	2,900
(c) Water Harvesting Pond Schemes (2,100 ha @ $1,400/ha)	1,900	1,000	2,900
Sub Total (B1)	7,100	3,600	10,700
2. Chak Development (7,700 ha @ $650/ha)			
(a) Survey, planning, design @ $62.5/ha	320	160	480
(b) Field channels and allied structures @ $125/ha	640	300	940
(c) Land development @ $400/ha	2,055	1,000	3,055
(d) Field drains and access roads @ $62.5/ha	320	160	480
Sub Total (B2)	3,335	1,620	4,955

D E S C R I P T I O N	A.I.D. (LC)	GOHP	TOTAL
3. Irrigated Agricultural Extension Support	2,000	950	2,950
C. Rural Development Department Repairs to Flow Systems (2000 ha @ $900/ha)	1,325	450	1,775
D. Forest Department	3,000	1,500	4,500
E. Horticulture Department	3,000	1,500	4,500
GRAND TOTAL	50,000	25,000	75,000

Notes: 1) Budget estimates are inclusive of cost escalation. Subject to mid-project review, any cost escalation over and above that already included in the above budget estimates will be provided by the Government of Himachal Pradesh.

2) Variations up to 10% may occur between line items, subject to the availability of funds, without formal agreement between the GOI and A.I.D.

Table 4

Project Expenditures by U.S. Fiscal Year
($ 000)

U.S. FY	U S A I D			GOHP	Grand Total
	Loan	Grant	Total		
1985	2,000	752	2,752	1,175	3,927
1986	5,990	1,398	7,388	2,990	10,378
1987	7,000	1,173	8,173	3,485	11,658
1988	9,900	400	10,300	4,915	15,215
1989	10,400	129	10,529	5,160	15,689
1990	9,040	75	9,115	4,480	13,595
1991	5,670	73	5,743	2,795	8,538
Total	50,000	4,000	54,000	25,000	79,000

Table 5

Project Expenditures by GOI Fiscal Year
(Rs. million)

GOI FY	U. S. A. I. D			GOHP	Grand Total*/
	Loan	Grant	Total		
1985	13.98	4.97	18.95	7.00	20.98
1986	48.85	12.54	61.39	24.38	73.23
1987	72.59	13.89	86.48	36.32	108.91
1988	96.15	7.79	103.94	48.06	144.21
1989	112.23	2.60	114.83	56.10	168.33
1990	105.44	1.07	106.51	52.70	158.14
1991	76.98	0.81	77.79	38.50	115.48
1992	23.78	0.33	24.11	11.94	35.72
	550.00	44.00	594.00	275.00	825.00

*/ Excludes grant funds

Note: Figures in these tables are estimates and subject to change.

III. Implementation Plan

A. Project Direction

1. State Level Implementing Committee

A State Level Implementing Committee will be established and chaired by the Agricultural Production Commissioner. The Committee will comprise the various administrative secretaries of the concerned departments as Members. The Commissioner-cum-Secretary (Finance) and Commissioner-cum-Secretary (Planning) are also Members. The Commissioner-cum-Secretary (Irrigation) will be vice Chairman of the Committee. A Chief Project Officer will be responsible for coordinating and implementing all project actions, will act as Member-Secretary of the Committee and will also direct the Land and Water Development Cell. Other Members may be included by special invitation.

The Committee will formulate policies for proper planning, coordination and implementation of the project and will resolve problems of execution. It will ensure that departmental and Cell responsibilities are scheduled and implemented. It will approve overall project work plans, budgets and annual departmental plans upon recommendation from the Land and Water Development Cell. It will assure adequate staff deployment and planning for design, monitoring, execution, materials management, coordination, quality control, evaluation, training, research and technology adaptation and for the development of community-based management systems.

The Committee will also take particular care to assure that the approach and organizing principles agreed for the implementation of the project are adhered to in the planning, execution and management of schemes and activities funded by the project. It will address itself particularly to questions of technology adaptation, institutional configuration and management practice as experience is gained and feedback from studies and research may suggest. The Committee will also review and approve schemes and activities proposed by the Cell.

2. Land and Water Development Cell

A Land and Water Development Cell will be established and directed by a Chief Project Officer, not below the rank of Additional Chief Engineer. The Chief Project Officer will serve as Member/Secretary of the State Level Implementing Committee. The details of this Cell are found in Annex III. Specialists in irrigation, forestry, land and water management, chak development, training and research and other staff support will be assigned. The Cell will provide technical and administrative staff support to the State Level Implementing Committee.

The Cell will have the following specific responsibilities:

i) preparation of guidelines, recommendations on new technologies, scheduling and other matters of overall project planning, coordination, monitoring, evaluation and quality control;

ii) review of scheme proposals as developed at the district and sub-district level;

iii) assistance in monitoring project implementation by:

- visiting scheme sites on a regular basis, reporting on progress and problems in implementation and suggesting remedial action;

- processing annual development and work plans for approval by the State Level Implementing Committee;

- reviewing seasonal technical reports on progress of different project components;

-compiling semi-annual progress reports on physical implementation for presentation to the State Level Implementing Committee;

- reviewing statements of expenditure, keeping accounts, forwarding reimbursement proposals to GOI, processing budget requests and reviewing annual statements of audited accounts;

- initiating, supporting and monitoring community-based management approaches; and

iv) assessment of training needs, development training plans, and coordination of the research, studies evaluation and technology adaptation programs.

As a condition precedent to disbursement, the State of Himachal Pradesh will issue formal orders for establishment of the State Level Implementing Committee, establish and create the necessary organization and staff positions for the Land and Water Development Cell, make adequate budget provision for both, submit initial (i.e. first year) plans for training, studies, research and evaluation and submit a staffing plan for project implementation.

B. Project Implementaion

An outline of the project cycle and responsibilities may be found at Annex IV. Operating responsibilities are as follows:

1. State Technical Departments

Implementing departments include Irrigation, a component of the larger Public Works Department; the Soil Conservation and Agricultural Extension Wings of the Agriculture Department; the Rural Development Department; the Department of Horticulture and the Forestry Department including its own Soil Conservation Wing. Collaborative relationships will be developed with state and all-India institutions including the Agricultural University, with campuses at Palampur and Solan, the polytechnic institutes in Sundarnagar and Hamirpur, and the Ministry of Irrigation at the Center.

Individual schemes and other project components under the jurisdiction of these departments and agencies will be planned and designed by scheme preparation units already in existence under the administrative control of the participating departments. They will receive guidance from the Land and Water Development Cell and will be reviewed for technical and financial soundness.

2. District Level Implementation

Heads of implementing departments and agencies will be responsible for coordinating development activities within their own districts. In addition, it will be necessry to ensure coordinated efforts to identify and resolve problems of implementation in each district. Interdepartmental coordination will be assured by organization of a District Level Project Committee headed by the Deputy District Commissioner and consisting of district heads of implementing departments and agencies. The Committee will facilitate training, study and research activities, and will assure that the directives of the State Level Implementing Committee and Land and Water Development Cell are adhered to, oversee scheme preparation, fix priorities within their district and coordinate project work with ongoing development activities.

3. Block Level Implementation

Success of the project depends on the efficacy and adherence to plans and schedules, involvement of localities in planning and implementation of project activities, and monitoring and follow-up. To ensure this, a Sub-Project Committee will be established and chaired by the senior officer of the head department in the block. It will include the Block Development Officer, local revenue and concerned project staff. Community and/or panchayat representatives may also be members. The Committee will agree on annual action plans and detailed work plans for each scheme. It will also help technical staff obtain locality participation in the execution and management of schemes. Annual work plans will include identification of areas for project action, a calendar of operations, and identification of opportunities for community-based participation.

4. Community Participation

Each scheme will usually cover more than one village panchayat. As schemes will affect cultivators across villages, agreement to resolve common issues will have to be arrived at by more than one panchayat, and user associations might also have to cross village lines. To incorporate cultivators' participation in planning, determining priorities, implementation of different activities, protection and maintenance of structures, and systems operations, the Sub-Project Committee will be responsible for maintaining contact with the cultivators and community. A desired or optional sequence might include:

i) discussion of proposed project activities with the cultivators of each village, explaining reasons for different components and the purpose of each. The formation of some form of user group might follow;

ii) explaining the role cultivators can play in making a success of each project component and deciding on priorities;

iii) preparation of an action plan based on agreed priorities;

iv) discussion of the action plan in each village and obtaining agreement on locations where project actions are to be carried out, extent of community participation required in execution, and community responsibility for protection of project works; and

v) provision of guidance to establish more formal user associations to assure equitable distribution of water and maintenance of irrigation structures.

5. Planning and Budgeting

The Departments of Irrigation and Agriculture are charged with development of the state's irrigation potential using both surface and ground water. Irrigation development is planned on a five year basis. This is annually reviewed and, if necessary, budgetary adjustments are made to meet Five Year Plan targets. Annual developmental programs of the Irrigation, Agricultural and the Rural Development Departments are reviewed by the state Planning Department and a final program is submitted to the GOI Planning Commission for approval. After approval of the overall state sectoral programs by the Planning Commission, the departments proceed with detailed workplans and implementation of the schemes. The state has submitted a comprehensive irrigation development program for the upcoming Seventh Five Year Plan (1985-90).

C. Project Implementation Schedule (First Two Years)

1. Pre-Implementation Phase:

- tentative selection of initial set of schemes for assistance under project
- GOI FY 1985 budget and VII Plan budget targets for project established
- establishment by AD of two soil survey units for detailed soil survey of schemes
- nominations for state, district, and subproject committees and Land and Water Development Cell
- staffing plan for the Land and Water Development Cell
- preparation of draft Project Implementation Letter (PIL)

2. Implementation Phase:

July-1984:

- GOI/USAID sign Project Agreement

Aug-Oct 1984:

- USAID issues PIL No. 1
- committees and Land and Water Development Cell established
- plans for training, studies, research and evaluation are developed
- conditions precedent to first loan disbursement met

Nov-Dec 1984:

- begin in-country training/workshops
- begin to develop scope of work for each of the field studies
- identification of long and short term U.S. training needs and technical assistance
- identify potential institutional groups within state and country for training, field studies, research and evaluation as appropriate

- terms of reference for development-cum-demonstration schemes

Jan-Mar 1985

- first annual work plans for training, field studies and research completed
- U.S. training commences
- guidelines for identifying chak development schemes on existing projects developed
- arrangements for liaison and coordination completed

Apr-June 1985

- field studies and research commence
- first set of schemes appraised

Jul-Sep 1985:

- pilot projects activities initiated

Oct-Dec 1985:

- first set of schemes, including chak development on existing schemes, approved by State Level Implementing Committee; construction commences
- subproject committees identified and appointed
- first annual evaluation (PES)

Apr-Jun 1986:

- user operation and management initiated on 20 schemes
- second set of schemes identified for planning and appraisal

D. Monitoring and Evaluation

An essential feature of the project will be the monitoring and evaluation of progress and impact. The proposed system should generate data with which to measure output, effects and impact of project actions thus providing management guidance to those responsible for project implementation and base line for in-depth studies of longer term effects brought about by the project.

1. Project Supervision and Monitoring

Monitoring is intended to ensure continuous gathering of information on project inputs and activities, and on conditions and complementary activities that are critical to the success of the project. It will utilize basic information prepared during scheme design and preparation and data generated by baseline surveys to be developed and continued throughout the project life. Monitoring will thus help both in alerting project management and policy makers to implementation problems requiring corrective action and also provide information for project evaluation.

Project activities will be monitored at three levels: first at the sub-project, then at district and ultimately the state level. Prior to preparation of an action plan for development of individual schemes, socio-economic data will be collected. It will be necessary for the Sub-Project Committees to assure that officers continue to collect data on a continuous basis on various project inputs and activities, and record physical and financial achievements.

Monitoring at the state level will be the responsibility of the Land and Water Development Cell and will include review of design criteria and of adherence of subprojects to those criteria; a comparative examination of small-scale irrigation and afforestation performance within the state; range and effectiveness of community engagement and participation; progress of training, institutional development and research programs; and recommendations on areas that should be intensively monitored and proposed changes in the monitoring system. The Cell will provide assistance to district and subproject committees in identifying and improving weak areas, and will collate monitoring reports of those committees and forward them with comments to the State Level Implementing Committee. The state will submit to USAID progress reports each June and December, giving details of staff positions, a summary of activities undertaken in the past six months, physical and financial targets achieved and problems encountered during project implementation.

2. USAID Monitoring Arrangements

By late in FY 1984, USAID's Office of Irrigation Management had under implementation the Irrigation Management and Training Project and five state-specific projects. To manage these projects and design future projects, USAID has assigned a staff of three U.S. direct hire, one Joint Career Corps appointee, six fulltime Indian professionals and two part-time Indian professionals. Of the total planned staff of twelve professionals (one full-time Indian PSC yet to be recruited), five will be project officers and seven will form a technical resource pool available to assist in the implementation and monitoring of all six projects. The Irrigation Management and Training Project is managed by a U.S. direct hire with assistance from four

individuals from the resource pool. Each of the state-specific projects is managed by an Indian employee. Training, special studies and pilot activities are common to all the projects. To ensure maximum coordination, one Indian employee has been given the responsibility for training under the Irrigation Management and Training Project and will coordinate those activities with the training in the state-specific projects. Similarly, a staff member has been given the responsibility for action research and special studies under the Irrigation Management and Training project and will coordinate the similar activities under state specific projects. The Office of Irrigation Management has, or has immediate access to, technical expertise in the areas of irrigation management, on-farm development, community management, extension, training, irrigation engineering and construction quality-control. Expertise in economics, contracting, procurement and voucher processing is available in other USAID offices.

USAID/India has designated a Project Officer who will be responsible for the overall management and implementation of this project. He will be assisted by Mission staff as required and by a Project Committee with representatives of all relevant USAID offices.

Grant funds have also been budgeted for coordination and liaison functions for the project. The funds can be used to provide technical guidance and management and oversight for training, special studies and action research and pilot studies. Any technical assistance deemed necessary by the head of the Project Cell can be provided through contracts with suitable individuals on institutions with preference first for institutions in HP, secondly in India generally and thirdly outside India. A total of 84 work months of expatriate technical assistance and 270 work months of Indian expertise are budgeted under this project, although actual usage will depend on precise needs which will be determined in consultation with GOI and H.P. government.

3. Potential Problem Areas:

The following problem areas for intensive monitoring by the mission were identified during project development based on review of state organizational capabilities:

a. delays in establishing Committees and Cell:

Intensive monitoring is planned during the initial stages of the project to insure establishment of the different level committees and Project Cell. Establishment of these committees and the project cell will be included in the Project Agreement as a condition precedent, and monthly visits to Simla will be made during the first year to monitor this and other key sets of activities.

b. delays in finalizing training plans; identifying appropriate institutions to conduct training; designation of suitable candidates to be trained; delays in finalizing scopes of work for analysis, review, field studies and research and/or arrangements to conduct same:

The training of field staff has been identified as a critical project input. Similarly, the proposed studies and research will be utilized for improving, plans designs, operations and management of proposed schemes. Monitoring of these activities on a day-to-day basis will be undertaken by the project cell, supplemented by periodic visits of USAID staff to Simla and various project sites.

USAID and the Project Cell will monitor each study and, upon completion, USAID and the state will evaluate recommendations and findings. Most studies will begin in the first year and will be completed by the third year.

c. inadequate ID/AD/RD Department budget allocations for timely initiation and completion of project schemes and activities:

Construction activities under the project will only fully commence during the second year of project implementation. The first two years will be mainly devoted to carrying out training, field studies and pilot work funded under the grant. This sequencing will assist the state in substantiating budget requests and should ensure funding availability during the Seventh Plan period. As a covenant, the GOI/GOHP will assure budgetary adequacy during the project life.

d. inadequate supervision and adherence to specifications, poor quality control:

The state, fully recognising the significance of this potential problem, will establish quality control units under the Chief Project Officer of the proposed Project Cell. Staff of the quality control units will visit selected schemes on a regular basis to assess status and initiate corrective measures, if needed, with primary attention focused on the lower end of the irrigation systems. These quality control units will be independent of the sub-project units actually implementing individual schemes.

Training workshops are proposed for field construction units with the objective of improving construction quality and adherence to proper specifications. It is intended that the quality control units will take an activist approach to improving quality and assisting the field staff rather than an inspector's role. USAID will devote a major portion of estimated monitoring time and budget in assuring quality construction. During each site visit the quality control units will be contacted and test results reviewed. In addition,

USAID will monitor training and institutional development activities and participate, where appropriate.

There could be up to 150 schemes 50 hectares and above and approximately 1,800 very small schemes averaging 5 ha. Thus almost 2,000 sites will be developed during the project. USAID staff will endeavor to visit each of the main sites at least once during the project life. In addition, at least ten percent of the very small schemes will be visited on a sample basis. The full-time project officer will schedule one trip to the state each month, although during the first year of the project, there will be no construction to inspect. During the remaining six years the project officer will make approximately 72 visits to the state and will visit an average of two sites per visit. In addition, other staff members of the Office of Irrigation Management will visit project sites; approximately 100 visits will be made by this staff over the life of the project. Visits will average five days including travel time, and each will cover an average of two project sites. The Mission will also engage a local engineering firm on a task order basis to supplement monitoring where necessary. The percentage of coverage will be higher in the initial years because fewer sites will be active. Fuller coverage is critical at the beginning, however, to assure that new criteria are applied, new practices followed and interaction with communities occurring as expected.

e. <u>inadequate training; transfer of participants who have completed project financed training from project activities to other unrelated assignments</u>:

USAID staff will monitor in-country training through selective visits. The USAID project officer may attend some of the sessions and workshops, and USAID staff will participate periodically as technical resource persons. In addition, a system will be established by the Project Cell for assisting the State Level Implementing Committee to monitor the location and utilization of trained participants. Each new training activity will be monitored by irrigation staff during its initial session. Thereafter, spot checking will be done on a random basis.

f. <u>lack of coordination among participating departments below the outlets</u>:

This problem has already been anticipated by the state. To help ensure smooth implementation of the schemes, the state has established three tiers of coordinating committees: State Level Implementing Committee, District Level Committees and Sub-Project Committees. These committees will ensure proper coordination and assignment of agency responsibility, allocation of adequate yearly budgets, timely appraisal and approval of schemes and carefully review of implementation progress. The Project Cell will assure timely appraisal and approval of schemes by the State Level Implementing Committee.

The project will be monitored to assure timely availability of budget provisions for project operations.

4. USAID Monitoring Schedule

July-Sep 84		Work Days
Monthly visits by project officer @ 5 days		15
Delhi staff time		30
Subtotal in work weeks	9	
Oct-Sep 84/5		
Monthly visits to Simla @ 3 days		36
Site vists: 7 @ 5 days		35
Observation of in-country training		40
Special studies review and recommendations		10
Delhi staff time		100
Subtotal Work Weeks	44	
Oct-Sep 85/6		
Quarterly visits to Simla @ 3 days		12
Site visits: 12 @ 5 days		60
Observation in-country training		20
Special studies review and recommendations		15
Delhi staff time		100
Subtotal work weeks	41	
Oct-Sep 86/7		
Quarterly visits to Simla @ 3 days		12
Site visits: 12 @ 5 days		60
Observation of in-country training		10
Special studies review and recommendations		15
Delhi staff time		100
Subtotal work weeks	40	

5. Evaluation

Evaluation contemplates continual analysis during project implementation of project outputs, effects and overall developmental impact. It will provide project management and policy makers with analytical support to enable assessment of and, if required, adjustment to policies, objectives, institutional arrangements and resources affecting project implementation. Evaluation studies will also provide feedback for preparation of new schemes and consideration of a follow-on project. Three kinds of evaluations will be undertaken during the project: (i) ongoing evaluation, (ii) a mid-term review, and (iii) final evaluation.

a. ongoing evaluation will cover two main aspects: technical and behavioral evaluation. Technical evaluation will involve an examination of progress in meeting project objectives and of the modification necessary to the design criteria, design principles or scheme models applied in project implementation. Behavioral evaluation will be primarily concerned with cultivators' and community responses to and perceptions of scheme development and their direct role. The data collected will provide an additional dimension to the information gathered under the monitoring system. The areas covered by the evaluation will include the success of community participation efforts in systems planning and management. Both technical and behavioral evaluation will lead to analyses, review and field studies which will be short-term in nature covering a period of not more than three months) on subjects directly related to project design and performance. An evaluation plan for the first year will be required as a condition precedent in the Project Agreement.

b. mid-term review. Given the innovative nature of the project, it has been agreed that a mid-term review of the project will be undertaken by a joint team from the GOI, Himachal Pradesh and USAID within the first quarter after the completion of the third project year. This exercise will be in the nature of a re-design, wherein project principles, design, allocation of funds, staffing patterns and components will be re-assessed in the light of performance. This could result in substantial modifications to the project and approach originally approved. It could also support the development of a Hill Areas II project.

c. final evaluation. In addition, a final end-of-project-status evaluation will be conducted by a team of consultants jointly selected by A.I.D., the GOHP and the GOI. Project outputs will be measured using institutional and baseline data. The achievement of project purpose will be assessed based on verifiable indicators and interviews with state officials, community groups and individual farmers.

IV. Summary Project Analyses

A. Institutional Analysis

1. Participating Agencies

a) Irrigation Department (ID) is a part of a larger Public Works Department (PWD) whose other major wing is Buildings and Roads (B&R). ID was broken out as a separate entity in 1974. At present ID has six independent circles, with the four remaining still combined with B&R. It is expected that these remaining circles will be separated out shortly.

The FY 83-84 budget for irrigation was $6.28 million. The ID is headed by a Chief Engineer (CE) who has staff responsibility for both domestic water supply and minor irrigation. He is assisted by ten Superintending Engineers, six of whom have independent implementing responsibilities in each of six circles. One Superintending Engineer coordinates planning and design at the state level. These officers are supported by a field staff structure down to districts and blocks.

The ID focuses its investment attention on construction of new flow irrigation systems and their operation and maintenance to the outlet, primarily minor schemes but including several medium; construction and operating lift schemes; and, until recently, the remodeling of community and public kuhls with subsequent management responsibility. Until ID is autonomously organized there will be little incentive for engineering staff to specialize in technical irrigation, to be concerned with matters of systems operation or the interface of the systems with communities and the agricultural regime. The establishment of the Land and Water Development Cell is a positive step in this regard.

b) Soil Conservation Wing of the Agriculture Department (SC/AD) was separated from Forestry in 1983. It has a tradition of working with both individual farmers and community groups. It was a major participant in the Indo-German Agricultural Project and has developed considerable experience with small-scale irrigation and water management. The SC/AD currently focuses on the following irrigation activities: installing groundwater systems, water harvesting facilities (i.e. collection tanks, check dams, etc), and assisting cultivators to develop watercourses and field chnnels to distribute water from minor canals to individual farms. In addition, SC/AD has responsibility for conservation throughout the state. In FY 1983/84, SC/AD was allocated $1.0 million for irrigation.

In addition to the Soil Conservation Wing, the Agriculture Department has an active program of extension activities carried out through subject matter specialists at the district level and

Extension Officers at the block level in the 69 development blocks in the state.

c) Rural Development Department (RD) grew out of earlier community development programs. It is strongly oriented to work at the block level and undertakes many activities with local panchayats. The RD is involved with minor repairs to community kuhls, loans to small and marginal farmers (some for irrigation) and new flow systems in particularly backward areas of the state.

Budget availabilities are modest, but community contributions are usually required and work is generally with very small and technically simple systems. The RD is headed at the state level by a Director-cum-Joint Secretary. At the district level, there is a Rural Development Agency with the Deputy Comissioner as Chairman. Besides repair of kuhls and small water supply schemes, the Rural Development Department has responsibility for a number of other programs involving training, rural employment and nutrition. Irrigation works and other activities involving physical infrastructure, repair or construction are implemented by a corps of engineers headed by an Executive Engineer at state level, twelve Assistant Engineers at the district level and Junior Engineers at each of the state's 69 blocks. The staff members have comparable training to the same level as engineers in the ID.

d) Forestry Department including Soil Conservation (Forestry). The Forestry Department, including Soil Conservation (Forestry), is responsible for managing much of the watershed that supports irrigation. The Forest Department is organized under the Chief Conservator of Forests, who is assisted by ten Conservators of Forests and 37 Deputy Conservators. Conservators of Forests have responsibility for scientific management of forests including exploitation, plantations and protection and construction of forest roads and maintenance of depots. Deputy Conservators have responsibility for management of forest business, financing and operations within the working plans of the Chief Conservator of Forests and Forest Conservators. Range management on specific ranges is under the charge of a Forest Ranger assisted by professional field staff.

The Soil Conservation Department in the Department of Forestry is concerned primarily with protection of watersheds through reforestation and engineering works. The department is headed by a Director with a Deputy officer for watershed management and planning, an Executive Engineer, a hydrologist and two Chief Foresters. Officers trained in forestry are given specialized soil conservation training at training and research institutes maintained by the Indian Council of Agricultural Research.

e) Department of Horticulture. Because of the importance of horticulture products in the state, there is a separate Department of Horticulture. Few of the important horticultural crops grown in the middle hills region now depend upon irrigation. The Department of Horticulture believes that much of the potential for future growth lies with the production of certain tropical fruits in the lower hills region where rainfall is lower. State officials see a greater interaction between irrigation development and horticulture producton in the future and recognize the need for greater interaction among the other concerned departments.

The Department maintains offices in all twelve districts in the state. There are senior subject matter specialists at the directorate level in Simla. For administration of the extension program, the state is divided into two zones. The subtropical zone is administered by an Additional Director of Horticulture. In addition to his overall responsibilities, the Director also administers the temperate zone. There are three deputy directors with headquarters in Una, Kulu and Simla. At the district level, a District Horticultural Officer is responsible for extension and, in most districts, a Horticultural Development Officer is responsible for management of departmental orchards. Horticultural Inspectors are available at the block level. At the community level, the extension program is implemented by a village level worker who is a functionary of the Rural Development Department.

f) Civil Administration. For purposes of civil administration, the state is divided into twelve districts. These are further subdivided into tehsils, and in some cases, sub-tehsils. The Chief Secretary has overall reponsibility for civil administration. Deputy Commissioners are responsible at the district level. They are responsible to Divisional Commissioners who are in turn responsible to the Chief Secretary. Deputy Commissioners are assisted by an Additional District Magistrate and General Assistant.

Development programs are carried out through 69 development blocks. At the district level, the Deputy Commissioner chairs a Rural Development Agency which is responsible for these programs. The Deputy Commissioner is assisted by an Additional District Magistrate (Development), Project Officer, Assistant Engineer (Development), Lady Circle Supervisor in charge of women's programs and Block Development Officer. The governing body lays out programs for the district within the framework of guidelines issued by the state. At the block level, programs are implemented through the Block Development Officers.

2. Aspects of Institutional Performance

The word "institution" is used herein to refer to both specific organizations and to broad policies, rules, formal laws or

conventions for taking action. Particular attention in project design was given to four key institutional aspects of irrigation performance:

-- improved procedures and criteria for planning, design and construction of irrigation systems to meet the needs of a changing agriculure;

-- increased attention to systems operation and management, including water distribution, application and utilization;

-- increased beneficiary involvement in project planning, implementation and subsequent management, including mobilization of local knowledge, experience and resources;

-- greater mobilization of non-governmental resources.

a) Design

The need to improve design and efficiency of irrigation systems is apparent. The reasons for low efficiencies include absence of controled distribution, absence of relationship between water availability and crop requirements, and, in Himachal Pradesh, absence of defined standards for water application at the farm level. On specific systems, reasons for difficulties may not always be fully evident, thus a systematic approach to diagnosis is important. Systems difficulties can be remedied on new schemes through improved planning and design criteria (See Annex II). These design criteria will reverse the process, emphasizing a bottoms-up approach (i.e. introduction of soil and topographic analyses, hydrology and consderation of soil-water-plant relationships, in addition to the introduction of control and regulatory structures).

b) System Operations

On most irrigation systems, the distribution of water is permissive and offers enormous scope for improvement. Very often water is allowed to flow continuously without rotation. Head reaches often receive too much water and tailenders too little, if any at all. The delivery of water is often unreliable, untimely, and not known about by cultivators in advance. Nearly all irrigation activities in the state are aimed at building new irrigation works or repairing existing ones. This is true of both ID and RD and largely true of the work of SC/AD under its water harvesting schemes, although in SC/AD's work of assisting individual farmers to install irrigation facilities, more attention is given to how the farmer uses water for agricultural production. There is, then, much scope for improved system operations.

There is concern in the state about low water utilization, and there is new commitment to chak development. In short, there is growing interest in system management and better use of irrigation facilities. Superintending Engineers have even been told to start putting provision in their budget requests for irrigation management schemes. These moves are in the right direction and will be encouraged by the project (e.g., planning and construction of improved schemes, emphasis on chak development below-the-outlet and the engagement of communities supported by training and special studies leading to an improved institutional capacity to plan, implement, maintain and operate more effective small-scale irrigation systems).

c) Community Participation

The irrigation builders of Himachal Pradesh traditionally have been the rural communities themselves. Even now, their achievements in irrigation still exceed those of the various state agencies. Nevertheless, their status and future in the present institutional setup is not defined. With the exception of the responsibility of cultivator groups for developing and operating field channels at the chak level, there is no explicit state policy regarding the role of cultivators or the community in irrigation development. Thus, there are few programs in place to support communities in implementing their own irrigation development activities. In contrast, there are agency programs that do it for them.

A dialogue has been initiated within the state on the appropriate mix of state and locality responsibilities for creating and sustaining small scale irrigation systems. Clearly, neither cultivators nor the state can do the job alone; each has resources which the other lacks. Communities periodically require the large financial inputs that governments can mobilize, the advanced technical knowledge that professional staff may have, or the initiative a state agency can take in resolving community deadlocks and inertia. Equally important is the role state agencies can play in assuring the ecological stability of the hill areas. Review, evaluation and modification of the state-locality mix is a basic design principle for this project.

Perhaps the most significant way to develop capability and test effectiveness of community operation and management of irrigation systems will be comparative analysis and review of community and departmental activity throughout the state. Quality work here, and effective feedback, could pay high dividends. Of course, the proposed disbursement procedures also serve to reinforce the agreed design principles.

d) Resource Mobilization

The advantages of increased mobilization of local resources in irrigation development and operations are obvious in a

resource-short situation. However, the state may not have capitalized on opportunities to do this. Cultivators who receive economic benefits from reliable, well-run irrigation systems should be prepared to pay for them.

The complex relationship between the state and its localities (in this case, with regard to irrigation costs and investments) obviously reflect social choice and professional practice. The patterns of irrigation investment are unlikely to be greatly modified during the life of the project, but the goals and process of modification can be put firmly into place. It is agreed, as a design principle, to seek to engage cultivators and the community in the management of systems (particularly in operations and maintenance). If successful, the implications for recurrent costs are important. It is agreed to introduce the AD cost-sharing principle to land development activities (i.e. state beneficiary recovery over ten years, with two-year grace, and including center contribution under the GOI Soil Conservation Act). It is agreed to consider increases in water charges and other assessments, and for that purpose a committee has already been established. It is agreed that no community irrigation works or chak development on community systems financed under the project will be transferred to the state, except under extraordinary circumstances.

3. Institutional Development

a) Consolidation

As already noted, responsibility for parts of the irrigation development and support process is scattered across several agencies, but is the primary responsibility of none of them. The result is that each of the departments can only implement a part of the total irrigation task and each lacks some required skills, some that are found in other units such as engineering expertise, agricultural skills or the capacity to strengthen community groups.

For each of these departments to acquire a full complement of staff needed to develop irrigation skills seems unrealistic and costly. Expecting a quick shift in the existing pattern with one group assuming comprehensive responsibility seems equally unrealistic. Nevertheless, experience suggests that irrigation development proceeds best when one strong agency is able to enlarge its staff capacities (including engineering, agricultural and social science professionals) so that it can operate in an interdisciplinary mode equipped to work on planning and implementing both the construction and institutional parts of the task.

Thus, in Himachal Pradesh, a strategy for institutional development should be concerned with concentrating irrigation development capacity in a specialized agency in the long run while continuing to support the irrigation activities of both SC/AD and RD and

other action research and training institutions dealing with irrigation matters in the short run. The organization of the Land and Water Development Cell is an important first step.

Inclusion of research and training in the project builds on the assumption that not all factors constraining irrigation development nor the corrective actions required are yet understood. There is, therefore, need for monitoring and evaluation of past performance and outcomes as well as designing and testing innovative strategies for irrigation development through field-based studies and action research. Typically, implementing agencies, although, they have the mandate, do not have the capacity systematically to inquire and innovate. Thus, expanding the reach of irrigation-related institutions to include research and training adds this capacity for flexibility and adaptability. These efforts will be an important part of the project and they suggest significant roles for the Agricultural University and the polytechnic institutes.

b) Training

Special staff development and training programs will be organized for personnel drawn from the various state departments included in project implementation. In general, staff development and training will be directed toward improving knowledge and skills to plan and design irrigation facilities, manage and operate irrigation systems, understand and analyze irrigation systems in an integrated manner and involve and work with cultivators and community groups. Only persons qualified and experienced in irrigation management and development who will continue to work on these activities shall be deputed for training. The some principle shall apply to other departments as well.

Particular attention will be given to improving the technical knowledge of the engineering field staff on irrigation system design and management. Most of this training can be done in Himachal Pradesh, including various short courses that may be organized through the agencies themselves, the Agricultural University, or one or both of the polytechnic institutes. More advanced training in specialized irrigation topics as required can be provided through all-India programs or those of several U.S. universities. Training that gives emphasis to the integrated nature of irrigation systems and to issues of irrigation system management also will be organized for staff in Himachal Pradesh. Other related programs may be offered in-country or in appropriate U.S. universities.

Workshops and seminars to review and explore the issue of community participation and formation of cultivators groups will be organized to draw on experiences with traditional irrigation systems in Himachal Pradesh, experiences elsewhere in India, other parts of Asia, and the U.S. Appropriate study tours may be organized to ob-

serve selected programs in action such as community irrigation programs in other parts of South Asia. Training activities for leaders and members of community water user associations will also be organized. Major responsibility for this training will be with the Agriculture Department which has long experience with cultivator organization and participation.

Because of the difficulties of releasing personnel for long-term instruction and the need to proceed expeditiously with implementing new project criteria and methodologies, initial one or two week workshops will address these particular concerns. There is need for more formal basic training on such topics as chak development, irrigation water management, including soil-plant-water relationships and integrated project planning. This could be accomplished through longer-term (6-10 months) training such as that provided at the Water and Land Management Institutes located in various states. Tentatively, project strategy is to meet these needs using training periods of from six weeks to two months. For irrigation management, U.S. assistance can be provided if necessary to train trainers and an indigenous institution such as Himachal Pradesh agricultural university can provide resident courses on integrated project planning and management. A condition precedent prior to project disbursement is submission of training plan for the first year. Following is a summary, taken from Volume II of items tentatively identified as desirable for inclusion in the in-country professional development activity:

<u>In-Country</u>

- Initial Subproject Design and Implementation (Ch. III, Section B6), 4 Workshops - 2 weeks each - 20 trainees each;

- Conveyance and Distribution Systems including Closed Systems (Ch. III, Section F), 2 Workshops - 2 weeks each - 20 trainees each;

- Planning and Design of Lift Facilities (Ch. III, Section F), 6 Workshops - 1 week each - 20 trainees each;

- Hydrology, Water Requirements, Water Budget (Ch. III, Section E1, F3), 3 Workshops - 1 week each - 20 trainees each;

- Planning and Design of Water Harvesting Schemes, (Ch. III, Section F), 3 Workshops - 2 weeks each - 15 trainees each;

- Chak Development (Ch. III, Section F2), 8 Workshops - 3 weeks each - 24 trainees each;

- Watershed Treatment and Maintenance (Ch. II, Section D), 3 Workshops - 2 weeks each - 15 trainees each;

- Operation and Maintenance of LIS and FIS (Ch. III, Section F3), 6 Workshops - 1 week each - 20 trainees each;

- Small Watershed Hydrology (Ch. III, Section F1), 5 Workshops - 2 weeks each - 20 trainees each;

- Quality Control (Ch. III, Section F), 10 Workshops - 1 week each - 20 trainees each;

- User Organization, Participation and Social Analysis (Ch. VII, Section B2c), 10 Workshops - 2 weeks each - 20 trainees each;

- Irrigation Water Management (Ch. III, Section F2, 3)

  - Training of Trainers
    1 Session - 6 weeks - 25 trainers

  - Training of Trainees
    8 Sessions - 4 weeks each - 25 trainees

- Integrated Project Planning and Management (Ch. VII, Section B2k);

- Courses at Indian Institute of Management, Ahmedabad
  9 weeks - 20 trainees
  1 week - 25 trainees

- Economic Analysis (Ch. VI), 1 Workshop - 2 weeks - 20 persons;

- High Lift Systems, 1 Workshop - 1 week - 20 trainees;

- Postgraduate Training in Irrigation and Water Resources Planning and Development, 3 trainees - 18 months each;

- Diagnostic Analysis of each of the three types of Irrigation Systems (Ch. VII, Section B2c), 3 Sessions - 6 weeks - 25 trainees each.

- Leadership Training for User Groups. To be developed under action research activity, Section B2ai-1.

Illustrative U.S. or International Training: Provision has been made in the grant budget for limited training in the U.S. These courses will normally be from six weeks to two months in length. They will be in selected specialty areas using organized international courses already available insofar as possible. Some study tours will be organized for senior officers also. For budgeting purposes, the following have been tentatively identified (number refers to the same numbered item in the in-country training program above):

- Hydrology, Water Requirements, Water Budget, 1 trainee - 6 weeks;

- Chak Development, 4 trainees - 6 weeks each in Irrigation Water Management;

- Small Watershed Hydrology, 2 trainees - 4 months each;

- User Organization, Participation and Social Analysis Observation Visits in Asia, 12 persons - 1 months each;

- Irrigation Water Management, 8 trainees - 6 weeks each;

- Integrated Project Planning, 10 persons - 4 weeks each;

- Senior Level Observation Tour, 5 persons - 5 weeks.

Some U.S. training has also been provided for support of field and pilot studies, tentatively estimated as follows:

- Action Research on Conveyance, Distribution and Utilization, 2 trainees - 2 months each;

- New Irrigation Technology, 2 trainees - 2 months each.

Agricultural Extension: By support of new staff costs and training, the capacity of the Agricultural Extension Service to provide better information to individual farmers and farm organizations about rotational water supply, operation and management of field channels, water application and water crop requirements and increased production under irrigated agriculture will be enhanced. The exact lines along which this will be accomplished have not been decided but will be developed during Project implementation. AID loan funds in the amount of $2 million have been budgeted for this activity. Grant funds may be used to support short-term training in-country. The program will need to be coordinated with other workshops as described above under In-Country Training.

c) Analyses, Review and Field Studies

Three broad types of analyses, review and field studies will be implemented during the project. These will include basic soils, agronomic, irrigation management and institutional analyses. To identify, plan, and implement this work, a set of resource institutions will work closely with the project implementing agencies and the Land and Water Development Cell.

Field studies are also basic to the institutional objectives of the project. Illustrative topics, outlined in Volume, II include the following:

- Small Watershed Hydrology (Ch. III, Section C1a);
- Integrated Action Research on Conveyance, Distribution and Utilization (Ch. III, Section E1; Ch. VII, Section B2b(i);
- Crop Water Requirements (Ch. III, Section E1);
- Soil Survey Unit (Ch. II, Section E1);
- Crops Research (Ch. II, Section E2);
- Action Research on User Participation/Social Aspects (Ch. VII, Section B2b(i):
- Water Scheduling and Distribution;
- Farmer Involvement in Kuhl Management;
- Nature and Level of Farmer Participation;
- Pump Groups for Small and Marginal Farmers;
- Alternative Forms of Water User Organizations;

  Involvement of Women in Irrigation Activities (Ch. IV, Section D);
- Socio-Economic Baseline Studies (Ch. IV, Section D1); and
- Environmental Monitoring (Ch. V, Section D).

In addition to these field studies, there is need for data to be collected through analyses and review. For agronomy and water management, these include developing soil survey capability and utilization information, ponding and flow effects on rice yields, improved varieties of crops for hill areas, small watershed hydrology and estimating crop water requirements. There is also a need for environmental monitoring. In the socio-economic area, a number of issues requiring special review are likely to arise during the course of the project. Two can be identified now as of special importance. These are:

> integrated studies of a range of traditional kuhl systems which are still operated and managed by community groups themselves. The kuhls selected for study should include a range of types, perhaps different physical apparatus, cropping patterns, etc. Needed are socio-technical studies that collect information

on the engineering principles and structures being used, the agricultural production patterns that are supported by the system and the organizational arrangements that exist for implementing key system processes such as water distribution, system maintenance and conflict resolution.

- socio-economic studies of selected irrigation schemes that provide detailed information on land ownership and tenancy in the command area, investigate the total farming system being operated by cultivators, both within and outside the command area and including both horticulture and animal husbandry. These studies should examine who benefits from irrigation development and through what mechanisms these benefits flow.

4. Toward an Institutional Strategy

Experience with institutional development elsewhere, including limited experience with the irrigation sector, and the guidelines presented in A.I.D.'s recent document on institutional development, suggest several general elements of an institutional development strategy. Two points made in the A.I.D. Policy Paper seem especially relevant in the case of Himachal Pradesh. One is the reminder to consider the appropriate mix of government and community roles, a matter illustrated by the very premise of this project to reexamine the respective roles of the irrigation agencies and the water user groups or localities. The second highly relevant point is the idea that institutional development should encourage the emergence of organizations that are flexible and adaptable to the environments in which they are operating. To achieve this, stronger capacities are required, including effective information handling systems, strong analytic capacities and closer linkages to community and user groups. The human resource and institutional development component of this project are directly relevant.

B. Social Soundness Analysis

1. Panchayat Administration

The three tier panchayati raj system operates with slight modifications to suit local needs. At the lower level is the gram panchayat, a committee of seven to eleven members elected by the gram sabha (village assembly), a body comprising the adult members of a group of villages. At the next level is the panchayat samiti which covers a development block and comprises 20 members elected by constituent gram panchayats. At the district level is a district development council comprising one elected member from each panchayat samiti, chairmen of constituent panchayat samitis, local members of the Lok and Rajya Sabhas, local members of the state legislature and the Deputy Comissioner of the district.

The responsibilities of a gram panchayat cover health, water, agriculture, forestry and communications. In addition, the state can transfer to it the management and maintenance of forest and government waste lands within and near the boundaries of its jurisdiction; the protection of any irrigation works and the extension and regulation of the distribution of water from those works. The income of a gram panchayat derives from grants, donations, income from common lands and 20 percent of the total amount of the land revenue collected in its jurisdiction. In addition, gram panchayats can raise funds through levying of fees and taxes.

The functions of a panchayat samiti are somewhat wider and cover agriculture (including forestry, animal husbandry, and fisheries), health and rural sanitation, communications, social education and cooperation. In addition, samitis are entrusted with the supervision and control of constituent gram panchayats to whom they can also delegate any matter which is under the direct administrative control of the samiti. Sources of operating funds are the same as those of a gram panchayat.

The zilla parishad (district development council) functions mainly as an examining, advisory and coordinating body. Its sources of funds are similar to those of a gram panchayat, but it can also levy contributions from constituent samitis with prior government approval.

The state assists and supervises panchayats through the provision of staff, funds and audits. The staffing pattern is the same for every block and does not take into accout variations in population, differences in topography or distances between villages. At the district level, the Deputy Commissioner supervises all panchayats, and is also an appellate authority. He is assisted by the District Development and Panchayat Officer (DDPO) who is the ex-officio secretary of the district development council. At a lower level is the Subdivisional Magistrate (SOM) who is in charge of a Block, the lowest administrative unit and covering a number of villages. The Block Development Officer is also the Executive Officer and ex-officio Secretary of the panchayat samiti and is assisted by a number of lower level functionaries who act as subject matter specialists.

2. Need for Community Organization:

Irrigation development requires attention not only to technology but also to organization. Past studies have shown a clear relationship between beneficiary participation and beneficiary organization. Only when local people are organized are they able regularly and productively to participate in agency supported activities. Thus, the lack of beneficiary participation in most irrigation development activities in Himachal Pradesh is not surprising since only the most rudimentary efforts have been made so far by concerned agencies to assist in group formation. None of the three agencies, at present,

is equipped to deal with this organizational dimension. As such it represents a significant constraint to future irrigation development and management. In the case of community kuhls, attention to local organization of water users could reduce the need for government management (though not necessarily the total need for state aid). Attention to appropriate local organization could also significantly enhance the payoff of state investments currently under way. For example, when kuhl remodeling is planned to create new command area, careful pre-project involvement of the old and new beneficiaries is necessary to bring irrigation water efficiency to the command area.

Of course, the need for water user organization is not limited to flow schemes. A lift scheme serving a group of farmers is complicated to manage especially if water-users are not organized to articulate their individual demands, coordinate their cropping patterns and allocate water from outlets. The agencies implementing irrigation projects in Himachal Pradesh could improve their capability to deal with problems of poor water utilization and irrigation management through community-based strategies. They need both a clear policy mandate and the adequate staff.

In addition to assistance to community kuhls, preliminary thinking of ID about the use of water rotation procedures further illustrates the need for preparation in the use of community-based strategies. In northern India, the commonly used system of water distribution is known as warabandi. Warabandi basically uses a roster of turns to rotate the stream of water from the outlet among the farmers in a chak. Based on proportionate land holdings in the chak, each operator is assigned a specified period of time when he has the right to draw water from the public outlet. At present there is considerable interest in India in applying the warabandi method.

Evidence from elsewhere in India and other countries suggests that implementing a successful system of rotational supply, such as warabandi, requires the following conditions:

-- water scarcity;

-- appropriate physical facilities to carry water to the designated rotation units;

-- a well managed system that ensures reliable water supplies to the point of rotation; and

-- some form of social control among those who share in the rotation.

The ID is considering applying warabandi in the irrigation systems as a possible solution to water utilization problems. However, ID needs to broaden its approach, drawing on the right of the

government to establish an irrigation record as provided in the Minor Canals Act, towards providing incentives for effective community organizations.

Though user participation in planning and management of public schemes is limited, cultivators participate in initiating irrigation scheme requests and in selection of schemes. Most initiatives begin with representations from local people to their elected representatives or directly to the technical agencies. ID projects are identified initially in this manner. Following examination for feasibility, schemes actually submitted for budget approval are the subset of the locally requested projects judged by the department as being technically and economically feasible. For RD schemes, priorities are fixed by the panchayat samiti at block level in response to requests coming through various panchayats.

ID also has nearly completed a master plan for minor irrigation. The planning unit is the tehsil (sub-district). Water sources are selected in consultation with local water users in the area. The extent of local participation in planning is not clear. Master plans have been completed for 49 of 54 tehsils. Relevant experiences in other state subsectors may provide a useful basis for testing various approaches to more cultivator involvement in irrigation activities. One of these experiences is a successful program of the Horticulture Department for the establishment of packing house co- operatives for fruit producers. These cooperatives have an advisory committee which includes several farmer members.

A second experience with community participation comes from the Indo-German Dhaula Dhar Project. This project is concerned with the protection of hill lands and watersheds in the Kangra region. It explicitly endorses a community self-help approach and advocates the formation of community level self-help groups for implementation of various project activities. The project also has created a new village level role, the village motivator, who acts as a link between the community and the project staff.

3. Women in Development:

In general, the socio-cultural setting in India tends to keep women in the background (see recent Women in Development Mission Strategy). Very often their productive role in society is neither appreciated nor formally recognized. A more visible role for women is contemplated under the project which should, among other things enhance water user efficiency. In reality, women have long played a vital role in agriculture. Although the word "farmer" in the Indian language is a masculine word, in practice it is often women who are engaged in farming activities. In fact some agricultural activities such as transplanting, harvesting and weeding are done almost exclusively by women.

It has been observed that men and women show different attitudes towards cropping patterns. That is, men seem to prefer cash crops while women more often show a preference for subsistence crops. Thus, regarding the choice of crop to be sown, decisions have to be made jointly.

It has also been noted in field operations that women are generally more health-conscious. In irrigated areas, women have pointed out potential health hazards, such as more mosquitoes due to stagnant pools of water. As a result better drainage systems are often put in place.

A potentially important sociological factor is related to the practice of village exogamy, requiring a girl to be married outside the village. This practice results in each village having daughters-in-law drawn from other villages. These daughters-in-law bring along with them the knowledge of traditional water management systems and farming techniques practised in their natal villages. This might prove to be a useful social mechanism for disseminating new water management techniques as well. Similarly, wherever extension programs are introduced, female extension workers should be employed. This will facilitate outreach to village women because in the village situation, women-to-women communication is usually better.

Project funded base-line studies should have a women component and the data collected should be categorized by gender. The project, through field studies, will address the role of women both as water users for cultivation and for household requirements.

Membership in the water-user associations should be extended to women. The project will also include qualified women in its research and training programs. A target for women participants in all formal and informal training programs may be desirable. Provision of incentives and facilities to encourage women to participate in training workshops may be necesary.

Finally, the higher male migration rates out of hill areas often leaves women behind in the villages to look after the crops. Therefore, women's involvement in this project is even more important than in projects located in other areas of India. Another area in which women require special attention is private small scale enterprise. Women should be encouraged to grow vegetables and fruits and sell their products for profit.

In conclusion, project programs that affect the community, either as participants or as beneficiaries, should specifically include women as a target group. Initially, there may not be enthusiastic support for a more explicit female role from the irrigation authorities or male members of the community. Yet, persistent ef-

forts usually yield results. A.I.D. experience in Madhya Pradesh both in social forestry and irrigation have demonstrated positive results in this regard.

4. Benefit Incidence:

Given the small scale of irrigation schemes contemplated under this project and the prevailing land tenure pattern of the state, direct project benefits will accrue mainly to the rural poor. The scheme command area is likely to vary from a few hectares to a few hundred hectares. Since the median size farm is approximately one hectare, this implies involvement of roughly ten farm families per chak or one hundred families per scheme on average. Groups of this size tend to be more cohesive, especially when benefits are highly local and visible. The incentives for organization and benefit-sharing should lead to significant increases in small farmer productivity and corresponding incomes. The short gestation period of investment for each scheme means that project benefits will be observed directly during project life.

Secondary beneficiaries of the project will include irrigation staff who benefit from training and research programs. This could take two forms: a) greater institutional efficiency in irrigation investments and operations, and b) greater career mobility for irrigation staff associated with the project. Moreover, there will be indirect benefits accruing to the population as a whole through improved water use and watershed management. These benefits tend to represent "externalities" which impact in various ways on the quality of life and the sustainability of agricultural production. While difficult to quantify, they represent a real contribution to the welfare of the rural population.

The economic viability of the project was examined using discounted flow analysis drawn from a sample of eight proposed subprojects and seven existing projects. The eight subprojects, selected from a list of about 32, are representative of different types of irrigation works contemplated and operated by different departments of the state. The sample consisted of two lift irrigation schemes (LIS), two flow irrigation schemes (FIS) and one each of remodeling, tubewell, shallow well and water harvesting schemes. In addition, a sample of seven existing projects consisted of two LIS, one FIS, two pump schemes, one water harvesting scheme and one community kuhl. The economic methodology and project criteria results of sensitivity analysis testing key assumptions indicate that the project is economically viable (see Section D - Economic Analyses).

C. Technical Analysis

1. Types of Schemes

a. Flow Schemes

Much of the area presently irrigated by surface water is served by community kuhls diverted from various sources such as perennial rivers, small streams and springs. The command areas of these systems range in size from one or two up to several hundred hectares. The Irrigation Department builds, maintains and operates new kuhls, rehabilitates and, in some cases, operates systems. The existing community kuhls vary in present condition from reasonably good to poorly maintained and non-functioning.

Rehabilitation consists mainly of repairing breaches in the main channel along steep hillsides, lining the more obviously leaky portions of the kuhl or in some cases replacing certain lengths with a closed conduit. After rehabilitation, ID usually assigns a water master to supervise the water distribution within the command and to check for any maintenance or repair needs which are then taken care of by the department.

The main canals generally do not have structures at turnout locations and water can be diverted from them at almost any point simply by cutting the bank. Because most of the watercourse channels are located on ridges they usually follow slopes that result in excessive velocities and erosion of channels. The lack of turnout and grade stabilization structures is one of the serious deficiencies of the existing kuhls. Particularly for the larger perennial streams, there usually is no permanent diversion weir. Small loose rock diversions are placed in the streams for directing the water into the kuhls during low flows. This seems to be a satisfactory manner of handling the matter because the cost of a permanent structure designed to pass the flows during the monsoon would be prohibitive.

In general, little attention has been given to the distribution of water to the fields of cultivators, either for design and layout of the system or for its operation. The assumption has been that cultivators served by minor canal are responsible for developing the watercourses and field channels below-the-outlet required for distribution to each individual field, but this often has not happened. Most of the land served by the kuhls has been bench-terraced in small irregular parcels. Because there are very limited watercourses and field channels, field-to-field irrigation usually serves as both the conveyance and application system. This results in inequitable distribution, with those users nearer the outlet receiving full or excess irrigation while those further down suffer shortages or receive no water at all. Lack of water distribution facilities is one of the contributing factors to low water utilization in most commands.

b. Lift Schemes

i) surface water

There are numerous lift schemes in Himachal Pradesh in which water is pumped from perennial streams (khuds) and other water sources such as non-perennial streams (nullahs) to irrigate agricultural lands at higher elevations. Pumps for these schemes are most frequently powered by electricity. The state has an excess of electrical energy although supply is often at some distance from pumpsites. Lifts vary from a few meters up to about 100 meters. Because of rising stream levels during the monsoons, pumps at many installations have had to be removed during the rainy season. Small rock walls are often constructed to raise the river water level sufficiently to cover suction pipes of pumps during the dry season. This eliminates the possibility of using the scheme for supplemental irrigation during kharif.

ii) groundwater

Tubewells with electrically powered pumps provide irrigation water in a few alluvial valleys and low foothills. Vertical turbine pumps are preferred because they are more efficient, but when the alignment of the bore hole prevents the installation of a turbine pump, a submersible pump is often used. As on flow schemes, there is a serious lack of chak development including land preparation by leveling on construction of watercourses and field channels. Lack of chak development is one reason for low utilization of irrigation. Another important reason is that the water supply itself often is inadequate to fully irrigate the design potential. Estimated irrigable area is calculated using a standard "duty" rather than on water requirements based on the soils, crops, climate, and conveyance and application losses. A third reason for low utilization is that actual well yields are less than those estimated in design.

c. water harvesting

A typical water harvesting scheme involves construction of a masonry check wall or small earthen dam at a suitable location across a nullah to impound runoff water from the small watershed above the site and facilities to utilize the stored water for irrigation. Generally the cost of the storage component/check dam and appurtenances is borne by the AD, although land development costs are borne by the beneficiaries. The primary emphasis appears to be on the location and construction of the dam with no comprehensive planning for utilization of the developed water resources. At many sites, water is being used for irrigation of a few hectares of land by individual cultivators who on their own initiative purchase pumps. Diesel powered pumps are used when there is no nearby electrical power supply. Other types of water harvesting involve construction of concrete

storage tanks to hold small flows of water over several days until enough accumulates to irrigate some small areas. It is important to note the distinction between these water harvesting scheme, the AD approach and the larger ID schemes. These schemes often involve only a handful of cultivators with none of the complication of designing, or organizing or managing larger systems. In other words, the departmental approach used is not simply a matter of choice. Situations also define opportunities.

d. afforestation

Work in the watershed scheme areas will largely be confined to afforestation. Where gully formation is threatening productive agricultural land, villages, small towns, buildings or roads, construction of the appropriate anti-erosion structures will be undertaken. In areas where an effective vegetative cover can be established, minor erosion will be controlled by the planting of suitable plant species together with construction of small check-dams constructed from brush and other local but readily available material. In areas requiring larger protective works, detailed surveys will be undertaken to determine the location, size and type of each structure. Such structures will take the form of check dams (using both drop structures and constructed drainage).

e. horticulture

There are substantial numbers of fruit trees (mainly pear) growing wild on common land and in reserved forest areas. In many places such groves are to be found growing in compact blocks. In such areas, which are often located near villages, "top working" is done through grafting with improved varieties by staff of the Horticultural Department. Wherever necessary, gap filling is carried out to ensure economic stands. Wild fruit species need little care and maintenance as they are well adapted to ecological conditions, very hardy and drought resistant. The panchayats collect and market the produce from such orchards.

Privately owned land near villages, which is normally marginally suitable for growing cereal crops, can be converted into fruit orchards. Such a program is already in operation in the state and is popular with cultivators.

2. The Project and Design Criteria

For all three of the principal implementing departments, irrigation development is one of the major activities, an activity to which they contribute while carrying out other important, and sometimes competing, mandates. Having irrigation activities embedded in departments with broader mandates is not all bad. It means, for example, that good engineers in ID construct irrigation systems and that

RD ties irrigation work to the local community through its close contacts with the panchayats. On the other hand, and as discussed earlier, it leaves the state without a specialized irrigation agency for irrigation water management.

The present approach to irrigation development by these agencies gives primary attention to constructing works with less attention to efficient water utilization or application. For example, consistent with its mandate to construct new irrigation facilties, the ID seems to focus on maximizing the creation of irrigation potential. Irrigation potential is defined as the area of land suitable for agriculture which lies below the outlet and which could be served by the volume of water being supplied to the system using a standard "duty" of water for calculation. In nearly all cases, the cultivatable command area (CCA) greatly exceeds the hectares actually being irrigated in a particular system. Often the actual irrigated area may be only 60 percent or less of the planned CCA. Nevertheless, it is irrigation potential which is reported as the accomplishment of the construction-oriented ID. Crop and soil water requirements are not included in design and operational decisions. Design criteria that utilize a fixed water duty throughout the state (usually one cusec per 150 acres) clearly will result in overgeneralization regarding the specific water requirements of any particular site and may be a partial explanation for the low rates of water utilization reported. The approach of the Agriculture Department in designing its systems appears to be equally simplified.

The focus on CCA and the inadequate use of agronomic data in system design is exacerbated by the present rule which divides responsibility for system operation into two tiers. The main works are operated and maintained by ID down to the outlet, or chak, a unit commanding from 5 to 8 hectares and involving perhaps twice as many farmers. Below the outlet, the state expects that a chak group will develop and maintain the physical facilities to distribute water from the public outlet to individual farm plots and implement an orderly system of water allocation among the users. This is not an unreasonable division of responsibility, but its success depends upon several preconditions. One is that the main system facilities operate satisfactorily and provide a reliable water supply to the outlets. Unfortunately, this often is not the case. Cultivator inaction, or community disorganization, is then attributed as a social problem, without recognizing that technical shortcomings influence cultivator behavior. A second prerequisite of successful community action at the chak level is that the state be prepared to assist cultivators in carrying out the functions that have been assigned to them. This does not mean doing the job for them, but rather providing technical advice, organizational assistance and perhaps limited financial and to plan and implement the work to be done. Often the separate roles of the cultivators and the state agencies are not well defined or understood.

One result of these various factors is a pervasive problem of low water utilization. Low water utilization is simply another means of referring to the gap between planned CCA and actual irrigated area. The delivery of water to the farm fields as intended in the project design does not occur. Direct and interrelated reasons for this seem to be inadequate control structures and operation of the main system, lack of watercourse facilities and absence of water user organizations. The revised design criteria can be found in Annex II.

3. Legislative Authority

The large role the ID has assumed in all facets of irrigation development seems to reflect the basic tone of the legal provisions contained in the Himachal Pradesh Minor Canals Act, 1976, which became operative in April, 1976. The Act provides the state with broad powers to regulate the supply of water to irrigation works of various kinds and to regulate the distribution of water to users within a given system.

The Act explicitly recognizes a category of irrigation schemes which are community operated and managed. These are designated as Schedule II systems and are defined as irrigation works serving more than one cultivator, commanding more than 8 hectares and not owned or operated by the state. While this class of community system is thus legally recognized, operation and management of such systems can be appropriated by the state if the community is judged to be carrying out operations in a manner harmful to the rights of others. The present irrigation law lacks any affirmative provision for cultivators or communities to organize into legally recognized community organizations with specified rights or responsibilities. However, if no manager or representative of the community has been designated, the Collector may require, by proclamation, the community to nominate one. If this is not done by a specified time, the Collector may appoint a manager or representative as suggested in the minor canals Act of 1976.

In contrast to these community operated schemes, the Schedule I systems under the Act are those owned and operated by the state itself. No records have been compiled to identify the number of irrigation works in these two categories. However, a roster of Schedule I and Schedule II systems at the time the Act was promulgated was appended to the Act. This roster includes a total of 361 state-managed systems. This includes 212 kuhls originally built and operated by communities. The remainder are publicly built kuhls. Since 1976 an additional 75 community kuhls have been rehabilitated by ID. Only a fraction of the total community operated kuhls are listed.

The Act also provides for irrigation works to be transferred from one category to another. Community systems can thus become government-managed systems by the initiative and consent of the water users or if the state judges that the community's operation of the system is detrimental to the welfare of others.

For both categories of systems, the right to apportion water shares between and within irrigation systems lies with the state. In government-managed systems, the state has the responsibility for preparing a "record" for each system indicating the rule of irrigation in that place and identifying the rights to water held by the various water users, including mill operators. For community-managed systems, the state can fix the amount of land that can be irrigated, establish the amount and kind of water rates that can be collected by the community and regulate the supply and distribution of water to and from the main canal of the system.

4. Scheme Selection Practice

Rural people in Himachal Pradesh initiate requests for scheme assistance. ID schemes are identified initially in this manner. Following examination for feasibility, schemes actually submitted for budget approval become the sub-set of the locally-requested projects judged by the department as being technically and economically feasible. In the Rural Development Department, priorities are fixed by the panchayat samiti in response to block-level requests coming through the various panchayats.

Recently, the ID has begun another process of project identification which parallels that described above. This is the Master Planning effort in which possible minor irrigation projects in each tehsil (sub-district) are identified and compiled in a tehsil plan. Forty-nine of 54 proposed master plans have been finalized and the remaining five are under investigation or are being finalized. Water sources are selected in consultation with the pradhana and cultivators in the area. Cultivators are employed for surveys, investigations and execution of the schemes and are paid for their services. Recently there appear to be efforts to include an even broader range of beneficiaries in the process and the project proposes innovative testing of alternatives.

5. Chak Development

Subprojects will provide for full development of chaks to insure reliable, equitable and efficient distribution of the water and its proper application to fields. Selection of the command area and its development will be based on soil surveys as specified in Vol. II, Chapter II, Section E. All chak development will be based on maps and surveys as specified in Section Cle. The project will provide water courses and field channels for water distribution from

the minor canal to individual fields. Capacity of field channels may range from 10-30 l/s depending on local conditions. Field channels will provide a minimum of 15 cm working head above the highest field to be served. They will be equipped with appropriate gates and control structures. Where economical, closed or a combination of closed conduit and open channels using Alfalfa Valve type controls will be used. Gravity sprinkle systems could be a possibility. Planning will include agreement among cultivators as to the proposed location of outlets and field channels, water rotation or delivery schedules and acceptance of the responsibility for maintenance and operation of field channels and drains to assure continued distribution of the water as planned.

Planning of schemes will provide for full development of chaks to ensure reliable, equitable and efficient distribution and utilization of the water and its proper field application. Selection of the command area and its development will be based on topographic and soil surveys. The chak development will provide watercourses and field channels for water distribution from the minor canal to individual fields. Distribution networks will be equipped with appropriate gates and control structures. Chak development will also include installation of field drainage channels connected to main system drainage facilities. Planning will include agreement among the cultivators and the responsible agency as to the proposed location of outlets and field channels, water rotation or delivery schedules and acceptance of the responsibility for maintenance and operation of field channels and drains to assure reliable distribution of the water.

The actual amount of water allotted to a farmer will be a function of cropping pattern and land holdings in the command area. A plan for rotational distribution including proposed periods of rotation and timing allowances per hectare will be worked out with the user organizations. The plan shall show rotation schedules to outlets on the distributary section and for individual chaks. Plans showing location of outlets and field channels will be included in the feasibility report along with a water distribution plan and bear the concurrence signature of representative(s) designated by the cultivator group or panchayat.

Much of the area served by present and proposed irrigation is used for paddy production during the monsoon. As a consequence, sloping lands have been bench terraced, often irregularly with varying lengths, widths, and configurations. This complicates the design and layout of any irrigation distribution system. On a pilot basis, some realignment of terrace boundaries will be undertaken to improve layout of water distribution channels. Where possible, this will encompass a realignment of property boundaries to coincide with field channel alignment. Bench terraces with uniform widths will be located on the contour with the field channel going down the maximum slope.

ID staff has had only limited experience with chak development. With 31,000 hectares scheduled for chak development under the project, a large increase in the number of personnel trained in this activity will be needed. In-country training in chak development for junior and assistant level personnel will be an early activity under the project. In addition to the design of field channels, drainage and on-farm development, training will include soil-water-crop relationships, irrigation water management, organizing and working with cultivator and community groups to involve them in chak development activities. Moreover, training will be given to the cultivators in operation and maintenance of water courses and field channels.

Land development including construction of level bench terraces will be included as a project activity with cost recovery from beneficiaries. Technical standards for on-farm land development will be developed from the proposed research program. This will be done by ID and AD and incorporated into subproject criteria.

D. Economic Analysis

1. Present GOHP Procedure:

Estimates of benefits and costs are currently developed for projects by GOHP/AD and ID, following procedures that use neither economic prices for inputs and outputs, nor time discounted cash flows. Using market prices, the net direct annual benefits (B) at full development and annual costs (C) are separately determined for each project. The ID computes and reports net benefit per hectare as (B-C)/(CCA), while the AD computes and reports the benefit/cost ratio as B/C.

The net direct annual benefit at full development, taken as total increase in net farm income due to irrigation, is calculated as the difference in the net value of production "before" and "after" irrigation. Data relating to cropping pattern, yields and financial prices are provided by the AD. Costs of inputs are generally taken as certain fixed percentage of gross farm revenue.

The annual costs are taken to be the sum of the annual interest at ten percent on capital investment, depreciation calculated linearly over the lifetime of the project and annual operation and maintenance costs (O&M).

2. Revised Methodology:

The economic analysis used for this project differs from the GOHP procedures in several aspects. Using economic rather than financial prices, the Economic Rate of Return (ERR) has been calculated for each of the proposed and existing subprojects. Only direct benefits, the economic value of the incremental net farm income de-

fined as "With Project" (W/P) minus "Without Project" (WOP) net farm income (excluding transfer payments such as taxes and water charges) and after adjustment for operation and maintenance costs (O&M) were included in the benefit stream. Subproject costs included the capital investment needed to achieve the increased income, such as irrigation works, distribution system, land development, and replacement of machinery and equipment. Total investment cost included capital costs of land acquisition for pump house construction and delivery chamber. In the case of the latter no deductions were made for foregone income from these lands.

The project analysis utilized World Bank (IBRD) forecasted 1990 world economic prices expressed in 1983/84 price level and "backed" to farm gate. In light of the recent (downward) revisions in IBRD agricultural price forecasts, the world market prices of some traded comodities, particularly wheat and rice, have come close to parity with the domestic market and in some case the world prices have moved below the market prices received by Indian farmers.

In calculating private farm costs economic prices were used to develop crop budgets. The opportunity cost of farm labor was taken at the prevailing rate and all labor whether farm family supplied or hired was included as a cost. Market prices of other inputs were likewise adjusted to reflect their real economic value.

Similar adjustments were made to public costs of construction. A construction costs factor (CCF) of 0.75 was used to convert financial cost to economic cost. O&M costs were adjusted by a Standard Conversion Factor of 0.80. Capital costs of construction were provided by the GOHP. A land development cost of Rs. 5,200/ha of CCA was included in the analysis. All costs and benefits were expressed in terms of 1983/84 purchasing power.

The stream of net benefits took into account transition periods involved in land and irrigation development and expected growth in agricultural productivity. A four-year linear transition period for irrigated area expansion was assumed. However, considering the small size of some of the subprojects in terms of command area, the expansion could take <u>less</u> time.

For the W/P case in this analysis, an eight-year linear transition period was assumed for agricultural productivity, beginning at 0.5 level. This transition was applied sucessively to each incremental area brought under irrigation. A combined transition factor was obtained by multiplying area and productivity transitions for each sucessive incremental area and summing. The resulting factor was then applied to the W/P net return stream. For the WOP case, an eight-year linear transition was assumed for transition of net returns from the "Present" case. No transitions were assumed for shifts in cropping patterns; these were expected to be relatively short and were taken to be subsumed in land transition.

Following this procedure, future benefit and cost streams were calculated for each subproject. Each annual cash flow entry was then discounted by the Present Worth (PW) factor derived from the expression $PW=(1+r)^{-n}$. In this expression r is the interest or discount rate equal to the opportunity cost of capital and n is the number of years after the base year. Finally, the Economic Rate of Return (ERR) was determined through an iterative procedure. That is, solving for the discount factor (i) such that net benefits are equal to zero in the present period.

3. Economic Rate of Return (ERR):

Based on a sample of subprojects the following ERRs were calculated:

Subproject	Capital Cost/ha Rs.	O&M Cost/ha Rs.	ERR %	CCA ha
1. LIS:Lambagaon	9,421	1,839	11.0	103.68
2. LIS:Shivpur	7,467	1,014	3.9	138
3. FIS:Dharpra	3,500	438	21.0	56
4. FIS:Malhloon	4,530	566	18.5	28
5. Remodelling:Jadul	2,401	300	21.9	164
6. Tubewell:Tihal	15,623	1,953	17.2	40
7. Shallow well: Una	24,020	3,002	17.4	1.20
8. Water Harvesting: Bilaspur	9,469	1,184	24.0	40

E. Financial Analysis

The estimated ERR varies consideraly from one subproject to another. However, except in the case of LIS:Shivpur, the ERR in all the subprojects is greater than 12 percent which is generally taken to be the opportunity cost of capital in the Indian economy. Two factors seem to have been responsible for the low ERR in the case of LIS Shivpur: (a) projected W/P cropping intensity is the same as the present cropping intensity; and (b) no change in the cropping pattern is projected "with project", and significantly enough, the cropping pattern does not include vegetables.

In summary, investments in irrigation schemes to be pro- posed under the project can be expected to yield economic returns greater than 12 percent. The assumptions made in this analysis are generally conservative. Owing to the small size of the schemes, con- struction periods could be considerably reduced and land development expedited; thereby reducing the gestation period for investment.

A financial analysis has been undertaken for a proposed subproject, FIS Dharpra. In the financial analysis, construction

costs and O&M costs are not adjusted by the Construction Cost Factor (CCF). Outputs are valued at farm harvest prices while inputs are valued at their current market prices. With some modifications, the present GOHP project evaluation methodology is adequate to calculate financial rates of return.

The calculation of the net financial returns for the present, WOP and W/P cases is shown in Table 7. Output prices are estimated farm harvest prices of 1983-84. Inputs valued at 1983-84 market prices include human labor, animal labor, seeds, farmyard manure, fertilizer, chemicals, land revenue and interest and water charges. Net value per hectare is the difference between value of output (including biproducts) and value of inputs per hectare. The sum of net value per hectare multiplied by percentage of cropped area is the net return per composite hectare. Culturable Command Area, multiplied by net return per composite hectare equals total net return. Annual net returns are calculated by applying the transition factor to net returns at full project development.

Table 7

Annual Crop Net Returns, FIS Dharpra

	Transitions		.....Net Returns Rs 000.....					
			..... W/P.....					
Year	Composite	Old Area	New Irr	Area	Present Total	WOP	Net	Total
3					123	123	123	0
4	.14	0.75	53		95	148	127	21
5	.30	.50	114		66	180	132	48
6	.47	.25	179		34	213	136	77
7	.66	0	251			251	141	110
8	.72		274			274	145	129
9	.78		297			297	151	146
10	.84		320			320	155	165
11	.91		347			347	159	188
12	.95		362			362	159	203
13	.98		373			373	159	214
14	1.00		381			381	159	223
...	..		"			"	"	"
...	..		"			"	."	."
24			381			381	159	222
25			381			381	159	222

Major works are projected to be completed in three years, and the costs have been allocated as 30 percent, 50 percent and 20 percent of total costs. Likewise, land development costs have been allocated on the same basis. Annual incremental benefit or the cash flow is derived as the difference between estimated total annual costs and estimated net annual returns. As in the case of economic analysis, each annual cash flow entry is discounted by multiplying by $(1+R)^{-n}$ where r is the discount rate and n is the number of years after the base year. The financial internal rate of return (FIRR), obtained by iteration, is defined as that rate of discount i, at which the sum of the discounted cash flow is zero. The FIRR in this case is estimated at 25.8 percent.

1. Methodology:

The following steps were taken in calculating the financial internal rate of return:

- Financial Crop Enterprise Budget is prepared for the Present, WOP and W/P cases. Output is valued at the base year's farm harvest prices; all inputs are valued at base year's market prices. Net value of production for each crop is estimated for the Present, WOP and W/P cases.

- Cropping pattern in the CCA is prepared for the Present case and projected for the WOP and the W/P cases.

- Annual net economic returns are estimated by applying transition factors to the ultimate net return at full development.

- Capital costs of major works, land development and any other required investments, and annual O&M costs are estimated for each year.

- The stream of annual cash flow is discounted and the FIRR is estimated by iteration.

2. Farm Income:

The project's effect on farm incomes has been estimated through an analysis of crop budgets, cropping intensity and typical cropping pattern of a 1.6 ha farm. The Present and WOP cropping pattern include maize and paddy in kharif, and wheat and barley in rabi seasons. The cropping intensity in the Present and WOP case is about 162 percent of the gross cropped area. The W/P cropping intensity is assumed to be 200 percent.

Given these assumptions, the typical farm in Himachal Pradesh would experience the following changes in income:

Farm	Time	Gross Value	Labor costs	Other Inputs	Net Value Total	Net Value per ha cropped
Ha		Rs.				
1.6	Present	6345	2210	730	.3405	1310
	Future without Proj.	7559	2320	822	4417	1698
	Future with Proj.	21850	5097	3227	13526	4227

In summary, the project will modify the current GOHP project evaluation methodology toward a fully discounted cash flow approach using market pricing of outputs and inputs to calculate the financial rate of return. Once institutionalized, these modifications will permit more complete financial analysis in support of more effective project appraisal, planning and implementation. For subprojects qualifying under the loan, FIRR calculated along these lines shall not be less than 12 percent.

F. Environmental Scoping Statement:

1. Nature of Project

Due to the variety of subprojects supported -- i.e., flow irrigation schemes, lift irrigation schemes, dug wells and tubewells, water harvesting projects--the overall range of potential environmental issues to be addressed appears to be quite large. However, it is highly unlikely that the environmental concerns and impacts of any one sub-project activity (e.g. a flow irrigation scheme) will be the same as that of another (e.g. dug wells or tubewells). The range of agro-climatic zones found in Himachal Pradesh and the concomitant diversity of its physical environment (relief, soils, precipitation) further supports the perception that the potential environmental impacts of supported subprojects will vary considerably from site to site. Finally, the direct environmental impact of each supported subproject will be greatly restricted in spatial extent because the size of each scheme will be comparatively small, the majority less than 100 hectares command area. Consequently, in this project careful attention to the specific characteristics of the local physical environment in the planning and design process and the adoption of environment-sensitive design criteria for each supported activity is the most appropriate procedure to follow to restrict or eliminate adverse environmental impacts while simultaneously enhancing the possibility for significant positive impacts on local environmental conditions.

2. Project Potential for Positive Environmental Impact

It is useful to recognize that the Hill Areas Land and Water Development Project is likely to have several important, albeit local, positive impacts on the natural and physical environment of Himachal Pradesh. Many supported subprojects will involve remodeling or otherwise improving existing flow irrigation systems (community and government kuhls). The positive environmental impacts of these activities will include, for example, a) reduction of water losses and seepage losses in conveyance systems through channel lining or closed conveyance systems, thereby increasing existing water supplies and reducing drainage problems, b) increasing the utilization of water supplies through improvement of distribution facilities below the farm outlets, c) improved field terracing and field bunding which will reduce soil losses from farm fields, d) enhanced watershed management activities through soil conservation and revegetation programs, thereby reducing the rate of runoff and sedimentation below system catchments and increasing the sustained flow potential of the water source.

Water harvesting schemes in the low and mid-hill agroclimatic zones of Himachal Pradesh will result in a substantial reduction in soil loss and the rate of gully and ravine erosion and advancement. This will result from the construction of small dams and water storage ponds, sediment traps and revegetation of microcatchment areas through associated watershed management activities. Water stored in the ponds, when carefully managed, typically will be sufficient for irrigation of more remunerative rabi crops (e.g. wheat) in the limited new commanded areas below the structure. Water also will be sufficient to provide an essential one or two irrigations--so called "life saving irrigation"--for kharif season crops (maize, rice) when the monsoon ends (September) or is deficient prior to completion of the growing season. In the long run, the regenerative capacity of managed watersheds above these water harvesting schemes will renew as well as increase fodder, fuel, timber and water supplies available to the farming communities they serve.

Shallow well and tubewell subprojects in areas of Una, Bilaspur, Solan, Hamirpur or Kangra Districts where groundwater resources are available for development will significantly reduce the probability of waterlogging in potentially susceptible low lying areas.

3. General Recommendations: Environmental Issues and Concerns

- Subproject environmental evaluation procedures and adoption of design criteria which reflect a sensitivity to highly localized environmental conditions will be implemented as the best way to ensure that impact on the physical and natural environment will be minimized or eliminated.

- A representative sample of subprojects in the different agro-climatic zones of Himachal Pradesh will be identified by the state. The sample will be monitored by an Indian research organization selected by the state for adoption and implementation of design criteria to mitigate potential adverse impacts on the physical and natural environment of subproject locales.

- As part of the mid-project evaluation by A.I.D., the adoption and implementation of appropriate design criteria to eliminate or avoid adverse environmental impacts will be examined and evaluated for selected A.I.D.-supported subprojects.

- No further environmental assessment is required for this project.

V. Conditions and Covenants

A. Conditions Precedent

Prior to the first disbursement of Loan assistance, the Cooperating Country will, except as A.I.D. may otherwise agree in writing:

1. establish a State Level Implementing Committee to review policies pursuant to implementation of the project, to review and approve subprojects financed under project and immediately be responsible for

   a) establishing and adequately staffing a project cell to provide technical support to the project;

   b) preparing a plan for training, field studies, research and evaluation for the first year of project operations; and

   c) submitting a staffing plan for additional personnel of all cooperating departments to implement the project.

B. Covenants

1. The Cooperating Country will take appropriate measures to ensure adequate provision of counterpart financial and staff resources, at the state level, for expeditious implementation of the project;

2. The Cooperating Country will introduce community-based management systems on project financed irrigation schemes;

3. The Cooperating Country will explore ways to share more fully the costs of project financed schemes with their beneficiaries;

4. The Cooperating Country agrees that responsibility for Schedule II (community) schemes rehabilitated or upgraded under the project will not be transferred to Schedule I under the Minor Canals Act of 1976, except under extraordinary circumstances.

Annex I

USAID India's Irrigation Strategy
a. Summary Statement

USAID's approved assistance strategy for irrigation in India is based upon irrigation's key role in accelerated agricultural growth and the high priority attached by the Government of India (GOI) to irrigation development. India's population of nearly 750 million is growing at over two percent annually, or by 15 million or more each year. In order to feed and clothe this growing population and gradually reduce unemployment, poverty and malnutrition, agricultural production will have to grow by nearly 4 percent per year for the remainder of the century, as compared with historical growth rates of under 3 percent. Since very little additional land can be brought under cultivation, production increases will have to come primarily from rising cropping intensities and yields, both of which depend heavily on reliable water supplies. The scope for yield increases is indicated by the estimates that actual average foodgrain yields are 0.7 metric tons per hectare (MT/ha) on unirrigated land and 1.7 MT/ha on irrigated land. Moreover, foodgrain yields with available seed varieties can be increased to 4-5 MT/ha annually with good water management and appropriate fertilizer applications.

About 30 percent of India's cultivated area of 140 million hectares receives enough rainfall to produce at least one crop per year. Given the seasonal rainfall pattern characteristic of India's monsoon climate, irrigation is needed in these areas to permit double and triple cropping. Another 25-30 percent of the net cultivated area receives low rainfall but can be reached by irrigation. Thus irrigation can ultimately cover about 55-60 percent of net sown area. Thus far about half of this area has been reached. The GOI hopes to create the remaining irrigation potential by the year 2000 or shortly thereafter. This implies a growth rate of irrigated area of over four percent annually for the rest of the century.

Irrigation water can be provided from surface sources (rivers, reservoirs, "tanks") or underground sources ("groundwater"), including dug wells and drilled wells ("tubewells"). Irrigation in India is classified as "major" (covering over 10,000 hectares of irrigated area), "medium" (2000-10,000 hectares) or "minor" (under 2,000 hectares). As of 1981-82, India had developed about 61.5 million hectares (ha) of the 113.5 million ha of "irrigation potential" (area irrigated times cropping intensity). Surface irrigation accounts for about half of this ultimate potential, and for about 50 percent of the potential developed thus far. USAID's irrigation assistance has concentrated thus far on surface irrigation, since the problems

in surface irrigation development (in India as elsewhere) are especially challenging. Groundwater irrigation generally involves wells controlled by an individual farmer or small group of farmers and provides water for a small area. Water supply and use can be regulated relatively easily, and water use efficiencies as well as crop productivity levels are generally high. Surface irrigation, on the other hand, involves the management of larger and more complex systems, and water use efficiencies (the proportion of the water diverted from its source that actually reaches the plant) have generally been low (i.e., in the 25-30 percent range rather than the 50-55 percent range desired. Crop productivity under surface irrigation is often correspondingly low. Unless the efficiency of both existing and new surface irrigation systems rises closer to its potential, the prospects for achieving India's food production growth targets are poor.

The supply and use of water in surface irrigation systems may be regarded as two parts: the system of reservoirs and canals built by the state irrigation departments, extending down to an outlet covering an area ranging up to 200 ha, but often averaging 40 ha; and the area below the public outlet, where farmers are responsible for distributing water among themselves to reach their fields. In most states the agriculture department is responsible for assisting farmers in constructing the necessary field channels below the outlet and adopting the practices appropriate to irrigated agriculture. In the past decade the problems of irrigation water management in both parts of the system have received a great deal of attention from the GOI and others. Given the complexities characterizing the interactions among technical, biological, administrative and social systems in surface irrigation, the constraints to improved water management and increased irrigation efficiencies are numerous and varied. However, the basic problem is that too few farmers in surface systems receive supplies of water adequate to shift to scientific intensive agriculture because of the lack of chak development.

At the technical level, designs often cannot be adequately adapted to site conditions and do not include the control structures required for precise management of water flows within the main system due to financial constraints. Little data is available on actual system performances. Below the outlet, technical guidance for construction and maintenance of field channels and drainage works by farmers or contractors is not generally available; irrigation departments feel that their technical responsibilities end at the outlet, and agriculture departments do not have sufficient staff trained in on-farm irrigation development. This point has been recognized. Efforts are being made to provide more guidance to all involved departments. The bifurcation of bureaucratic responsibility between various departments also results in fragmented understanding of irrigation and related farming

system problems and poor coordination between irrigation activities and complementary agricultural activities such as extension, input supply and marketing. These institutional shortcomings are compounded by the failure of public sector agencies to involve farmers in assessing and solving system problems, and by the absence of private sector alternatives to complement or perhaps compete with public sector irrigation services.

The GOI recognizes the need for qualitative improvements in irrigation as well as continued system expansion, and has introduced several reforms. In order to deal with the issue of coordination between irrigation and agriculture departments in addressing water use problems below the outlet, the GOI introduced the Command Area Development (CAD) program for major irrigation projects. More recently, the GOI reduced the size of the block ("chak") to be served by each public outlet from 40 ha to 8 ha, thus reducing the magnitude and complexity of the task facing farmers in field channel construction. The GOI is also encouraging the introduction of the rotational water supply (RWS) or "warabundi" systems of northwestern India (Punjab, Haryana and Western Uttar Pradesh) to surface irrigation systems throughout India. Under this system, each farmer within a block receives an amount of water proportional to his holding, according to a predetermined schedule which is strictly followed. This system has the advantage of administratively established scarcity as well as predictability, and encourages efficient water supply and use. This contrasts sharply with surface systems prevalent elsewhere in India, which generally have no organized procedure for water distribution among outlets or below the outlet. In addition, the Sixth Five Year Plan called for increased emphasis on 1) analysis of water losses in various parts of the system and development of appropriate corrective measures; 2) coordinated use ("conjunctive use") of surface and groundwater sources; 3) higher water charges; 4) improved monitoring of system performance; 5) irrigation research by agricultural universities; and 6) training of irrigation staff in efficient operation of completed systems.

A.I.D. shares the GOI's objectives of increased food production and rural employment through irrigation development. Limited resource availabilities, however, dictate that A.I.D. concentrate its efforts on selected aspects of the GOI's irrigation development program. Within that program, returns to efforts to increase efficiencies on existing and new surface irrigation systems are likely to be especially high, since efficiencies with current designs and management approaches are quite low, as noted above. Thus USAID's sub-sector goal is to assist the GOI and selected states to bring about a gradual rise in overall surface irrigation efficiencies, from perhaps 25-35 percent at present to 50-55 percent on a significant number of systems by the year 2000. Improving efficiencies at this rate will require

continuous improvements in water management through state-level implementation of policy reforms, mobilization of the creative energies of farmers and private sector suppliers of irrigation expertise and services, adoption of better technical solutions to problems of water supply and use in surface irrigation systems, and a reorientation of the irrigation establishment toward more systematic management approaches to problems. Establishing the human resource base to bring about long-term changes of this magnitude affecting tens of millions of hectares of irrigated land in many states will in turn require a sustained program of water management training for professionals and farmers, based on the design, construction and operation of actual systems. This implies a package of A.I.D. inputs combining investments in construction of new or rehabilitated irrigation systems with technical collaboration and training, all focused on the four strategy elements of policy reform, private sector mobilization, research and technology development, and institutional reorientation. Given the scale and construction times of surface irrigation projects in the "major" category, A.I.D. must limit itself to direct involvement with medium and minor surface irrigation; similarly, A.I.D. cannot work directly with more than a limited number of India's states at any one time.

The approved assistance strategy for A.I.D. support of GOI and state irrigation development efforts covers a portfolio of five existing projects and three projects scheduled for authorization in FY 1984 or FY 1985. The five existing projects are the three state medium irrigation projects (Gujarat, Rajasthan and Maharashtra), the one state minor irrigation project (Madhya Pradesh), and the Irrigation Management and Training (IM&T) project. The IM&T project supports irrigation studies and training in the four above states and in Tamil Nadu (as well as similar efforts at the center), and is the "core" project for A.I.D.'s irrigation assistance in India. The Hill Areas Land and Water Development and Maharashtra Minor Irrigation projects proposed for FY 1984 add two more minor irrigation programs to the portfolio, and each provides important new opportunities to work with state governments on key technical and institutional problems in irrigation.

USAID is not proposing any irrigation projects for authorization in FY 1986. A.I.D. assistance to irrigation development for the period FY 1987 and beyond will be the subject of an assessment to be carried out by outside irrigation experts in late FY 1984. This assessment will review experience thus far under existing projects, analyze prospects for progress with respect to each of the four strategy elements, and recommend future directions for collaboration between A.I.D., the GOI, and the states in helping irrigation realize its potential contribution to accelerated agricultural growth and rural poverty alleviation.

Annex II

Qualifying Criteria Where Applicable

1. Project Criteria

A. At least 20 percent of the ID subprojects shall be remodeling schemes.

B. The Project Cell will review various design criteria where USAID and GOHP agree that these need to be clarified or can possibly be improved. Some possible examples are improved rock diversion weirs using gabions, criteria for size of stream to fields, improved well drilling techniques, use of regional climatic factors for estimating water requirements, soil survey/land capability criteria for irrigation, improved inlets for pumping stations, etc.

C Full chak development will be required on all qualifying subprojects. Plans and farmer agreements for chak development will be included in design reports. Chak development on existing schemes will be implemented on a subproject basis and all subproject procedures and applicable criteria will be met.

D. The Appraisal and Implementing Committee shall appraise all subprojects and certify them for compliance with subproject criteria.

E. Socio-economic baseline surveys will be made for a representative set of schemes to be agreed upon by GOHP and USAID.

II. Subproject Criteria

A. Planning

Subproject feasibility and design must to be reviewed by the Appraisal and Implementing Committee and shall include plans for activities of all concerned departments.

B. Financial

Qualifying subprojects must show an estimated financial internal rate of return (FIRR) of not less than 12 percent using time discounted cash flow analyses.

C. Social

1. Socio-economic and administrative surveys will be included in feasibility studies for qualifying subprojects.

2. For individuals, the size of farm served by any scheme shall not exceed five hectares. For groups, 85 percent of the farms shall be less than five hectares in area.*/

D. Environmental Enhancement

1. Watershed conditions upstream and on the agricultural watershed will be evaluated by appropriate agencies and plans for desirable afforestation and erosion control measures incorporated into feasibility reports and final designs. Costs for these features will be included in the subproject price (See Water Harvesting Criteria for mosquito control items).

E. Technical Criteria

1. Surveys

a. Main channel location will be based on strip surveys with contours at not more than one half meter.

b. For distributaries and chak development, map scale shall be 1:2000 and shall show field boundaries, land use and all salient features including alignment and full supply level elevations for main canals. Contour interval will not be more than 20 cm based on 8-10 spot levels per hectare. At least one spot level will be taken and elevation shown on the map for each survey number. Suitable standards of accuracy for control surveys will be agreed upon by GOHP and USAID.

2. Water Supply and Headworks

a. Estimated water supply in any month shall be at the 75 percent probability level.

b. Runoff will be estimated using rainfall and runoff models or correlation procedures agreed upon by GOHP and USAID and discharge measurements will be made as a check during the low flow season in the year preceding subproject construction.

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*/It is recognized that in HP unique family and land holding customs result in extended family units on land under legal ownership of one individual. This project acknowledges this situation. Appropriate allowance will be made on a case-by-case basis to accommodate this.

c. Other water uses from the same source will be determined. Qualifying subprojects will not jeopardize existing water uses.

d. Permanent diversion structures will be installed where flood flows do not exceed (25 m3/sec) and CCA exceeds 20 ha. Foundations will be explored using test pits and stability analyses will be made in accordance with standard practice. Main canals will be fully controlled with headgates and provided with emergency wasteways.

e. Sluicing facilities to reduce sediment load entering canals will be incorporated into headworks facilities.

f. Pumps and ancillary equipment for lift schemes from surface and groundwater sources will be properly housed for protection and security and installed fully in accordance with manufacturers specifications. Provision shall be made for partial operation and standby using multiple sets for surface sources. Full performance information will be included in design report.

g. Where electricity is used for pumping, the installing agency shall ensure that voltage and capacity is fully adequate. A statement of capacity and availability will be obtained from the electrical cooperative or local State Electricity Board office and included in the feasibility report.

h. Clearance by the Central Groundwater Board or the State agency responsible for groundwater development will be required for all tubewells in order to avoid overdraft.

i. Newly drilled wells will be pumped continuously for not less than ten days to determine pumping lift and sustained discharge. Final design of pumping equipment will be based on pumping lift at sustained yield.

3. <u>Water Budget/Command Area</u>

a. Culturable command area (CCA) will be calculated from a water budget based on the peak fortnightly water requirement computed using FAO crop coefficients and potential evapotranspiration using 75 percent effective rainfall probability and full allowance for operational and seepage losses to and on fields. Schedules of minimum loss allowances will be agreed to by GOHP and USAID.

b. Cropping patterns will be as recommended by AD and shall take into account soil survey and land capability characteristics. They shall include tree crops for fuel and fodder as appropriate.

c. For tubewells, design CCA will be determined based on the sustained yield determined from an extended pumping test and allowances for losses as per a schedule agreed upon by GOHP/ID.

4. Conveyance

a. Channels shall be of sufficient size to transmit maximum peak capacity based on fortnightly crop water requirements.

b. Velocities will be such that erosion will not occur. Drop structures for controlling grade will be fully protected against downstream erosion.

c. Open channels will be lined or installed in closed conduit where they pass through shattered or weathered rock or through soils classified as coarse grained (G or S types) in the Universal Soils Classification System for engineering or where seepage would contribute to instability. Surveys will show nature of rock, or if in earth, test pit samples will be taken and soils classified according to Universal Soils Classification System at not less than 100 m intervals.

d. Appropriate by-pass structures or wasteways capable of passing peak floods will be installed at all cross drainages. Condition of cross drainage watershed will be noted and plans developed for any needed protective measures.

e. Control gates will be provided at the head of each branch canal. Measuring devices will be installed at main headgate, at branches and at the entries to distributary sections.

f. For distributary reaches channel will be controlled by check structures so that water level under all operating flow conditions can be maintained at outlets at elevations not less than 45 cm above the highest point in the chak to be served.

g. Outlets will serve a maximum of eight hectares.

h. Conveyance systems for tubewell schemes shall be designed based on the sustained yield determined from actual pump tests.

i. For tubewell schemes, flow will be controlled by gates at branching points. Outlets will serve approximately two hectares and will consist of alfalfa type valves served through risers. Open standpipes will provide water level and pressure control. Design standards for closed pipelines will be those adopted by the American Society of Agricultural Engineers or comparable ones developed in India.

5. Drainage

Drainge channels sufficient to remove maximum five year rainfall within 24 hours from the command area will be provided.

6. Chak Development

a. Selection of command area will be based on soil survey information and land capability criteria agreed to by GOHP and USAID.

b. Field channels will be equipped with appropriate gates and control structures and will provide a minimum of 15 cm working head above highest point in field served.

c. Size of stream to be rotated (10-30 l/s estimated range) will be determined in consultation with farmers and on best available information and experience. Criteria for appropriate stream size will be developed by GOHP/USAID.

d. Surface drains to main system drains to remove maximum five year rainfall in 24 hours will be provided.

e. Where economical, closed or a combination of open channel and closed conduit will be used, suitably equipped with standpipes and turnout valves.

f. Planning of chak development will include agreement with farmers on location of outlets, watercourses, field channels and surface drains.

g. Plans for management of water within the chaks will be developed and agreed to by farmers.

h. Farmers in each chak shall be encouraged to be responsible for implementing the water management plan and for maintaining watercourses, field channels and drains in the chak to standards agreeable to the Implementing Agency.

i. Farmer agreements on location, scheduling and operation and maintenance certified by designated representative or the farmers themselves shall be included in finalied design reports.

j. Field channels shall be provided to deliver water to each farm unit thus eliminating field to field irrigation.

k. Field channels, land leveling and terracing of individual fields will be included in chak development plans and their implementation will be a Project obligation. GOHP/USAID will develop financing and implementation plans for accomplishing this feature.

l. For mosquito control, outlets shall be provided so that tanks and ponds can be fully drained during April to mid-June each year.

7. Water Harvesting Schemes

a. Water harvesting schemes shall be comprehensive including storage pond or tank, pumps if any, full chak level development as prescribed in that section, cropping patterns and plans for protection and utilization of the watershed.

b. Foundation conditions for dams will be fully examined and stability calculations made. Earthen dams, masonry or concrete retaining walls and diversion structures will be designed and constructed in accordance with standard practice. Dam slopes shall be adequately protected from wave and rainfall erosion and adequate freeboard provided to prevent overtopping.

c. Water supply estimates will be made as described under the section on water supply.

d. GOHP shall compile and provide for USAID review and concurrence, its technical standards for hydrological assessment, and design of dams, retaining walls, pumping stations and conveyance structures for water harvesting schemes.

e. GOHP will monitor well discharges and water levels on a monthly basis on all tubewell schemes and develop criteria for safe rates of extraction and permissable number and locations of new wells. In order to develop improved watershed hydrology, ID will establish standard stream gauging and rainfall stations in a representative set of watersheds and AD will establish measuring weirs and rainfall stations and maintain reservoir records on a representatie set of water harvesting schemes, as agreed by GOHP/USAID.

f. Tanks or ponds should be located 1.5 km from the nearest village, or if not possible, arrangements shall be made for monitoring mosquito density population in neighboring villages.

Annex III

Project Cycle and Responsibilities

1. Preparation of Training Plan - Land and Water Development Cell

Action	Content
- Preparation of training needs inventory	- Detailed outline based on assessment of design and management requirements
- Identification of training institutions	- Canvass state and all-India institutions, but including any U.S. requirements for long-term training
- Submit training plan to State Implementing Committee	- Detailed plan and cost estimate for each component
- Inititate training	- Professional staff assigned and committed to project
- Appraise and evaluate training program	- Engagement of suitable evaluating unit
- Develop, submit and initiate cultivator and user assciation training	- Agricultural extension and horticultural field activities initiated in project areas

2. Research and Technology Adaptation - Land and Water Development Cell

Action	Content
- Prepare R&TA needs assessment including analyses, review and action studies	- Detailed outline based on assessment of requirements. Outline should include inputs from institutions outside Land & Water Development Cell
- Identification of participating institutions	- Canvass state and all-India institutions, including any requirements for special consultancies

Action	Content
- Submit plan to State Implementing Committee	- Detailed plan and cost estimate for each component
- Initiate work	- Professional staff assigned, grants or contracts awarded
- Appraise and evaluate R&TA program	- Engagement of suitable evaluation
- Develop feedback into program design and operations	- Land & Water Development Cell establishes procedures and linkages

3. Preparation of Minor/Chak Projects - Sub-Project Level Committee

Action	Content
- Preparation of ground survey, community potential feasibility report	- Detailed plan and cost estimates for each component as per appraisal criteria
- Discussion of proposed operations with cultivators in project areas	- Details of operations under each component
- Clear with concerned block and agency level authorities	- Tentative implementation plan
- Planning/design for project reports	- Feasibility, technical and management reports
	- Chak development plan
- Submit proposals to Land and Water Development Cell	- Detailed estimates for proposed works
	- A note on results of discussions with cultivators, their response to project proposals and willingness to participate in project activities

4. Appraisal - Land and Water Development Cell

Action	Content
- Designate appraisal team organizing Cell expertise and consultants as needed	- In case of rejection of proposals give detailed reasons suggestions and technical assistance
- During appraisal, check: adherence to criteria, adequacy of design, cost estimates, technical and economic viability, and community management plan	- Suggestions (if any) on modifications, project implementation, etc.
- Forward copies of approvals for minor irrigation and chak development to USAID as well as sanctioning of smaller-scale program	- Information
- Submit proposals to State Implementing Committee for approval or rejection	

5. Approval and Sanction - State Level Implementing Committee

Action	Content
- Review whether criteria met - Review cost estimates - Obtain formal approval of Secretaries of concerned departments	- While considering proposals for approval, confirm availability of budget provision and incremental staff, and any other implementing actions
- Budget provision and clearing with finance - Sanction	- Sanction letter contains detailed instructions and directions for releasing of funds, reporting procedures, and other project implementation matters

6. Implementation - District Level and Subproject Level Committees

Action	Content
- Discussion of projects with communities	- Obtain agreement on location for outlets.
- Fix priorities and prepare action plans based on agreed priorities	Prepare calendar of operations and define responsibilities of community for different activities
- Discuss action plan in each village	
- Mobilize community resources and engage user organization	- Opportunities for mobilizing local labor and initiating community activity

7. Supervision - Land Water Development Cell

Action	Content
- Visit project area on a regular basis, discuss problems and take remedial action	- Suggestions for resolving technical, administrative construction problems
- Designate district and sub-district supervision teams to carry out detailed supervision of project activities	- Progress of each project component, community participation, adherence to agreed criteria and coordination arrangements. Suggestions for improvement

8. Monitoring and Evaluation - District Level Committee, Land and Water Development Cell and State Level Implementing Committee

Action	Content
- Preparation of semi-annual progress reports by DLC and send to State LWDC	- Physical progress of each project component and progress of expenditure

Action	Content
- Compilation of semi-annual reports by LWDC of approved schemes and submit to State Level Implementation Committee for consideration and also to MOA	- Review and ascertain reasons for slow progress, if any, and remedial action needed
- Prepare and forward reimbursement proposals to GOI	
- Review semi-annual progress reports and statements of expenditures received from states (SLIC)	- Suggest remedial action to states
- Arrange for periodic evaluation of project components (SLIC)	

Annex IV

Staffing Pattern for Land and Water Development Cell ("Project Cell")

The Project Cell, will be responsible for planning, coordination, design, monitoring, execution, material management, quality control, evaluation, training, research etc. of the project. The incremental project staff as mentioned below is agreed to be paid under the project and this forms part of unit cost estimates given in Table 1, p. 22. This Cell will also provide technical and administrative staff support to the State Level Implementing Committee. It will also coordinate and integrate the activities of the participating departments in preparing annual and long term work plans in liaison with GOI and USAID. It will conduct necessary investigations and prepare reports and returns as may be required by the State Level Implementing Committee. Proper scrutiny and appraisal of subproject feasibility reports and obtaining approval of the State Level Implementing Committee will also be its responsibility. This Project Cell shall be created at an appropriate time subject to the approval of the competent authority as per procedure of the Government of Himachal Pradesh. Adequate vehicles will also be provided for monitoring operation of the project.

The Project Cell will be headed by a Chief Project Officer not below the rank of an Additional Chief Engineer. The Chief Project Officer shall be Member Secretary of the State Level Implementing Committee. He shall have his usual personal staff as per norms.

The Chief Project Officer will be assisted by two Superintending Engineers who will have two Work Sections under them as per requirements of the project. While the superintending engineer (works) shall also be controlling accounts officer, stores purchase officer and legal section, the other superintending engineer (design) will control design section, monitoring, evaluation and training.

An Accounts Officer, assisted by two office superintendents grade I, one incharge of Budget Section and the other of Contract, Accounts etc. will assist the Chief Project Officer in the matter of preparation and scrutiny of the budget proposals, expenditure statements, reconciliation of the expenditure with the Accountant General, arranging reimbursement from the GOI and other allied matters.

A Store Purchase Officer, assisted by a Store Purchase Section in the office of the Chief Project Officer, will provide necessary staff support to assist in efficient material management for timely execution of the Project.

A Cash Section and an Establishment Section with usual clerical staff will be under the charge of a Deputy Registrar, who will assist the Chief Project Officer, for arranging the required staff from concerned disciplines and their proper placement for the successful implementation of the Project.

A Public Relations Officer will look after the publicity, publications an[illegible]lied matters and will help in arranging conferences, workshops [illegible]ere beneficiary participation is required.

A Leg[illegible]stant will advise the Chief Project Officer regarding legal matters connected with land acquisition and other disputes which may arise during the implementation of the subprojects to ensure that the progress of the subprojects according to time bound schedule is not adversely affected. He will also provide necessary advice for enactment for required legislation to achieve the aims of the project.

Plans, estimates and feasibility reports of subprojects will be prepared at the subdivisional level in the ID and equivalent level in AD & RD. These plans and subproject reports will be received in the Project Cell and also by the District Project Committee for comment.

Another Design Unit within the Project Cell, headed by an Executive Engineer, ID, will issue directives to field officers regarding introduction of project criteria, new technology, etc. The Unit will have supporting staff from the participating departments. It will deal with quality control and with inspections and investigations.

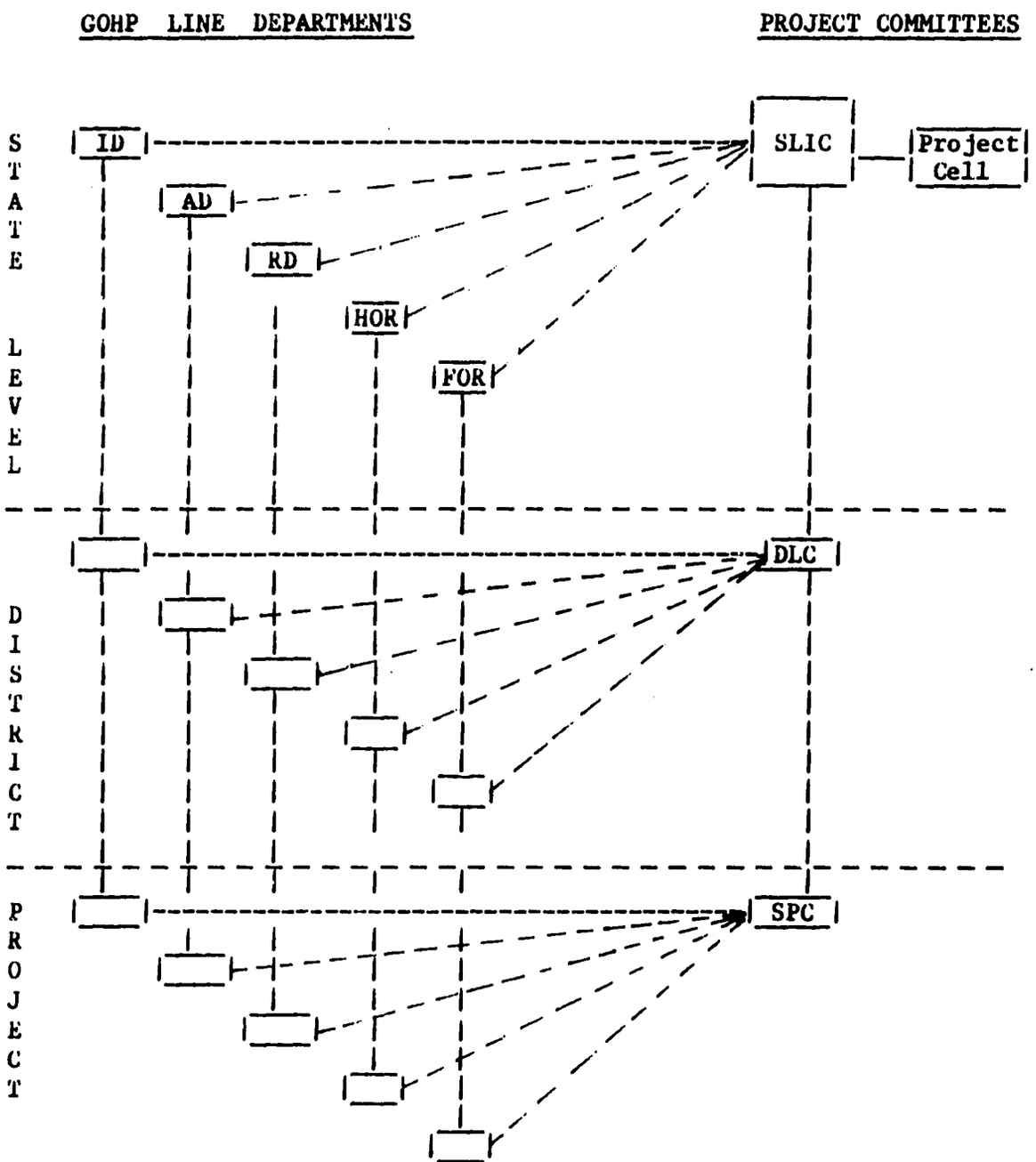
A Design Unit headed by a Superintending Engineer and assisted by two Executive Engineers (Design) from ID, a Deputy Director from AD and equal level officers from Soil Conservations, Horticulture, and Forest Departments with staff as per norms, will be responsible for scrutinizing plans, estimates and feasibility reports of subprojects received from the implementing departments to see that they fully comply with project criteria and that the estimates have been prepared in accordance with the prescribed schedule of Rates and fixed amount prices. This unit will also be responsible for preparing and submitting complete subprojects and feasibility reports to the State Level Implementing Committee and getting them approved. This Unit will also prepare designs and detailed estimates for subprojects for getting technical approvals falling within the competence of the Additional Chief Engineer.

Another Unit will be responsible for implementing in-depth monitoring, review of progress of subprojects from initial planning through construction and ultimately operation. This unit shall be responsible for monitoring in the field and preparing subproject and project level monitoring evaluation reports. It will also be responsible for identifying constraints to project implementation and reporting these to the State level implementing Committee. This Cell will be manned by an Executive Engineer of ID, with necessary supporting staff from various disciplines.

A separate Unit will prepare plans for the various training programs, workshops, research, etc. to be organized under this project. It will also coordinate the selection of trainees and oversee the progress of these programs. This Cell will also be headed by an Executive Engineer of ID, and will have supporting staff from the participating Departments. The Public Relation Officer will function in this unit.

Annex V

Project Organization and Relationships



Annex VI

Logical Framework

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Assumptions
Goal: To increase agricultural Production and Rural Incomes	Average yields per hectare Shift in cropping patterns Increase in per capita income	Agricultural census and and National Income Accounts Data	Normal weather conditions Markets function normally
Project Purpose: To increase irrigation efficiencies and expand area under irrigation	2,000 micro-irrigation schemes and 150 new and remodelled minor schemes built to improved design criteria 38,700 hectares of irrigated chak development	Feasibility reports Appraisal reports USAID site visits GOHP records Engineer Certification	GOHP willingness experiment and use study results Community willingness to participate if given appropriate opportunities SLIC able to successfully coordinate various departments GOHP sustained commitment to irrigation and land development
Outputs: New and improved designs for hill area irrigation schemes Irrigation system extended to chak level Community based management systems	Incorporation of improved feasibility criteria and approved appraisal reports Detailed system design plans and specification including chak development GOHP Directives and certification that cultivator groups have been organized	Review of state budgets Progress reports submitted by cell USAID Monitoring activities including On-site visits Financial records EOPS evaluation	Field level data gathered uses sound methodology and is accurately interpreted Low staff turnover in Land and Water Development Cells

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Assumptions
Land and Water Development Cell and Committees	GOHP Directives and formation of Cell and Committees		Open, sustained dialogue maintained between communities and irrigation field engineers
Introduction of AD cost recovery system for Chak Development	Cultivator contributions to cost recovery		High collection rate for cultivator contribution
Enhanced professional and staff capacity	Trainees trained against aproved training plans		Attrition is low among trained personnel
Communities oriented to operation and maintenance techniques	Detailed analysis of 50 schemes and sample of all other schemes documenting community operation and maintenance of schemes		State irrigation department integrates evaluation findings into chak designs
Inputs: Financial Support for Construction	Loan disbursements against performance indicators	AID records	AID funds made available
Training and Technical Assistance	Grant disbursements against Training Plan and Studies/Research Programs		Subsequent audits reaffirm reimbursement system
Monitoring and Evaluation Support			
Studies and Research			

Annex VII

PID and Project Development
Issues and Responses

Excerpted below are pertinent passages from 83 STATE 319508. This telegram reported the APAC approval and raised the following issues to be addressed during project design.

1) Local participation: PP should describe how farmers will be involved in design of watercourses, selection and supervision of contractors and distribution of water:

The Government of Himachal Pradesh has agreed to community based management systems as a major premise for minor irrigation development. While for any given scheme, communities will have to agree upon the level and formality of organization, it is agreed that the principle of engagement or participation will be adhered to and that wide experimentation will be encouraged. Confirmation of this approach was given by the Chief Secretary and Secretary of Irrigation. It is reflected in the disbursement method and included as a project covenant. An important allocation to the agricultural extension service has been included as have a number of demonstration-cum-development pilot projects. Refer to Section I.C.4.d; II.B.I; III.B.4; IV,A.2.c.; IV.B.2. and IV.C.5.

2) Operations and Maintenance: How will operations be financed? What can be done to improve the farmers' willingness and ability to maintain the watercourses?

The notion of a financial gap is accepted by the state and there is active interaction between the technical and financial departments on this subject. On the recurrent cost side there is agreement to experiment with operations and maintenance, particularly through the introduction of community based management systems. The state has also agreed to a covenant in the project agreement to explore ways to share more fully the costs with beneficiaries.

3) Number of Prototype Schemes: Because of AID inexperiencein implementing this type of project as well as its inherent complexity, APAC suggests that implementation of project be phased, initiating in the first year a portion of the schemes and training activities.

The project has been designed as a seven year project. During the first two years, there will be a heavy emphasis on analysis, research and field studies as well as training and workshops. The subproject development, appraisal and implementation standards and procedures will be developed during this period and administrative personnel assigned. As subprojects are reviewed and approved, implementation will be initiated and this will be an continuous process during project years three through six. Due to the scale of the irrigation schemes contemplated under the project, physical completion of subprojects will require a relatively short period of up to three years. Hence, there will be an intensive series of starting-up activities, mostly grant funded, followed by staged construction activities funded under the loan (see Project Paper Implementation and Monitoring Plan).

4) FAR Financing: APAC expressed reservation regarding use of traditional FAR approach given the experimental nature of the project, and, consequently, the difficulty in making reasonably accurate cost estimates. Moreover, traditional FAR approach puts focus on completion of infrastructure rather than achievement of institutional objectives. A modified FAR approach might be developed for the project which ties release of funds to performance benchmarks rather than construction progress. This system would not necessarily preclude final disbursement upon completon of construction.

The Project proposes to use a performance based disbursement method as outlined in Section IIB of Project Paper. This financial procedure will encourage the achievement of institutional objectives directly related to project purpose while reimbursing on the basis of detailed cost estimates for subproject construction. Similar to the FAR method, the proposed disbursement mechanism finances outputs rather than inputs with final payments being made upon satisfactory completion of construction. This mechanism is more suitable, given the large number of subprojects being financed and is more commensurate with financial monitoring capabilities of the Mission.

5) Training: Detailed Plan should be developed in PP design. In accordance with the FAA participants in long term training should come to the U.S.

The detailed training plan is provided in Section IV, Institutional Development (p. 46-49). All long term training (one year or

more) will be done in the U.S. In addition, it is recommended that two persons receive eight (8) month training at Roorkee University in Water Management. All other training will be shorter term and in-country.

6) PVO Involvement: Mission should consider utilizing PVOs as agents for project implementation and management.

PVOs will be utilized in the project, wherever possible, given their strong motivation and community orientation. It is anticipated that the chak development program under the project will be an area for active PVO participation. Special mention was made of involving the Himachal Pradesh Agricultural University.

Annex VIII

5C(2) - PROJECT CHECKLIST

Listed below are statutory criteria applicable generally to projects with FAA funds and project criteria applicable to individual fund sources: Development Assistance (with a sub-category for criteria applicable only to loans); and Economic Support Fund.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP-TO-DATE? Yes.

HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT? Yes.

A. General Criteria for Project

1. Continuing Resolution Unnumbered: FAA Sec.653(b); Sec. 634A. (a)Describe how Committees on Appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more that $1 million over that figure)?	(a) Formal Notification to Congressional Committees was given in AID's FY 84 Congressional Presentation. A Congressional Notification will be forwarded prior to the initial obligation of funds. (b) Yes.
2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000 will there be (a) engineering, financial and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?	(a) Yes. (b) Yes.
3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?	Not applicable.
4. FAA Sec. 611(b); Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as per the Principles and Standards for Planning Water and Related Land Resources dated October 25, 1973?	Yes.

5. FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability to effectively maintain and utilize the project?	Yes.
6. FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not executed? Information and conclusion whether assistance will encourage regional development programs.	No. Regional development programs are not pertinent to minor irrigation projects.
7. FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce and (f) strengthen free labor unions.	(a) Not applicable. (b) Yes, in the letting of certain construction and technical assistance contracts. (c) Yes, especially rural credit institutions, and water user cooperatives. (d) Not applicable. (e) Yes, especially in regard to irrigation technology. (f) Not applicable.
8. FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	U.S. technical assistance will be provided under this project; Indo-U.S. collaboration will be encouraged.
9. FAA Sec. 612(b); Sec. 636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized to meet the cost of contractual and other services.	The Government of Himachal Pradesh will finance between 45 and 50 percent of construction costs and is contributing sufficient amount of local currencies to meet the cost of contractual and other services.

10. FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and if so, what arrangements have been made for its release?	U.S. owned rupees are being used for various U.S. government agencies programs and administrative support.
11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?	Yes.
12. Continuing Resolution Sec. 522. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity.	Not applicable. Agricultural products produced will be consumed in India.

B. Funding Criteria for Project

1. Development Assistance Project Criteria

a. FAA Sec. 102(b); 113: 281a. Extent to which activity will (a) effectively involve the poor in development, by extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?	(a) These represent the entire intent of the project. (b) Water user organizations will be created on a prototype basis. Cooperative modes may be tried. (c) This project entirely supports Indian self-help in agricultural development. (d) A special pilot activity will encourage the increased participation of women. (e) Not applicable.

b. FAA Sec. 103, 103A, 104, 105, 106, & 107. Is assistance being made available: (include only applicable paragraph which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.)	
(1) [103] for agriculture, rural development or nutrition; if so, extent to which activity is designed to increase productivity and income of rural poor.	The project is specifically designed to increase the agricultural productivity of small farmers.
c. [107] is appropriate effort placed on use of appropriate technology?	Yes, especially regarding agricultural inputs and improved water management.
d. FAA Sec. 110(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or has the latter cost-sharing requirement been waived for a "relatively least-developed country)?	Yes, the recipient country will provide at least 25% of the costs of the program.
e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to the Congress been made and efforts for other financing, or is the recipient country "relatively least developed"?	Not applicable.
f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civil education and training in skills required for effective participation in governmental and political processes essential to self-government.	The project addresses the need for increased food production and will also minimize the risks of drought through the development of irrigation systems. Institutional development will be fostered insofar as the host country's implementing agencies will acquire a strengthened capacity to design, execute and maintain an effective irrigation system. Cooperative water management activities will be strengthened, encouraging local, self government efforts.

g. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase or productive capacities and self-sustaining economic growth?	Yes, especially land made more productive by irrigation.
2. Development Assistance Project Criteria (Loans Only).	
a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan including reasonableness of repayment prospects.	This $50 million loan is well within India's capability to pay and given India's track record there is no reason to doubt that it will be paid.
b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?	Not applicable.
3. Project Criteria Solely for Economic Support Fund Support Fund	

This section not applicable.

Department of State

UNCLASSIFIED Annex IX

TELEGRAM

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ORIGIN AID-00

ORIGIN OFFICE ASPA-01

INFO AMAD-01 ASDP-07 PPCE-01 PDPR-01 PPPB-02 GC-01 GCAF-01
GCFI-01 STFD-01 ASTR-02 STAG-02 SAST-01 AGRI-01 STFA-01
RELO-01 NMST-01 ASBI-02 /035 A4 326

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AID/PPC/CDIA:THILLER (DRAFT)
AID/ASIA/DP:LCHANDALL (DRAFT)
AID/ASIA/DP:JMCCARTHY (DRAFT)
AID/ASIA/BI:FBECKMAN (DRAFT)
AID/ASIA/BI:JHUNLEY (DRAFT)
AID/ASIA/PD/E:JLEMAIR (DRAFT)
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TAGS:
SUBJECT: APAC GUIDANCE - INDIA MAHARASHTRA MINOR IRRIGATION PROJECT (386-0490)

1. APAC REVIEWED AND APPROVED SUBJECT PP ON JUNE 6. FOLLOWING IS DISCUSSION OF ISSUES AND RECOMMENDATIONS.

2. FARMER PARTICIPATION: APAC WAS CONCERNED THAT PROJECT WAS NOT DOING ENOUGH TO INCREASE FARMER PARTICIPATION, ESPECIALLY GIVEN PROGRESSIVE ENVIRONMENT AND MATURITY OF INSTITUTIONS IN MAHARASHTRA. IT WAS SUGGESTED THAT SINCE THIS IS AN EXPERIMENTAL PROJECT, THE MISSION AND GOM SHOULD BE WILLING TO TAKE MORE RISKS. APAC WOULD HAVE LIKED PP TO INCLUDE GREATER FARMER PARTICIPATION IN CONSTRUCTION OF SCHEMES AND GREATER INVOLVEMENT OF PVOS IN THE FORMATION OF WATER USER ORGANIZATIONS. AID/W WOULD CONSIDER IT A SUBSTANTIAL ACHIEVEMENT IF ORGANIZATION OF OUTLET COMMITTEES TOOK PLACE IN AT LEAST HALF OF THE COMMAND AREA ON A.I.D. FINANCED SCHEMES. ALTHOUGH THIS IS IDENTIFIED AS PART OF THE FINAL DISBURSEMENT TRIGGER, THE PP DOES NOT ELABORATE ON HOW THE MISSION AND GOM WILL GO ABOUT ORGANIZING THE COMMITTEES; NOR DOES IT DEFINE THE COMMITTEES. APAC RECOMMENDED A COVENANT

WHICH REQUIRES THAT THE GOI SUBMIT A PLAN WITHIN TWO YEARS OF THE INITIATION OF THE PROJECT THAT DESCRIBES THE ORGANIZATION, AUTHORITIES, AND RESPONSIBILITIES OF THE COMMITTEES AND PROVIDES A SCHEDULE FOR ACTIVATING THE COMMITTEES. THESE COMMITTEES SHOULD HAVE ASSURED FUNDING FOR OPERATIONS AND MAINTENANCE. IDEALLY, THEY SHOULD HAVE DIRECT ACCESS TO USER FEES.

3. OPERATIONS AND MAINTENANCE: APAC FELT THAT PROJECT PAPER SHOULD HAVE DIRECTED MORE ATTENTION AND RESOURCES

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TO OPERATION AND MAINTENANCE OF IRRIGATION SCHEMES. IT WAS NOTED THAT IMPROVED DESIGN AND CONSTRUCTION STANDARDS PROMOTED UNDER PROJECT WILL DECREASE MAINTENANCE REQUIREMENTS. HOWEVER, TO FURTHER ENSURE SUCCESSFUL OPERATION AND ADEQUATE MAINTENANCE OF SCHEMES IT WAS RECOMMENDED THAT FARMERS BE INVOLVED EARLY ON IN DISCUSSIONS ON O AND M AND THAT APPRAISAL REPORTS BE REVIEWED FOR SUFFICIENT O AND M FUNDS. IT IS ALSO HOPED THAT THE MISSION EXPLORE THE POSSIBILITY OF EXTENDING A.I.D.'S INVOLVEMENT WITH A FEW OF THE EARLY COMPLETED SCHEMES TO EXPERIMENT WITH VARIOUS WAYS OF IMPROVING O AND M PROCEDURES WITH ACTUAL COMMUNITY MANAGEMENT SYSTEMS OPERATIONS, INCLUDING FUNDING SUPPORT IF NECESSARY.

4. POTENTIAL IMPLEMENTATION AND PIPELINE PROBLEMS: APAC QUESTIONED GOM ABSORPTIVE CAPACITY IN TERMS OF BUDGET SUPPORT AND TRAINED MANPOWER, PARTICULARLY IN VIEW OF MAHARASHTRA IRRIGATION TECHNOLOGY AND MANAGEMENT PROJECT (MITM) UNDER WHICH GOM HAS NOT YET PROVIDED SUFFICIENT STAFF AND ADEQUATE FUNDS. APAC WAS ALSO CONCERNED THAT, IN VIEW OF THE LARGE VOLUME OF DESIGN AND CONSTRUCTION IN THE MISSION'S PORTFOLIO, REQUIRING ENGINEERING EXPERTISE, THE MISSION DID NOT HAVE THE U.S. DIRECT HIRE ENGINEERING CAPABILITY TO MONITOR CONSTRUCTION OF 102 SEPARATE IRRIGATION PROJECTS. GIVEN THESE PERCEIVED CONSTRAINTS, APAC FELT THAT IMPLEMENTATION MIGHT MOVE TOO SLOWLY AND THAT PIPELINE PROBLEMS WOULD ENSUE. MISSION REPRESENTATIVE INDICATED MISSION SATISFACTION WITH PROGRESS UNDER THE MITM PROJECT NOTING THAT OVER 30 PERCENT OF GOM PROJECT STAFF WAS IN PLACE AND THAT PROJECT EXPENDITURE RATE WAS ACCEPTABLE. HE EXPRESSED CONFIDENCE THAT THE GOM WOULD PROVIDE SUFFICIENT FUNDS AND STAFF FOR THIS PROJECT. HE ALSO EXPLAINED HOW MISSION STAFF WAS ORGANIZED TO IMPLEMENT PROJECT AND ASSURED APAC OF MISSION'S ENGINEERING MONITORING CAPABILITY. APAC RECOMMENDED THAT IMPLEMENTATION AND MONITORING BURDEN BE TAKEN INTO

CONSIDERATION IN DETERMINING SITES FOR USAID FINANCED SCHEMES.

5. DEGREE AND TYPE OF INSTITUTIONAL CHANGE: APAC FELT PP TO BE UNCLEAR AS TO DEGREE AND TYPE OF INSTITUTIONAL CHANGES THAT WOULD BE ACCOMPLISHED THROUGH THE PROJECT. PROPOSED ASSESSMENT OF IRRIGATION SECTOR SHOULD IDENTIFY MISSION'S ULTIMATE GOALS AND OBJECTIVES IN INDIA'S IRRIGATION SECTOR AND DISCUSS WHERE MISSION WILL BE IN REGARD TO THE ACHIEVEMENT OF THESE GOALS AND OBJECTIVES AS A RESULT OF THIS PROJECT.

6. TECHNICAL ASSISTANCE: APAC ENDORSED PP PROPOSAL TO TAP WATER MANAGEMENT SYNTHESIS PROJECT FOR TECHNICAL ASSISTANCE. IT WAS AGREED THAT THIS WOULD ACCELERATE PROJECT IMPLEMENTATION AND ENABLE THE MISSION TO COORDINATE TA FOR THIS PROJECT WITH TA BEING PROVIDED UNDER OTHER STATE SPECIFIC PROJECTS. TO COMPLEMENT ENGINEERING SKILLS OF OLSEN AND TO FACILITATE GREATER FARMER PARTICIPATION, APAC RECOMMENDING THAT LONG TERM EXPATRIATE FUNDED UNDER THIS PROJECT HAVE STRONG SOCIAL SCIENCE CREDENTIALS. HOWEVER, MISSION'S STATED INTENTION TO USE WHS II FOR TA TO SEVERAL STATE LEVEL PROJECTS RAISES SEVERAL IMPORTANT ISSUES FOR WHS II THAT MUST BE RESOLVED. THESE INCLUDE MANAGEMENT OF THE ACTIVITIES (GIVEN THREE MAJOR PARTICIPATING UNIVERSITIES IN THE PROJECT) AND THE LIKLIHOOD THAT THE PROJECT FUNDING CEILING WILL BE REACHED BY FY 86.

7. ECONOMIC VIABILITY: THE APAC NOTED THE PARTICULAR SENSITIVITY OF THE ERR TO ASSUMPTIONS ABOUT THE FRACTION

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OF THE DESIGNATED AREA TO WHICH IRRIGATION IS ACTUALLY PROVIDED, AS WELL AS THE UNCERTAINTY ABOUT UTILIZATION RATES BASED ON CURRENT PRACTICES. IN VIEW OF THIS SENSITIVITY, THE APAC RECOMMENDED THAT THE MISSION, IN EVALUATIONS, INSURE THAT DATA ARE AVAILABLE THAT PERMIT RECALCULATION OF FARS THAT REFLECT ACTUAL EXPERIENCE.

8. DISBURSEMENT PROCEDURES: FM CONCURRED WITH DISBURSEMENT PROCEDURES PROPOSED IN PP PROVIDED A CLEAR AUDIT TRAIL OF MISSION MONITORING AND DISBURSEMENT APPROVAL ACTIONS IS CREATED AND ANNUAL REVIEWS TAKE PLACE OF PROJECT RELATED FINANCIAL RECORDS MAINTAINED BY THE GOM. THESE REVIEWS CAN BE CONDUCTED BY GOVERNMENT AUDIT AGENCIES OR INDEPENDENT ACCOUNTING FIRMS PAID BY LOAN PROCEEDS.

9. PROJECT OUTPUT: APAC NOTED THAT THE PROJECT COSTS WERE BASED ON THE COST PER HECTARE OF IRRIGATION AND

DRAINAGE SYSTEMS. AS SUCH THE APAC CONCLUDED THAT THE PROJECT PAPER SHOULD BE ADJUSTED SO THAT RATHER THAN NUMBERS OF SCHEMES, THE OUTPUT WILL BE 31,000 HECTARES BROUGHT UNDER IRRIGATION CONSISTING OF APPROXIMATELY 90 SCHEMES INCLUDING THE REHABILITATION OF APPROXIMATELY 12 EXISTING SCHEMES. SHULTZ

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Annex X

D.O. No.F2(10)AID/83

भारत सरकार

वित्त मंत्रालय

आर्थिक कार्य विभाग

Government of India (Bharat Sarkar)

Ministry of Finance (Vitta Mantralaya)

Department of Economic Affairs (Arthik Karya Vibhag)

H C PANT
DIRECTOR (AC)
Tele. No. 372020

सत्यमेव जयते

New Delhi, 31st July, 1984.

Dear Dr. Brown,

This has reference to our recent discussions regarding the US assistance for Himachal Pradesh Hill Areas Land and Water Development Project. The total cost of this project is presently estimated as $ 79 million. US AID have expressed an interest in providing assistance to the extent of $ 54 million during the life of this project. The balance amount of $ 25 million would be the Indian contribution for this project.

2. As a first instalment, I am to request that an amount of $ 15.5 million ($ 14.5 million in loan and $ 1 million in grant) may kindly be provided for this project. The balance amount may be provided in subsequent instalments. The Indian contribution towards the first instalment would be $ 7.25 million and the balance amount of $ 17.75 would be provided at the time of concluding Agreements for the subsequent instalments.

3. I shall be grateful if the earliest consideration to this request is accorded.

With kind regards,

Yours sincerely,

(H C Pant)

Dr. Richard M. Brown,
Acting Director,
US AID,
New Delhi.

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Section 611(e) Certification
Hill Areas Land and Water Development Project

This project will strengthen institutional and community capacity to develop and manage minor irrigation systems including land development in the hill areas. The A.I.D. loan will finance two-thirds of eligible construction costs for up to 150 minor irrigation schemes including land development. The A.I.D. grant will fully finance technical assistance, training, research and field studies to enhance institutional capabilities and develop more appropriate technologies and community management systems.

I, Owen Cylke, Principal Officer of the Agency for International Development in India, do hereby certify that in my judgment the Government of India and the Government of Himachal Pradesh have both the financial capacity and the resources to carry out, maintain and utilize this project effectively. This judgment is based upon the analyses contained in the Project Paper, as well as upon the successful maintenance and utilization of projects in India previously financed or assisted by the United States.

Owen Cylke, Director
USAID/India 06/11/84

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AGENCY FOR INTERNATIONAL DEVELOPMENT

WASHINGTON, D.C. 20523

PROJECT PAPER

INDIA

HILL AREA LAND AND DEVELOPMENT PROJECT

(386-0489)

VOLUME II

PROJECT ANALYSIS

USAID/NEW DELHI

MAY 1984

UNCLASSIFIED

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HILL AREA LAND AND WATER DEVELOPMENT PROJECT

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	II	-	Agricultural Analysis
	III	-	Technical Analysis of the Irrigation Facilities
	IV	-	Social Soundness Analysis
	V	-	Environmental Scoping Statement
	VI	-	Economic and Financial Analysis
	VII	-	Project Development and Implementation

CHAPTER I

INSTITUTIONAL ANALYSIS

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A. Introduction

The USAID Mission has identified institutional development as one of the important means for achieving desired irrigation development outcomes in India.[1] The basic assumption on which this strategy rests is that the existing "institutional setup" in irrigation is an important determinant of the performance and outcomes associated with irrigation projects. That is, it is assumed that improving performance and outcomes may benefit from improvements in the present institutional arrangements.

This discussion seeks to consider institutional development matters related to irrigation development in the state of Himachal Pradesh by examining the present "institutional setup" in the state, and relating these institutional arrangements to important aspects of irrigation performance. For purposes of this discussion, the meaning of institutions presented in AID's recent discussion of institutional development will be adopted.[2] Institutions is used to refer to both the specific organizations and to broad policies, rules, formal laws or conventions for taking action. Particular attention is given to the institutional aspects of four key aspects of irrigation performance that have been identified by the Mission as desirable:[3]

- Increased attention to system operation and management, including the important matter of water utilization;
- Increased beneficiary involvement in project planning, implementation, and subsequent operation, including the mobilization of local knowledge, experience, and resources;
- Greater mobilization of private sector resources, including individual farmer entrepreneurs, private farmer groups, small business enterprises, private voluntary agencies and research groups; and
- Improved procedures and criteria for the planning, design and construction of irrigation systems that meet the needs of a changing agriculture.

1/ See the Country Development Strategy Statement, 1983.

2/ AID Policy Paper: Institutional Development. Washington, U.S. Agency for International Development, 1983.

3/ These are extracted from the Country Development Strategy Statement, 1983.

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As will be discussed below, while the State's irrigation agencies have achieved a great deal, there is much in the present institutional setup that limits the achievement of these four outcomes. And, thus, there can be derived particular project activities that can contribute to instititional development. Prior to discussing these points, a more basic description of the agencies and groups involved in Himachal's irrigation sector is required.

B. Himachal Pradesh Irrigation Sector: Policy Context and the Key Actors

1. The Sector

Government policies and actions in the State of Himachal Pradesh are profoundly influenced by the State's conception of itself as a welfare state. Government is viewed as responsible for providing a broad range of services to its citizens including the service of irrigation. And, since the citizens of the State, particularly in the rural sector, are viewed as economically weak and disadvantaged, these services are expected to be provided at only "nominal" charges. As will be described below, both the political system and the technocratic agencies which it controls, act to produce this desired image of the State's role. Within this large ideological context irrigation policies are formulated and action taken by the Government.

In Himachal Pradesh both government agencies and farmers have created irrigation systems though farmers have been at it longer. In March 1983, the Department of Irrigation and Public Health reported an irrigated area of 136,255 ha. of which 78,993 ha. or 56 percent are served by community systems.[4/] Other sources suggest that this percentage may be even higher.[5/] Both farmer and public systems are small, in Indian terms minor.[6/] Only about six projects, existing, under construction or planned exceed 2,000 ha with a total of 20,000 ha. Farmer schemes normally are flow schemes, known as kuhls; public schemes include both flow and lift systems. The water source for kuhls is either perennial or seasonal springs or streams. Lift schemes use both surface and groundwater sources.

4/ Strictly speaking, some of these farmer-built systems may actually have been built by the governments of earlier periods, i.e. by the rajas using the institution of corvee labor. Others may have been built by more spontaneous and independent cultivator actions. Basic historical information on these processes is lacking.

5/ Report of the ICAR Research Review Committee for Himachal Pradesh, Krishi Vishva Vidyalaya. Indian Council of Agricultural Research. New Delhi, 1982, p.9.

6/ Nominally irrigating less than 2,000 ha.

Various statistical sources up to 1978 and over the previous decade report a net area of about 90,000 ha. irrigated with about 66,000 ha. sown more than once or a gross cropped area irrigated of about 156,000 ha.[7/] Public investment in irrigation began to take hold during the Fifth Plan (1973-78), but the increased area is not reflected in most statistical sources. Information from the Narmada P.P. Cell and the Central Water Commission of the GOI Ministry of Irrigation show areas somewhat lower than those reported by GOHP (see Chapter II, Section B3). Since essentially all of the development in recent years has been public, by inference about 79,000 ha. are now served, and have been served for some time in the past, by community kuhls.

Several governmental agencies are engaged in irrigation development. They are involved in creating new commands, repairing and remodeling existing facilities and intensifying facilities at the watercourse level. The major agency involved in irrigation development effort and budget is the Irrigation and Public Health Department (ID) of the Department of Public Works, followed by the Soil Conservation Wing (AD/SC) of the Agriculture Department. The Rural Development Department (RD) mostly carries out repairs, maintenance and construction of small flow schemes costing up to Rs 50,000. The following paragraphs describe the various activites of these three irrigation implementation agencies and of other supporting resource organizations. Some information about present relative budgets and staff capacities is included.

2. Irrigation and Public Health (ID):

As mentioned, the ID is a component of the larger Public Works Department (PWD) whose other major wing is the Department of Building and Roads (B&R). The separate ID was created in 1974. Previously, ID and B&R functions were combined. At present, the ID has six independent circles and the four remaining combined with B&R. Efforts are underway to separate these circles also since it has an important implication for the degree of specialization which is required, or desirable, for staff to achieve. This will avoid common "construction" orientation to the activities of both wings of Public Works.

The public health activities of the ID are focused on constructing village water supply systems for domestic water needs. The ongoing program of providing drinking water supplies to the many and scattered villages of the State is also a difficult challenge which appears to be met. These accomplishments are important in considering the Department's irrigation activities which it tends to approach with the same enthusiastic attitude as for its other tasks.

7/ See for example: Statistical Outline of Himachal Pradesh 1980. Directorate of Economics and Statistics. Himachal Pradesh, Simla, p. 74,76.

With regard to irrigation, the ID focuses its attention on the following activities:

-- Construction of new flow irrigation systems and operation and maintenance of these schemes to the outlet level,[8/] primarily minor schemes but including six or more medium schemes;

Constructing and operating lift irrigation schemes (using either surface, groundwater, or both), primarily minor schemes but including one or more medium schemes.

-- Remodeling of community and public kuhls and the subsequent operation and maintenance of these systems; while a considerable activity in the past, present ID policy is no longer to rehabilitate, operate and maintain community kuhls.

In FY 83-84,[9/] the ID has a budget of Rs. 172.1 million ($17.2 million) for its domestic water supply activities and Rs. 62.76 million ($6.28 million) for minor irrigation projects. The ID is headed by a single Chief Engineer (CE) who with his staff has responsibility for both irrigation and domestic water supply activities. He is assisted by ten Superintending Engineers (SE), six of whom have independent implementing responsibility for each of six regions, called circles, and the other four have joint responsibility of irrigation, domestic water supply, building and roads (B&R). Another SE at the headquarters coordinates planning and design activities at the state level. He is assisted by four Executive Engineers (EE), Design, one EE (Monitoring), and one EE (Master Plan). Eight EEs assist in the design activities at the circle level and another EE assists in the groundwater exploration activities. In addition, 29 EEs assist circle level Field Superintending Engineers, each responsible for a division of the circle. EEs are assisted by Assistant Engineers (AE) working at the subdivision level and Junior Engineers (JE) working at the project level. Presently, there are 101 AEs and 415 JEs in position. About ten percent of sanctioned staff positions are unfilled for various reasons.

At entry level, AEs and JEs are degree graduates from engineering colleges or diploma holders from polytechnic schools. Higher ranks are filled by promotion and most are engineering college graduates, though some may be diploma holders with extensive years of experience in the department.

8/ The outlet is the canal service gate through which water is delivered from the public system to groups of farmers. In Himachal Pradesh outlets normally serve 5 to 8 hectares.

9/ For India beginning April 1, 1983 and ending March 31, 1984.

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Reportedly, at the level of the senior posts, SE, and EE, there presently are more incentives available to those in the B&R division than those in the ID unit. One Superintending Engineer, recently moved from B&R to ID, indicated that in the circle to which he was assigned, both the SE and the EE in the B&R unit were provided housing, while none was available for him. Thus, the present incentives structure appears to favor the B&R group. As mentioned earlier, the present pattern of moving staff between B&R and ID, and the preference that many staff may have for being with the B&R unit, discourages specialization in irrigation activities or concern with irrigation matters other than engineering design and construction. At present are no incentives for ID engineers to be concerned with matters of system operation and the interface of these systems with agricultural production. However, with the anticipated separation of ID from other functions of Public Works Department which is under consideration, the ID staff will enjoy the same facilities as available to B&R engineers.

3. Soil Conservation Wing of the Agriculture Department (SC/AD):

The SC/AD is headed at the State level by a Joint Director. For a brief time, this unit was combined with a similar soil conservation wing from the Foresty Department into a single, independent, Soil Conservaton Department. However, early in 1983, this separate department was disbanded and the two units returned to their respective departments. As a part of the Agriculture Department, the SC/AD has a tradition of working with both individual farmers and community groups. The Agriculture Department was a major participant in the Indo-German Agriculture Project (1966-1977), a previous cooperative program with the German Government. This included a number of irrigation development activities.[10/] As a result of this project, the Agriculture Department was actively involved in a number of irrigation development activities, including the installation of tubewells and assisting farmers to install dug wells with pump sets.

The present activities of the SC/AD with regard to irrigation include:

-- Installing groundwater irrigation systems (both dug wells and tubewells). Dug wells serve primarily individual farmers though some are provided to groups of small and marginal farmers;
-- Installing water harvesting facilities (collection tanks, check dams, etc.). These serve both individual farmers and groups; and
-- Assisting farmers to develop watercourses to distribute water from the main system outlets provided by the ID.

10/ S.C. Tawari and R.K. Sharma: Impact of the Performance of the Indo-German Agriculture Project Kangra. Palampur, H.P.: Dharama Light Press. n.d.

In addition to its irrigation activities, SC/AD has responsibility for conservation activities on private, common and waste lands and erosion control on watersheds (Chapter II, Section C 3).

This unit of the Agriculture Department appears to be a strong component of the overall department. In addition to the Joint Director, the unit has two Assistant Soil Survey Officers trained at the B.Sc. or M.Sc. level and 16 Assistant Soil Conservation Officers with six months special training in soil conservation trained at B.Sc. or M.Sc. level and 10-12 years field experience. At the field level, the work of the Soil Conservation wing is implemented by 47 Agricultural Inspectors and 145 Agricultural Sub-Inspectors. The SC/AD also employs 13 diploma level Junior Engineers. This cadre is responsible for all activities of SC/AD.

For FY 83-84, SC/AD reported a budget of approximately Rs. 13.96 million ($1.4 million) for its various soil conservation projects. For irrigation activities for FY 1984-85, SC/AD has requested Rs. 11.4 million ($1.1 million).

4. The Rural Development Department (RD):

This department, which grew out of India's earlier community development programs, is strongly oriented to work at the block level and has activities in collaboration with the local government units, called panchayats. In Himachal Pradesh, the RD is engaged in the following irrigation-related activities:

-- Assisting panchayats to finance and implement minor repairs to community kuhls;
-- Under its Integrated Rural Development Program, providing subsidized loans to small and marginal farmers, a portion which they may invest in irrigation facilities; and
-- With funding from the center's Desert Development Program, constructing new flow schemes in the regions of Lahaul-Spiti and Kinnaur. These systems are subsequently operated and maintained by the ID.

In FY 83-84, the RD has a budget of approximately Rs. 3.5 million ($350,000) for its work with community kuhls. This modest figure translates into a very limited budget at the block level, about $5,000 per block on the average. In one block visited in Kangra District, an area reported to have a total of 80-90 community kuhls, the total budget for this activity was Rs. 80,000. These funds are used for small repair projects not exceeding Rs. 50,000 in cost and are matched by a 12.5 percent contribution from the beneficiaries; usually in labor, but sometimes in cash. The RD is headed at State level by a Director cum Joint Secretary. At District level, there is a Rural Development Agency with the Deputy Commissioner as Chairman. He is assisted by an

Additional Rural Magistrate (Development), Project Officer, Assistant Engineer, Lady Circle Supervisor in charge of women's program and Block Development Officer. Besides repair of kuhls and small water supply schemes, the Rural Development Agency has responsibility for a number of other programs involving training, rural employment and nutrition, among others. Irrigation works and other activities involving physical infrastructure repair or construction, is implemented by a corps of engineers headed by an Executive Engineer at State level, 12 Assistant Engineers at District level and Junior Engineers at each of the State's 69 Blocks. The staff members have comparable training to the same level of engineers in the ID.

5. Other Resource Organizations:

In addition to the three mainline irrigation organizations desribed above, there are several other important resource instititions that should be mentioned.

a. Agricultural University

The Himachal Pradesh Agricultural University has campuses in Palampur and in Solan. While both are engaged in teaching, the Palampur campus is more involved in graduate training and research. For the past several years, the Soil and Water Management Deparment has been involved in various studies concerned with watershed management, and plant-soil-water relationships and has conducted some limited research on water losses in selected flow irrigation schemes. The Department of Economics has conducted a limited amount of research in irrigation economics and plans to do more. The University appears to have good interaction with the Agriculture and Horticulture Departments, but only very limited involvement with the ID.

b. Polytechnic Institutes

Also of importance are the two Polytechnic Institutes located in Sundarnagar and Hamirpur. These institutes offer a three-year diploma program with specializations in several fields including civil engineering. The curriculum in civil engineering includes some instruction regarding irrigation. The polytechnics are the source of most of the Junior Engineers employed by the irrigation implementation agencies. With the proposed establishment of an Engineering College in the state, the availability of engineers from within the state is likely to enhance in future.

c. Agricultural Extension

In addition to the Soil Conservation Wing, the Agriculture Department has an active program of extension activities carried out

through subject matter specialists at the district level and extension officers at the block level in the 69 development blocks in the State. Currently there is discussion between the World Bank and the Extension Wing about introducing the Training and Visit (T&V) system.

d. Department of Horticulture

Because of the importance of horticulture products in the State, there is a separate Department of Horticulture. Few of the important horticultural crops grown mostly in the middle hills region now depend upon irrigation, practically none of the important peach, plum, apricot and pear crop is irrigated, for example. The Director of Horticulture believes that much of the potential for future growth lies with the production of certain tropical fruits in the lower hills region where rainfall is lower. He sees a greater interaction between irrigation development and horticulture producton in the future and recognizes the need for greater interaction among the other concerned departments.

The Department maintains offices in all of the twelve districts in the State. There are senior subject matter specialists at the Directorate level in Simla. For administration of the extension program, the State is divided into two zones. The subtropical zone is administered by an Additional Director of Horticulture. In addition to his overall responsibilities, the Director also administers the temperate zone. There are three Deputy Directors with headquarters in Una, Kulu and Simla. At district level, a District Horticultural Officer is responsible for extension and in most districts, a Horticultural Development Officer is responsible for management of departmental orchards. Horticultural Inspectors are available at block level. At the village level, the extension program is implemented by the Village Level Worker who is a functionary of the Rural Development Department.

The Department's responsibilities are to provide service and assistance in development of all sectors of horticulture; plantation, input supply, production management, plant protection, plant nutrition, credit, marketing and processing and development of ancillary activities like bee-keeping, floriculture, mushroom cultivation, etc.

e. Forestry Department including Soil Conservation (Forest)

The Forestry Department including Soil Conservation (Forestry) is responsible for managing much of the watershed that provides irrigation water. Watershed management is important to irrigation because it influences the amount of silt produced, the magnitude of floods, duration of flow and recharge of groundwater.

The Forest Department is organized under the Chief Conservator of Forests, who is assisted by 10 Conservators of Forests and 37 Deputy Conservators of Forests. Conservators of Forests have responsibility for scientific management of forests including exploitation, plantations and protection and construction of forest roads, maintenance of depots, etc.

Deputy Conservators of Forests have responsibility for management of forest business, financing and operations within the working plans of the Chief Forest Conservator and Forest Conservators. Range management on specific ranges is under the charge of a Forest Ranger assisted by Deputy Forest Rangers and Forest Guards.

The State has a goal of bringing at least 50 percent of its area under forest cover. In accordance with the Prime Minister's 20-Point Program, social and farm forestry is given emphasis. During 1982-83 afforestation was provided on an area of 19,700 ha, 13,700 ha under social forestry programs. The target for 1983-84 afforestation is 15,000 ha. Emphasis is also being given to fuel and fodder species.

The Soil Conservation Department in the Department of Forestry is concerned primarily with protection of watersheds by reforestation and engineering works. The department is headed by a Director with a deputy officer for watershed management and planning, an executive engineer, a hydrologist and two chief foresters, one at the Simla office and one at Dharamsala. There are five deputy forestry officers under each chief forester and three or four rangers under each deputy forestry officer. These officers along with six assistant soil conservation officers have responsibility for all of the field operators in the districts. Officers trained in forestry discipline are given specialized soil conservation training at training and research institutes maintained by the Indian Council of Agricultural Research.

6. Civil Administration

For purposes of civil administration, the State is divided into 12 districts. These are further subdivided into tehsils, and in some cases, sub-tehsils, Table 1. The Chief Secretary has overall reponsibility for civil administration. Deputy Commissioners are responsible at district level. They are responsible to Divisional Commissioners who are in turn responsible to the Chief Secretary. Deputy Commissioners are assisted by an Additional District Magistrate and General Assistant.

Development programs are carried out through 69 Development Blocks. At district level, the Deputy Commissioner chairs a Rural Development Agency which is responsible for these programs. The Deputy Commissioner is assisted by an Additional District Magistrate (Development), Project Officer, Assistant Engineer (Development), Lady Cirle Supervisor in charge of women's programs and Block Development Officer. The governing body lays out programs for the district within the framework of guidelines issued by the State Government. At the Block level, programs are implemented through the Block Development Officers.

Table 1: Administrative Divisions/Subdivisions in Himachal Pradesh

District	Subdivisions	Tehsils	Sub-Tehsils
1. Bilaspur	Bilaspur	Bilaspur	Shri Naina Deviji
	Ghumarwin	Ghumarwin	
2. Chamba	Chamba	Chamba	
	Churah	Churah	Salooni
	Pangi	Pangi	
	Bharmour	Bharmour	
	Dalhousie	Bhattiyat	Sihunta
3. Hamirpur	Hamirpur	Hamirpur	Nadaun
			Sujanpur
	Badsar	Badsar	
4. Kangra	Kangra	Kangra	
	Palampur	Palampur	Jaisinghpur
	Nurpur	Nurpur	Indora
	Dehra Gopipur	Dehra Gopipur	Khundian
5. Kinnaur	Nichar	Nichar	
	Kalpa	Kalpa	
		Sangla	
	Pooh	Pooh	Hangrang
		Moorang	
6. Kulu	Kulu	Kulu	
		Nirmand	
	Ani	Banjar	Ani
7. Lahaul-Spiti	Lahaul Spiti	Lahaul Spiti	Udaypur

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District	Subdivisions	Tehsils	Sub-Tehsils
8. Mandi	Mandi	Mandi	Thunag
		Chachiot	Balichowki
	Jogindernagar	Jogindernagar	Bharol
	Sarkaghat	Sarkaghat	Sandhol
	Sundernagar	Sundernagar	
	Karsog	Karsog	
9. Simla	Simla	Simla	
		Suni	
	Theog	Theog	
		Kotkhai	
	Rampur	Rampur	Nankhari
		Kumarsain	
	Chopal	Chopal	Nerwa
	Rohru	Rohru	
		Jubbal	
10. Sirmur	Nahan	Nahan	
		Renuka	
		Shillai	
	Paonta Sahib	Paonta Sahib	
	Kajgarh	Pachhad	
		Rajgarh	
11. Solan	Solan	Solan	
		Kasauli	
	Nalagarh	Nalagarh	Ramshahar
	Arki	Arki	
	Kandaghat	Kandaghat	
12. Una	Una	Una	Haroli
		Amb	
		Bangana	

7. Financing and Credit

Financing of irrigation development is primarily through loans or transfers from the Central Government (called plan funds, i.e. approved under State and Center Development Plans). Operation and maintenance funds are from non-plan funds provided by the State.

For ID schemes, except for some increases in land revenues because of higher assessments on irrigated land, investment in development is a full subsidy, water charge receipts do not cover costs of O&M. (See Section 5D) Traditionally, this investment has paid for facilities for diversion and distribution of irrigation water down to outlets serving about 40 hectares, recently main systems distribution have been extended to outlets serving 5 to 8 hectares.

Under the Project, development of watercourses and field channels along with land development on individual farms is required as part of the project.

For SC/AD schemes, which include field channels and land development, about 50 percent of the initial public cost is an outright subsidy. The remainder is met by appropriations by the State to provide credit to small and marginal farmers. (See Chapter II, Section C5). However, there are ceilings on subsidies to individuals and schemes, so some additional private financing, mostly through commercial banks, adds to the total investment. How much the private investment in irrigation development amounts to is unknown, but it is probably relatively small.

Except for a 12 1/2 percent matching requirement, capital investments in irrigation made by the RD are publicly financed with no repayment obligation.

On public schemes under the Irrigation Department, annual appropriations are made for operation and maintenance. About 12.5 percent of the annual budget goes for O&M. For private kuhls and facilities constructed by SC/AD and RD, operation and maintenance is the responsibility of the users.

Short-term crop loans are provided principally through primary Agricultural Cooperative Societies, but also by commercial banks. (See Chapter II, Section C5)

C. The Foci of Agency Efforts

For all three of the principal implementing departments, irrigation development is one of the major activities, an activity to which they contribute while carrying out other important, and sometimes, competing mandates. Having irrigation activities embedded in departments with broader mandates is not all bad. It means, for example, that good engineers in ID construct irrigation systems and that RD ties irrigation work to the local community through its close contacts with the panchayats. On the other hand, it leaves the State without a specialized irrigation agency for irrigation water management.

The present approach to irrigation development by these agencies tends to be less than comprehensive. Primary attention is given to constructing works with less attention to water utilization for increased agricultural production. For example, consistent with its mandate to construct new irrigation facilties, the ID seems to focus on maximizing the creation of irrigation potential. Irrigation potential is defined as the area of land that is suitable for agriculture, which lies below the head of the outlet and which could be served by the volume of water being supplied to the system using a standard "duty" of water for calculation. In nearly all cases, the actual CCA greatly exceeds the actual number of hectares being irrigated in a particular system, often the actual irrigated area may be only 60 percent or less of the planned CCA. Nevertheless, it is irrigation potential which is reported as the accomplishment of the construction-oriented ID. Crop and soil water requirements are not included in design and operational decisions. Design criteria that utilize a fixed water duty (usually reported to be one cusec per 150 acres) clearly will result in over-generalization regarding the specific water requirements of any particular site and may be a partial explanation for the low rates of water utilization reported. The approach of the Agriculture Department in designing its systems appears to be equally simplified.

The focus on CCA and the inadequate use of agronomic data in system design is exacerbated by the present rule which divides responsibility for system operation into two tiers. The main works are operated and maintained by ID down to the outlet, or chak, level, a unit commanding from 5 to 8 hectares and involving perhaps twice as many farmers. Below the outlet, the State expects that the chak "group" will develop and maintain the physical facilities to distribute water from the public outlet to the individual farm plots and implement an orderly system of water allocation among the users. This is not an unreasonable division of responsibility but its success depends upon several preconditions. One is that the main system facilities operate satisfactorily and provide a reliable water supply to the outlets. Unfortunately, this often is not the case. Farmer inaction, or farmer disorganization, is then

attributed as a "social" problem, without recognizing technical shortcomings that influence farmer behavior may exist. A second prerequisite of successful farmer action at the chak level is that the State be prepared to assist farmers in carrying out the functions that have been assigned to them. This does not mean doing the job for them, but rather providing technical advice, organizational assistance and perhaps limited financial aid to plan and implement the work to be done. Often the separate roles of the farmer and the government agencies are not well defined or understood.

One result of these various factors is the pervasive problem of low water utilization mentioned above. Low water utilization is simply another means of referring to the gap between planned CCA and actual irrigated area. The delivery of water to the farm fields as intended in the project design does not occur. Direct and interrelated reasons for this seem to be inadequate control structures and operation of the main system, lack of watercourse facilities and absence of water user organizations.

The SC/AD, sometimes working with much smaller systems, such as a lift system for a single farm, has usually adopted a more comprehensive approach to irrigation development. Nearly all of the individual pump systems observed had a developed physical layout for distributing the water throughout the farm. Often, the costs of the distribution system were part of the original investment. But the SC/AD has a less comprehensive approach to the community water harvesting facilities that it constructs. In two such projects observed the SC/AD had built storage tanks with little or no provision for delivering water from them to nearby fields and with no attention to protecting the adjacent watershed of the tank. In other words, there was no technological or organizational effort to integrate the tank into a self-sustaining minor irrigation system. This situation is now being improved and this project aims at elimination of such conditions.

D. Beneficiary Participation

Himachal Pradesh views itself as a welfare state, but it also stands as a democratic state. These two images sometimes have opposing consequences for farmer participation. However, the history and nature of irrigation works in the State appear to favor farmer involvement and participation. A large portion of the existing irrigation systems are presently farmer-managed, and nearly all are small. This small size should be a positive factor for involving the water users in a variety of management and maintenance activities.[11/]

11/ For example, the team was provided information on completed kuhl projects in Dalhousie Circle (Chamba District). Of the 55 completed projects, 85 percent were systems of less than 100 ha. and 64 percent were less than 50 ha.

1. Initiation of Project Requests and Selection of Projects

Rural people in Himachal Pradesh participate in initiating requests for project assistance. The process of requesting irrigation assistance seems to follow the general pattern that Bhargava has identified in Karnataka. Most initiatives begin with representations from local people to their political representatives or directly to the technical agencies.[12] ID projects are identified initially in this manner. Following examination for feasibility, schemes actually submitted for budget approval become the sub-set of the locally-requested projects judged by the department as being technically and economically feasible. In the Rural Development Department, priorities are fixed by the Panchayat Samiti in response to block-level requests coming through the various panchayats.

Recently, the ID has begun another process of project identification which parallels that described above. This is the Master Planning effort in which possible minor irrigation projects in each tehsil (sub-district) are identified and compiled in a tehsil plan. Forty-nine of 54 proposed master plans have been finalized and the remaining five are under investigation or are being finalized. Water sources are selected in consultation with Pradhana, prominent water users of the area. Users are employed for surveys, investigations and execution of the schemes and are paid for their services. The extent to which local representations are used to prioritize among the various projects identified for any particular tehsil is not clear. Particularly in ID irrigation projects, there appears to be little beneficiary participation following the initial request stage. Recently, there appears to be an effort in this direction to associate beneficiaries.

2. Policy/Himachal Pradesh Minor Canals Act

The large role the ID has assumed in all facets of irrigation development seems to reflect the basic tone of the legal provisions contained in the Himachal Pradesh Minor Canals Act, 1976, which became operative in April, 1976. The Act provides the State with broad powers to regulate the supply of water to irrigation works of various kinds and to regulate the distribution of water to users within a given system.

The Act explicitly recognizes a category of irrigation schemes which are community operated and managed. These are designated as Schedule II systems and are defined as irrigation works serving more than one farmer, commanding more than 8 hectares and not owned or operated by the Government. While this class of systems is thus legally recognized, operation and management of such systems can be appropriated by the government if the community is judged to be carrying out operations in a manner harmful to the rights of others. The present irrigation law does

12/ See: B.S. Bhargava, Minor Irrigation Administration, New Delhi: Ashish Publishing House, 1980.

not provide any affirmative provision for water users to organize into legally recognized organizations with specified rights and responsibilities. However, if no manager and representative of the shareholders has been designated, the collector may require, by proclamation, the shareholder to nominate one. If this is not done by a specified time, the collector may appoint such a manager/representative.

In contrast to these community operated schemes the Schedule I systems under the Act are those owned and operated by the government. No records have, however, been compiled, identifying the number of irrigation works in these two categories. However, a roster of Schedule I and Schedule II systems at the time the Act was promulgated was appended to the Act. This roster includes a total of 361 government-managed systems. This includes 212 kuhls originally built and operated by communities. The remainder are publicly built kuhls. Since 1976 an additional 75 community kuhls have been rehabilitated by ID. Only a fraction of the total Government operated kuhls are listed.

The Act also provides for irrigation works to be transferred from one category to another. Community systems can thus become government-managed systems by the initiative and consent of the water users or if the government judges that the community's operation of the system is detrimental to the welfare of others.

For both categories of systems, the right to apportion water shares between and within irrigation systems lies with the State. In government-managed systems, the government has the responsibility for preparing a "record" for each system indicating the rule of irrigation in that place and identifying the rights to water held by the various water users, including mill operators. For community-managed systems, the government can fix the amount of land that can be irrigated, establish the amount and kind of water rates that can be collected by the community and regulate the supply and distribution of water to and from the main canal of the system.

3. Relation to Activities of the Irrigation Department

a. User Operation and Maintenance of Irrigation Facilities

Operation and maintenance of irrigation facilities by the users has the advantage of relieving the public sector of the cost and for providing O&M staff. Because of the remoteness of many of the schemes, logistics for supporting O&M staff is difficult and costly. Accordingly, efforts should be made, at least on a trial basis, for developing the capability of users to operate their own systems and testing the effectiveness of this approach. Traditionally, community kuhls have been operated by the users, so there is considerable basis for presuming that this approach would be not only feasible but effective. Basically, the

principle applies equally well to any scheme, whether a new one or a remodelled community kuhl, although users may be more experienced in the latter case. The three agencies have different strategies regarding beneficiary participation. For SC/AD and RD schemes, operation and maintenance remains with the users after the scheme is constructed. ID, in contrast, assumes permanent responsibility for the recurrent tasks of operating and maintaining the facilities that it constructs. This was true even when it remodelled or rehabilitated traditional community kuhls which were originally constructed and maintained and operated for many years by the users.

For community kuhls, ID provided assistance only if the irrigation community, acting through the concerned panchayats, passed a resolution agreeing to turn over operation and management (O&M) of the system to ID. This turnover meant that the ID assumed full rights and responsibilities to operate and maintain the irrigation works down to the public turnout, or chak level.

The full consequences of this policy are not known at this time. No detailed studies of the organization and operation of traditional community kuhls is available, thus no judgment can be made on their present operations and performance. There is evidence that these have persisted over long periods of time, perhaps several centuries or more in some cases and there is some feeling that many of the systems have fallen into disrepair and require government assistance. One could speculate about the reasons for this, but no firm evidence of why this is happening is available.

Post-project responsibility for operating and maintaining the kuhls taken over shifted these costs from the community to the ID. More of the ID budget is thus permanently committed for maintenance and more of the ID staff has to be assigned permanently to look after O&M activities. In sum, government activities permanently replaced former community responsibilities and the community of water users made directly dependent upon the future policies and actions of the ID.

The former policy had the positive effect that some ancient kuhls were improved or, if in complete disrepair, restored to operation. Though capital investments were increased, recurring total maintenance costs, whoever is responsible for them, should be decreased. Studies of analogous systems in Nepal and in parts of Southeast Asia suggest that labor requirements for operation and maintenance could amount to as much as 20-30 days per cultivator annually.

Reduction of community involvement in the traditional systems may not have the desired result of providing a more reliable water supply or of increasing the area irrigated. The assumption that the government agency can manage the main system better than the community is yet to be established.

In fact, the reverse may be true. Training and experience of ID staff is largely in design and construction. Hiring the former common irrigator (Kuhli) as irrigation staff with flexibility to follow the old rules would be helpful. Another assumption which may be faulty is that the existing water users will be prepared to share an increased water supply with new water users rather than use it themselves. One former community kuhl visited by the Study Team illustrated this point well; farmers in the "extension area" received a very erratic water supply because the original water users asserted rights over not only the old supply but also over a significant portion of the added supply. This illustrates that the Minor Canals Act even though it assigns prime responsibility to government can operate successfully only through a combination of State and community efforts.

Present policy leaves the RD as the sole agency responsible for rehabilitating communiy kuhls, but RD's resources are very limited. In these cases, operation and maintenance remains the responsibility of the users. Studies of traditional community systems under this Project should reveal whether or not there is a need for bolstering these efforts.

b. Need for Organization

Irrigation development requires attention not only to technology but also to organization. Past studies have shown a clear relationship between beneficiary participation and beneficiary organization.[13/] Only when local people are organized are they able to regularly and productively participate in externally-controlled activities. Thus, the lack of beneficiary participation in most irrigation development activities in Himachal Pradesh is not surprising since only elementary efforts have been made by the irrigation agencies to assist in group formation, however, the ID has recently initiated efforts to establish societies. None of the three agencies at present is adequately equipped to deal with this organizational dimension, a significant obvious constraint to future irrigation development and management below the outlet. Attention to appropriate local organization could significantly enhance the payoff
of the State investments being made. For example, when kuhl remodeling is planned to create new command area, careful preproject involvement of the old and new beneficiaries is necessary for there to be any hope of water reaching the extension area.

13/ See for example: Robert Wade: "The Social Response to Irrigation: An Indian Case Study". Jour. of Development Studies 16(1), October 1980, p.2-25; also Norman Uphoff. Unpublished Field Report on the Gal Oya Program. Cornell University, 1982-83.

Of course, the need for water user organization is not limited to flow schemes. A lift scheme serving a group of farmers is complicated to manage in any event but the more so if the water users are not organized to articulate their individual demands, coordinate their cropping patterns and allocate water from outlets. The agencies implementing irrigation projects in Himachal Pradesh appear to be aware of the problems of poor water utilization and irrigation management through community-based strategies, though they have not been able to involve themselves due to various constraints such as inadequate institutional strength and finances.

c. Water Rotation/Warabandi

In addition to assistance to community kuhls, preliminary thinking of ID about the use of water rotation procedures further illustrates the need for further preparation in the use of community-based strategies. In northern India, the commonly-used system of water distribution is known as warabandi. Warabandi basically uses a roster of turns to rotate the stream of water from the outlet among the farmers in a chak. Based on his proportionate land holdings under the chak, each operator is assigned a specified period of time when he has right to draw water from the public outlet. At present there is popular interest in India in applying the warabandi method wherever water distribution problems are encountered.

The ID is considering applying warabandi in the systems of the State as a solution to their water utilization problems. The approach being considered is a rather legalistic one, drawing on the right of the government to establish an irrigation record as provided in the Minor Canals Act. Evidence from elsewhere in India and other countries suggests that implementing a successful system of rotational supply, such as warabandi, requires the following preconditions:

-- A shortage of water;
-- Appropriate physical facilities to carry water to the designated rotation units;
-- A well managed system that ensures reliable water supplies to the point of rotation; and
-- Some form of social control among those who share in the rotation.

There is no evidence in Himachal Pradesh that attempts to implement warabandi would select locations with the above conditions in place or that complementary efforts will be undertaken to create the needed conditions. The initial document prepared by the ID to introduce warabandi in the State stresses enforcement procedures for obtaining compliance but this would require incentives, involvement of farmers and setting up of a suitable organizational structure for its implementation.

4. Experience with Beneficiary Participation in Himachal Pradesh

While there is little evidence of farmer participation in irrigation development in Himachal Pradesh there are counter experiences in the State in other subsectors.

One of these experiences, about which the Team had little information, is a program of the Horticulture Department for the establishment of packing house cooperatives for fruit producers. Such cooperatives have an adivsory committee which includes several farmer members.

A second experience with community participation comes from the Indo-German Dhaula Dhar Project. This project is concerned with the protection of hill lands and watersheds in the Kangra region. It explicitly endorses a community self-help approach and advocates the formation of community-level self-help groups for implementation of various project activities. The project also has created a new village-level role, the village motivator, who acts as a link between the community and the project staff.

In 1982, the project sponsored a very interesting seminar on the topic of local participation and development.[14/] This seminar was attended by both government officials and representatives of various non-governmental organizations (NGOs) none of which are based in Himachal Pradesh. It reviewed the topic and indentified the interest of both politicians and bureaucrats as a major constraint to a self-help approach. The implication was that both politicans and the government bureaucrats have much at stake in advancing development activities in which government has the major role and exercises major control over resources. Nevertheless the seminar participants remained firm in their assertions that little success could be achieved without significant community involvement.

These experiences may provide important examples for new directions in the irrigation field. The inter-agency Implementing Committee proposed for this Project includes two members, one from Forestry and one from Horticulture, familiar with these experiences. Their experiences may be very useful in recognizing the needs for and possibilities of greater user participation in future irrigation projects.

14/ Report of the Seminar on Promotion of Participation of Village People and their Mobilization for Self-Help. Palampur: Indo-German Media Service, 1982.

5. Subsidies and Local Mobilization of Resources

Irrigation in Himachal Pradesh is heavily subsidized by the state. Small and marginal farmers and farmers in scheduled castes can receive partial grants and low cost loans to finance irrigation investments. Electrically-powered pumps, either individual or public, are supplied power at subsidized rates. For public lift systems visited, only a portion of the actual costs of operation is charged. In public systems, both lift and flow, farmers are assessed irrigation rates which are set low; and often not collected.

Typical water rates for various crops are:

	Flow Irrigation (Rs/ha)	Pumped Irrigation (Rs/ha)
Sugarcane	41.6	83.2
Vegetables	20.75	41.5
Paddy	24.5	49.0
Maize	14.1	28.2
Wheat	14.8	29.6
Oilseeds	16.0	32.0
Fodder	9.5	19.0

Where more than one seasonal crop per year is grown, the annual rate is the sum of the rates for each crop, thus a paddy, oilseed, vegetable sequence as at FIS Samlotti would be assessed 61.25 Rs/ha. The average irrigation cropping intensity in the State is about 170 percent.

At their 1982 Conference, the State Ministers for Irrigation estimated O&M costs in hill areas at Rs 150/ha. The Conference recommended that water rates be increased to cover full O&M costs plus one percent capital recovery.[15/] Apparently, no State has moved to implement these recommendations. Given that water rates are set by State legislators, the political difficulties of raising them are obvious. GOHP officials indicated that they consistently seek legislation to increase water rates and have had some success over the years. A special committee has been set up by GOHP to review water charge rates.

15/ Summary of Conference of State Ministers of Irrigation and Flood Control and Command Area Development, held in Madras, 15 Dec 1982. GOI, Ministry of Irrigation, New Delhi, Sept. 1983.

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Information provided by ID on a sample set of prospective subprojects to be used for economic analyses gave projected Operation and Maintenance costs. For ten flow irrigation schemes, schemewise average O&M cost was Rs 542.5/ha/ann. with a range of Rs 213/ha/ann. to Rs 1,214/ha/ann. For six lift schemes, the average was Rs 1,678/ha/ann. with a range of Rs 984/ha/ann. to Rs 2,785/ha/ann. For five remodelling schemes, the average was Rs 401/ha/yr. ranging from Rs 109/ha/yr. to Rs 752/ha/yr.

The total water charge assessed in the State is not known. Much of the irrigated area is still community-managed and would not be subject to water charges. Much of the remainder is new or still under development. The repair and maintenance budget of ID for 1982-83 is Rs 12.07 million ($ 1.2 million), up from Rs 7.19 million in 1980-81. Water charge collections for 1982-83 totalled Rs 0.14 million, up from Rs 0.07 million for 1980-81. Water charges are not the only source of increased revenue for irrigation. Land revenue assessments are approximately doubled.

One reason advanced for low collection of water charges is the complicated procedure for collecting them by Revenue Department and not by ID directly. Separate revenue staff to be permanently employed in the Irrigation Department is under consideration. Because they are assessed on the basis of cropped area rather than amount of water delivered and because they are collected as general revenues, there would be no direct relationship between performance of an individual system and the return of water charges by that system, in any case.

The traditional approaches of both Agriculture and Rural Development were more effective than that of ID in mobilizing local resources. Several of AD's programs require farmer financing. Partial grants and low interest loans are available for small and marginal farmers who comprise a large share of the farmers in the State, and for scheduled castes.[16/] Historically, ID has not been charged with the responsibility nor provided the finances necessary to carry out mobilization of local resources.

Financing development of communal distribution facilities below outlets is normally considered the responsibility of the beneficiaries. However, GOI directives provide for constructing watercourses to lead water to 5 to 8 ha blocks at project cost on all ongoing and new irrigation projects including modernization projects. Under GOI policy, a 50 percent subsidy, one-half provided by the Center and one-half by the State, is available to support these developments under approved Command Area Development Projects. Because of problems of financing at state level, this policy has been only partially operative in India. In some States, for donor-financed projects, the State has included these facilities as project costs, proposing various steps, such as increasing the water charge rates, to recover the extra costs.

16/ Marginal farmers are those holding less than one hectare. Small farmers hold bewtween one and two hectares.

For kuhls rehabilitated by the Rural Development Department, beneficiaries are required to directly contribute one-eighth of the costs.

The Desert Development Program supports integrated development in cold desert areas of Spiti subdivision of Lahaul and Spiti District, using funds provided 50 percent by the Center Government and 50 percent by the State. Main components are irrigation and afforestation. The program is relatively small. No Project activities are scheduled in this subdivision.

The Small Farmers Development Agency has a program to assist small and marginal farmers. A budget of Rs 0.5 million ($50,000) is allocated to each of the 69 blocks in the State. Under the Integrated Rural Development program, subsidy of 50 percent is provided for purchase of pump sets (about 70 percent of the budget) for planting fruit or fruit trees.

The small scale of most irrigation systems in Himachal Pradesh and the dominance of locally created kuhl systems presents a strong opportunity to base future irrigation development on greater mobilization of local resources. This is likely to be achieved only if:

-- State policies regarding subsidies are significantly reworked (no doubt, a politically unpopular approach);
-- Agency capacity (including professional skills, incentive structures and procedural arrangements) to relate to and work with community groups is radically increased; and
-- Significant incentives are provided and requirements are included for local groups to mobilize their own resources.

In many places in South and Southeast Asia, not only local labor and finances need to be mobilized but also local knowledge and experience. The small size of minor irrigation systems and their scattered locations normally make it difficult for the development agency to directly collect the data and information necessary for location-specific planning. Development agencies are aware that mobilizing local knowledge and experience regarding cropping patterns, soil types, drainage patterns, stream flows, property boundaries, etc., can be of immense value for preliminary design efforts and can be valuable checks for preconstruction evaluation. It appears, however, that agencies in Himachal Pradesh could improve procedures to mobilize this important information resource in their planning and design processes.

E. Large Institutional Issues

The previous discussion leads to identification of several important institutional issues needing attention if irrigation development in Himachal Pradesh is to proceed satisfactorily. Resolution of these issues will be necessary for the successful expansion of irrigation, increasing the irrigated area toward the upper limit of about 340,000 hectares and for the intensification phase, managing the existing commands effectively to support more intensive agricultural production.

1. The Need to Consolidate Irrigation Responsibility

As already noted, responsibility for parts of the irrigation development and support process is scattered across several agencies, but is the primary responsibility of none of them. The result is that each of the agencies can only implement a part of the total irrigation task and each lacks some required skills, some that are found in other units such as engineering expertise, agricultural skills or the capacity to strengthen local groups.

For each of these three departments to acquire a full complement of staff needed to develop irrigation seems unrealistic and costly. Expecting a quick shift in the existing pattern with one group assuming comprehensive responsibility seems equally unrealistic. Nevertheless, experience in the Philippines suggests that irrigation development proceeds best when one strong agency is able to enlarge its staff capacities (including engineering, agricultural and social science professionals) so that it can operate in an interdisciplinary mode equipped to work on planning and implementing both the construction and non-construction parts of the task.

Thus, in Himachal Pradesh a strategy for institutional development should be concerned with concentrating irrigation development capacity in a specialized agency in the long run while continuing to support the irrigation activities of both SC/AD and RD and other action research and training institutions dealing with irrigation matters in the short run. There is initial discussion in the State concerning the separation of irrigation activities from the other functions of the Public Works Department and this may occur in the future.

Notwithstanding the advantages of having a single integrated irrigation agency, there are other alternatives. Some other form may be more feasible in India. There will always be an interface between departments, especially AD and ID and in this Project, Forestry and ID at some location. The important principles are that overlapping responsibilities are reduced to a minimum, responsibility for functions not now adequately covered is clearly fixed and duplication of specialized cadres of personnel is minimized. One approach would be to

have an interdisciplinary irrigation wing in AD or possibly ID which would be responsible for working with farmers and groups/organizations, for providing technical assistance in system operation, maintenance, design improvements, etc., leaving construction of civil works to the Public Works Department. This is similar to the idea of forming a separate "irrigation management cadre" being widely discussed in India with a few States actually initiating steps in that direction.

2. The Need to Move Beyond Construction to Irrigation Management

Nearly all of the irrigation activities in the State are aimed at building new irrigation works or repairing existing ones. This is true of both ID and RD and largely true of the work of SC/AD under its water harvesting schemes. In SC/AD's work of assisting individual farmers to install irrigation facilities, more attention is given to how the farmer uses water for agricultural production.

At the same time, one hears much discussion in ID about low water utilization and instituting a command area development authority program similar to that elsewhere in India. In short, there is a growing concern with system management and better use of irrigation facilities. Superintending Engineers have been told to start putting some provisions in their budget requests for irrigation management schemes. These moves are in the right direction and should be encouraged through the various activities of the proposed Project: planning and construction of improved schemes, chak development below the public outlet and increased user participation supported by training and special studies leading to an improved institutional capacity to plan, implement, maintain and operate more effective irrigation systems.

3. The Need to Increase Utilization of Existing Irrigation Systems

The need to increase utilization of existing irrigation systems is linked to the need to move beyond construction to irrigation management discussed in Section 2 above, but specifically relates to existing systems. Utilization on four publicly constructed and operated schemes visited ranged from 25-30 percent to 60-65 percent. Utilization on small schemes constructed under cost sharing arrangements and community or individually operated was reported as generally higher. Apparent reasons for low utilization range from over estimations of available water supplies, failure of or inadequate power supply for pumping, problems with diversion works and canals; conflicts over water rights and, most pervasive, lack of distribution facilities below public outlets. On specific systems, reasons for difficuslties may not always be fully evident, thus a systematic approach to diagnoses is important. Main

systems difficulties can be remedied or avoided on new projects through improved planning and implementation criteria. An important element of the Project should be development of the area below the outlet, the chak.

4. The Need to Increase Mobilization of Local Resources for Irrigation Development

The advantages of increased mobilization of local resources in irrigation development and operations have been noted earlier. However, traditionally the State was not capitalizing on opportunities to do this through organizing and assisting users in operating and maintaining systems, or in recovering costs. Farmers who receive economic benefits from well-run irrigation systems often are prepared to pay for these services. This is evident in the case of individually-owned lift systems.

The complex relationship between the state and its citizens (in this case, with regard to irrigation costs and investments) obviously reflects political philosophies and matters of political gain and loss. The current patterns of subsidized irrigation investment are unlikely to be greatly modified during the life of the Project but the goals and process of modification can be put firmly in place. There is the need to consider carefully the impact of this institutional norm (balance of public and private responsibility) on other institutional components and on performance in the irrigation sector.

If beneficiaries are indeed to assume the responsibility for operating and maintaining irrigation facilities, there must exist incentives for doing so. The direct incentive is forgiveness of water charges. At present levels, users would likely prefer to have the water charges assessed and leave this task to ID. This would be especially true if there is a good chance that water charges would not be collected. Thus prerequisites for user involvement in O&M are: (1) a more realistic schedule of water charge rates and (2) high likelihood that assessments will be collected.

Finally, resource mobilization is not limited to labor and money. Especially for flow and lift schemes, which serve communities, there is ample opportunity and need to mobilize local knowledge and experience in planning and design. Systematic agency procedures need to be developed and training provided to achieve this.

5. The Need to Identify the Appropriate Role of the Community of Water Users in Irrigation Development

The irrigation builders of Himachal Pradesh traditionally have been the rural communities themselves. Even now, their achievements in irrigation still exceed that created by the various government agencies. Nevertheless, their role in the present institutional setup is a tenuous

one. With the exception of the stated responsibility of farmer groups for developing and operating the watercourses at the chak level, there is no explicit statement that the role of the community in irrigation development is recognized and valued. Thus, there are few procedures in place to support communities in implementing their own irrigation development activities in contrast to agency programs that do it for them. The modest efforts of the RD approach this style of supporting community initiatives, but their total impact is negligible. In contrast, ID is mandated to proceed very differently. In exchange for its remodeling investment, the rights and responsibilities of main system management and operation are removed from the community and lodged with the agency.

There is a great need to review the current mix of government and community rights and responsibilities with special concern for the suitability of this mix as irrigation development activities expand and as attention moves from only construction to construction and management. Clearly, neither farmers nor the government can do the job alone; each has resources which the other lacks. Communities periodically require the large financial inputs that governments can mobilize or the advanced technical knowledge that staff may have. Equally important to the agencies are the specialized knowledge of locale that local people have and the ability to translate rules into behavior that community social controls can provide. Review, evaluation and modification of this state-community mix will be an essential requirement for advancing irrigation development activities. The project should give attention to various ways in which an enhanced community role can be considered, demonstrated, and hopefully, achieved in Himachal Pradesh.

One of these ways is to develop the capability and test the effectiveness of user operation and management of irrigation schemes. This should be done not only on traditional kuhls rehabilitated by ID, but on other schemes also. The ultimate advantage to the State will be essentially the same whether the user-managed schemes are traditional kuhls returned to users or entirely new ones.

6. <u>The Need for An Integrated Approach to Soil and Water Resource Management</u>

While this Project, which is concerned primarily with irrigation, could hardly mobilize a comprehensive approach to soil and water resource management in hills areas, small scale irrigation is an important element in a strategy leading toward that goal.

Small scale irrigation relates to overall land and water resource management in several ways. An overwhelming reason for deterioration of these resources is people pressure on the watershed. Irrigation helps relieve this pressure by providing alternative economic opportunities.

it could also provide a basis for community organization. With alternate economic opportunities and a broader basis for organization, there could be a greater community interest in participating in watershed management; in implementing and maintaining watershed protection and improvement measures and in sharing in the increased productivity of the watershed itself. The Project should explore these possibilities through pilot level field research. Because of the bureaucratic structure and allocation of agency responsibilities, a comprehensive land and water resource management initiative including small scale irrigation under a single project would be extremely complex. Very likely, however, opportunities exist for donor support of complementary watershed activities in hills areas which could further advance progress toward the goal of an integrated program of land and water resource management.

F. Elements in a Strategy of Institutional Development

Experiences with institutional development elsewhere, including those limited experiences with the irrigation sector, and the guidelines presented in AID's recent document on institutional development,[17/] suggest several general elements of an institutional development strategy. Two points made in the AID Policy Paper seem especially relevant in the case of Himachal Pradesh. One is the reminder to consider the appropriate mix of public and private roles -- a matter that is illustrated in the need to reexamine the respective roles of the irrigation agencies and the water user groups. The second highly relevant point is the idea that institutional development should encourage the emergence of organizations that are flexible and adaptable to the environments in which they are operating. To achieve this, capacities not now well developed in the irrigation agencies of Himachal are required. These include effective information handling systems, strong analytic capacities and close linkages to client and user groups.[18/] All of this suggests the following three general points.

1. The Mix of Institutions for Irrigation Development

There is a need to expand the range of organizations engaged in the overall processes of planning, implementing and evaluating/monitoring irrigation development. Experience elsewhere shows that where breakthroughs have been occurring in approaches to irrigation development, the work of the mainline agencies such as ID is being complemented by other relevant departments, such as cooperating research and training institutions dealing with both technical and social science materials, and management institutions. Including these additional organizations in the irrigation development process implicitly recognizes two facts.

17/ AID Policy Paper: Institutional Development op. cit.
18/ ibid., p. 1

First, inclusion of research and training institutes builds on the assumption that not all the factors constraining irrigation development nor the corrective actions required are yet understood. There is, therefore, need for monitoring and evaluation of past performance and outcomes as well as designing and testing innovative strategies for irrigation development through field-based studies and action research. Typically, implementing agencies, though, have the mandate but do not have the capacity to systematically inquire and innovate and need strengthening and updating. Thus, expanding the set of irrigation-related institutions to include research and training groups adds this capacity for flexibility and adaptability. These efforts should be an important part of the Project and suggest significant roles for the H.P. Agricultural University and the polytechnic institutes.

Second, the inclusion of management specialists operates on the assumption that one reason for poor irrigation performance may be the structure and procedures of the irrigation agency itself. Its procedures for planning, budgeting, project implementation, staff development, etc. may be contributing to poor irrigation performance and preclude the successful implementation of greater community involvement and/or the mobilization of local resources.

2. Creating New Institutional Components

The second element of institutional development has to do with creating new components in existing institutions or creating new institutions. In the irrigation sector this commonly means some modification in the irrigation agency to allow it to interact more effectively with a larger range of elements in its relevant environment; primarily the agricultural, economic and community elements. In some cases this has meant creating new staff positions for agriculturalists and economists or whole new operational units as with community organizers in the National Irrigation Administration of the Philippines. Staff development and training are of great importance in developing these expanded capacities.

This component of institutional development will loom large in the Himachal Pradesh project because the ID has only a partial capacity to implement irrigation development at present below the outlet. It can plan, design and construct systems effectively, though some important improvements are possible. However, it needs to increase its capacities to operate and manage systems more effectively and to successfully interact with the community of water users. Project inputs to assist in strengthening those capacities will be of great importance.

One specific issue which is very relevant to the Project is what will be the approach to chak development. Following a strategy of consolidated agency responsibility as suggested in Section E 1, the

resources and capacity for this element would be developed in the consolidated agency. Other alternatives include forming a Command Area Development Authority or assigning the task to an existing agency as discussed in Section B5. Chak development involves a different set of skills than planning and constructing irrigation diversion and conveyance structures and might not be particularly attractive to the career civil engineer. However the task is done, experience in India shows that substantial training efforts will be required. Training need not take a long time, but with some 38,700 ha. planned for chak development under the Project, a fairly large number of personnel (10-15 six-person crews) will be required.

There is also the need to strengthen the capacity of the Agriculture Department to serve a growing and changing irrigated agriculture sector. This needs to be done for both the early stages of project planning and design when the ID requires critical information on soils and cropping patterns and at later stages when extension information regarding plant-soil-water relationships and crop production under irrigation, is required by farmers.

Another institution which needs attention is the community of water users. For a number of reasons the vitality and persistence of these communities are in jeopardy. Present policies create few incentives for communities to continue an active role in irrigation development and there are practically no specific agency programs designed to assist in the strengthening or formation of active water user groups. The Project's institutional development strategy must address this issue; recognizing the present policies and directions, urging as much change as possible and identifying further alternatives for discussion and testing.

Finally, institutional development requires formation of some new organizational unit, perhaps in the form of a committee or working group composed of the mainline agencies and the various resource groups involved in irrigation development.[19/]

G. Project Administration

Field implementation of the proposed schemes will be the responsibility of the ID, AD, RD, Forestry and Horticulture Departments. The necessary administrative coordination will be achieved through a three-tier committee system. This three-tier system will help integrate policy formulation and administrative decision-making to ensure proper selection of schemes and incorporation of appropriate design standards.

19/ See: David C. Korten, "Community Organization and Rural Development: A Learning Process Approach". Public Administration Review 40 (1980).

1. Project Committees and Project Cell

a. State Level Implementing Committee

The State Level Implementing Committee is to be headed by the Agricultural Production Commissioner as Chairman with various administrative Secretaries of the concerned departments as Members. The Commissioner-cum-Secretary (Finance) and Commissioner-cum-Secretary (Planning) are also Members. Commissioner-cum-Secretary (Irrigation) will be Vice-Chairman of the Committee. The Chief Project Officer shall be the Member-Secretary of this Committee. Any other Member needed shall be made a special invitee.

The State Level Implementing Committee will formulate policies for proper planning, coordination and implementation of the project and will ensure that the tasks of the several agencies under the project are properly scheduled and achievements met in timely fashion. It will approve annual and long-term work plans and budgets of each concerned department on recommendations from the Project Cell in accordance with the Project Agreement. Moreover, it will be responsible for seeing that the staff necessary for planning, design, monitoring, execution, material management, coordination, quality control, evaluation, trainng, etc., is sanctioned. The State Level Implementing Committee will be responsible for seeing that jointly agreed goals and purposes of the project as well as information gained from various studies, research or by innovation during the implementation of the project are applied through appropriate policy and procedural changes in the concerned departments of the GOHP. It will also ensure that the personnel trained under the project are effectively utilized. Finally, this Committee will formally review and approve scheme proposals submitted by the Project Cell. This Committee will also oversee the work of other committees and the Project Cell.

b. District Level Project Committee

These committees will be headed by the Deputy Commissioner. All District Level Officers of the concerned departments of the project will be the Members. The District Level Officer of the department having the major share of expenditure shall be the Member-Secretary.

Committees at the level will mobilize resources of the various agencies, i.e., ID, AD, RD, Extension Service, Forestry, Horticulture, Revenue, etc. for proper preparation and implementation of subprojects. The Committees will also provide assistance in field studies, pilot projects, organization of workshops, training, etc. It will also help in implementation of the various policies and procedural changes approved by the State Level Implementing Committee. They will oversee subproject preparation and fix subproject priorities within their districts.

c. Subproject Level Committee

These Committees will be headed by the Officer of the department having the major share of expenditure under the subproject. The representatives of AD, RD, Extension Service, Forestry, Horticulture, Revenue, etc. will be Members at the subproject level. A representative of the beneficiaries will also be Member of this Committee.

The main tasks of the Subproject Level Committees are to coordinate the inputs and expertise of participating departments for project preparation and implementation, and to interact with beneficiaries for obtaining advice and assistance.

d. Project Cell

The Project Cell will be responsible for planning, coordination, design, monitoring, execution, material management, quality control, evaluation, training, research, etc. of the project. This Cell will also provide technical and administrative staff support to the State Level Implementing Committee. It will also coordinate and integrate the activities of the participating departments in preparing annual and long-term work plans in liaison with GOI and USAID. It will conduct necessary investigations and prepare reports and returns as may be required by the State Level Implementing Committee. Proper scrutiny and appraisal of subproject feasibility reports and obtaining approval of the State Level Implementing Committee will also be its responsibility. This Project Cell shall be created at an appropriate time, subject to the approval of the competent authority as per procedure of the Government of Himachal Pradesh.

The Project Cell will be headed by a Chief Project Officer not below the rank of an Additional Chief Engineer. The Chief Project Officer shall be Member Secretary of the State Level Implementing Committee. He shall have his usual personal staff as per norms.

The Chief Project Officer will be assisted by two Superintending Engineer's who will have two Work Sections under them as per requirements of the project.

An Accounts Officer, assisted by two office superintendents grade I, one in charge of Budget Section and the other of Contract, Accounts, etc. will assist the Chief Project Officer in the matter of preparation and scrutiny of the budget proposals, expenditure statements, reconciliation of the expenditure with the Accountant General, arranging reimbursement from the GOI and other allied matters.

A Store Purchase Officer, assisted by a Store Purchase Section in the office of the Chief Project Officer, will provide necessary staff support to assist in efficient material management for timely execution of the Project.

A Cash Section and an Establishment Section with usual clerical staff will be under the charge of a Deputy Registrar, who will assist the Chief Project Officer, for arranging the required staff from concerned disciplines and their proper placement for the successful implementation of the Project.

A Public Relations Officer will look after the publicity, publication and allied matters and will help in arranging conferences, workshops, etc. where beneficiary participation is required.

A Legal Assistant will advise the Chief Project Officer regarding legal matters connected with land acquisition and other disputes which may arise during the implementation of the subprojects to ensure that the progress of the subprojects according to time-bound schedule is not adversely affected. He will also provide necessary advice for enactment for required legislation to achieve the aims of the project.

Plans, estimates and feasibility reports of subprojects will be prepared at the subdivisional level in the ID and equivalent level in AD and RD. These plans and subproject reports will be received in the Project Cell and also by the District Project Committee for comment.

Another Design Unit within the Project Cell, headed by an Executive Engineer, ID, will issue directives to field officers regarding introduction of project criteria, new technology, etc. The Unit will have supporting staff from the participating departments. It will deal with quality control and with inspections and investigations.

A Design Unit headed by a Superintending Engineer and assisted by two Executive Engineers (Design) from ID, a Deputy Director from AD and equal level officers from Soil Conservation, Horticulture, and Forest Departments with staff as per norms, will be responsible for scrutinizing plans, estimates and feasibility reports of subprojects received from the implementing departments to see that they fully comply with project criteria and that the estimates have been prepared in accordance with the prescribed schedule of rates and fixed amount prices. This Unit will also be responsible for preparing and submitting complete subprojects and feasibility reports to the State Level Implementing Committee and getting them approved. This Unit will also prepare designs and detailed estimates for subprojects for getting technical approvals falling within the competence of the Additional Chief Engineer.

Another Unit will be responsible for implementing in-depth monitoring, review of progress of subprojects from initial planning through construction and ultimately operation. This Unit shall be responsible for monitoring in the field and preparing subproject and project level monitoring evaluation reports. It will also be responsible for identifying constraints to project implementation and reporting these to the State Level Implementing Committee. This cell will be manned by an Executive Engineer of ID, with necessary supporting staff from various disciplines.

A separate Unit will prepare plans for the various training programs, workshops, research, etc. to be organized under this project. It will also coordinate the selection of trainees and oversee the progress of these programs. This Cell will also be headed by an Executive Engineer of ID, and will have supporting staff from the participating Departments. The Public Relation Officer will function in this Unit.

2. Preparation and Approval of Schemes

Individual schemes under ID/AD/RD will be planned and designed by the scheme preparation units already in existence under the administrative control of the participating departments. These units will receive guidance on design criteria from the Project Cell. The schemes planned and designed at the unit level will then be reviewed by the Superintendent Engineer/Deputy Director/Executive Engineer in charge for their technical and financial soundness. After submission and review by the Project Cell, proposals will be forwarded to the State Level Implementing Committee for final approval.

3. Monitoring and Evaluation

Follow-up monitoring and evaluation of subprojects will be the responsibility of the Project Cell. This cell will be headed by a senior officer of the ID, with participation by AD, RD officials and from other departments and resource institutions as appropriate. The Project Cell will serve as the technical and administrative arm of the State Level Implementing Committee. Besides assisting in the preparation of subproject schemes and obtaining their approval, it will assist in planning, scheduling and organizing training programs and in planning and facilitating special studies, action research and pilot studies and draft necessary progress and other reports. The Project Cell will also assist the participating departments in preparing annual and long-term plans.

Monitoring and evaluation will be carried out through field level units responsible for in-depth monitoring, review of project progress and construction quality control. These field units established at the district level will regularly visit schemes under construction, prepare a quarterly review report for submission to the Project Cell. The Project Cell will keep the State Level Implementing Committee regularly informed. The Project Cell will also keep USAID iunformed every six months on project implementation progress through its reporting system.

CHAPTER II

AGRICULTURAL ANALYSIS

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A. Physiography and Agro-Ecology

1. General Summary of Resources

Himachal Pradesh, is predominantly a Himalayan mountain state. It lies in northwest India between 30°-22'-40" and 33°-12'-40" N latitude, and 75°-47'-55" and 79°-04'-23" E longitude. The elevation ranges from above 350 meters to 7000 meters above sea level. The state is bordered on the North by Jammu and Kashmir and the Tibetan highlands on the East, Punjab on the West, Haryana on the South and Uttar Pradesh on the Southeast.

The geographical area of the state is 55,538 sq. km according to the 1981 census and is comprised of 12 districts, Table II-1, about 17,000 villages under 10,000 population (12,000 with populations under 200) and 46 towns. The population is 4,237,569 of which about 92 percent is rural (1981 census). About 80 percent of the population is engaged in agriculture and a little more than 10 percent of the total land area is under cultivation.

The state can be divided into four physiographic regions:1/ (1) Submontane low hills and valleys (Shivalik Hills) - generally up to 800 meters altitude occupying about 35 percent of the State's area; (2) mid-hills subhumid from 800 to 1600 meters; covering about 32 percent of the geographical area; (3) high hills and interior valleys (temperate wet) between 1600 meters to 2800 meters with 25 percent of the area under them, and (4) cold dry region above 2800 meters spread over the remaining area.

Four main tributaries of the Indus (Sutlej, Beas, Ravi and Chenab) originate or pass through Himachal Pradesh. Most of the state's large rivers are snow fed perennial streams. These provide substantial hydroelectric potential, much of which is yet untapped, and feed the irrigation canals on the plains of Punjab, Haryana, and Rajasthan. Most of the State's water resources other than hydro-elecricity comes from the smaller perennial or seasonal monsoon-fed streams and limited groundwater. Agriculture, forestry horticulture, animal husbandry and fishing contribute about half of the net state domestic product; mining and quarrying contribute only about seven percent.

1/ From: Report of the ICAR Research Review Committee on the National Agricultural Research Project for Himachal Pradesh, Krishi Vishva Vidyalaya
Indian Council for Agricultural Research, Krishi Bhawan, New Delhi, July 1982.

2. Agro-Climatic Zones

There are two rainy seasons in the state. About 25 percent of the precipitation occurs during December to March with 75 percent occuring during the summer monsoon months of June to October. Average annual rainfall is 1134 mm, but along with temperature varies widely geographically.

Because of the mountainous terrain the agro-climatic zones are difficult to delineate precisely. In a general way, the four physiographic regions described above approximate the four agro-climatic zones recognized in the state, Fig. II-1.[2/]

a. Sub-Montane Low Hills and Valleys (Shivalik Hills)

This is a subtropical zone of over 900,000 hectares. It comprises about one-sixth of the total area of the state and has over one-third of the cultivated land. The elevation is generally below 650 meters above sea level. This zone covers Una, Hamirpur, Bilaspur and a large part of Kangra, Solan and Sirmur districts.

The rainfall averages about 1100 mm ranging from about 750 mm to about 1500 mm. The year-to-year variation is quite large. For example, at Bilaspur, the rainfall was 446 mm in 1974 and 1575 mm in 1978.

The daily average maximum temperature for the year as recorded over a 6-year period in Bilaspur at an elevation of 587 meters is 29°C. During the warmer months, March through October, it is 32.6°C. The average daily minimum temperature for the year is 14.8°C, averaging 6.2°C during the four cooler months and 20°C during the warmer months.

The soils of the low hills zone vary widely ranging from those on the relatively fertile alluvial plains with little profile development to those found on terraces with a distinct profile development. Shallow soils occur on the steep slopes. Most of the soils appear to be coarse textured ranging from gravelly loamy sands to sandy loams with areas of somewhat finer textured sandy clay loams. Except for the heavier soils used for growing paddy, the soils are well drained and neutral to slightly acid, properties which are favorable for crop production. Organic matter and therefore nitrogen is generally low. Phosphorus is also low. Under good management with an adequate water and nutrient supply, a substantial fraction of the soils with favorable topography should be highly productive.

2/ Ibid. this information differs in some respects from that contained in the June 1983 Status Report of Himachal Pradesh by the Narmada P.P. Cell of the Ministry of Irrigation, New Delhi.

In the main rainy season (kharif) the principal crop is maize on unirrigated land with some paddy. Under irrigation the main crop is paddy. In the relatively dry (rabi) season the main crop is wheat and there are smaller areas of barley, pulses and oilseeds. Perennial crops such as subtropical fruits occupy a small area. Some crops such as oilseed and vegetables may overlap into the zaid or hot-dry season. The area and production of the principal crops in this zone are given in Table II-2. A large portion of the project's activities will be implemented in this zone.

b. Sub-humid Mid Hills and Valleys

This zone with an elevation from 650 to 1800 meters comprises about 1,200,000 hectares which is about one-fifth of the total geographic area of the state. This zone contains about two-fifths of the cultivated land in the state and comprises parts of the districts of Kangra, Mandi, Solan, Kulu, Chamba and Sirmur.

This zone has the highest rainfall, in some areas as high as 3000 mm but mostly in the 1000 mm to 2000 mm range. As in the other zones, the bulk of the rain comes during the monsoon season, June to September, and most of the rest from December to March. The year-to-year variation is quite large. For example, in 1970 in Kangra the rainfall was about 2500 mm and the following year, 1971, it was less than 1200 mm.

The average annual daily maximum temperature as recorded over a 10-year period in Dharmsala at an elevation of 1211 meters is 23.6°C. During the cooler months of November through February, this averages about 17°C and during the warmer months, March through October, about 23°C. The average annual daily minimum temperature is 15.5°C with the four cooler months averaging about 9°C and the warmer months about 19°C.

The soils of the low hills zone as in the other zones are quite variable depending largely on local rainfall conditions, topography and parent materials. In general, the soils have a finer texture than those in the low hills ranging from sandy loams to clay loams. They are neutral to somewhat acidic depending on the amount of rainfall. The soils on the slightly to gently sloping land have developed a deeper profile and have a fair amount of organic matter in the surface but respond to both nitrogen and phosphorus fertilizer. Soils on the steeper slopes are subject to serious erosion.

The main crops during the kharif season without irrigation are paddy and wheat with smaller amounts of maize, pulses, barley and oilseeds. Under irrigation the main kharif crop is paddy. In the

rabi season, wheat, oilseeds and pulses are most important. About eight percent of the total cropped area is devoted to both temperate and subtropical fruits and nuts. Apple is the major fruit crop. The area and production of the principal crops in this zone are given in Table II-3. A large portion of the project's activities also will be implemented in the mid-hills zone.

c. High Hills and Interior Valleys Wet Temperate Zone

The high hills zone lies at an altitude for the most part above 1800 meters and comprises about 1,300,000 hectares, almost one-fourth of the state. The cropped area is less than 20 percent of the total in the state. Practically all of the Simla district and parts of Kulu, Solan, Chamba, Mandi, Kangra and Sirmur districts are in this zone.

The rainfall averages about 1000 mm annually but as in the other zones annual precipitation can vary substantially. For example, over a 12-year period from 1967 the rainfall at Simla had a low of 611 mm in 1974 and a high in 1967 of 1418 mm.

The average annual daily maximum temperature as recorded over a 30-year period at Simla at an elevation of 2202 meters is 17.1°C. During cold months of November, through February this averages about 11°C and during the warmer months, March to October, about 20°C. The average daily minimum temperature for the year is 10.1°C; for the four cold months this averages about 4°C and the warmer months about 13°C.

The soils of this zone are mostly shallow to bedrock because of the steep slopes. There are deeper soils on the terraces and alluvial fans which are common in the region but occur in relatively small areas. The soils are somewhat acid and respond to lime. Deficiencies of nitrogen and phosphorus are common. The surface texture of most of the soils ranges from sandy loam to clay loam. Erosion is a serious hazard especially on the steeper slopes where the forests have been decimated. In the higher elevations the soils have a relatively high organic matter content in the surface.

The main crops during the kharif season without irrigation are maize and paddy and there are some areas under barley, pulses and oilseeds. In the rabi season unirrigated wheat is the principal crop. With irrigation the main crop is paddy during kharif and wheat during rabi with some vegetables and potatoes. Apples and other temperate fruits are grown throughout the zone and comprise over 15 percent of the total cropped area. Table II-4 gives the area and production of the principal crops in this zone. Relatively few project activities will occur in this zone.

d. High Hills Temperate Dry Zone

This is the largest agro-climatic zone in the state estimated to comprise about 2,200,000 hectares or roughly about two-fifths of the total geographical area of the state. The altitude of most of the zone is above 1800 meters. The cultivated area of about 24,000 hectares under this zone represents only about 2.6 percent of the cultivated area of the state. The zone comprises the districts of Kinnaur, Lahaul and Spiti, and part of Chamba.

The annual rainfall is low, averaging about 250 mm and the zone has snow cover during most of the period from November to March. The low temperature most of the year permits only a four-month cropping season from May to September and irrigation is required for practically all crops.

Most of the soils are on steep slopes and are generally shallow and coarse textured. Erosion is a serious hazard. The cultivated land is mostly in the valleys where the soils are deeper. Most are relatively high in organic matter and neutral in reaction.

The main crops are wheat, maize, barley, pulses, and potatoes practically all of which are grown under irrigation. There are a few areas where apples and other temperate fruits and also nuts and dry fruits are grown. No project activities are planned for this zone.

B. Agricultural Development

1. Level of Agricultural and Irrigation Development

Agriculture dominates the economy of the state although because of the mountainous terrain only a little over 10 percent of the total land area of 5,540,000 hectares is under cultivation. Because of the high rural population the pressure on cultivated land is very high. The landholdings of most of the farmers are very small, 76 percent have holdings less than 2 ha but this represents only one-third of the cultivated area. Fifty-five percent of the farmers hold less than one ha and 34 percent, less than one-half ha. Details of the landholdings are given in Table II-5. Landholdings of the state are reported to be mostly self cultivated. Of the net area sown of 560,000 hectares, about 374,000 hectares are sown more than once giving an average crop intensity of about 167 percent. Many farmers get three crops during the year and some get as many as four.

A reported constraint to agricultural development in the state is fragmentation of landholdings of many farmers into small parcels. This may result in inefficient land use, water management and crop production. A government program is being considered for

consolidation on of small holdings. Consolidation of fragmented holdings is a complex and difficult undertaking especially under highly variable ecological conditions such as exist in the state. However, in some uniform areas consolidation may be feasible.

Fruit growing has developed into an important industry in the State during the past 20 years. In 1960-61, there were only about 6,000 hectares of fruit and in 1982-83 there were almost 109,000 hectares. This is a remarkable growth. The main fruit crop is apple, followed by other temperate fruits such as plums, pears and peaches. There is a substantial area of almost 20,000 ha devoted to citrus, with lesser areas devoted to other subtropical fruits. Another small but important crop is seed potatoes which are exported to other states. Mushroom culture is also a notable activity. Mushrooms are also exported to other states.

Livestock raising and production are important in the state and have a major role in the rural economy. The total livestock population, (cattle, buffaloes, sheep and goats) according to the 1977 census, is about 4,800,000 or more than one animal per capita.

Statistics on the area under irrigation in Himachal Pradesh are confusing probably because of the way allowance is made for multiple cropping, the use of the terms "irrigation potential" (the cumulative sum of planned culturable command areas) and "utilization", which is less than potential. Nominally the net sown area is reported as about 90,000 ha or about 16 percent of the cultivated land with multiple cropping bringing the gross cropped area to about 156,000 ha.[3/] [4/] (See Table II-6 for gross cropped areas for principal crops.) These figures are probably somewhat out of date though they appear with minor variations for the 1970s up through 1977-78 and are still quoted. The ID reports as of 1982-83 a total of 136,255 ha with 57,322 ha potential created by the Public Works Department beginning in 1951 and the remainder of 78,993 ha under private kuhls with some very limited assistance on a few schemes by RD. These values appear to be net area of CCA potential created. They presumably would not take into account areas going out of potential because of failure or need for repairs.

3/ Ibid p. 9, 10

4/ See also Report on the Status of Irrigation Development in India through Major, Medium, Minor and C.A.D. Schemes. Central Water Commission, New Delhi, October 1981. Himachal Pradesh p.5

Central Water Commission reports 96,500 ha cumulative in 1980 with the creation of 16,500 ha of new potential in minor irrigation during V Plan (1973-78) and Annual Plans (1978-80). An additional 8,000 ha were reported added during 1980-82 bringing the total minor irrigation to 104,500 ha. During this same period, 4,000 ha were reported as created under medium schemes. This would bring the 1981-82 total up to 108,500 ha.[5/] Target during the VI Plan (1980-85) is an additional 22,000 ha (4,000 ha from groundwater) under minor and 6,000 ha under surface medium schemes.[6/] This would bring the 1985 target to 126,500 ha net area, however, at least part of this would be potential CCA not area utilized or irrigated.

At present, the net sown area actually irrigated is not known. It probably is not much greater than 100,000 ha with a multiple cropping factor of about 1.7. There is a need for better information on actual net sown and gross cropped area irrigated and attention will be given to this under the Project. Possibly remote sensing, air photos or Landsat imagery might be used for this purpose. About 90 percent of the irrigation is by surface sources (lift and gravity flow systems) and the remainder by tube wells and dug wells. The Central Water Commission estimates an ultimate potential for irrigation of 340,000 ha, 290,00 ha from surface and 50,000 ha from groundwater sources.

2. Productivity and Crop Yields

The area, production, and average yields of crops in Himachal Pradesh in comparison with national average yields are given in Table II-6.

Major cereal crops grown in the state are wheat, maize and paddy. Yields of maize are well above the national average, almost 1900 kg/ha compared with about 1050 kg/ha. Wheat, which occupies the largest area, 332,000 ha, averages 1170 kg/ha compared to 1450 kg/ha. nationally. State paddy yields average 1340 kg/ha compared to 1200 kg/ha. nationally.

Among the pulses, the state average yields are a little lower than the national average. Oilseeds, rape and mustard yields are well below the national average, while linseed and sesame are well above. Cash crops like potatoes and sugarcane are way below the national average, about 50 tons/ha compared to 118 tons/ha for potatoes and about 17 tons/ha compared to about 54 tons/ha for sugarcane.

5/ Op. cit. p. 7,9.
6/ Narmada P.P. Cell, Ministry of Irrigation. Status Report of Himachal Pradesh with Special Reference to Irrigation Development. New Delhi, June, 1983. Annex 15, 17.

3. Significance of Irrigation to Crop Production

Recent detailed economic analyses of a number of flow irrigation and pump schemes in Himachal Pradesh (Chapter VI) have given some data on the net benefits at economic prices of irrigated crops in comparison with the same crops unirrigated. Net benefits for irrigated crops appear to be at least twice those for unirrigated as shown in the following table.

Table II-7

Net Benefits (Rupees per Hectare at Financial Prices)

	Paddy	Maize	Wheat	Pulses	Vegetables
Irrigated	3498	2223	2876	2574	12469
Unirrigated	1560	1339	1322	1106	6251

In addition to increased net benefits, irrigation has resulted in a shift in cropping patterns from rainfed, see Table II-8. Total proportion devoted to cereals does not change, but there is a significant shift to paddy from maize and other cereals. Pulses are displaced by other food crops (potatoes, sugarcane, ginger, chillies) and by oilseeds.

At present, only small areas of fruit tree crops are irrigated, mainly in the mid-hills zone. The Horticulture Department is planning to expand fruit production in the low hills subtropical zone. Because of the lower rainfall in this zone, irrigation may be an important factor in the development of fruit tree crops.

Reference to statistical sources shows that there has been little shift in cropping patterns either on total (rainfed plus irrigated) or on irrigated land during the past decade or so; although the total area devoted to food grains, on the basis of a linear regression 1971-72 to 1977-78. r=0.736, shows an annual increase of 0.4 percent.7/ 8/ Both gross and net irrigated area

7/ Indian Agriculture in Brief - Thirteenth Edition p.36
8/ Indian Agriculture in Brief - Eighteenth Edition p.34
9/ See also: Statistical Abstract of Himachal Pradesh 1980 p.79

reported remained essentially constant during 1969-1978: about 156,000 ha gross cropped area, about 90,000 ha net.[9] During this period irrigated area devoted to food grains did not change, but fruits, vegetables and oilseeds apparently increased from about seven to eleven percent of the irrigated area.

C. Agricultural Support

1. Extension Activities

Extension work in the field is the primary responsibility of the village level worker and he is directly responsible to the Block Development Officer. There is one village level worker for about every 10 villages. The village level worker gets technical guidance from Agricultural Inspectors and various subject matter specialists at the block level. The Training and Visit System is not in place in Himachal Pradesh, but is under consideration.

At the block level, Agriculture Inspectors, Horticultural Inspectors and Plant Protection Inspectors are responsible for all agricultural extension activities. These inspectors provide technical information to farmers in camps organized before commencement of each season. These officers are also responsible for the layout of demonstration plots and for providing training to village level workers.

Deputy Directors of Agriculture in eight districts, project officers in two districts, and agricultural officers in two districts have overall district responsibility for agricultural extension. These officers are assisted by various subject matter specialists, for example, plant protection officers, district training officers, and assistant soil chemists, in the implementation and monitoring of extension activities. Assistant Soil Conservation Officers at present provide training as water management subject matter specialists. The subject matter specialists hold regular training programs for supervisory and block level personnel. They are also responsible for making timely and adequate arrangements for supply of various agricultural inputs through the various agencies for the layout of demonstration plots.

At the state level agricultural extension is coordinated in the Directorate by a Joint Director of Agriculture under the overall guidance of the Director of Agriculture. State level workshops for recommended farmer practices are organized in collaboration with Himachal Pradesh University at Palampur and Soland for the kharif and rabi seasons. District, block and village level training camps are organized. Detailed instructions are given for the layout of demonstration plots. Production of certified seed on farms in

different districts is also planned at the state level. Arrangements are made with various national organizations for the procurement and distribution of various inputs such as fertilizers and pesticides, and for seed which is not produced in the state. Evaluation of the effectiveness of the system has not been made.

The Horticulture Department has a Deputy Director for Extension and Development and under him there is a Divisional Director for the East zone and one for the West zone who are responsible for horticultural extension activities in the various districts. Campaigns for the control of various pests are conducted. Horticultural shows, exhibitions, and farmers' training camps are organized by the extension division. Seeds, seedlings, cuttings, and grafts are distributed as are pesticides and other chemicals.

The Forestry Department has no formal extension arm but feels that one is needed.

Several local sources reported to the Design Team that Agricultural Extension Services are rather weak despite the apparent organized efforts. There is little or no contact with large numbers of farmers and many of those contacted are not provided with adequate and timely information to be of much help. No doubt the rugged terrain and poverty of country roads in many areas make communication with large numbers of farmers in isolated areas difficult. Also inadequate training and low wages of Extension personnel may be a problem.

The Agricultural University has a separate Directorate of Extension Education with staff positions sanctioned (1981) for 33 assistant professors and one associate professor. At that time 25 of the assistant professor positions were vacant. The Directorate has the responsibility of planning, implementation, and coordination of the various extension education programs of the different departments and the associated research programs of the colleges at both campuses. The Directorate maintains communication with various departments of the State Government to provide a flow of research results for practical farm application and formal and informal mechanisms for the feedback of field problems. The Directorate organizes two workshops every year for district level officers of the Departments of Agriculture, Horticulture and Animal Husbandry to inform them of the latest agricultural technology developed at the University. These workshops are usually held prior to the kharif and rabi crop seasons and modifications of the packages of practices based on the latest research findings are discussed and put into final form. As a follow-up, the University subject matter

specialists participate in the district level training camps organized by the State government agencies to provide training to the extension staff working at the block level and to progressive farmers of the district.

Other programs provided by the Directorate of Extension Education are: Organization of field days, specialized training in agriculture, horticulture and animal husbandry for young farmers, practical field training in gardening and other extension activities.

2. Education and Research

a. Teaching

The Agricultural University, (Krishi Vishva Vidyalaya) of Himachal Pradesh is relatively new, having been inaugurated in 1978. The former agricultural complex of Himachal Pradesh University was upgraded at that time to form the Agricultural University. There are two campuses, one at Palampur and the other at Solan, both in the mid hills zone. Both are involved in teaching, with most of the research at Palampur. The campus at Palampur has a large research component and a number of outstations. There are seven departments at Palampur: Plant Breeding, Agronomy and Meteorology, Soil Science and Water Management, Animal Science, Agricultural Economics, Home Science with minor units except Home Science at Solan. The Solan campus has six departments: Horticulture and Fruit Technology, Vegetable Crops and Floriculture, Forestry, Mycology and Plant Pathology, and Entomology and Apiculture with minor units at Palampur. Both campuses have a department of Basic Sciences and Humanities. On the two campuses, (1981) a total of 98 faculty teaching, and 245 research positions ranging from assistant professor level to professor had been sanctioned, but there were 37 teaching and 84 research vacancies.

The University offers B.Sc. and M.Sc. degrees in Agriculture. Ph.D. programs are offered in Agronomy, Plant Breeding, Soil Science, Animal Science, and Agricultural Economics at Palampur and Horticulture and Fruit Technology, Mycology and Plant Pathology, Entomology and Apiculture, Vegetable Crops and Floriculture at Solan. Among the students enrolled in 1981, 425 were enrolled in graduate progams and 444 in undergraduate ones.

b. Research-General

Research at the university is carried out under grants-in-aid principally from the State Departments of Agriculture, Animal Husbandry, Forests and Fisheries. The Indian Council of Agricultural

Research (ICAR) finances building of infrastructure and provides grants-in-aid for education, research and extension. ICAR also has a number of All-India Coordinated Research Projects on various commodities and resource problems. Hill area components of a number of these projects are integrated with the university's research program. There are several other miscellaneous sources of support, e.g. the GOI Department of Science and Technology, revenues from sales, etc.

Research is conducted on experimental farms and elsewhere at both campuses, at four regional research stations one in each agro-climatic zone and 11 research stations or sub-stations.

Low Hills Zone: A regional research station (Dhaulakuan) screens and evaluates new varities of wheat, maize, paddy, barley, pulses and soybeans for the northern zone of India. This research station also takes care of research on sub-tropical fruits. Another research station (Berthin) does research on pulses and development of dry land farming technology.

Mid-Hills Zone: Palampur conducts research on wheat, oilseeds, forages, tea, potato and animal breeding and on water management. Solan with the regional research station (Bajura) conducts research principally on the development of high yielding varieties of maize and barley. Four research stations/substations cover rice breeding, oilseeds such as linseed, rape, mustard and soybean, cereal crops and pulses and stone fruits such as plum, apricot, almond and peach. There is some limited work on honey production and litche and mango.

High Hills Temperate Wet Zone: Work done by the Regional Fruit Research Station (Mashobra) and two research stations/substations covers apples and some other temperate zone fruits and rice.

High Hills Temperate Dry Zone: The regional research station (Kukumseri) and four research stations/substations does primary research in wheat, barley, potatoes and dry fruit. Other crops being researched are millet, saffron and beet. Research is also done on seed production of cabbage and sugar beet. Yak breeding and management is also researched.

Facilities and Staff: Besides inadequately filled staff positions to carry out their assigned responsibilities many stations have little or no laboratory facilities. Consequently they have only limited influence on farm practices. Proposals are being considered to strengthen some of these stations by providing additional land, staff and facilities.

c. Water Management Research

Of particular interest to the Project is research conducted primarily at Palampur under the Coordinated Project for Research on Water Management in High Rainfall and Temperate Hill Zones. These studies include among other related ones, development of a small research watershed, performance of kuhl irrigation systems in the hill region and irrigation scheduling and water use by crops, loss of nutrients in field to field continuous flow irrigation and some pot experiments on the effects of low water temperature on rice yields.10/ Results have not yet been reported for the kuhl study. For the pot experiments ponding resulted in water temperature 2.2°C to 4.5°C higher and yields were 25.4 percent higher than for continuously flowing water. Not all of the difference in yield can be attributedto temperature differences, because of higher loss of nutrients under continuous flow.11/

d. Central Research

In addition to the research stations of the Agricultural University, four substations of the Indian Agricultural Research Institute (IARI), conduct research on horticulture, cereal/crops, rust on wheat and barley and vegetables. Other research stations maintained by Central GOI organizations are the Central Potato Research Institute and the Plant Introduction Substation, both at Simla, the Sheep Breeding Station at Kulu, the Animal Nutrition Centre in Palampur and the Regional Research Laboratory at Palampur which does research on medicinal plants and tea.

e. ICAR Recommendations

The ICAR Research Review Committee has recommended that a Research Committee be constituted in each zone to identify promising results of research for testing in farmers fields. The Committee would have representatives from the State Departments of Agriculture, Horticulture, Animal Husbandry, and Forestry. The Review Committee also recommended that the Regional Research Stations should be

10/ Research on Water Management in Hill Regions 1977-79 Indian Council of Agricultural Research, New Delhi. p.13, 16, 21-35

11/ A Brief Report of the Work Done on Water Management in High Rainfall Area and Temperate Hill Zones (1972-81) Dept. of Soil Science, Himachal Pradesh Krishi Vidyalaya, Palampur, mimeo. p.2, 13.

responsible for promoting the adoption of agricultural technology, developed as a result of research, through the extension specialists by various means: collaboration with the Departments of Agriculture and Horticulture in designing, executing and analysing adaptive mini-kit trials and to insure proper feedback; organizing field days at least twice a year; studying farming constraints in collaboration with State Departments of Agriculture and Horticulture.[12]

3. Soil Conservation

In addition to its activities in irrigation (Ch. I Sec. B.3), the Soil Conservation Wing of the Agriculture Department is responsible for soil conservation activities on private agricultural lands. Seriously eroding areas in watersheds are treated by establishing permanent vegatative cover of trees, shrubs, and grasses. Erosion control on streams is done using check dams, gully plugging, construction of spurs, etc.

The Soil Conservation Wing in the Department of Forestry is concerned primarily with protection of watersheds and areas other than the agricultural lands by reforestation and engineering works.

4. Agricultural Production Inputs

Fertilizers and pesticides are a government monopoly and sales to farmers are heavily subsidized.

Procurement and distribution of fertilizers is solely by the State Cooperative and Marketing Federation. Fertilizers are distributed mainly through District Units/Unions to primary Agricultural Cooperative Societies which are the main sources for farmers. There are 2069 retail fertilizer depots in the State; 1792 are with the Cooperative Societies, the remainder are with private traders/depot holders and Himachal Pradesh Agro-Industries Corporation. About 20,000 tons nutrients are distributed annually.

Seeds and pesticides are made available through Agriculture Inspectors and Sub-Inspectors posted in the Blocks. Agriculture Inspectors/Sub-Inspectors are to stock required quantities well in advance of sowing season. Farmers may also purchase seed from the National Seed Corporation or from H.P. Agricultural University. As far as the distribution of horticultural production inputs is concerned, the same is being arranged through the Block Horticultural Inspectors and developmental plant protection centers.

12/ Op. Cit. p.69-74

Most farmers use only a fraction of the recommended fertilizer application. The average use during 1978-79 was 25 Kg/ha of net sown area (15 Kg/ha of gross cropped area) increased from 14 Kg/ha in the five years since 1975-76.[13/] On a gross cropped area basis, current consumption was reported as 19 Kg/ha compared to 34 Kg/ha nationally and 134 Kg/ha in the neighboring state of Punjab. The Agricultural Department reported plant protection programs carried out on 392,000 ha. during 1979-80, up from 176,000 in 1976-77. Intensity of use was low, however, about 0.36 Kg/ha in 1979-80. The statistics do not show perceptible increase in yield over the three year period 1975-76 to 1977-79 for which concurrent yield and fertilizer data are available; however, yields are highly variable from year to year and the use levels are still low so no conclusion can be drawn on the effect of increased fertilizer. Interestingly a linear regression model using data published in the state statistical outline[14/] shows that rice yields have risen by about 60 Kg/ha/year over the period 1972-73 to 1977-78 (correlation coefficient r = .735). No significant increase was detected for wheat or maize over this same period. Ample supplies of fertilizers and pesticides are generally available and the substantial subsidy should make them attractive for farmers to use. Undoubtedly, the risk factor in investing in fertilizer has deterred many farmers from buying it, especially for unirrigated lands.

Reasons for the relatively low average fertilizer use given by AD officials are: (1) the relatively low percentage of cropped land under irrigation[15/] and (2) high availability of barnyard manure because of the high animal population. The experience of the Indo-German Agricultural Project in promoting the use of fertilizer in the Kangra district is interesting. In spite of campaigns and demonstrations on the benefits of fertilizer use, over 63 percent of the farmers in the project area reported that they were applying less than 15 percent of the recommended amounts. The main reasons given by farmers for using such small amounts were high cost, poor financial situation, ignorance of use of fertilizers and lack of availability when needed. Other reasons why farmers use limited

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13/ Statistical Outline of Himachal Pradesh 1980 Directorate of Economics and Statistics. Simla p.97

14/ Op.Cit. p.80

15/ A regression analysis using the average fertilizer use per gross cropped hectare (1978-79), F, vs. percent of cropped area irrigated two years earlier, I, from 19 states gives $F=0.6+1.03\ I$, $r=0.8$. This shows that increased fertilizer use is closely related to irrigation. Data source Indian Agriculture in Brief. Eighteenth Ed. p.37, 171

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fertilizer could include: lack of knowledge of how and when to apply; losses of nutrients during heavy rains and through irrigation; inadequate cultural practices, lack of seed treatment, and disease and insect infestations.

The Agriculture Department has a number of seed multiplication farms scattered throughout the State. The National Seed Corporation is responsible for production of certified seed. Though there are strong promotional efforts by the Agriculture Department and Agriculture University for distribution of improved seed, only a small percentage of the total area sown in the State uses improved seed varieties.

5. Credit

For the purchase of agricultural inputs such as seed, fertilizer and chemicals, crop loans are available through the primary Agricultural Cooperative Societies up to a norm fixed per hectare. Commercial banks also make crop loans.

For the construction of small irrigation schemes, land development, and soil conservation, loans are available through the Agriculture Department. If approved, the Department prepares a design and does the construction. Individual small farmers (up to one ha.) receive a 33 1/3 percent grant subsidy; and marginal farmers (1-2 ha.), 25 percent. For an organized group of small and marginal farmers, the subsidy is 50 percent, up to Rs. 5,000 ($500)[16/] the remainder may be borrowed from the Agriculture Department at relatively low interest rate, currently 6.5 percent . If more money is needed for the project, the farmer can apply to a commercial bank at a current interest rate of about 11 percent.

6. Marketing

Marketing facilities for agricultural produce are provided in accordance with the Himachal Pradesh Produce Market Acts of 1969 and 1972. These Acts are intended to ensure marketing access for the

16/ One reference in the material received from GOHP indicates that farmers holding more than 2 hectares are eligible for 20 percent grant subsidies, but this is not consistent with GOI policy. This point should be checked. It is recommended that AID not reimburse for land development subsidies granted to farmers holding more than 2 hectares.

agricultural products of the farmers of the State. They provide for a State Agricultural Marketing Board chaired by the Director of Agriculture, to advise the State Government on improved marketing relations, better regulation of trade and improvement of marketing practices in the regulated markets of the State. District level Marketing Committees headed by Deputy Commissioners of Agriculture have been set up under the Board in eight Districts. Inspectors trained in marketing serve as Secretaries. Ninety-one market yards were reported established by 1982. These were distributed as follows: Simla, 33; Solan, 11; Nalagarh (Solan), 2; Bilaspur, 6: Paunta, Sahit (Sirmur), 8; Una, 9; Kulu, 12; Kangra, 10. As of 1984, the number had been increased to 110 with 11 regulated markets. In addition, organizations like Feed Corporation of India, the Civil Supply Department and Cooperatives are involved in the marketing of agricultural products in the State. In each district, Agriculture Inspectors collect daily market rates of important commodities. These are broadcast from All India Radio.

For the marketing of horticultural products, a special horticultural produce marketing organization, namely the Himachal Pradesh Horticultural Produce Marketing and Processing Corporation, has been established. The Department of Horticulture-Himachal Pradesh, provides services like market intelligence, training in picking, handling, grading and packing of fruits to the farmers for helping them in getting remunerative prices.

D. Watershed Management

Because of the rugged topography in much of the project area, the heavy rainfall at times during the monsoon period, and shallow and erosive soils in many areas, attention must be given to watershed management in the design and construction of irrigation schemes. For subprojects, an assessment should be made of the kinds of soil conservation measures required to protect the proposed investment. These will of necessity be site-specific because of the variable soil and slope conditions and amount and distribution of rainfall (see Ch.III Sec.C5c).

Large scale soil maps prepared as stated in Sec.E 1 will help in the design of watershed management in the subprojects. If not available from All-India Land Use and Soil Survey, they can be prepared by the Soil Survey Units proposed for the Agriculture Department.

E. Special Studies and Activities to be Conducted Under the Project

1. Soil Surveys

Detailed soil surveys will be required as a qualification criteria for the proposed subprojects. These should be supplemented by soil analyses. These data will be interpreted in a report to provide information on water and nutrient requirements for different soils for the different crops and cropping patterns adopted for the subproject areas. The surveys should be completed before the final planning and design of the watercourses and distributaries.

At present, there are two assistant soil survey officers in the Department of Agriculture, each with a M.Sc. degree and six months training in soil conservation and soil survey. However, they apparently do not make soil maps with interpretations that are used in irrigation project design.

In order to begin to meet the needs for soil survey information, two full soil survey units will be established in AD. These units will make detailed soil surveys of proposed subproject areas supplemented by the necessary laboratory analyses and prepare the interpretive report on land capability and crop nutrient requirements and suitability of crops. The detailed soil surveys and land classification will be made in accordance with the procedures of the National Bureau of Soil Survey and Land Use Planning, Nagpur.

Grant funding will be used for partial support of these units including six to twelve months training at Nagpur for two specialists and one cartographer for five years and for equipment and materials. Salaries for other unit personnel, establishment and maintenance costs, transporation etc, will be eligible for 100 percent loan reimbursement.

2. Research

The work on effects of cooler flow-through water on rice yields in contrast to warmer ponded water needs to be extended to the field at representative sites using varieties which may have been adopted for cooler conditions taking into account differences in nutrient losses.

Yields for the basic crops of rice, maize and wheat in Himachal Pradesh did not enjoy the usual fillip in yields when HYV seeds were introduced. There is a good chance that this is because the varieties chosen, which were very responsive in the Plains may not have been responsive under hill conditions. An enhanced program of variety trials and crop breeding would appear to be very worthwhile.

A two-pronged program in crop adaptation research: (1) effects of flow-through vs. ponding on rice yields and (2) selection or breeding of better adapted varieties of maize, rice and wheat will be supported under the grant. The program will need to be planned carefully. Variety trials are already being conducted and work already done or underway needs to be taken into account and availability of staff resources considered. The plan will be developed with HPAU and concerned Center and State agencies early in

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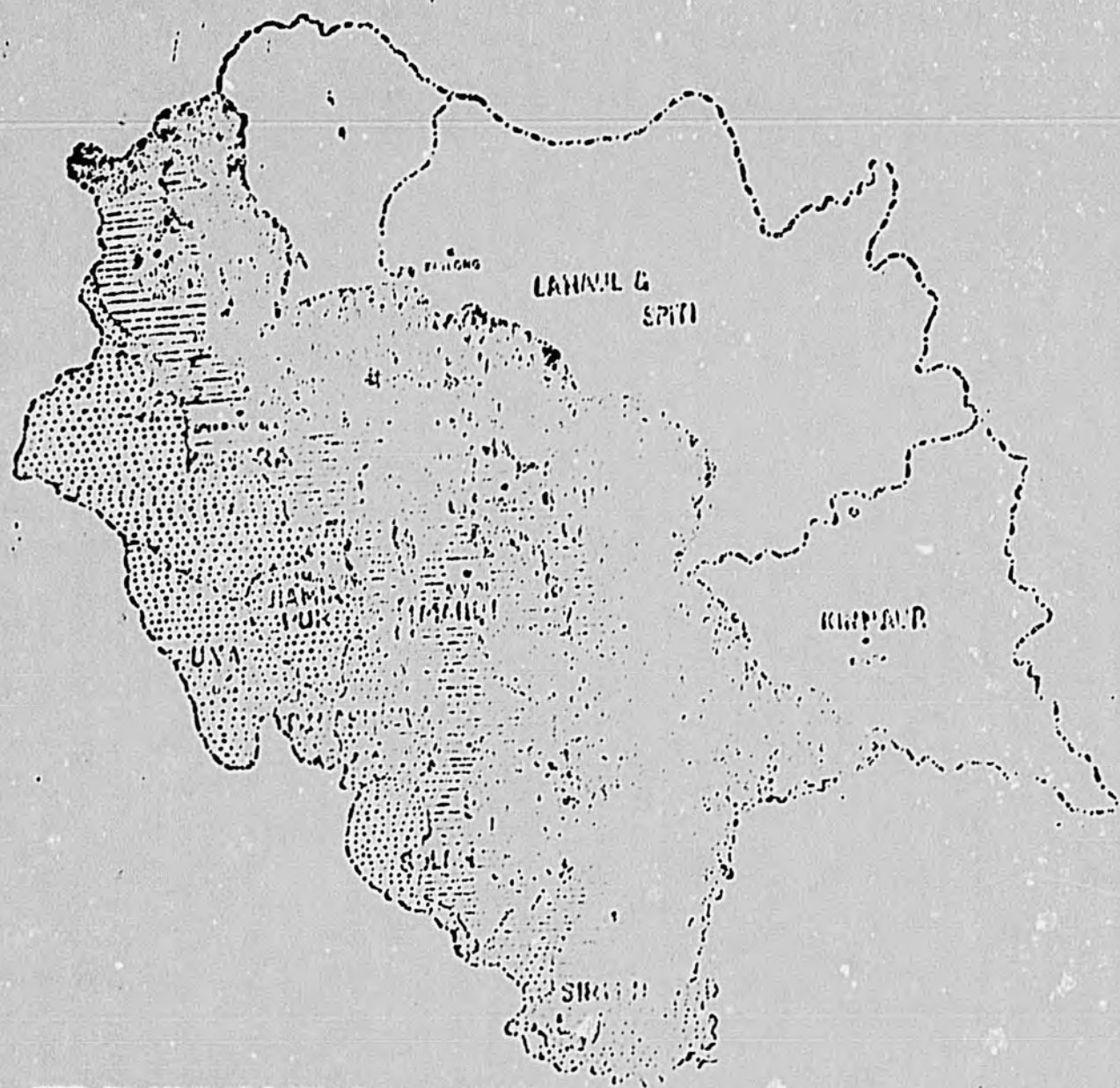
the implementation stage of the Project. Work may not be promising on all three crops because of either agronomic or economic reasons. Grant funds are proposed for local salary costs of an estimated three agronomists/plant breeders with appropriate assistant scientists, laboratory technicians and field hands for the life of the Project, necessary equipment, short-term training and local costs of Indian and U.S. consultants as needed.

Fig. II-1 Agro-Climatic Zones of Himachal Pradesh



Source: Report of ICAR Research Review Committee, July, 1982.

Table II-1

District-wise Area, Population and Density per sq. km

District	Area (000 sq km)	Population 1981	% of urban to rural population 1971	% of urban to rural population 1981	Decennial Percentage Change 1971-1981	Density of Population per sq. km 1981
1	2	3	4	5	6	7
Chamba	6.5	309,562	4.50	6.87	+23.23	47
Kangra	5.7	965,488	4.33	5.25	+20.56	168
Hamirpur	1.1	314,942	1.39	5.03	+18.85	282
Una	1.6	315,874	3.96	7.76	+20.86	205
Bilaspur	1.2	244,614	4.88	4.69	+25.58	210
Mandi	4.0	641,175	9.36	7.36	+24.46	162
Kulu	5.5	239,123	5.59	7.05	+24.30	43
Lahaul and Spiti	13.7	32,063	--	--	+16.31	2
Simla	5.1	507,793	14.59	15.75	+20.95	99
Solan	1.9	301,854	10.09	10.81	+27.15	156
Sirmur	2.8	305,927	8.45	8.77	+24.85	108
Kinnaur	6.6	59,164	--	--	+18.70	9
Total	55.7	4,237,569	6.99	7.72	+22.46	76

Source: Census 1981, Government of India, as reported by ICAR Research Review Committee, July 1982.

Note: The Table is based on the data taken from the report of the Surveyor General of India in which the area under hills and mountains is also considered and usually the density of population is expressed only on the basis of this area.

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Table II-2

Area and Production of Principal Crops in Zone I

	Area (000 ha)	Production (000 tones)	Average yield (q/ha) Zone	State	National
Field crops					
Wheat	145.0	159.1	11.0	10.3	14.8
Maize	120.4	192.1	16.0	16.8	10.4
Rice	34.8	45.5	13.1	13.1	13.2
Barley	7.8	12.1	15.5	13.3	11.6
Pulses	42.3	22.2	5.2	4.7	5.0
Potatoes	1.2	5.0	41.7	48.5	122.7
Oilseeds	8.4	3.0	3.6	3.3	5.8
Fruit Crops					
Apple	---	---	--	33.8	N.A.
Other temperate fruits	1.0	0.7	7.0	7.1	N.A.
Nuts and dry fruits	---	---	--	5.8	N.A.
Citrus	6.6	3.0	4.6	4.4	N.A.
Other sub-tropical fruits	4.3	1.0	2.3	2.2	N.A.

	Zone	State	% of State Area
Total geographical area (000 ha)	913.2	5567.3	16.4
Total cropped area (000 ha)	355.1	934.3	38.0

Source: Report of ICAR Research Review Committee, July, 1982.

Table II-3

Area and Production of Principal Crops in Zone II (1977-78)

	Area (000 ha)	Production (000 tones)	Average yield (q/ha) Zone	State	National
Field crops					
Wheat	105.6	107.4	10.2	10.3	14.8
Maize	92.5	167.0	18.0	16.8	10.4
Rice	53.6	71.3	13.3	13.1	13.2
Barley	15.3	20.2	13.2	13.3	11.6
Pulses	26.9	10.0	3.7	4.7	5.0
Potatoes	3.2	16.1	50.3	48.5	122.7
Oilseeds	8.5	2.8	3.3	3.3	5.8
Fruit crops					
Apple	15.2	53.1	34.9	33.8	N.A.
Other temperate fruits	8.2	5.9	7.2	7.1	N.A.
Nuts and dry fruits	2.5	1.5	6.0	5.8	N.A.
Citrus	3.0	1.2	4.0	4.4	N.A.
Other sub-tropical fruits	2.8	0.6	2.1	2.2	N.A.

	Zone	State	% of State Area
Total geographical area (000 ha)	1183.2	5567.3	21.3
Total cropped area (000 ha)	383.4	934.3	41.0

Source: Report of ICAR Research Review Committee, July, 1982.

Table II-4

Area and Production of Principal Crops in Zone III (1977-78)

Crop	Area (000 ha)	Production (000 tonnes)	Average yield (q/ha) Zone	State	National
Field Crops					
Wheat	65.9	60.2	9.1	10.3	14.8
Maize	57.3	95.1	16.6	16.8	10.4
Rice	13.5	17.1	12.7	13.1	13.2
Barley	9.9	12.0	12.1	13.3	11.6
Pulses	10.5	5.1	4.9	4.7	5.0
Potato	8.6	41.3	48.0	48.5	122.7
Oilseeds	2.0	0.4	2.0	3.3	5.8
Fruit Crops					
Apple	23.5	77.9	33.1	33.8	N.A.
Other temperate fruits	4.9	3.5	7.1	7.1	N.A.
Nuts & dry fruits	1.7	1.0	5.9	5.8	N.A.
Citrus	-	-	-	4.4	N.A.
Other sub-tropical fruits	-	-	-	2.2	N.A.

	Zone	State	% of State Area
Total geographical area (000 ha)	1280.9	5567.3	23.0
Total cropped area (000 ha)	171.8	934.3	18.4

Source: Report of ICAR Research Review Committee - July, 1982.

Table II-5

Size Distribution of Holdings 1967-77

Hectares	No. of Holdings	% of Holdings	Area (ha)	% of Acres
Below 0 5	2,13,535	34.36	50,894	5.04
0.5 to 1.0	1,26,248	20.32	92,057	9.12
Marginal farmers	3,39,783	54.68	1,42,951	14.16
1.0 to 2.0	1,36,449	21.96	1,96,548	19.46
Small and marginal farmers	4,76,232	76.64	3,39,499	33.62
2.0 to 3.0	63,154	10.16	1,53,939	15.24
3.0 to 4.0	31,749	5.11	1,09,267	10.82
4.0 to 5.0	17,401	2.80	77,960	7.72
5.0 to 10.0	25,141	4.04	1,96,532	16.79
10.0 to 20.0	6,069	0.98	79,341	7.96
20.0 to 30.	908	0.15	21,380	2.12
30.0 to 40.0	312	0.05	10,708	1.06
40.0 to 50.0	133	0.05	10,708	1.06
above 50.0	319	0.02	6,123	0.61
Total	6,21,418	100.00	10,09,768	100.00

Source: Directorate of Agricultral Census, Himachal Pradesh
Note -- The landholdings include fallow and other land besides net area sown, owned by the individuals.

Table II-6

Area, Production and Average Yield of Principal Crops in Himachal Pradesh

(average from 1974-75 to 1978-79)

CROP	Total Area (000 ha)	Irrigated Area (000 ha)	%	Production (000 tonnes)	State Average yield(q/ha)	National Average yield(q/ha)
1	2	3		4	5	6
Cereals						
Wheat	332.2	52.7	16.0	367.7	11.70	14.48
Maize	268.2	16.5	6.1	441.9	18.72	10.56
Rice	97.0	55.4	57.1	116.9	13.39	12.01
Barley	38.7	5.3	13.7	46.3	13.31	11.17
Millets & Other Cereals	29.8	3.6	12.1	17.3	5.79	4.06
Ragi	12.1	0.5	4.1	9.0	7.45	10.01
Pulses						
Gram	31.2	1.0	3.2	18.3	5.85	6.75
Other pulses	40.7	0.1	1.2	14.8	3.63	3.90
Oilseeds						
Rape and Mustard	5.4	0.3	5.6	1.7	3.14	5.35
Linseed	6.1	5.3	86.9	2.3	4.63	2.58
Sesamum	8.0	0.1	1.2	2.3	2.84	2.00
Cash Crops						
Potato	14.7	2.9	19.7	72.6	49.42	118.00
Sugarcane (gur)	3.9	0.6	15.4	6.7	17.24	53.61
Ginger	2.3	1.0	43.5	1.2	5.26	17.44
Chillies	0.7	0.2	28.6	0.2	3.03	6.69
Other Crops						
Tea	3.5	1.0	28.6	1.3	3.64	14.34
Tobacco	0.5	0.1	20.0	0.2	4.61	9.92
Horticulture						
Apple	37.0	N.A.		123.2	33.30	N.A.
Other temperate fruits	13.2	N.A.		9.9	7.53	N.A.
Nuts and Dry Fruits	4.2	N.A.		1.5	3.57	N.A.
Citrus	8.8	N.A.		8.8	10.0	N.A.
Other sub-tropical fruits	6.2	N.A.		5.5	8.92	N.A.

Source: Report of ICAR Research Review Committee, 1982

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Table II-8

Areas Cropped and Irrigated by Crops
1977-78

		State Total (000 ha)	Per Cent	Total Irrigated[a/] (000ha)	Per Cent[b/]
1.	Wheat	320.3	35.8	56	36
2.	Maize	271.9	30.3	(b)	(b)
3.	Rice	101.9	11.4	52	34
4.	Other Cereals	76.4	8.5	24	15
5.	Total Cereals	770.5	86.0	134	86
6.	Pulses	80.9	9.1	4	3
7.	Total Food Grains	851.4	95.2	137	88
8.	Other Food Crops[c/]	21.6	2.4	8	5
9.	Oil Seeds	18.9	2.1	9	6
10.	Other Non-food Crops	4.0	0.4	-	-
	Total	895.9	100.0	155	100.0

a/ May not add due to rounding.
b/ Maize is included under other, line 4
c/ Inludes potato, sugarcane, ginger and chillies.

Source: For totals: Statistical Outline of Himachal Pradesh, 1980, p.79;
For Irrigated Crops: Indian Agriculture in Brief, 18th Edition, p. 35

CHAPTER III

TECHNICAL ANALYSIS OF THE IRRIGATION FACILITIES

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This Chapter describes technical aspects of the various kinds of existing small scale irrigation in the State of Himachal Pradesh. It looks at the current planning, design and operating procedures, analyzes their performance and presents the proposed planning and design criteria to be followed under this project. Conclusions are based on field visits to various sites in the state, conversations with GOHP officials and technical personnel and a study of different schemes. The technical, economic and social performance of a set of eight existing schemes was investigated in the field during September and October, 1983. The four basic types of schemes to be supported under the project: flow schemes, lift schemes from surface water sources, lift schemes from groundwater sources, both tube and dug wells and water harvesting schemes were included in the study. Sample schemes were drawn from both low and mid-hill regions and represented three management forms: departmental, community and individual.

A. Description of the State's Facilities

The irrigation sector and responsibilities of the various agencies are described in Chapter I, Sec. B. Technical aspects of the various types of schemes to be supported and relationship to responsive agency are discussed below:

1. Flow Schemes

Much of the area presently irrigated by surface water is served by community kuhls diverted from various sources such as perennial rivers, small streams and springs. These command areas range in size from one or two up to several hundred hectares. The Irrigation Department builds, maintains and operates new kuhls and rehabilitates and operates old ones built by the farmers themselves. Construction of both new kuhl sytems and rehabilitation of old ones is at government expense. The existing kuhls vary in present condition from reasonably good to poorly maintained and non-functioning.

Rehabilitation consists mainly of repairing breaches in the main channel along the steep hillsides, lining the more obviously leaky portions of the kuhl or in some cases replacing certain lengths with a closed conduit. After rehabilitation ID assigns a water master to supervise the water distribution within the command area and check for any maintenance or repair needs which are then taken care of by the government. Two such kuhls observed were in the Baijnath area. One kuhl was 23 km long and served a Culturable Command Area

(CCA)[1/] of 784 ha with design capacity of 0.365 cumecs (12.9 cusecs)[2/]. Another was 29 km long serving approxi- mately 1800 ha with a capacity of approximately 1.25 cumecs (44.2 cusecs).

The conveyance channels generally do not have structures at turnout locations and water can be diverted from the main canal at almost any point simply by cutting the bank. Because most of the distributary channels are located on ridges they usually follow slopes that result in excessive velocities and subsequent erosion of the channel beds. The lack of turnout and grade stabilization structures is one of the serious deficiencies of the existing kuhls. Particularly for the larger perennial streams, there usually is no permanent diversion weir. Small loose rock diversions are placed in the streams for directing the water into the kuhls during low flows. This seems to be a satisfactory manner of handling the matter because the cost of a permanent structure designed to pass the flows during the monsoon would be prohibitive.

In general, little attention has been given to the distribution of water to the fields of the beneficiaries, either to design and layout of the system or to its operation. The assumption is that the users served by an outlet will be responsible for developing the watercourses and field channels required for distribution to each individual field but this often has not happened. Most of the land served by the kuhls has been bench terraced in small irregular parcels. Where conditions are favorable water is used for paddy in the kharif season. Because the soils tend to be medium to light textured, there is substantial loss of water to deep percolation. Because there are very limited watercourses and field channels the field-to-field irrigation usually practiced serves as both the conveyance and application system. This results in unequitable distribution with those users near the outlet receiving full or excess irrigation water while those further down suffer shortages or receive no water at all. Lack of water distribution facilities is one of the contributing factors to the low water utilization, the percent of designed area irrigated, that concerns those involved with irrigation in the state.

1/ The net geographical area suitable for cultivation to be served by the scheme.

2/ One cumec is a stream which flows at the rate of one cubic meter per second. A cusec flows at the rate of one cubic foot per second.

Both the AD and RD also repair and rehabilitate kuhls. For these agencies, construction costs are shared by farmers and the government does not assume the responsibility for operation and maintenance of the system nor asses water charges. Kuhls rehabilitated by the AD and RD tend to be smaller than those assisted by the ID. The RD provides technical and financial assistance to community khuls for repair and/or rehabilitation up to a limit of Rs.50,000 with 12.5 percent of the cost provided by users. As with kuhls rehabilitated by the ID, distribution facilities in AD and RD supported schemes are poorly developed. The AD, however, has had some limited experience with watercourse development.

2. Lift Schemes

a. Surface Water

There are numerous lift schemes in Himachal Pradesh in which water is pumped from perennial streams (Khuds) and other water sources such as non-perennial streams (nullahs) to irrigate agricultural lands at higher elevations. Pumps for these schemes are most frequently powered by electricity. The state of Himachal Pradesh has an excess of electrical energy though supply is often at some distance from pumpsites. Lifts vary from a few meters up to about 100 meters on the schemes visited. Because of rising stream levels during the monsoons the pumps at one installation visited had to be removed during the rainy season. A small rock wall was being constructed to raise the river water level sufficiently to cover the suction pipe of the pump during the dry season. This eliminates the possibility of using the scheme for supplemental irrigation during kharif.

b. Groundwater

Tube wells with electrically powered pumps provide irrigation water in a few alluvial valleys and low foothills areas. Vertical turbine pumps are preferred because they are more efficient, but when the alignment of the bore hole prevents the installation of a turbine pump, a submersible pump is used.

Unlike some other states in India, Himachal Pradesh has no State Groundwater Board. GOI's Central Groundwater Board has done a limited amount of hydrological survey spanned over an area of 4290 sq.km within the state and has published reports showing groundwater contours for Una, Kangra and Hamirpur Districts. Areas in which groundwater resources are available are limited. Approximately ten percent of the area of the state, located in valleys and along the

foothills has been deemed worthy of hydrologic survey. The Central Groundwater Board reportedly maintains 37 hydrographic stations in the state. These monitor groundwater levels five times annually.

Much of the groundwater development observations reported here relate to the Indo-German Agriculture Project[3/] visited by the team. This program has provided groundwater information, well drilling logs, screen design, etc. for various wells, especially in the Nurpur District. The wells have been drilled and cased and the pumping plant installed by the AD. They were then turned over to the ID for operation and maintenance. Log books are kept by the pump operators which show the farmers' requests, the days and hours during which the pumps are operated and the farmers and crops receiving water.

Distribution systems are usually buried pipe lines with valves at each chak[4/] and operate at medium pressure. Only one valve is opened at a time so that the total discharge of the pump flows to the chak served by the valve. Because of differences in distance from the pump and in elevation the actual flow varies from chak to chak. Some needed improvements in the design of these distribution systems are discussed under Section C2.

As on flow schemes there is a serious lack of chak development including land preparation by leveling and construction of watercourses and field channels. Lack of chak development is one reason for low utilization of irrigation. Estimated irrigable area is calculated using a standard "duty" rather than on water requirements based on the soils, crops, climate, and conveyance and application losses. Another reason for low utilization is that actual well yields are less than those estimated in the design.

In addition to tube wells the AD also constructs shallow hand dug wells from which water is lifted for irrigation.

3/ Tawari, S.C. and R.K. Sharma. Impact and Performance of Indo-German Agricultural Project Kangra. Indo-German Agricultural Development Agency, Palampur; undated. 213 p. p. 22-23.

4/ A "chak" is the land area served by an outlet

3. Water Harvesting

A typical water harvesting scheme involves construction of a masonry check wall or small earthen dam at a suitable location across a nullah to impound runoff water from the small watershed above the site and facilities to utilize the stored water for irrigation. Generally the cost of the storage component/check dam and appurtenances is borne by the AD. The rest of the facilities are developed by the beneficiaries. For small and marginal farmers and scheduled castes, financial assistance is available through the AD. The water in the pond is available gratis to the potential users. From sites visited, the primary emphasis appears to be on the location and construction of the dam with no comprehensive planning for the utilization of the developed water resources. At both sites visited, the water was being used for irrigation of a few hectares of land by individual farmers who on their own initiative had purchased pumps using AD financial assistance. Diesel powered pumps were used at these two sites because there was no nearby electrical power supply. Other types of water harvesting involve construction of concrete storage tanks to hold small flows of water over several days until enough accumulates to irrigate some small areas.

4. Agency Responsibilities

The principal GOHP agency responsible for irrigation is ID. This agency is also responsible for the development of community potable water systems. Besides constructing and rehabilitating flow scheme the ID also plans, designs, constructs, operates and maintains lift schemes from both surface and groundwater sources. The staff has gained more experience in domestic water supply than in irrigation. Professional development through training is desirable for certain areas, particularly planning and design of systems on the basis of crop water requirements, planning and design of chak level and on-farm facilities, and the involvement and participation of the beneficiaries in all phases of the work.

The AD has a limited engineering staff, involved in the planning, design and construction of tubewell irrigation schemes, dug wells and water harvesting schemes.

In addition to staff development through specialized training, both ID and AD need to develop an integrated multidisciplinary approach to irrigation which should include engineering, soils, crops, agricultural inputs and farmer involvement. The Project will support this development through special studies, demonstrations, workshops, pilot projects and training.

B. Present Planning and Design Criteria

1. Planning and Design

In general, there are some established criteria for planning and designing irrigation projects in the State of Himachal Pradesh. Regular project design activities of the ID are undertaken by the various circles established throughout the State, each under the direction of a Superintending Engineer. Designs for individual minor irrigation projects are then submitted to the Planning and Design Division in Simla for review and approval and inclusion in the State budget.

Hydrological data on the surface water supplies are not adequately available and collected on a regular basis. This may concern the effect the project may have on prior user's rights. Rainfall data is also not adequately used in the planning process. Data on soils are not collected. Crop water requirements are not estimated based on soils and climatological varieties, instead a standard duty of water of 150 acres (60 ha.) per cusec is used. This is based on the past experience with the existing system.

Economic analyses are made for proposed schemes and benefit cost ratio is calculated. These do not take into account time discounting of money and use financial rather than economic costs and benefits. Economic analysis procedures and criteria are discussed in some detail in Chapter VI.

2. Review of Existing Schemes

This section summarizes the technical findings of the schemes studied. Four of the eight study schemes, selected as a typical sample, are discussed. In general, hydrological data related to rainfall and runoff were used only to a limited extent in design. The hydraulic design involved computation of static and dynamic water levels for sizing pumping plants and pipes and channel cross sections, weir lengths, etc. for the flow schemes. For the schemes studied, these elements were generally well covered. Structural factors such as stability considerations were covered in a very limited manner. Design and installation of tubewells were treated adequately.

a. Lift Scheme - Jawali Lift Irrigation Scheme

1. Planning

The Jawali Lift Irrigation Scheme is located in the low hill region in Nurpur Tehsil, Kangra District. This scheme was designed by ID to put to use a portion of an existing canal scheme,

Sidhartha, constructed earlier but which was not successful. The source of supply of water for the scheme is the Dehr khud. Stream flow and other hydrological data were not reported in the project plans. They show an assessment of 15 cusecs as the total flow. After deducting for current upstream usage, the net available flow in the khud for LIS Jawali was assessed as 10.5 cusecs.

The gross command area of the Jawali Lift Irrigation Scheme was reported as 651.82 ha. Assuming an intensity of irrigation of 80 percent, and a duty of water of about 160 acres (65 ha)/cusec, irrigation interval of 30 days and pump operation of 16 hours per day during peak demand for 8 months each year, the water requirements for a CCA of 471 ha were assessed. These work out to 10.5 cusecs, the proposed capacity of the pumping plant to be installed. For delivering this water against a total head of 49.4 m and on the basis of certain assumptions regarding frictional and other losses and plant efficiency, the capacity of the pumps were assessed as 340 hp. The pumping plant was chosen with two electrical driven pumping sets, each of 180 hp and a total expected discharge of 10.5 cusecs. A third pump of equal capacity was provided as a stand by. Pipe sizing of the rising main was done through an economic analysis of different pipe diameters.

The project plans also reveal certain modifications to be done in the erstwhile Siddhartha distributory. These were worked out using standard procedures employing continuity and Manning's velocity equations. Though the project plans indicate a projected cropping pattern, no computations were made to assess the crop water requirements.

ii. Performance

Though the expectations of the scheme were to provide irrigation to a CCA of 471 ha, on an average, during the last three years, irrigation from the scheme has benefited only about 121 ha.

Technologically, the pumping plant designed for lifting water appears adequate. However, since the scheme started only one out of the two pumps has been operating because of limitations in the electric power supply. Operation of both pumps at the same time trips the system. Work on augmentation of the power supply was reported to be under way with the project authorities hoping to put the second pump in operation in another three months. There are also constraints in operating the pumping plant during peak load hours in the evening.

Though the discharge available for pumping was assessed as 10.5 cusecs, an inspection at the site indicates likely shortfall. In any case, only about 4.8 cusec was being pumped because of the electrical problem mentioned above.

The distribution system for the command area is an open channel system skirting one side of the area being irrigated. Apart from seven or eight outlets constructed by the department, there are a large number of informal (kuccha) outlets . With field to field irrigation, lack of appropriate field channels, and poor land development in the chaks, irrigation water could hardly get beyond a length of 30-45 m from the main canal. As of now, the system is not effective in serving the CCA for which it was meant. However, this could be possible once the land is properly developed for efficient irrigation.

The head works for the lift irrigation scheme comprises of the diversion bund in the Dehr khud, the feeder channel for drawing off water from the khud to the sump, the sump and the pumping plant. Because of flow and other conditions the head works require periodic maintenance. The diversion bund in the khud needs to be reconstructed every year, the silt in the feeder channel needs removal every two months and the sump well needs cleaning twice each year. The general state of the head works at the time of the visit needed adequate repairs since it had been damaged by recent heavy rains.

The field conveyance and distribution system, however, is the weakest component of the project. The distribution system, is not now able to extend water to all parts of the command area. The main canal, particularly at the tail end, is in a poor state of maintenance. Watercourse development at the chak level was inadequate. The area being irrigated has some high spots, needing land levelling. The system of irrigation from field to field, easy accessibility of water to farmers near the main canal and perhaps unauthorized usage of irrigation water denies water to large parts of the command area, particularly at the tail end. Field losses in distribution were assessed at about 35-40 percent.

No special problems related to drainage or salinity were reported from the area.

The water delivery procedures comprised of the farmers signing up for water and the Junior Engineer in-charge of the project preparing a schedule in consultation with the farmers. The farmers register their demands for water with the pump operator. The pump operator is responsible for the operation of the pump and the beldars are responsible for the distribution of water.

Conflicts in use of water are reportedly resolved either mutually or through the efforts of Irrigation Department officials. With hardly any mechanism for regulating and controlling water in the main distributory, the water delivery procedures, one expects, can only be ineffective.

The Jawali Lift Irrigation Scheme was started in 1972 and completed in 1975. In a strict sense, the scheme still remains incomplete because of its failure to provide irrigation to the extent perceived. Full irrigation of the CCA can never be achieved even through increased water supply unless proper distribution is introduced and chak development is completed.

b. Remodeled Flow Scheme: Samlati-Uster

Samlati-Uster flow scheme is located in the mid-hills in Kangra District. The remodeling consists of a diversion from the Joggal Khud to Dibber Nullah and a weir in Dibber nullah to direct flow into the Mari kuhl. Stream flow records or an estimation of expected water supplies were not available. However, the design is based on observations of the lean period discharge. The proposed CCA was 32 ha., based on the standard duty of water of 60 ha/cusec, requiring a flow rate of 0.53 cusecs. Utilization of the system over the past three years has only averaged about 20 ha in kharif and 9 ha in rabi.

Designs for the diversion system were based on one cusec but in the design of the various components of the system, analysis of hydrologic, hydraulic and structural design aspects were meager. Canal lining work and replacement of the diversion weir that was breached has not yet been completed. Only limited semi-permanent regulating structures are provided in the main channel.

As in the case of Jawali LIS, there is a lack of water-courses and field channels at chak level and field-to-field irrigation restricts the availability of water to the tail enders. Water delivery procedures are not effective with the farmers located near the canal being the major beneficiaries.

c. Lift Scheme, Department of Agriculture: Gutkar Village, Manli

he majority of the lift irrigation schemes sponsored by AD are located in the Una, Hamirpur and Mandi Districts. A typical scheme consists of the water source - usually a shallow hand dug well, pump and motor (usually electrical) and a distribution system. The observations presented here are for a scheme managed by a group of seven or eight farmers covering an area of 3.83 ha.

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located in Gutkar Village in Mandi District. Technical planning information available on the project was limited to analysis of the static and delivery head and capacity for the pumping plant. A 60 mm irrigation depth at 10 day intervals with 10 hours per day of operation at 65 percent efficiency was assumed. No computations on crop water requirements were made. Groundwater surveys were not made as the well is near a perennial khud.

Reportedly the entire 3.83 ha area benefits from the scheme. The distribution system consists of 186 m of galvanized iron pipe discharging the water to open unlined channels which carry the water to the individual plots. Water is usually available on demand. There are essentially no regulating structures in the system. The study team estimated that 15 to 20 percent of the water could be saved by improving the conveyance system. All operation and maintenance charges are distributed to the beneficiaries in proportion to land area owned in the command.

d. Deep Tubewell Scheme - Kher I

A tubewell near Nurpur in the Kangra District in the low hills region was selected for detailed study. The well was constructed by the AD in 1977 under the Indo-German Agriculture Project with the technical approval of the Central Groundwater Board. It was made operational in 1979 and transferred to ID for operation and maintenance in 1981. This well is one of 20 planned under the Indo-German Agriculture Project. These well schemes were generally planned assuming a discharge of one cusec and a command area of 40 ha. Soil and climatological data were not incorporated into the project design.

Well design and construction procedures followed were generally in accordance with technical standards. The underground distribution system consists of some asbestos cement (AC) pressure pipe and some reinforced cement concrete (RCC) low pressure pipe. Twenty-eight outlets were provided for distribution in the command area. The CCA was estimated at 32.4 ha but the average area irrigated over the past three years has not exceeded 17 ha. This is because of reduced well discharge (0.75 cusecs) lack of watercourses and field channels below the outlets, poor chak development, field-to-field irrigation and over irrigation of paddy thus depriving other areas of water.

e. Water Harvesting Scheme: Tarsooh

A review of the selected project, located near Village Tarsooh in Bilaspur District in the low hills region, indicated

that the site had been selected through reconnaissance and field inspection by AD officials in consultation with farmers in the area. No foundation studies were made and runoff was calculated using the rational method, based on rainfall estimated from a station 16 km away. Stage-storage curves were developed from topographic surveys of the reservoir area. The gravity dam is a rubble masonry structure 16 m long and 7.5 m high with an overflow spillway and apron downstream. No stability calculations were included, nor were there any studies regarding the potential irrigate area.

Initial efforts by the AD to develop an integrated scheme, including irrigation, generated no interest among the farmers. Only after the storage pond was developed did two groups of beneficiaries, one on each bank, implement irrigation by using pumps to lift water to the command area. The original area planned was about 6.35 ha. In actual practice, the irrigation has tended to be extensive with four to twenty ha irrigated in the kharif season and 22.25 ha in the rabi season. The distribution system consists of about 600 m of pipeline and many open, unlined channels. Chak development is poor and the distribution system is poorly developed and maintained. Land leveling and additional lengths of pipe are required for effective use of the water.

The condition of the watershed is poor. Many of the small check dams previously constructed by the Forest Department are breached or silted up. The catchment area is open to grazing and devoid of forest cover. As a result there is considerable inflow of sediments into the reservoir. Unless watershed treatment is included as an integral part of water harvesting schemes, their expected life will be severely shortened.

C. Proposed Planning and Design Criteria:

1. Flow Schemes

a. Water Supply

To attempt to gather complete hydrological information in any kind of systematic way for the many small and varied surface water sources of Himachal Pradesh would be a tremendous task and probably not be justified. However, subproject plans must be based on some reasonable confidence that the required supplies will be available.

For new flow systems the following criteria will be met for estimating available water supply.

i. Monthly runoff at 75 percent probability level will be estimated using rainfall and appropriate runoff models or correlation procedures.

ii. As a check, flow measurements using stage discharge relations will be made during the period of low flow in the year preceeding construction of the subproject.

iii. A determination will be made of existing schemes which are diverting water from the same source and an assessment made of the impact of the proposed development on the prior water rights. No subproject will be initiated which jeopardizes existing water uses as is the present practice.

For rehabilitation kuhls, where command area is not increased, documentation provided by kuhli or water users, if substantiated by historical records, may be substituted. If command area is increased, then the same criteria as for new schemes will apply.

Appropriate procedures for rainfall-runoff correlations will be identified collaboratively with USAID. If desirable, models such as those developed by Linsley, may be utilized. For routine flow discharge measurements, the float-velocity method, if carefully done, is satisfactory. In order to collect data to improve runoff prediction techniques, standard stream gauging and rainfall stations will be installed in five to ten representative watersheds in the Project area. ID/AD will be responsible for collecting stream flow and precipitation information from these stations. Some additional small watershed sites (See C4c) representative of water harvesting activities will also be included in the watershed hydrology activity. Technical assistance for identifying appropriate rainfall

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correlation formulas or procedures for implementing rainfall-runoff correlations and stream gauging programs and for instrumentation and data collection on representative watersheds and a training program in watershed hydrology will be supported by grant funding.

b. Headworks

Temporary loose rock diversion structures will be acceptable streams where flood flows exceed 25 m^3/sec. or on smaller streams for command areas less than 20 ha; otherwise permanent structures will be installed. For these, test pits will be dug and foundation conditions reported using the Indian Unified System of Soil Classification.5/ Structural stability both under normal service and full flood conditions will be calculated and energy discipation structures designed using standard engineering practice. 6/ Regardless of type of diversion structure, main canals will be fully controlled by gates and provided with emergency wasteways of permanent or fuse-plug type, so that canal head reaches will be protected from floods. Slucing facilities to reduce sediment load will be incorporated into the headworks design. There is a need to improve utility of diversion weirs including deciding when permanent structures are justified and to improve the design and performance of temporary diversion structures, e.g. by appropriate use of gabions, etc. This and other later mentioned design aspects of hills region irrigation systems will be examined by a consulting commission whose membership, including international technical assistance if needed, will be agreed upon by GOHP and USAID.

c. Conveyance

Size of conveyance channels will be sufficient to transmit maximum demand based on peak fortnightly crop water requirements with allowances for operational and seepage losses. Sizing shall be calculated using accepted open channel flow formula such as Chezy's or Manning's. Velocity will be such that erosion will not occur in earthen materials. Differences in elevation where these exceed hydraulic grades will be taken up by appropriate erosion control structures fully protected against downstream erosion. Open channels will be lined where soils are sufficiently permeable that losses greater than 5 c.f.s/million square feet can be expected (all coarse grained - S, G, types in the Unified Soil Classification System),

5/ Indian Standards Institution Publication: 1.S.1498-1970. See also U.S. Bureau of Reclamation, Earth Manual. 1974, p. 12.
6/ "Standard Practice" is defined in Section C5.

in shattered or weathered rock, or where seepage would contribute to unstable soil conditions. For permeable reaches or reaches along steep transverse slopes where the canal is subject to damage from earth or rock movement, closed conduit will be used when economic analysis shows least capital and maintenance costs.

Surveys for conveyance channels will include notation of earth or rock material at intervals of 100 m or whenever changes occur. Test samples will be taken when in earth and classified according to the Unified Soil Classification System. This information will be shown on plans and profiles. Where cross drainage occurs, the channel will be provided with bypass structures or waste ways adequate to bypass or divert cross-channel floods with peak flows estimated by the Rational formula or some other method agreed upon by GOHP and USAID. Feasibility reports shall include an evaluation of the condition of the cross drainage watershed by SC/AD or FD as appropriate with a plan for any needed protective measures. Implementation of such plans shall be included as part of subproject construction and operation maintenance.

A control gate shall be provided at the head of each branch. Measuring weirs or flumes (cutthroat or broad crested type) will be installed immediately downstream from the main headgate at branches and at the entry to the distributary section.

In addition to supply channels, subprojects will provide adequate drainage channels sufficient to remove maximum 5-year rainfall within 24 hours from the command area into a natural drainage channel.

For distributary reaches, the channel shall be controlled using appropriate check structures so that the water level can be maintained at outlets at not less than 45 cm above the highest point in the chak to be served. Outlets will be designed to serve a maximum of eight hectares and will be equipped with a suitable permanent gate. Distributaries will normally be designed to provide a flow of 10-30 l/s to outlets on a rotating basis depending on the size of stream desirable for efficient irrigation application. Attention needs to be given to selecting optimal stream size under various local conditions.

All structures, drops, cross regulators, siphons, chutes, bridges, road crossings etc. shall be designed according to standard engineering practice.

Where the canal traverses cultivated areas, a closed pipe line to reduce land losses for right of way and the possibility or opportunity of unauthorized water diversion will be given preference unless clearly uneconomic. Chak area development criteria are presented under Section C1c "Water Distribution and Application".

d. Irrigation Water Budget

For subprojects, CCA for a given available water supply or necessary water supply for a given CCA will be calculated from a water budget based on computed crop water requirements and appropriate allowances for seepage and operational losses. Semi-monthly values of crop water requirements will be calculated for the cropping pattern suggested by AD using crop coefficients given by FAO 7/ applied to the potential evapotranspiration as estimated from available climatic data. The 75 percent probability values of effective precipitation will be used to obtain the net irrigation water requirement.

Values of potential evapotranspiration and effective precipitation can be developed in a zonal basis. A special study will assemble and process available climatological data for various zones and test the feasibility of using a zonal approach. Where successful, zonal values of evapotranspiration and effective precipitation may be used for estimating irrigation requirements. Alternatively, evapotranspiration may be computed using local climatological data and temperature/solar radiation formulas (Blaney-Criddle, Jansen-Haise, Hargreaves-Samani).8/ Approach to be used on various subprojects will be as agreed upon by GOHP and USAID.

In the absence of specific information the following loss rates and efficiencies will be used for computing water budgets for open channel systems. These values assume installation of lining or closed conduits in permeable reaches as specified above and fields properly shaped to receive irrigation.

7/ See: Crop Water Requirements, Irrigation and Drainage Paper No. 24, Rome, 1975. See also: A Guide for Estimating Crop Water Requirements. Water Management Division, Ministry of Agriculture, New Delhi, July 1971.

8/ Ibid. See also Hargreaves, George H. and Zohrab A. Samani, Estimating Potential Evapotranspiration. Jour. Irrigation and Drainage Division. American Society of Civil Engineers, Vol. 108, No. IR3, September 1982, p. 225-230.

	Kharif		Rabi	
	Loss	Efficiency	Loss	Efficiency
	%	&	%	%
1. Conveyance, Diversion to Outlet	10	90	15	85
2. Operations	15	85	15	85
3. Field Channels	10	90	15	85
4. Field Application	15	85	20	80
Overall		58.5	-	50.0

Other water requirements may be taken as follows:

1. Land preparation (paddy) 100mm
2. Transplanting (paddy) 150mm
3. Pre-sowing 100mm

e. Surveys

Topographic maps prepared by the Survey of India (20m contours) may be used for general location. Strip surveying for location of main canal should show contours of not more than one meter. More accurate maps are needed for location of distributaries, watercourses, field channels and land development on farms. Criteria stated here apply to all types of irrigation schemes. Village maps (scale 1:4000) with proper enlargement may be used as base maps. Topographical surveys will be carried out taking spot levels in each survey number. Survey map will depict ground elevation on fields, including existing terraces, location and elevation of benchmarks, ownership, all permanent structures, visibly uncultivated and uncommanded areas and alignment of main canals with full supply level (FSL) indicated at appropriate places. The following specifications will be used.

1. Spot levels 8-10 per ha
2. Contour interval 20 cm
3. Mappling scale 1:2000

Accuracy of controls for strip and topographical maps shall be such that vertical error of closure does not exceed 0.1 feet times the square root of the length of the traverse in miles (0.024 meters times the square root of the traverse in kilometers) where miles or km is the length of the traverse; nor horizontal error of closure exceed 1/2,500.

f. Water Distribution and Application - Chak Development

Subprojects will provide for full development of chaks to insure reliable, equitable and efficient distribution of the water and its proper application to fields. Selection of the command area and its development will be based on soil surveys as specified in Chapter II, Section E. All chak development will be based on maps and surveys as specified in Section C1e. The Project will provide field channels for water distribution from the outlet to individual fields. Capacity of field channels may range from 10-30 l/s depending on local conditions. Field channels will provide a minimum of 15cm working head above the highest field to be served. They will be equipped with appropriate gates and control structures. Where economical, closed or a combination of closed conduit and open channels using Alfalfa Valve type controls will be used. Gravity sprinkle systems could be a possibility (see Section D1). Planning will include agreement among the farmers as to the proposed location of outlets and field channels, water rotation or delivery schedules and acceptance of the responsibility for maintenance and operation of field channels and drains to assure continued distribution of the water as planned.

Chak-level irrigation development involves planning and construction of common water distribution channels or conduits to deliver water from the main channel or conduit outlets to individual farms. It also includes drainage channels in the same area and on farm land development including land shaping, leveling or terracing on individual farms. Training for chak development is proposed early in the life of the project. The training would be in a workshop format. The workshops would serve junior and assistant level personnel responsible for planning for designing, and construction of schemes.

Planning of schemes will provide for full development of chaks to ensure reliable, equitable and efficient distribution of the water and its proper field application. Selection of the command area and its development will be based on topographic and soil sur- veys. The chak development will provide water courses and field chan-nels for water distribution from the outlet to individual fields. Distribution network will be equipped with appropriate gates and

control structures. Where economically justified, closed or a combination of closed conduit and open channels using "alfalfa valve" type controls will be used. Chak development will also include installation of field drainage channels connected to main system drainage facilities. Planning will include agreement among the far mers and the responsible agency as to the proposed location of out lets and field channels, water rotation or delivery schedules and acceptance of the responsibility for maintenance and operation of field channels and drains to assure reliable distribution of the water.

The actual amount of water allotted to a farmer would be a function of cropping pattern and land holdings in the command area. A plan for rotational distribution including proposed period or periods of rotation and timing allowances per hectare will be worked out with the users organizations. The plan shall show rotation schedules to outlets on the distributary section and for individual chaks. Plans showing location of outlets and field channels will be included in the feasibility report along with a water distribution plan and bear the concurrence signature of representative(s) designated by the farmer group.

Much of the area served by present and proposed irrigation is used for paddy production during the monsoon. As a consequence, sloping lands have been bench terraced, often irregularly with varying lengths, widths, and configurations. This complicates the design and layout of any irrigation distribution system. On a pilot basis, some realignment of terrace boundaries will be undertaken to improve layout of water distribution channels. Where possible, this will encompass a realignment of property boundaries to coincide with field channel alignment. Bench terraces with uniform widths will be located on the contour with the field channel going down the maximum slope.

ID and AD staff have had only limited experience with chak development. With 38,700 hectares scheduled for chak development under the Project, a large increase in the number of personnel trained in this activity will be needed. In-country training in chak development for junior and assistant level personnel will be an early activity under the project. In addition to the design of field channels, drainage and on-farm development, training will include soil-water-crop relationships, irrigation water management, organizing and working with farmer groups to involve them in chak development activities. Moreover, training will be given to the farmers in operation and maintenance of water courses and field channels.

Amount of water allotment to a farmer will be in proportion to land holdings under the Command. A plan for rotational distribution including proposed farm stream size, period or periods of rotation and timing allowances per acre or hectare will be worked out with the users organization or committee; the plan shall show rotation schedules to outlets on the distributary section and for illustrative representative chaks. Plans showing location of outlets and field channels and rotational distribution will be included in the feasibility report documents and bear the concurrence signature of representative(s) designated by the farmer group or by 75 percent of all group members.9/.

GOI/GOHP will covenant to continue the system of user collaboration and scheduling throughout the useful subproject life.

Land leveling including construction of level bench terraces will be included as a Project obligation. Technical standards for on-farm land development need to be developed. This will be done, possibly by ID and AA and incorporated into subproject criteria.

Much of the area served by present and proposed irrigation is used for paddy production during the monsoon. To facilitate this, sloping lands have been level bench terraced, but irregularly with various lengths, widths, and configurations. This complicates the design and layout of any irrigation distribution system network. On a pilot basis some realignment of terrace boundaries will be undertaken to improve layout of water distribution channels. Where possible this will encompass a realignment of property boundaries to coincide with field channel alignment. Bench terraces with uniform widths will be located on the contour with the field channel down the maximum slope at right angles to the terraces. Required drop and turnout structures will be provided. The watercourse would deliver water to two fields at each turnout, one on either side. This system would provide for basin irrigation for paddy. Level furrows could be used for rabi vegetables and intermittent border flooding for close growing crops such as wheat. An alternative design would substitute a pipeline with appropriate stand pipes and Alfalfa type valves for grade control and water distribution to the open channels.

9/ See Othman, Yem, "The MUOA II Experience" and Moya, Tolentino B., "Experience on the Lower Talavera River Irrigation System"; Agricultural Administration Unit, Overseas Development Institute. Network Paper 2/81/1. London, 1981 for experiences and techniques for involving farmers in chak development activities.

ID and AD staff have had only limited experience with chak development. With some 38,700 hectares scheduled for chak development under the Project, a large increase in the number of personnel trained in this activity will be needed. In-country training in chak development accordingly will be an early activity of the project. In addition to the design of field channels, drainage and on-farm development, training will include soil-water-crop relationships, irrigation water management, and organizing and working with farmer groups to involve them in chak development activities and in operation and maintenance of facilities after construction is completed.

2. Lift Schemes - Surface Sources

a. Water Supply

A reliable estimate of the available water supply for lift schemes is even more critical than for flow schemes in order to properly size and select the pump. For these schemes the same procedure will be used for estimating water supply as for flow schemes (see Section C1a).

b. Diversions, Feeder Channels, Pump Sumps

Diversions, feeder channels and pump sumps serving lift schemes are difficult to maintain because of the great variation in flow, siltation problems, etc. Designs will minimize siltation and required cleaning and, where feasible, include sluicing facilities. The degree to which design of these might be improved to save recurring maintenance and shutdown costs is not known. This aspect will be studied in detail and recommendations incorporated in these designs.

c. Pumping Stations and Pumps

Pumps shall be adequately housed in buildings designed to insure security and protection from the elements. Provision shall be made for easy access to make replacements and repairs. Pumps and motors or engines shall be selected according to manufacturers specifications and shall operate at optimal efficiency at normal design discharge and total head. Provision shall be made for partial operation and standby (e.g. three pumps operated in parallel, two at a time, with one on standby). Electrical motors shall be served by starting equipment, circuit breakers and protective equipment according to manufacturer's specifications. Problems with electrical service are common. Where electricity is used the irrigation agency

shall determine the location of an adequate power supply and shall insure that capacity and voltage will be adequate. A statement regarding the availability and capacity of electrical supply will be obtained from the electrical cooperative and included in the feasibility report. The feasibility report will also include performance curves, installation instructions and manufacturer's specifications for pumping and driving equipment, expected hydraulic and overall efficiency and estimated unit pumping costs.

d. Conveyance

In order to minimize seepage losses conveyance will be by lined open channels or closed conduits. The diameter of the rising main and the closed conduits for distribution will be determined economically to minimize the combined fixed and operating costs. Other general requirements of the conveyance system will be the same as those for the flow schemes.

e. Irrigation Water Requirements/Water Budget

Irrigation water requirements and water budget will be analysed as described in Section C1d.

f. Water Distribution and Application

Water distribution and application criteria will be as described in Section C1f for flow schemes. Cultivation of paddy under lift schemes, especially the ones with higher lifts should be discouraged on the medium to light textured soils. Under these conditions, paddy would not be included in the suggested cropping pattern. Better utiliztion of the water can be obtained by using it for crops which have lower water requirements and can be irrigated by more efficient methods.

3. Tubewells

Currently used drilling and well construction techniques are generally adequate. Proposed subprojects in areas with established groundwater availability will be constructed according to the present standards including screening and gravel packing. In order to insure against overdraft, clearance by the Central Groundwater Board will be required for all tubewells. For proposed subprojects in new areas with no proven groundwater supply, exploratory wells will be drilled and the availability of groundwater assessed in cooperation with and following the standards of the Central Groundwater Board. Emphasis needs to be given to techniques that improve the alignment of the

bore. The Project will give some attention to this matter (see Section C6). Procedures for design of pumphouse, pumps and driving equipment and assessment of availability of electricity will follow that for lift schemes (Section C2c) except that only a single pump without standby will be required. Installatio of electrical transmission facilities will be undertaken concurrently with the construction of the rest of the system to avoid delays in the project becoming operational due to unavailability of power.

The newly drilled wells will be test pumped for not less than 10 days continuously to determine drawdown, pumping lift and sustained discharge. The size of the command area and extent of the distribution system will be based on the sustained discharge determined by the pumping tests and water budget calculated as in Section C1d with loss allowances as follows.

	Loss	Efficiency
Closed conduits	0	100
Operational	15	85
Open main conveyance channels	10	90
Open field channels if used	10	90

As a condition precedent, monthly monitoring of well discharges and water levels in tubewell areas will be implemented by ID who will evaluate the short and long term effects of the development and adequacy of annual recharge. This information will be used to develop criteria for rates of extraction and permissible number and location of new wells.

Distribution systems for tubewell subprojects will consist of underground low pressure pipelines. The pump will discharge into a riser from which the flow will be controlled by gates into the required distribution pipelines. Outlets at delivery points to fields will be through risers and Alfalfa type valves. Open stand pipes will provide water level and pressure control. Design standards will be those adopted by the American Society of Agricultural Engineers or comparable ones developed in India. Outlets will be provided to serve chak sizes of about 2 ha. As a Project responsibility field channels from the outlet to each field will be constructed according to a plan agreed upon by the farmers. Implementation of chak development will be as described in Section C1f. Pilot projects (Section E2) will test the viability of extending the underground pipe distribution system to each individual field and will also consider sprinkle application to provide the optimum in water savings and equitable distribution.

4. Water Harvesting Schemes

a. Comprehensive Plan

Comprehensive plans will be prepared for water harvesting subprojects. These will include development of the storage pond or tank, lift pump designs, if lifts are used, conveyance facilities, on-farm land development, cropping patterns and farm budgets, economic analysis and plans for protection and utilization of the tributary watershed. User organizations or farmers shall be fully involved in development of the plans which shall be signed by representative(s) designated by the farmer group or by 75 percent of all group members, for farmer for individual schemes as well as by AD officials. Plans will be based on soil surveys as prescribed in Chapter II, Section E. Maps and surveys shall be as prescribed under Section C1e.

b. Site Selection, Water Supply and Hydrology

Selection of the dam site will consider foundation conditions, size of dam required in relation to the storage capacity of the reservoir area and its relative location with respect to the proposed irrigation area. Where feasible, gravity irrigation will be given priority over pumping water to land at higher elevations than the pond.

The tributary watershed will be surveyed to determine its general hydrological characteristics. Estimates of peak rates and volumes of runoff will be made using available local or adjusted rainfall data from nearby locations and an appropriate correlation formula as agreed on by GOHP SC/AD and USAID. Rainfall-runoff studies for small watersheds under about 500 ha in area are not available in India. Some data indicate that for the Shivalik (low hills) region with 1,000 - 1,200 mm rainfall, runoff is from 400-600 mm. For peak flows, the Rational formula is commonly used. Technical assistance on small watershed hydrology will be needed early in the project and will be provided under grant funding (see Section C1a).

Design water supply may be taken at the 75 percent probability level or on the available capacity of the reservoir as determined by terrain, whichever is smaller. Normally height of embankment will not exceed 12 meters above the streambed. Volume of storage/reservoir level relationships will be developed and simple water measuring devices installed at delivery channel or pipe distribution network entrance. On a set of not less than five

representative sites, measuring weirs (broad-crested type) or stream gauging stations will be installed in the source stream downstream from the impoundment. AD/SC will be responsible for collection of information on reservoir level, deliveries to command area and surplus flow to be used to improve runoff prediction procedures.

c. Tributary Watershed

An assessment will be made of tributary watershed conditions and potential erosion hazards on all subprojects. Where necessary, the subproject will include provision for vegetative protection (grass or trees), controlled grazing, terracing, small check dams, etc. to protect the storage area from becoming silted up from the erosion. Where forest lands are involved in the watershed, the Forestry Department will have the responsibility for carrying out and maintaining the required conservation works. For agricultural lands the AD will assume this responsibility. Experience has shown that beneficiaries themselves may be organized to improve and manage tributary watersheds on water harvesting schemes if they benefit from the products.[10/] Indeed watershed development over the long term is more likely to be beneficial if the beneficiaries are organized. Pilot projects for testing this concept will be supported by grant funds under the Project. If successful this approach will be introduced on appropriate water harvesting schemes as agreed by GOHP and USAID.

d. Impoundment and Diversion Structures

Earthen dams, masonry or concrete retaining walls, spillways and diversion structures through the dam shall be designed and constructed in accordance with standard practice. Dam slopes shall be adequately protected from wave and rainfall erosion and the dam provided with adequate cutoff arrangements to prevent seepage under the dam. Freeboard shall be adequate to prevent overtopping during flood. Detailed specifications are not included here because these are widely available. These need adaptation however to local

10/ See for example: Mishra, P.R., S.S. Grewal, S.P.Mittal, and Y. Agnihotri, Operational Research Project for Sediment Drought and Flood Control, Sukhomajri, Central Soil and Water Conservation research and Training Institute, research Center, Chandigar, 1980.

conditions. Apparently no specific standards for small impoundment and diversion structures have been published by SC/AD. As a condition precedent to funding of water harvesting schemes SC/AD shall compile and provide for USAID review its technical standards for design and construction of structures of the type described under this section. Pumping stations and pumps shall be designed as described in Section C2c except that multiple pumps or standby need not be considered.

e. Water Budget

The area to be irrigated will be determined based on a water budget calculated as described in Section C1d or C2e depending on whether open channel or closed pipe conveyance system is used.

f. Conveyance Systems

Conveyance facilities will be in accordance with Section C1c or C2d depending on type.

5. Chak Level Development on Existing Schemes

Chak developing on existing schemes will be in accordance with Section C1f.

6. Feasibility Reports - Meaning of Standard Practice

The basis for subproject appraisal for Project participation will be the feasibility report plus inspections in the field. Feasibility reports may follow the standard format prescribed by the State. In addition, they will include a section on Compliance with Project criteria. This section will include summary calculations, written descriptive material, test reports, analysis and documentation etc. relative to the technical and other criteria prescribed in this chapter and in Chapter II, Section E1, Chapter IV, Section E; Chapter VI, Section E. Where "standard practice" is specified this means following appropriate procedures specified by Indian Standards Institution, approved handbooks or guides put out by GOI or States, or up-to-date accepted engineering textbooks or handbooks. The report shall include a reference citation to the source of "standard practice" procedures used.

7. Mobilizing Current Technology

There are several areas where practice might be improved through transfer of technology or by pooling experienced engineering judgment. To this end, an organization will review certain problems

and make recommendations. This commission would include experienced Indian experts and would have a representative from Himalchal Pradesh. U.S. technical assistance could be provided if needed. The size of a commission should be small, not more than five, three when possible. Topics to which such a group/groups might give attention as applied to Himachal Pradesh conditions are:

Prediction of runoff
Standards for temporary and permanent diversion structures
Small channel structures
Land leveling and terracing standards
Size of stream for irrigation application
Improved well drilling techniques

Decision to constitute an organization, its terms of reference, scope of work and decision regarding implementation of its recommendations would be as agreed upon by GOHP and USAID.

D. New Technology

Application of irrigation water commonly involves flooding of small, irregularly shaped, bench terraces. These are roughly level but with some uneveness. This practice seems to have evolved from paddy production during the monsoon period with supplemental irrigation water applied to maintain inundated conditions. The flood irrigation practices have carried over into the dry season particularly in the case of field-to-field irrigation so prevalent in many areas. Many of the Project efforts are directed at improving surface methods of water application on fields and the systems which supply and deliver the water to them. Opportunities exist for innovation in water application, particularly in those cases where there is a shift away from the traditional crops to higher value crops such as vegetables, tree crops and oilseeds.

1. Sprinkle Irrigation

Most of the flow schemes in Himachal Pradesh divert water from natural streams and convey it in hillside ditches with minimum slope to the high point of the command area. The canal then typically follows the ridge of the command area. This is usually quite steep, with slopes of 5-10 percent or more. The conveyance of water then requires controlling velocity using grade control structures in the canal. This topography may provide the potential for a mixed system of surface and gravity sprinkler irrigation. Pressure to serve the lower lying lands could be generated by the difference in elevation between the water level in the open supply channel and those lower lying lands. Lands near the canal would be served by open channels.

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This system would permit a more equitable distribution of water among the landholders, reduce or eliminate field to field irrigation and increase application efficiency on those lands which could be sprinkle irrigated.

The extent of potential for fully closed gravity sprinkler systems in Himachal Pradesh is unknown. Many situations lead to lift schemes which are currently popular. Normally, present kuhls involve only small differences in elevation between water supply diversion point and command area. There must exist, however, configurations which would provide enough difference of elevation to permit installation of closed gravity sprinkler systems.

This approach on small scale systems has been very successful in Guatemala under a USAID program involving village participation in construction and full responsibility for operation and maintenance. These systems also provided potable water supply for the participating village. Investment costs were a modest $200-$250 per farm family.[11/]

How the economics of sprinkler irrigation would work out on lift schemes is also unknown. Where closed distribution systems are planned anyway the additional investment in equipment and extra cost of power might be offset by savings from increases in efficiency of water use where soil conditions and cropping patterns are favorable, e.g. at Central Arid Zone Research Institute, Jodhpur. Studies have been made in India of this alternative.

Pilot subprojects will be identified where topographic conditions offer the potential for gravity pressurized sprinkler systems. Economic feasibility studies will also be made of the potential for sprinkler irrigation on some selected lift schemes. If favorable, pilot subprojects of this type will be included. Appropriate technology will be developed and tested. Pipelines will be designed for continuous flow using a rotation scheme for distribution among the farmers in order to minimize pipe size requirements. Low pressure nozzles can be used to provide uniform coverage, thus reducing the difference in elevation or power required to operate the sprinklers. Designs will also include desilting boxes and trash screens to insure against clogging the nozzles.

11/ Embry, B., Annual Report: Small Farmer Irrigation Program. AID Contract PASA AG/GUA 233-1-77, Guatemala, 1980. See also: Embry, Bertis L., Final Report Small Farmer Irrigation Project (Mini Riego), January 1977 to April 1981, Contract AG/GUA 233-1-77, USAID Guatemala, C.A; Annis, Sheldon and Stephen B. Cos, The Integration of Small-Scale Irrigation and Village Potable Water Systems in Guatemala, ms submitted to Water Supply and Management, Pergamon Press, Oxford, November 1981.

2. Trickle Irrigation

Trickle irrigation is often proposed as a very efficient water application method in order to maximize the effectiveness of a limited water supply. Disadvantages are that trickle systems are quite sophisticated requiring a certain level of expertise to operate and maintain, have a high initial investment cost and require a clean water supply, often involving elaborate filtration equipment. Still, trickle irrigation may have some application in Himachal Pradesh, particularly for irrigating tree crops on the steeper lands. As with sprinkler, the required pressure could be generated by gravity.

Pilot projects for demonstration and testing of trickle irrigation will be identified. Likely candidate sites would be where the Department of Horticulture is promoting the establishment of tree crops.

3. Hose-Basin Aplication

A less sophisticated method of "localized" application requiring much simpler equipment but which is more labor intensive is the hose-basin method in which a hose from a low pressure source is used to fill individual basins. As in the case of gravity pressurized sprinklers, this approah could help solve both distribution and application problems. Sites will be selected where this method can be tested and demonstrated.

E. Special Studies and Pilot Projects

1. Crop Water Requirements

Present planning and design of irrigation systems using standard "duty" procedures do not adequately consider the crop water requirements in determining the land area that can be irrigated by a given water supply or the water supply required for irrigating a specified land area. A special study is proposed to collect and analyze available meterological data for the State of Himachal Pradesh to estimate potential evapotranspiration and dependable precipitation and attempt to establish geographical zones in the state where the calculated values apply. These values could then be used for estimating crop water requirements at a specified level of probability rather than going through the detail of Penman's analysis except as a check.[12/] Yearly records of daily precipitations and temperature data would be collected from the Indian Meterology

12/ See: World Water for Agriculture, Prepared for Agency for International Development. Utah State University, January 1977.

Department. This would be analyzed using a computerized procedure and a manual published for Himachal Pradesh. Workshops would then be held with staff members from both the ID and the AD to distribute the manual, review its development and demonstrate its uses. Grant funding would cover the costs of collecting the meterological data and putting it on tapes, computer time, analysis and publication and for holding workshops in India along with Indian and U.S. technical assistance.

2. Water Conveyance, Distribution and Utilization

There is a general concern among those responsible for irrigation about the efficiency of water use. No information based on actual measurements is available about present status. A special study is proposed to collect information on representative systems. This may be carried out in cooperation with the proposed social study of farmer organizations and participation (See Chapter VII, Section B2g). Data collected would include, but not be limited to: land ownership, flow measurements at source and along conveyance systems, monitoring of amounts and frequency of irrigation by all users, rainfall and maximum-minimum temperature, soils, cropping patterns and yields. Grant funding would provide for Indian and U.S. consultants, local costs including data collection, local and imported equipment as required, and costs of publications and workshops.

3. New Technology

Pilot projects to test sprinkle, trickle and hose-basin methods of irrigation water distribution and application were described in Section D. Technical assistance and equipment will be provided using grant funds to plan and implement studies on selected sites. Tentatively, ten sprinkler sites and six sites each for trickle and hose basin are suggested.

4. Watershed Protection and Management

Pilot watersheds in the low hills will be selected in connection with water harvesting schemes for experimental, evaluation and demonstration purposes. Activities will include watershed conservation, measuring runoff, reforestation and limited irrigation and utilization of watershed products. These special studies would be designed and implemented in cooperation with government agencies or by universities or any other organization.

5. Participation

Pilot projects and special studies will be developed in full collaboration with the concerned GOHP agencies who will also participate in conducting and evaluating the studies. Where possible, appropriate departments of Himachal Pradesh Agricultural University will also participate. An important component is the participation of farmers in the pilot areas who should be included at all stages. Special studies and pilot project efforts will include field days, work shops, reports and how-to-do-it manuals.

F. Training

Grant funds will be used to support such training costs as Indian and U.S. technical assistance, travel, per diem and educational expenses of international trainees, imported instructional equipment and publications; and local costs of instruction, travel and per diem of participants and instructional equipment and materials. Salary costs of participants will be provided by GOHP agencies.

1. Planning and Implementation Workshops

In order that Project criteria may be implemented on subprojects as expeditiously as possible one of the very first activities of the Project will be to hold general planning and implementation orientation workshops. These will familiarize those responsible for planning and design with Project requirements. Schedule and content for them will be worked out collaboratively by GOHP and USAID. Content should include engineering, agricultural, economic and social aspects of planning. Planning guides, handbooks and other written guidance materials will be provided. In order to proceed rapidly, assistance of AID's Water Management Synthesis Project may be helpful. About 80 persons will be trained in four workshops.

2. Short-Term Specialized Training

till early in the Project life, as a follow up of the general workshop, more intensive specialized training will be scheduled. Subjects to be covered by short workshops will include such topics as planning and construction of conveyance and distribution facilities, low and high lift facilities and water harvesting schemes; hydrology, water requirements and irrigation water budgets; construction quality control; economic analysis. Less immediate, but very important is operation and maintenance of both flow and lift schemes. Workshop duration will be usually one or two weeks. Overall attendance at the several workshops is estimated at 400, although probably most trainees would attend more than one, possibly several, workshops.

3. Design of Irrigation Systems at Chak Level:

hak level development (which has been termed improperly on-farm irrigation development) includes both the common water distribution channels or conduits that deliver water from the main canal or conduit outlets to individual farms, drainage channels in the same area, and ditches or conduits and land shaping and terracing on individual farms. Training for chak development is proposed early in the life of the project. The training would also be in a workshop format. Consideration should be given to holding a workshop in each of the eight districts; however, this may not be the best practical approach. The workshops would serve junior and assistant level personnel responsible for designing the subprojects. Case studies would be used at a proposed subproject site. Topography, soils, land ownership, cropping pattern and water supply information will be developed. The end result would be a system designed by the participants. Workshops would be three-four weeks duration and would train about 180 persons.

4. Small Watershed Hydrology

Relatively little is known about the hydrology of the small watersheds of Himachal Pradesh. Yet these have a major influence on the performance of all of the irrigation facilities. Water harvesting schemes are particularly sensitive to watershed variables. Training sessions are proposed for both ID and AD personnel to examine methods for estimating peak flow rates and runoff for these small watersheds. Some approximate procedures have been developed for various locations in India. Procedures of the U.S. Soil Conservation Service could also be considered. The two-three week courses would concentrate on assembling the relevant procedures and providing instruction on their use and application. Audience would include field staff such as assistant engineers, junior engineers, agricultural inspectors and assistant soil conservation officers. About 100 persons would be trained.

5. Irrigation Water Management

There is a need for longer term training in the basic principles of irrigation water management for junior and mid-level ID and AD officers. Long-term training (8-10 months) does not appear to be a realistic approach as a first step in Himachal Pradesh at this time. In lieu, a four to six weeks course serving about 200 officers during the Project's life is suggested. Trainers for this course would receive special training drawing on Indian and U.S. expertise for a six to ten week course. Strong consideration should be given to setting up this course at Himachal Pradesh Agricultural University or at one of the institutes of technology in order to help strengthen ongoing capability in an educational institution.

6. International Training

Some limited specialized international training will also be provided. Participants and subject areas will be identified during project implementation. Subjects may include, but not be limited to: soil and water conservation, irrigation scheduling, interdisciplinary irrigation water management, crop production functions small watershed hydrology, sociology/anthropology and resource economics. Training of this kind is available at several U.S. universities. In addition, some international study tours for senior officers will be organized. About 20 participants will be trained in the technical fields discussed in this chapter.

G. Technical Materials

There is a shortage of technical material such as design aids, manuals and references available to the field staff who are expected to plan, design and construct irrigation systems. Part of this deficiency will be met by the training materials used in the various courses and workshops.

Some useful documents are available immediately for sale and distribution and will be purchased using grant funds to partially satisfy immediate needs. A list of books and publications will be developed jointly by GOHP and USAID. These will be purchased using grant funds. Grant funding will also be reserved for development of additional useful handbooks.

CHAPTER - IV

SOCIAL SOUNDNESS ANALYSIS

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A. Socio-Economic Setting

1. General

Himachal Pradesh has a total population of just over 4.2 million (1981 Census). The bulk of this population, estimated at 90 percent, is located in rural settlements, of which there are nearly 17,000. Average village size is small; about 200 persons. As expected in this mountainous region, average population density is much lower than the all-India average (76 persons/km^2 as compared to 208 persons/km^2). However, there is considerable intra-state variation in density with some of the low hill districts such as Bilaspur, Hamirpur and Una having densities of 200+ persons/km^2, productive agricultural districts such as Kangra and Mandi with more than 150 persons/km^2 and remote districts such as Chamba, Kulu and Lahul-Spiti with less than 50 persons/km^2. The considerable ecological diversity discussed in Chapter II is mirrored in the State's pattern of population distribution. Project activities will be concentrated in the more populous districts.

The percentage of population classified as tribal is quite low, only four percent, while those in the scheduled caste category are approximately 22 percent of the total.

2. Nature of Agricultural Holdings

Being a rural state based on an agricultural economy a key socio-economic factor is land ownership and operational size of holdings. On these matters the present data are fragmentary. One published reference has described the situation as follows: "The unique feature of land distribution is that landholdings in the State are marginal and mostly self-cultivated".[1/]

Overall State figures indicate that the average per capita availability of cultivated land is 0.91 ha. The salient features of the existing pattern of land distribution are as follows:

- 55 percent of the farm units are less than 1 ha;

- 77 percent of the farm units representing only 33 percent of the cultivated area are 2 ha or less. This category of farmers is classified as marginal;

1/ Report of the ICAR Research Review Committee for Himachal Pradesh Krishi Vishva Vidyalaya. Indian Council of Agricultural Research, Krishi Bhawan, New Delhi, July 1982. p. 11.

while 23 percent of the farms are in units exceeding 2 ha, only 1.25 percent are in units larger than 10 ha, but these account for about 16 percent of the cultivated land area.

These data suggest a moderate degree of inequality of landholdings by Indian standards.

Information on land ownership in contrast to farm unit size is more difficult to obtain and is not reported on a State-wide basis.[2/]

B. Socio-Cultural Feasibility and Consequences

1. General

A major outcome of this project will be to assist rural communities in developing new, or improving existing irrigation works, and in working out a suitable combination of State and community rights and responsibilities for these facilities and the water supply that they will create. Project activities will have a high degree of cultural fit since irrigated agriculture is being practiced in many communities and is widely known about through the region of the State in which activities will be undertaken. For cultivators receiving irrigation water for the first time there will, of course, be new techniques to be learned and decisions to be taken, but the role of the irrgiation farmer would not appear to conflict with basic cultural ideas since many members of the same cultural group are already irrigating; some for centuries.

2/ Data collected by the Himachal Pradesh Agricultural Unsiversity in Palampur tehsil of Kangra District provides some interesting information. This area represents a relatively productive agricultural region and is not necessarily representative of the State as a whole. Data collected from a sample of 178 cultivators showed average farm size to be 0.48 ha. Fifty percent of the cultivators were full owners, 25 percent were part owners/part tenants and another 16 percent were reported to be tenants. Even on these small holdings, 47 percent employed labor in the rabi season; 43 percent, in the kharif season.

2. Effects on Farmer Groups

The more important social considerations have to do with the impact of the project activities on the group of farmers using water (or attempting to do so) in any particular scheme. Some subprojects will bring irrigation to previously rainfed farmers while others will improve the facilities of farmers who already have irrigation facilities. Some subprojects will do both.

In either old or new systems, irrigation works which are poorly constructed or poorly managed have the potential for exacerbating community conflict, increasing alienation while reducing solidarity and further disadvantaging the weaker sectors relative to the stronger. The prerequisites for avoiding this are several. First, the irrigation agency has to have the technical skills and capacity to create an effective irrigation works. Second, the agency has to have the capacity, either within its own unit or through close collaboration with some other unit, to assess the social situation before it begins its project and to monitor social consequences following project completion; developing modifications (both technical and managerial) as required. Third, communities have to have their own capacity to operate and monitor many of the irrigation processes, including water distribution, system maintenance and conflict resolution, perhaps in conjunction with assistance provided by the State agencies.

Several elements of the project are intended to deal with improvement of the process of technical planning, design and implementation, including the specific activities of chak development. In addition, subprojects under this project will be required to collect baseline socio-economic information which is not presently a part of the design process. These requirements are detailed in Chapter VII.

Concern with water user groups applies to all types of irrigation facilities serving more than a single individual including the flow schemes, the various types of lift schemes and the water harvesting schemes.

3. Form of Water User Organization

The appropriate form for water user organization is a complex one and will not be decided *a priori*. Rather, the project will support special studies to examine the nature of water user organizations in traditional irrigation systems (kuhls) where such local institutions still operate, provide opportunities for staff development and training on this topic and will provide for the

development of action research activities to test various approaches for forming new or assisting existing water user organizations. A basic principle is that the water users themselves agree upon the level and formality of the organization.

4. Activities Implemented by Agricultural Department

There are special problems with some of the irrigation activities to be implemented by the AD. The first set of problems are associated with AD's programs for assisting individual farmers to acquire and install irrigation facilities such as shallow-tube wells and pump sets on dug wells.[3/] These schemes are attractive because they avoid a continuing burden of public operation and maintenance costs and in contrast to lift and flow schemes where water charges are based on area cropped, they induce effective water use because there is a direct cost attached to the user's rate of water application. The difficulties arise in terms of the distribution of such assistance. The present procedures of AD are to provide facilities to farmers based on a partial subsidy and a partial loan. Grant subsidies are available to small and marginal farmers (see Chapter II, Section C5). The ceiling on the loan is determined by the size of the farmer's landholding because that land is given as collateral on the loan. In some cases, the total cost of the scheme may exceed that which is available through the subsidy-loan combination and thus the scheme cannot be implemented unless the farmer is able to obtain additional resources privately. The result is that larger farmers tend to benefit more than small ones. To participate, small farmers need to be grouped together for assistance but AD has had little experience in helping such groups to form and invest. Support for the AD's program of providing shallow tubewells and pump sets on dug wells will be provided by the Project with the condition that at least half of the pump sets installed serve small farmers (those operating less than 1 ha) either individually or as groups. The Project will also support technical assistance for the AD in developing capacity to work with such groups and sponsor action research to identify suitable procedures for implementing this aspect of the program.

AD's program of developing water storage tanks and ponds (water harvesting schemes) also needs careful scrutiny with regard to the beneficiaries. Thus far, insufficient attention has been given to the important matter of assigning rights and developing mechanisms for allocation of the new water supply among the potential water users. Problems arise partly because the AD does

3/ "Farmer" here refers to parent(s) and minor children with ownership rights.

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not enter into arrangements with the land owners immediately adjacent to the storage facility to create public access to the water; thus these riparian landowners are in a special position to exert control over distribution to others.

A second set of problems arises on water harvesting tanks and ponds because the AD does not attempt to create an agreement on water rights prior to the subproject construction. These problems are exacerbated by the fact that typically the water storage facilities are not constructed with provision for delivering the water to the irrigable command; neither by gravity flow nor by lift facilities. Often irrigation water has to be lifted from the storage pond, thus again creating problems of who has, or can acquire, the resources needed for such pump investments. The result is that a windfall profit opportunity is created at public expense in which relatively few are able to participate.

To qualify under the project, water harvesting subprojects must deal explicitly with both the technical and institutional provisions necessary for distributing water equitably from the pond to the command area. To assist in developing the capacity to plan, design and implement such programs, the Project will provide grant support for several demonstration integrated water harvesting projects to be implemented on qualifying subprojects.

5. Rehabilitation of Community Kuhls

In Himachal Pradesh, the existence of a large number of traditional community systems (community kuhls) raises special concerns regarding the project and its potential consequences. As suggested in Chapter 1, the various state agencies that provide assistance to irrigation systems have taken somewhat different approaches in their work with traditional water user groups. Lessons learned as a result of this project are expected to assist the State in identifying a suitable development strategy for these traditional systems. This strategy would combine both State and local rights and responsibilities.

There are two large questions for concern in schemes in which the agency provides assistance to an existing private water user group:

- What will be the impact of the agency's actions on the existing institutional arrangements and organizational patterns for handling irrigation activities?

- What will be the impact of the agency's actions on the existing patterns of irrigation and water rights in the system?

A possible cause of negative social consequences related to these two issues could arise because of the agency's lack of information about, and understanding of the situation in which they are intervening. Too often the assumption is made either that existing institutions and rights do not exist, or if they do, they are unimportant and are to be subordinated to the needs of development and modernization. The usual consequences of such an approach are commuity disorganization, under-utilization and reduced performance of the works created. GOHP intends to avoid negative social consequences related to these two issues. If a decision is made to take over the management and control of community kuhls at the request of a community, existing institutions will be consulted and their rights taken into consideration. The ability of the traditional groups to maintain their kuhls will also be considered and supported.

To help avoid these undesirable consequences, several provisions are made in the Project. First, the Project will support the search for effective ways of providing assistance to community kuhls. Second, in all work with community kuhls (or other existing irrigation systems) the ID and the AD will be required to conduct and report an institutional survey as part of the planning and design process. The RD is exempted from this because of the low upper cost limit that is placed on the activities that they implement. This survey will be a tool for determining the existing arrangements in the kuhl for handling basic irrigation tasks, the nature of relationships with neighboring kuhls, and the pattern of water rights in the system to be assisted. A detailed specification of the data to be collected is presented in Chapter VII. The special studies of community kuhls mentioned above, will add to the knowledge of how these kuhls operate, help to identify the types of assistance that may be required and develop effective patterns for implementing such assistance. In addition, action research projects can be used to test means of assisting these systems while leaving intact their community cohesiveness and thus their ability to operate and maintain the improved structures that the State may assist in providing.

C. Income and Spread Effects

For a typical 1.6 hectare farm, irrigation can be expected to increase net income from Rs 4417/annum to Rs 13,526/annum (see Chapter VI, Section D3). Cropping intensity would increase from 162 percent to 200 percent. Labor costs, including an allowance for family labor would increase from Rs 2320/annum to Rs 5097/annum; other costs of production would increase from Rs 822/annum to Rs 3227/annum. Under irrigation about 15 percent of the area would be devoted to production of vegetables. Besides direct cash or equivalent benefits to the farm family, substantial spread effects in the form of increased opportunity for hired labor, handling of inputs like fertilizer and pesticides and transportation and marketing of increased agricultural products would have direct spread effects at least equal to farm net income benefits.

D. Effects on the Role of Women

The focus of this Project is to increase the institutional capacity to manage irrigation management related problems. This is to be achieved by improving the management systems and water utilization to involve beneficiaries in project design, implementation and to mobilize knowledge and experience.

Women have played a vital role in agriculture for ages but given the socio-cultural setting in India, women are kept in the background amd their role is not formally recognized. This invisible aspect of women's existence must be taken note of by the project designers and efforts should be made to make them more visible. In order to enhance the efficiency of the water management system and to maximize the utilization of water, all men and women who are involved both in running the system and benefiting from it, must be involved. Therefore, it is important that women are treated as a specific group and mentioned as such in all community-related activities.

The "farmer" in Indian language is a masculine work, although in practice women are engaged in farming activities, in fact some activities such as transplanting, harvesting and winnowing are exclusively women's work yet only men are referred to as farmers.

Often decisions are made jointly regarding the choice of crop to be sown. Men and women show different attitude towards cropping patterns; men go in for cash crops and women more often show preferences for subsistence crops. They want to make sure that the family has enough food at hand. There is evidence that the cash in

hands of men does not always reach the family. Therefore, in order to increase family's welfare, women's participation in decision making is to be understood and encouraged.

In addition to all the farming uses of water, women use water for domestic purposes, cooking, providing drinking water, washing utensils, washing clothes, bathing children and animals. It has been noted in field operations that women are more health-conscious than men. In irrigated areas, many times women have pointed out the health hazards such as more mosquitoes and have asked for better drainage system.

In view of these facts, women ought to be woven into the project design fabric itself and not just left on the fringes. A very important sociological factor should be considered that is due to the practice of village exogamy, which requires a girl to be married outside the village, each village has daughters-in-law drawn from other villages far and near. These daughters-in-law bring along with them the knowledge of traditional water management systems and farming techniques practised in their natal villages. Leaving women out of the system analysis deprives the project of this valuable resource.

The baseline studies must have a women component and the data collected should be classified on gender basis. The project refers to the need to identify the appropriate role of water users in community development. It should address itself to the role of women both as water users for farming purposes and for houehold requirements.

The project should include women in all its research and training programs. It may be advisable to fix a certain percentage of women participants in all formal and informal training programs. Women may also be encouraged to occupy positions in matters of management administration. Incentives and facilities may be needed to encourage women to come forward, e.g. if a training workshop is to take place, women may be allowed to bring small babies and some arrangement should be made for their care. It would normally involve only a very small sum of money like Rs 10 a day to hire a local woman to mind the babies (they may not be more than a very few) and allot a small room.

Wherever extension program is introduced, female extension workers should be employed. Twenty-five to 40 percent of extension workers could be women. This would facilitate and increase the outreach to village women because in the village situation, women-to-women communication is always better.

Membership of the water management association should be extended to women; here also a certain percentage should be fixed.

It may be noted that the migration rate in hill areas is often quite high and the women stay behind in villages to look after cultivation, therefore women's involvement in these areas is even more important than in the plains. Hill women are also physically stronger and sturdy and do not shy away from heavy work.

Another area women require special attention is private small scale enterprise. Women should be encouraged to grow vegetables and fruits and sell their products for income generation. The integrated action research studies will include research on how women can get involved, e.g. in growing and selling particular vegetable crops.

In general, whatever programs the project undertakes which affect the community, either as participants or as beneficiaries, these must specifically include women as a target group. One may not get full and enthusiastic support from the authorities and from the male members of the community but a patient, persistent effort is bound to yield results. USAID experiences in Madhya Pradesh both in social forestry and irrigation have shown positive results.

E. Design Criteria for Social Soundness

To insure that adequate attention is given to consideration of possible social and institutional consequences of activities to be undertaken for any subproject, the procedures described below are to be followed. Subprojects are divided into two broad categories, those concerned with creating new irrigated area (as with lift pumps being installed to serve previously rainfed areas) and those in which all, or a portion, of the subproject deals with existing irrigation facilities. In the latter case, information regarding the existing organizational arrangements for operating the irrigation facilities and the present patterns of water rights also needs to be collected.

a. Socio-Economic Survey: For all subprojects serving more than one farmer, the implementing agency, except RD, will include a baseline socio-economic survey as part of the planning and design process. This survey will be made by an autonomous institution with experience in making socio-economic surveys under an arrangement with the agency. This survey will provide the basis for important project design and implementation decisions as well as the baseline for subsequent monitoring and evaluation. It will include, but not be limited to, the following:

1. Preparation of a cadastral map which will also include the location of significant actual, or proposed, irrigation facilities.

2. Summary of landholding data both within and without the command area indicating number of operational holdings, size and size distribution of holdings, extent of fragmentation and ownership-tenancy arrangements.

3. Existing cropping pattern by zones in the command area, e.g. by outlet, distributary, or head, middle, tail zones in existing or proposed systems.

4. Information regarding the use of farm inputs (labor, fertilizers, improved seeds, pesticides, etc.) for a sample of farm units.

5. Farm and non-farm household income for a sample of farm units in the command area.

6. Information regarding the number of water users in the command area who are scheduled castes or tribal people.

b. Organizational Survey: For all subprojects serving more than one farmer and in which there is existing irrigation in all or part of the command area the implementing agency, except RD, will include as part of the planning and design process a baseline organization survey in addition to the baseline socio-economic survey. This provision will apply primarily to remodeling of community kuhls. The organizational survey is intended to alert the implementing agency to critical features of the institutional and organizational aspects of the existing irrigation system and highlight matters, such as water rights, that will require agency-community discussions and agreements prior to the start of the subproject. Information will be collected from leaders among the water user community (e.g. the kuhli, if one exists) and other knowledgeable local informants and will include:

1. Preparation of a sketch map showing the boundaries of the command area, significant village boundaries and the location of the important irrigation structures.

2. Information regarding the existing rules and arrangements for implementing the critical tasks of water distribution, system maintenance and dispute resolution.

3. Information regarding the patterns of water distribution in kharif and rabi seasons, in other crop seasons such as zaid kharif and zaid rabi if they are used, and in times of unusual scarcity.

4. The nature of water rights among the various water users in the system's command area as well as the nature of rights between this system and other systems, both upstream and downstream.

5. The nature of traditional relationships between this system and neighboring systems with regard to common maintenance of facilities, dispute resolution, etc.

6. An indication of the villages in which landowners and/or cultivators in the command area of this system live.

7. Information regarding a formal, or informal organization that the water users have developed for the operation and upkeep of their irrigation facilities.

c. Size of Farm Holdings: For qualifying subprojects in order to insure that the Project serves the large majority of smaller farmers and to minimize windfalls to larger farmers, the size of farm served by a scheme for an individual will not exceed 5 hectares. For groups, 85 percent of the farm holdings shall be smaller than 5 hectares. Certification of landholdings will be provided by the Revenue Department.

CHAPTER V

ENVIRONMENTAL SCOPING STATEMENT

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A. Nature of Project

The Hill Areas Land and Water Development Project is focused upon the expansion of irrigated area in Himachal Pradesh by 25,000 hectares through support of minor irrigation subprojects undertaken by the Irrigation & Public Health Department,and the Soil and Water Conservation wing, Department of Agriculture.

Because the variety of subprojects to be supported is considerable--flow irrigation schemes, lift irrigation schemes, dug wells and tubewells, water harvesting projects--the overall range of potential environmental issues to be addressed appears to be quite large. However, it is highly unlikely that the environmental concerns and impacts of any one subproject activity (e.g. a flow irrigation scheme) will be the same as that of another (e.g. dug wells or tubewells). The range of agro-climatic zones found in Himachal Pradesh and the concomitant diversity of its physical environment (relief, soils, precipitation) further supports the perception that the potential environmental impacts of supported subprojects will vary considerably from site to site. Finally, the direct environmental impact of each supported subproject will be greatly restricted in spatial extent because the size of each will be comparatively small, typically less than 1,000 ha and the majority less than 100 ha C.C.A. Consequently, in this Project careful attention to the specific characteristics of the local physical environment in the planning and design process and the adoption of environmental-sensitive design criteria for each supported activity is the most appropriate procedure to follow to restrict or eliminate adverse environmental impacts while simultaneously enhancing the possibility for significant positive impacts on local environmental conditions.

B. Project Potential for Positive Environmental Impact

It is useful to recognize that the Hill Areas Land and Water Development Project is likely to have several important, albeit local, positive impacts on the natural and physical environment of Himachal Pradesh. Many supported subprojects will involve remodeling or otherwise improving existing flow irrigation systems (community and government kuhls). The positive environmental impacts of these activities will include, for example, a) a reduction of water losses and seepage losses in conveyance systems through channel lining or closed conveyance systems, thereby increasing existing water supplies as well, b) increasing the utilization of water supplies through improvement of distribution facilities below the farm outlets, c) improved field terracing and field bunding which will reduce soil losses from farm fields, d)

enhanced watershed management activities through soil conservation and revegetation programs, thereby reducing the rate of runoff and sedimentation below system catchments and increasing the sustained flow potential of the water source.

Water harvesting schemes in the low- and mid-hill agro-climatic zones of Himachal Pradesh will result in a substantial reduction in soil loss and the rate of gully and ravine erosion and advancement. This will result from the construction of small dams and water storage ponds, sediment traps, and revegetation of microcatchment areas through associated watershed management activities. Water stored in the ponds, when carefully managed, typically will be sufficient for irrigation of more remunerative rabi crops (e.g. wheat) in the limited new commanded areas below the structure. Water also will be sufficient to provide an essential one or two irrigations--so called "life saving irrigation"--for kharif season crops (maize, rice) when the monsoon ends (September) or is deficient prior to completion of the growing season. In the long run, the regenerative capacity of managed watersheds above these water harvesting schemes will renew as well as increase fodder, fuel, timber and water supplies available to the farming communities they serve.

Shallow well and tubewell subprojects in areas of Una, Bilaspur, Solan, Hamirpur or Kangra Districts where groundwater resources are available for development will significantly reduce the probability of waterlogging in potentially susceptible low lying areas.

C. Environmental Concerns and Issues to be Eliminated from In-Depth Analysis

1. Land Resources

a. Soils and Land Capability

Two broad categories of soils are dominant in Himachal Pradesh; Palehumults (brown hill soils derived from sandstone and shales) and Hapludalfs (sub-montane podsolic soils). However, the physio-climatic diversity of the State is reflected in the presence of nine different soil groups determined on the basis of their development and physio-chemical properties, ranging from Alluvial soils on river terraces and flood plains to Alpine humus mountain skeletal soils in the Himalayan highlands of Lahaul-Spiti, Kinnaur and Chamba District. (See "Status Report of Himachal Pradesh with Special Reference to Irrigation Development," pp. 5-8 for brief descriptions of these nine soil groups and identification of districts of occurrence.) Soils observed during extensive field

reconnaissance in the low- and mid-hill areas of H.P. appeared to be generally light sandy to sandy loams, low in humus or organic material and very well drained, as would be expected under prevailing conditions of slope. Generally these soils when managed for both rainfed and irrigated agriculture are deeper and enhanced by additions of significant amounts of carefully collected animal manures and crop residues turned under. Cultivated alluviums on river terraces and in the broader more gently undulating flood plains formed by the Soan River (Una District) and the Sutlej River and its tributaries (Solan and Bilaspur Districts) are deep sandy loams and appear to be well drained.

Detailed soil surveys and soil mapping of Himachal Pradesh has not been done, nor are soil studies and land capability assessments carried out as part of the planning and design process of Irrigation Department and Agriculture Department assisted minor irrigation projects. Nevertheless, officials of these departments do recognize that local soil conditions could have significant impact on landuse and cropping patterns developed under irrigation (with consequent important implications for the economic viablility of proposed subprojects).

Therefore, because of the wide range of soil conditions likely to be encountered in Project activities and the lack of specific knowledge about them, it is recommended that soil studies and land capability assessments should be a substantive part of the subproject planning and design process; possibly rapid soil reconnaissance techniques will be sufficient to identify any special problems posed by local soil conditions. The capability of I. & P.H. Department and Agriculture Department personnel to undertake such activities will be improved through training programs supported by the Project.

b. Construction Activities

Field reconnaissance of 21 completed minor irrigation schemes in Himachal Pradesh revealed no significant soil erosion problems associated with or resulting from the construction of flow irrigation system structures (intakes, distribution channels, outlets), water harvesting dams or sediment checks, lift irrigation or shallow well pump and tubewell schemes. Grasses, shrubs and other natural vegetation was successfully reestablished in and around the areas of completed projects.

In the hilly and mountainous environment of Himachal Pradesh, road construction is typically done by cutting a bench along the coutour and pushing spoil over the down slope side. By far the most

frequently observed soil slips and construction-related soil erosion problems were a consequence of P.W.D. road building activities. The majority of subprojects will be accessible through the existing road network, however, in a very few instances access road construction activities to subproject sites may have an adverse environmental impact unless improved road construction procedures are followed. Therefore, it is recommended that recognized environmentally sound procedures be adopted for access road construction in those few subprojects where it may be necessary. These would include, as appropriate, cut-off drains and culverts to avoid runoff over unstable areas or over cuttings, retaining walls to stabilize side slopes, stabilizing slopes with suitable grasses, shrubs and trees, hauling spoil for proper disposal in suitable fill sites.

c. Sedimentation in Water Harvesting Ponds

Sedimentation of ponds is an environmental concern for water harvesting subprojects. Watersheds throughout the mid- and low-hill zones of Himachal Pradesh are, by and large, extensively exploited for food, fuel and timber as well as for fodder resources. While substantial areas of steeply sloping land that have been cleared for cutlivation typically are carefully terraced and leveled for irrigated agriculture (surprising amounts of rainfed land are similarly managed), a considerable area of rainfed land is less well managed and terraces clearly are front sloping to varying degrees. The combination of heavy monsoon rains, sandy and readily erodable soils on indifferently vegetated steep slopes, front sloping agricultural terraces, and high rates of monsoon season runoff is reflected in excessive soil loss through sheet and gully erosion. (Even well managed slope land is subject to considerable soil loss, e.g. the small 26 ha watershed carefully managed by the Department of Soil Sciences & Water Management, Himachal Pradesh Agricultural University, under its Research Project on Water Management recorded 190 tons of total solids lost in a total volume of runoff of 1.38 million cu/ft during June-September, 1981.) It is well known that high levels of soil erosion in the catchments of the Beas and Sutlej Rivers have resulted in rates of sedimentation in the ponds behind Pong and Bhakra Dams far higher than anticipated, considerably reducing their planned useful life.

In the micro watersheds and catchments in the low- and mid-hills where the Department of Agriculture has constructed water harvesting ponds and soil conservation soil traps and checks, rates of sedimentation are unknown, but thought to be "high," especially where not accompanied by a program to revegetate the watershed with appropriate grasses and trees and to moderate human interventions. (The Department of Soil Sciences & Water Management, H.P.A.U., has

been conducting research on its carefully managed watershed, in which two water harvesting ponds have been constructed, for the past 10 years; data for runoff, soil loss and rates of sedimentation for this period appear to be the only such field data available in Himachal Pradesh. Additional data from this project should be obtained, and evaluated as one measure of the possible environmental benefits of water harvesting and soil conservation subprojects.) Guidelines currently followed in Himachal Pradesh for constructing water harvesting projects include a determination that the facility will provide at least two irrigations (each of 8-10 cm) in rabi season in the command area for at least 25 years; allowance is made for a decrease in pond storage capacity by allocating space for sediment accumulation over time. These design guidelines may be acceptable for such water harvesting structures, however, they will be further evaluated by the Phase II Project Design Team. Moreover, water harvesting subproject design should include an explicit provision for a watershed management program for the catchment (field observations suggest this is not always the case) to ensure that rates of sediment accumulation do not exceed those projected for the useful life of the structure.

d. Soil Erosion in Watersheds

As already noted, pressure on watersheds in the low- and mid-hill zones of Himachal Pradesh for fodder, fuel and timber is high and consequent soil erosion problems in most catchments are a cause for serious concern. State soil conservaton officials are acutely aware of the situation, however, their efforts to arrest soil erosion are hampered by limited State financial support for their programs. The Hill Area Land and Water Development Project thus is likely to have a very positive and welcome impact on existing soil erosion problems in many areas of Himachal Pradesh.

Soil conservation activities by the Himachal Pradesh Agriculture and Forestry Departments currently (1983-84) are concentrated in at least 40 microwatersheds (ranging from 2,000 to 5,000 ha each) identified by the All-India Land Use and Soil Survey as "high priority" for afforestation and soil conservation programs. They are supported through the Centre-sponsored River Valleys Project and the Watershed Management in Flood Prone Areas Project. (All-India Land Use and Soil Survey prepares soil maps of the specified microwatersheds at 1:15,000 scale based upon aerial photo interpretation [1:60,000 photos], SOI topographic maps and ground reconnaissanae. AILUSS soil maps are not available with the soil conservation wings of either Agriculture or Forestry Departments, Himachal Pradesh, however, they are reportedly available for reference at AILUSS, Nagpur. It would be useful to

try to obtain these large scale soil maps of critical watersheds in Himachal Pradesh for Project reference and use in subproject planning and design.) Other microwatersheds have been classified into "medium" or "low" priority categories and soil conservation and management activities there will begin following the completion of programs in all "high priority" microcatchments.

Subprojects in areas where soil conservation activities are already underway in "high priority" microwatersheds will benefit from programs that seek to encourage controlled grazing, promote afforestation and revegetation while reducing soil erosion there. (See "Plan for Sub-Watershed 14, 17 and 18, Giri Watershed" prepared by the Directorate of Soil Conservation, Himachal Pradesh, for details of a proposed watershed management plan; because this was a specially prepared document, it is not clear that such comprehensive plans are prepared as a matter of course for "high priority" microwatershed management. However, it is indicative of both current thinking and planning capability for microwatershed management in Himachal Pradesh.) Flow irrigation and water-harvesting subprojects located outside the "high priority" microwatersheds will include soil conservation and improved watershed management programs which will reduce soil losses in their microcatchments. (It is expected that controlled grazing, cut-and-carry harvesting and social fencing will be included in these management programs.) In microcatchment where existing soil erosion problems are especially severe, catchment pretreatment will be implemented prior to initiation of construction activities. Improved terracing in irrigation service areas below the outlet is an expected component of all subprojects and will further reduce existing soil erosion losses.

e. Salinity/Alkalinity and Waterlogging

Extensive field reconnaissance in Himachal Pradesh did not reveal the existence of any problems of salinity or alkalinity. However, it was frankly admitted that soil and groundwater conditions are not evaluted for potential for development of salinity or alkalinity problems in minor irrigation project preparationby either the Agriculture or Irrigation & Public Health Departments. Therefore, during planning and appraisal of subprojects to be located in the low-hills zone of Himachal Pradesh (Una, Solan, Bilaspur, Hamirpur & Kangra Districts) water and soil quality should be assessed to identify potential problem areas, and where needed, design and construction of subprojects will reflect a sensitivity for potential salinity and alkalinity problems in their command areas.

The related issue of waterlogging also was explored. No problems of waterlogging were observed in any minor irrigation site visited and only one instance of actual waterlogging was seen during extensive field reconnaissance. (This was a tract of paddy land of less than 10 ha in the Palampur Valley, Kangra District, where P.W.D. road construction had blocked natural drainage in the lower valley--clearly a culvert and drain are called for here to eliminate the problem. Researchers in the Water Management research project at H.P.A.U., Palampur also mention the existence of a "few" highly localized waterlogging problems in the lower valleys of Kangra District.) The comparatively high water table in the Soan River Valley (Una District), ca. 6 m, suggests that waterlogging could become a problem in this region. However, minor irrigation shallow well pump and tubewell projects already completed and other proposed in this area are more likely to greatly reduce the possibility of future waterlogging problems here. Irrigation & Public Health and Agricultural Department Soil Conservation officials are aware of the long term threat of waterlogging, and the adoption of appropriate design criteria to meet this problem (field drains, lining of or closed distribution systems, controlled turnout structures)--planned or already implemented in minor irrigation projects observed in potentially susceptible areas in Una and Solan Districts--confirm their recognition of potential waterlogging problems.

Clearly, the completion of soil and land capability surveys in Himachal Pradesh (at least in subproject areas), as previoulsy recommended, will assist in identifying potential subproject areas susceptible to the problems of salinity, alkalinity and waterlogging. An active extension program of Agriculture and Soil Conservation to alert farmers to appropriate crop water requirements and the dangers of overwatering will further mitigate the emergence of the problems.

2. Water Resources

a. Conjunctive Use of Groundwater

Topographical and geological conditions in Himachal Pradesh largely preclude the possiblity of conjunctive use of groundwater. Generally where subproject flow irrigation schemes are contemplated, there are no concomitant possibilities for groundwater development; where shallow well pump and tubewell minor irrigation systems are likely to be proposed, there are no apparent surface irrigation possibilities. Nevertheless, in subproject planning and design, possibilities for conjunctive use of groundwater will be evaluated as a matter of course.

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b. Water Losses and System Operation and Management

Loss of water from irrigation channels through seepage and operations is an issue that will be addressed specifically by proposed subprojects. Under prevailing soil and topographic conditions in Himachal Pradesh, water losses in unlined channels are high, estimated to range from 30 to 50 %. Canal lining and/or closed distribution systems are expected to be integral parts of many subprojects which seek to enhance existing patterns of water utilization. The impact of water losses as it relates to subproject economics, system operation and waterlogging will be further examined during the planning/design phase. In order to ensure continued reliable, effective and economical operation of supported minor irrigation subprojects, suitable provisions will be made for the prompt repair of damage to channel embankments and other components of the main distribution system from soil slips, falling rock, landslides, etc.

c. Streamflow Characteristics

Available water supply for flow irrigation systems in Himachal Pradesh is based upon the minimum lean period discharge over from three to five consecutive years. The location of flow system (kuhl) headworks and distribution of water through kuhl systems to the irrigated command area changes downstream flow charactersitics of perennial natural streams. However, because of preexisting water rights allocating perennial flows, no new or enlarged flow irrigation system can be proposed and implemented if it will reduce the downstream flow so as to diminish the share(s) allocated to downstream users. However, it has not been much of a problem due to abundance of water availability at source and existing criteria of designing the schemes using lean period discharge availabilities.

d. Floods

Water harvesting soil conservation structures reduce flood peaks and consequent damage levels in intermittent streams. The principal consideration here is structure safety. In practice, design for water harvesting soil conservation structure safety is site specific. State officials are highly aware of the need for safe structure design criteria and utilize adequate criteria for preventing structure failure.

e. Drainage

The topographical and soil conditions of Himachal Pradesh preclude the likelihood of drainage problems resulting from minor

irrigation development. Extensive field reconnaissance revealed no drainage problems in the 21 completed minor irrigation systems that were visited in the State.

f. Water Quality

Standards for irrigation water quality are well developed and used worldwide. However, discussions with Himachal Pradesh officials revealed that water quality tests are not made routinely and monitored by satisfactory laboratory analysis. The phase II project design team will examine water quality criteria for Himachal Pradesh minor irrigation systems and make appropriate recommendations where required. Project support should be considered for training I. & P.H. staff for water quality monitoring and establishing appropriate laboratory facilities for water quality analysis, if needed.

3. Health

a. Waterborne Diseases

Malaria is a significant health concern in certain areas of Himachal Pradesh below 2,000 m, primarily in Una, Bilaspur and Solan Districts. Only water harvesting and soil conservation structures in managed catchments will impact on the human health environment by creating potential sites for mosquito breeding in imponded water. No data are available for evaluating the comparative geographical incidence of malaria between areas where water harvesting structures and watershed management activities have been completed and areas where such activities have no been initiated in the affected districts.

It is recommended that project design criteria for minimizing malaria incidence as set forth in Annex I (attached) be adopted for all water harvesting subprojects in areas of Himachal Pradesh below 2,000 m. Moreover, district malaria incidence data will be obtained periodically from H.P. district health officers for review and evaluation during the Project.

The incidence of other waterborne diseases spread by water-associated vectors will not be increased by other minor irrigation subprojects contemplated in the Project. Indeed, such subprojects as tubewells are likely to impact positively upon the human health environment by providing a potentially safer source of domestic water then currently available in the village communities they serve.

b. Agro-Chemicals

Data on State-wide pesticide use in not available, however, pesticide use in India is positively associated with intensity of cropping. Insofar as irrigation potential is a useful surrogate measure of agricultural intensity the following table suggests that agricultural intensity in Himachal Pradesh is comparable to that of Gujarat and Rajasthan:

	Himachal Pradesh	Gujarat	Rajasthan	Maharashtra	Madhya Pradesh
% of total area cropped	19	49	44	59	40
% of total area irrigated	3	7.2	7.4	5.8	3.2
% of cropped area irrigated	16	14.7	16.8	9.8	8

The Rajasthan and Gujarat EAs examined the impact of pesticides, and the latter concluded that the problem of pesticide contamination is "not serious at all." Based upon the foregoing, this conclusion may be extrapolated to Himachal Pradesh, however, when information on State-wide pesticide use is made available, it should be examined to ensure that this conclusion remains justified.

4. Biological Resources

a. Flora

It is recognized that as agriculture becomes more extensive and intensive there will be a reduction in the habitat of indigenous flora. However, in the context of Himachal Pradesh's physical environment, there is little, if any, possibility for expanding agricultural area much beyond the current 19% of the total area of the State, a proportion well below that of Madhya Pradesh (40%), Rajasthan (44%), Gujarat (49%) or Maharashtra (59%) for example. It is highly unlikely that minor irrigation subprojects contemplated under the Project, the majority of which will be less than 100 ha and scattered throughout the low-, mid- and high-hill agro-climatic zones of the State, will have any adverse impact on indigenous

species of flora. Increased catchment protection and watershed management activities associated with flow irrigation and water harvesting subprojects will have a beneficial effect on flora habitat, not least in the latter by making available a resource essential for a shift from or reduction in pastoral animal husbandry activities to a more productive crop farming.

b. Fauna

Given the small size of contemplated subprojects, and the limited area of the State developed for agriculture, there is a scant likelihood for any adverse impact on indigenous fauna in Himachal Pradesh through this Project. Localized improved faunal habitat will result from catchment protection and watershed management programs associatd with water harvesting and flow irrigation subprojects.

c. Fisheries

Perennial streams tapped for flow irrigation (kuhl) systems are unproductive sources of fish given great variations in annual flow characteristics, and high sediment loads in the monsoon season. Water harvesting schemes will impound runoff from small intermittent streams which are otherwise dry much of the year. Design criteria to be followed for such schemes to minimize malaria incidence provide for outlets to drain dead storage during the pre-monsoon period thus precluding the possibility of stocking such small ponds with fish. Lift irrigation schemes utilizing river flows or water stored in large ponds (e.g. Nagal Reservoir) protect intakes to prevent fish or harmful debris from being ingested.

d. Livestock Diseases

As measures will be taken in subprojects to minimize or eliminiate the possibility of waterlogging wherever likely, there is no possibility for the transmission of animal diseases resulting from animals grazing in waterlogged or continuously moist areas.

D. General Recommendations: Environmental Issues and Concerns

1. Subproject environmental evaluation procedures and adoption of design criteria which reflect a sensitivity to highly localized environmental conditions will be implemented as the best way to ensure that impact on the physical and natural environment will be minimized or eliminated.

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2. A representative sample of subprojects in the different agro-climatic zones of Himachal Pradesh will be identified for monitoring by an appropriate Indian research organization [such as the Centre for Science and Environment (New Delhi) or the Centre for Environmental Impact Assessment and Planning, Water Resources Development Training Centre, University of Roorkee] for their concern for and adoption and implementation of design criteria to mitigate potential environmental impacts on the physical and natural environment of subproject locales.

3. As part of the mid-Project evaluation by AID, the adoption and implementation of appropriate design criteria to eliminate or avoid adverse environmental impacts will be examined and evaluated for selected AID-supported subprojects.

4. No further environmental assessment is required for this Project.

Water Harvesting Project Design Criteria for Minimizing Malaria Incidence

A. Background

Malaria has been identified as a problem in parts of Himachal Pradesh, the State proposed for AID-finanaced subprojects under the Hill Area Land and Water Development Project. This memorandum suggests design criteria for minimizing the effects of water tanks as mosquito breeding habitats. First, engineering safeguards to prevent or inhibit mosquito breeding will be basic to all water harvesting small tanks sites. Second, sites will be selected based on an assessment of (1) the location of a water tank from a village, and (2) basic malaria information. A discussion of each recommendation follows.

B. Engineering Safeguards

Engineering safeguards would be of two kinds; (a) standard hydrological and engineering quality control criteria for efficiently and safely harvesting, storing and distributing rainwater, (b) special design criteria for additional protection against mosquito breeding habitats. Standard criteria will include:

1. Water Requirements: Criteria for designing the tank capacity will be developed based on the water production capability of the watershed and consumptive use calculations, thus eliminating storage of unnecessary water.

2. Dam and Embankment: Cut off trenches and foundation treatment will be made to minimize seepage through the embankment, foundation and abutments. An emergency spillway will be provided so that excess water is passed on the existing natural drainage ways without abnormal pooling of water. As and where necessary, erosion of downstream and upstream embankment slopes will be minimized by protective plantings.

3. Drainage Requirements: A drainage system will be provided in all subprojects to remove excess surface water. Where necessary, downstream interceptor wells and drains will capture excess seepage below the dam.

Since some water harvesting subprojects will be located in malarial areas, special mitigation measures will be added to the technical design criteria to further minimize or in some cases eliminate mosquito breeding habitats. These measures include:

a. Tank Design: The critical transmission period of malaria occurs in the dry season from April to mid-June. Careful water management to control malarial vectors during this period is of primary importance. By this time, the reservoir would be at its lowest level awaiting replenishment by the monsoon. High evapotranspiration rates during this dry season will eliminate dead storage in many of the tank sites. As an additional mitigation measure, tank outlets will be designed to fully drain dead storage from the tank during this critical transmission period. Selective treament of the tank bed will be made to eliminate pooling of water since shallow storage water is a mosquito breeding habitat. The tanks will also be designed with a volume/area ratio of at least six to minimize such habitat. In addition, withdrawal of tank water for irrigation during kharif of rabi seasons will create water movement which can kill mosquito largae as the water is rapidly drawn down.

b. Irrigation Requirements: Irrigation field channels will be used intermittently and therefore be dry for considerable periods. The submerged area of the tank will become dry when the dead storage is removed at the end of the rabi season. During these dry periods, aquatic vegetation will be eliminated from the tank bed.

C. Site Selection

Where practicable, tanks will be located at a distance greater than 1.0 to 1.5 km from a village which is the flight range of the malaria mosquito in India. Where a village is located within the flight range of the mosquito, arrangements will be made with the local Primary Health Center (PHC) for larval and adult vector density monitoring of selected tank sites to detect any significant changes in the mosquito population.

CHAPTER VI

VI. ECONOMIC AND FINANCIAL ANALYSIS

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A. Introduction

1. General

Economic viability of the project was examined using time discounted cash flow analysis of a sample of eight proposed subprojects and of three existing projects. The eight subprojects selected from a list of about 32 are representative of different types of irrigation works operated by different departments of the GOHP; the sample consisted of two lift irrigation schemes (LIS), two flow irrigation schemes (FIS) and one each of remodelling, tubewell, shallow well and water harvesting schemes. The sample of seven existing schemes which was reviewed similarly consisted of two LIS, one FIS, two pump schemes, one water harvesting scheme and one community kuhl. Because of certain missing information, complete analysis was done for only three, two LIS and one tubewell scheme. Economic methodology and criteria, results of sensitivity tests for certain assumptions and estimates and the description of the subprojects are summarized.

2. Present GOHP Procedure

Estimates of benefits and costs are currently developed for projects by GOHP/AD and ID, following procedures that use neither economic prices for inputs and outputs, nor time discounted cash flows. Using market prices, the net direct annual benefits (B) at full development and annual costs (C) are separately determined for each project. The ID computes and reports net benefit per hectare as (B-C)/(CCA) where CCA is the Culturable Command Area, while the AD computes and reports the benefit/cost ratio as B/C.

The net direct annual benefit at full development, taken as total increase in net farm income due to irrigation is calculated as the difference in the net value of production "before" and "after" irrigation. Data relating to cropping pattern, yields and financial prices are provided by the AD. Costs of inputs are generally taken as certain fixed percentage of gross farm revenue.

The annual costs are taken to be the sum of the annual interest at ten percent on capital investment, depreciation calculated linearly over the lifetime of the scheme and annual operation and maintenance costs (O&M).

3. Methodology Used for AID Analysis

The anlaysis used in this chapter differs from the GOHP procedures in several respects. Using economic rather than financial prices, the Economic Rate of Return (ERR) has been calculated for each of the study subprojects. Only direct benefits, the economic value of the incremental net farm income - that is, "With Project" (W/P) minus "Without Project" (WOP), net farm income, excluding transfer payments such as taxes and water charges - after deduction of operation and maintenance costs (O&M) - were included in the benefit stream. Costs included the costs of capital investment needed to achieve the increased income, such as irrigation works, distribution system, land development, and replacement of machinery and equipment. Total investment cost included capital costs of land acquisition for pump house construction and delivery chamber. No deductions were made for loss of income on these lands.

The AID analysis utilized World Bank (WB) projected 1990 world economic prices expressed in 1983/84 price level and "backed" to farm gate. After the recent sharp downward revisions of WB agricultural price forecasts, the world market prices of some traded commodities, particularly wheat and rice, have come close to parity with the Indian market prices, while the world prices of some commodities have moved below the market prices received by Indian farmers. Consequently, Foodgrains Conversion Factor (FCF) of 1.0 was used in the economic analysis.

Economic prices were used to develop crop budgets. The opportunity cost of farm labor was taken to be Rs 5 per day (prevailing rates) and all labor, whether farm family supplied or hired, was included as a cost. Market prices of other inputs were likewise adjusted to reflect their true economic value.

Similar adjustments were made to financial costs of construction. A construction cost factor (CCF) of 75 percent was used to convert financial cost to economic cost. O&M costs were adjusted by the Standard Conversion Factor (.80). Capital costs of construction were provided by the GOHP. A land development cost of Rs 5720/ha of CCA was included in the analysis. All costs and benefits were expressed in terms of 1983/84 purchasing power. Construction cost estimates of 1980/81 were converted to base year 1983/84 with the help of a weighted construction cost index in which wholesale commodity prices and consumer prices for agricultural labor were combined with appropriate weights.

Estimates of benefits took full account of transition periods involved in land and irrigation development and in the development of projected levels of agricultural productivity. A four-year linear

transition period for irrigated area expansion was assumed. However, considering the small size of some of the projects (judged by the CCA), the area ultimately irrigated could perhaps be reached in less time.

For the W/P case in this analysis, an eight-year linear transition period was assumed for agricultural productivity, beginning at 0.5 level. This transition was applied successively to each incremental area brought under irrigation. To reduce calculations, a combined transition obtained by multiplying area and productivity transitions for each successive incremental area and summing for each year was applied to W/P net return. For the WOP case, an eight-year linear transition was assumed for transition of net returns from the Present case. No transitions were assumed for shifts in cropping patterns; these were expected to be relatively short and were taken to be subsumed in the land transition.

Following this procedure, future benefit and cost streams were calculated for each subproject. Each annual cash flow entry was then discounted by the Present Worth (PW) factor derived from the expression $PW = (1+R)^{-n}$. In this expression R is the interest equal to the opportunity cost of capital and n is the number of years after the base year. The Economic Rate of Return (ERR) was determined through an iterative procedure.

B. Analysis of Proposed Subprojects

1. Description of Subprojects

a. LIS-Lambagaon: The CCA of this lift irrigation scheme in village Lambagaon in Kangra district is 103.68 hectares. The scheme is designed to lift water from Beas river to a height of 71.18 meters with the help of three 35 HP electric pumps. Proposed irrigation intensity is 90 percent, the requirement of water being 0.063 cusecs. Beneficiaries of the project number about 1200. Maize, wheat, soyabean and oilseeds are the principal crops grown, cropping intensity being 180 percent. Projected cropping pattern includes paddy and vegetables and the projected cropping intensity is 200 percent. Capital costs are estimated at Rs 9421/ha.

b. LIS-Shivpur: Located in Akalgarh tehsil, the CCA of this LIS is 138 ha. The source of water is Giri river. Maize and wheat are the main crops. No change in the cropping pattern, nor in cropping intensity is projected with irrigation. Present cropping intensity is 180 percent. Capital costs are estimated at Rs 7467/ha.

c. FIS-Dharpra: This FIS is designed to irrigate a CCA of 56 ha with water from Tikkri Nallah. Present cropping intensity is 174 percent. Projected cropping intensityis 200 percent. Projected cropping pattern includes vegetables which is not currently grown in the CCA. Capital cost per hectare is Rs 3500.

d. FIS-Malhloon: This small FIS has a CCA of 28 hectares. Farmer beneficiaries number only three. Once again, maize and wheat are the main crops. Cropping intensity is projected to increase from 174 to 200 percent. Projected cropping pattern includes vegetables as a new crop. Capital cost is estimated at Rs 4530/ha.

e. Remodelling-Jadul: This remodelling scheme involves lining of 29.5 km canal in Kangra district. The kuhl's CCA is 164 hectares with about 150 farmer beneficiaries. Estimated cost is Rs 2401/ha. Projected cropping pattern includes vegetables as a new crop.

f. Tubewell-Tihal: This tubewell scheme in Kangra district will benefit about 30 farmers in a CCA of 40 hectares. Cropping intensity is projected to increase from 150 to 275 percent. Cropping pattern will include vegetables as a new crop covering about 27 percent of gross cropped area. Costs are estimated at Rs 15623/ha.

g. Shallow Well-Kotla Khurd: This shallow well project, located in Una district, has a CCA of 1.20 hectares consisting of two farm units. Cropping intensity is projected to rise from 200 to 300 percent. Costs are estimated at Rs 24020/ha.

h. Water Harvesting-Dhalyani: Located in Bilaspur district, the scheme includes the construction of a small dam with a storage capacity of 14,000 cum. The project will benefit about 35 farmers in a CCA of 40 hectares. Cropping intensity is projected to increase from 180 to 275 percent. Projected cropping pattern will include vegetables covering about 40 percent of the gross cropped area. Cost per hectare is estimated at Rs 9469.

2. Economic Returns of Subprojects

Using the procedure outlined in a Section A3, Economic Rate of Return for the subprojects was calculated.

Subproject	Capital* Cost/ha Rs	O&M Cost/ha Rs	ERR %	CCA Ha
1. LIS:Lambagaon	9,421	1,839	11.0	103.68
2. LIS:Shivpur	7,467	1,014	3.9	138
3. FIS:Dharpra	3,500	438	21.0	56
4. FIS:Malhloon	4,530	566	18.5	28
5. Remodelling:Jadul	2,401	300	21.9	164
6. Tubewell:Tihal	15,623	1,953	17.2	40
7. Shallow Well:Una	24,020	3,002	17.4	1.20
8. Water Harvesting: Bilaspur	9,469	1,184	24.0	40

*Without CCF. Does not include chak and on-farm development costs estimated at Rs 5720/ha.

The estimated ERR varies a great deal from one subproject to another. However, except in the case of LIS Shivpur and LIS Lambagaon, the ERR in all the subprojects is greater than 12 percent which is generally taken to be the opportunity cost of capital in the Indian economy. Two factors seem to have been responsible for the low ERR obtained for the two lift irrigation schemes: (a) projected W/P cropping intensity is the same as the Present cropping intensity; and (b) no change in the cropping pattern is projected With Project, and significantly enough, the cropping pattern does not include vegetables. With careful planning of cropping intensity and cropping pattern, at least one of these two schemes would be economically viable.

3. Sensitivity Tests of Subprojects

Sensitivity analysis was carried out assuming (a) a 25 percent cost overrun, (b) a one year delay in project completion, (c) a modified cropping pattern (area under vegetables was restricted to 10 percent of gross irrigated area in the W/P cropping pattern), and (d) a shortfall of 20 percent in irrigation water delivered to fields. The results are as follows:

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Subproject	Cost Overrun 25%	Delay in Complet.	Modified Cropping Pattern	Shortfall in Irrig. Delivery	Base Case ERR
1. LIS:Lambagaon	9.6	9.3	7.9	2.7	11.0
2. LIS:Shivpur	3.0	2.8	6.8	*	3.9
3. FIS:Dharpra	19.3	17.5	20.6	12.2	21.0
4. FIS:Malhloon	17.0	15.4	17.5	10.0	18.5
5. Remodelling:Jadul	20.5	18.0	10.6	8.5	21.9
6. Tubewell:Tihal	15.2	15.1	15.4	11.8	17.2
7. Shallow Well:Una	15.0	15.0	9.2	6.0	17.4
8. Water Harvesting: Bilaspur	21.5	21.7	14.6	17.0	24.0

*Incremental net benefit was less than O&M cost.

These results indicate that the ERR for most of the subprojects is highly sensitive to changes in the projected cropping pattern. Restricting area planted to vegetables to 10 percent of the area, brings down the ERR by about 50 percent, 47 percent and 29 percent in the case of Jadul (remodelling), Una (shallow well) and Bilaspur (water harvesting) subprojects. Rearranging cropping pattern of LIS Shivpur (where W/P cropping pattern does not include vegetables) to include 10 percent of the irrigated area under vegetables improves the ERR by about 64 percent over the base case. In six out of eight cases considered here, cost overruns by 25 percent would reduce the magnitude of ERR less than would delay in project completion.

Particularly dramatic are the effects of shortfall in irrigation deliveries to fields. This can occur in several ways, (1) over-estimation of available supply at source, (2) estimates of irrigation requirements that are too low and (3) failure to distribute the water equitably over the command area. Delivering too much water to part of the area at the expense of another part has about the same economic result as though the water were not diverted at all. This analysis highlights the economic importance of equitable water distribution. These results are particularly relevant to irrigation in Himachal Pradesh, where actual utilization is generally low.

C. Analysis of Existing Projects

Performance of a few existing minor irrigation projects in Himachal Pradesh was reviewed. The following is a summary of the economic analysis of three projects.

1. Jawali

A lift irrigation scheme in the low hills in Kangra district, the project has a CCA of 471 hectares. Work on this project began in 1972 and was completed in 1975. However, only about 25 percent of the designed irrigated area has been covered so far. Some work needs to be done to develop a system of field channels and watercourses; land development work - land grading and land shaping - is yet to be completed. A major problem appears to be that of electrical power supply, which is now in the process of being augmented. Assuming that the project would provide irrigation to the designed area, the ERR was estimated at 18.8 percent.

2. Chobin

A lift irrigation scheme in the mid hills, this project too is located in Kangra district. Although the project was designed to irrigate about 32 hectares, irrigation has so far been extended to about 62 percent of the area. Shortage of water in the kuhl on which this LIS depends, seems to be the main reason for this shortfall. Since 1976, there has been some shift toward orchard cultivation in the project's command area. Assuming that area under orchards will continue to increase, the ERR is estimated at 17.8 percent.

3. Kher

This deep tubewell scheme in Kangra district was constructed by the Agriculture Department in 1977 under the Indo-German Agricultural Project; it was electrified and made operational in 1979. The scheme's CCA is 32.4 hectares, but the average area irrigated in the past three years has not exceeded 17 hectares. On the assumption that the project would irrigate 20 hectares, the ERR is estimated at 14.9 percent.

D. Financial Analysis

Tools of financial analysis have been applied to a proposed subproject, FIS Dharpra. In the financial analysis, construction costs and O&M costs are not adjusted by the CCF. Outputs are valued at farm harvest prices while inputs are valued at their current market prices. With some modifications, the present GOHP procedures would be adequate to calculate financial rates of return.

The calculation of the net financial returns for the Present, WOP and W/P cases is shown in Table 1 attached. Output prices are estimated farm harvest prices of 1983-84. Inputs valued at 1983-84 market prices, include human labor, animal labor, seeds, farm yard

manure, fertilizer, chemicals, land revenue and interest and water charges. Net value per hectare is the difference between value of output (including biproducts) and value of inputs per hectare. The sum of net value per hectare multiplied by percentage cropped area is the net return per composite hectare. CCA multiplied by net return per composite hectare equals ultimate total net return. Annual net returns are calculated by applying the transition coefficients, Table 2, to the ultimate net returns as illustrated in Table 3. Estimated costs, net farm income and incremental benefits in base year 1983-84 prices are summarized in Table 4. Major works are projected to be completed in three years, total construction costs have been allocated as 30 percent the first year, 50 percent the second year and 20 percent the third year. Development costs have been allocated on the same basis. Annual incremental benefit or the cash flow is derived as the difference between estimated total annual costs and estimated net annual returns. As in the case of economic analysis, each annual cash flow entry is finally discounted by multiplying by $(I+R)^{-n}$ where R is the discount rate and n is the number of years after the base year, and summing. The FIRR, obtained by iteration, is defined as that rate of discount R, at which the sum of the discounted cash flow is zero. The FIRR in this case is estimated at 19.9 percent compared to an estimated ERR for this subproject of 21.0 percent. This analysis indicates that FIRR can be expected to be only slightly higher than ERR and thus provides a suitable indicator of economic viability for subprojects.

Summary of Procedures for Financial Analysis

1. Financial crop enterprise budget is prepared for the Present, WOP and W/P cases. Output is valued at the base year's farm harvest prices; all inputs are valued at base year's market prices. Net value of production for each crop is estimated for the Present, WOP and W/P cases.

2. Cropping pattern in the CCA is prepared for the Present case and projected for the WOP and the W/P cases.

3. Annual net economic returns are estimated by applying transition factors to the estimated ultimate net return at full development.

4. Capital costs of major works, land development and any other required investments, and annual O&M costs are estimated for each year.

5. The stream of annual cash flow is discounted and the FIRR is estimated by iteration.

E. Farm Income of an Average Farm

The project's effect on farm incomes has been estimated through an analysis of crop budgets, cropping intensity and typical cropping pattern of a 1.6 ha farm. The Present and WOP cropping pattern include maize and paddy in kharif, and wheat and barley in rabi. The cropping intensity in the Present and WOP case is about 162 percent. The cropping pattern in the W/P case includes vegetables in about 15 percent of the gross cropped area. The W/P cropping intensity is assumed to be 200 percent.

Given these assumptions, the typical farm in Himachal Pradesh would experience the following changes in income:

Farm Ha	Time	Gross Value	Labor Costs	Other Inputs	Net Value Total	Net Value Per Ha Cropped
		Rs				
1.6	Present	6,345	2,210	730	3,405	1,310
	Future Without Proj.	7,559	2,320	822	4,417	1,698
	Future With Project	21,850	5,097	3,227	13,526	4,227

F. Summary

Investments in irrigation schemes proposed under the project can be expected to yield economic returns greater than 12 percent if schemes are constructed and operated as planned. The assumptions made in this analysis are generally conservative. Owing to the small size of the schemes, construction period could be considerably reduced and land development expedited; since the gestation period could be reduced, benefits could start flowing soon after the schemes get underway. Projected yields could be higher than those assumed in this analysis. Greater shifts in the cropping pattern towards vegetable farming would also improve the economic returns. Generally shifts in cropping pattern and intensity raised net returns much more than increases in yield.

Sensitivity analysis shows that returns were highly sensitive to effectiveness with which adequate water is equitably delivered to all fields in the command. Even small shortfalls in this objective will result in failure to achieve acceptable economic returns on many otherwise attractive schemes.

It is recommended that current evaluation procedures followed by GOHP be modified to fully discounted cash flow analysis without shadow pricing of inputs and outputs, that is, Financal Analysis calculating FIRR, as described in Section D. Once institutionalized, the modifications will permit more complete economic analysis and support more effective project planning and implementation. For subprojects qualifying under the loan, FIRR shall be not less than 12 percent.

Table 1: Cropping Patterns and Ultimate Net Returns: FIS Dharpra

Crop	Cropped Area Percent	Net Value Rs/Ha	Composite Value Rs/Ha
Present: Rainfed			
Maize	78.0	1,339	
Paddy	0.8	1,560	
Pulses	12.2	1,106	
Wheat	58.0	1,322	
Barley	24.0	920	
Gram	1.0	1,106	
			2,190
WOP: Rainfed			
Maize	78.0	1,716	
Paddy	0.8	1,951	
Pulses	12.2	1,422	
Wheat	58.0	1,804	
Barley	24.0	1,038	
Gram	1.0	1,422	
			2,873
W/P: Irrigated			
Maize	21.0	2,223	
Paddy	75.0	3,498	
Pulses	1.8	2,574	
Vegetables	2.2	12,469	
Wheat	88.0	2,876	
Barley	4.5	1,794	
Gram	1.5	2,569	
Vegetables	6.0	12,469	
			6,809

CCA = 56 Ha

Ultimate Net Returns:	W/P:	(56)(6809) = Rs 381,319
	WOP:	(56)(2837) = Rs 158,885
	Present:	(56)(2190) = Rs 122,665

Table 2: Land and Productivity Transitions

Year	Area	Technology	Composite
	0.25	0.5625	0.1406
2	0.50	0.6250	0.2968
3	0.75	0.6875	0.4687
4	1.00	0.7500	0.6562
5		0.8125	0.7187
6		0.8750	0.7813
7		0.9375	0.8438
8		1.0000	0.9063
9			0.9532
10			0.9844
11			1.0000

Table 3: Annual Crop Net Returns: FIS Dharpra

Year	Transitions		Net Returns - Rs 000				
			W/P				
	Composite	Old Area	New Irr.	Present Area	Total	WOP	Net Total
3				123	123	123	0
4	.14	.75	53	95	148	127	21
5	.30	.50	114	66	180	132	48
6	.47	.25	179	34	213	136	77
7	.66	0	251		251	141	110
8	.72		274		274	145	129
9	.78		297		297	151	146
10	.84		320		320	155	165
11	.91		347		347	159	188
12	.95		362		362	159	203
13	.98		373		373	159	214
14	1.00		381		381	159	222
..	..		...		...	...	...
..	..		...		...	...	...
24			381		381	159	222
25			381		381	159	222

Table 4: Investment, Income and Incremental Benefits: FIS Dharpra

Period	Major Works	Land Dev.	O&M Costs	Total Cost	Farm Income	Incremental Benefit
			(in Rs 000)			
0	59			59		- 59
1	98			98		- 98
2	39	80		119		-119
3		80	6	86	21	- 65
4		80	12	92	48	- 44
5		80	18	98	77	- 21
6			24	24	110	86
7			24	24	129	105
8			24	24	146	122
9			24	24	165	141
10			24	24	188	164
11			24	24	203	179
12			24	24	214	190
13			24	24	222	198
14					...	...
..						
..					...	...
24			20	20	222	198
25	- 98*	- 320*				418*

*Salvage value

CHAPTER VII

PROJECT DEVELOPMENT AND IMPLEMENTATION

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A. Project Summary

The development and management of natural resources in the hill areas of India is a critical public policy issue. Along with the important ecological, technical and economic dimensions of the problem, institutional matters also loom large. Among the most significant of these institutional concerns is the need for an appropriate mix of public and private sector investments, control and management. The need is for an institutional arrangement that allows the State to provide needed technical expertise and limited financial resources in a manner that supports local initiatives, induces further private investments and creates appropriate incentives for a combination of public and private management responsibilities.

A key resource requiring development and management in the hill areas of India is water for agricultural, including horticultural, production. In the past, communities have had an important role in the development of traditional irrigation works in the sub-Himalayan region of South Asia. More recently, various State agencies have become involved in expanding and upgrading irrigation facilities. Thus, in the present period, there often is overlapping and interaction between these public and private efforts. A major challenge is to derive procedures for agency assistance to both existing and new, private groups that support their initiatives. An overall objective in Himachal Pradesh is to create high performance irrigation systems that protect the hill environment while allowing farmers to increase their production of needed foodgrains and other agricultural and horticultural products. A key assumption is that such high performance systems will be the result of combined agency and community actions and responsibilities.

In hill regions, most irrigation works will of necessity be small in size and dispersed in location. These two fundamental features of irrigation development in the hill areas simultaneously create both the need and opportunity for a strategy of upland irrigation development in which the beneficiary groups assume considerable control and responsibility for the individual schemes while selected assistance is provided by the public sector. The small scale of most, though not all, of the irrigation works means that the limited investments needed for routine maintenance and management may be compatible with local experience, resources and capacities. Moreover, there is need for this significant local participation because of the difficulty and expense of fielding and coordinating a large agency staff serving a number of schemes scattered geographically across a state or region.

Environmental deterioration, particularly erosion and deforestation is a serious issue in hill areas. Rather than adding to these hazards, irrigation schemes could build in programs of afforestation and erosion control that would positively enhance the aspects of environmental conditions on irrigation commands and adjacent watersheds. These interventions also need user particiption in implementing and protecting improvement measures and sharing in benefits.

These basic issues are all evident with regard to the development of minor irrigation facilities in the Himalayan state of Himachal Pradesh. The current situation is one in which both private water user groups and the public sector through its several technical agencies is involved in irrigation activities. Three agencies of State government are involved in developing, or improving, irrigation works: the Irrigation and Public Health Department (ID), the Soil Conservation Wing of the Agriculture Department (AD) and the Rural Development Department (RD). These three agencies, while carrying out somewhat different irrigation-related activities, also employ different strategies with regard to community participation and post-project responsibilities. In brief, the AD and the RD typically implement projects of smaller scope and leave the post-project management responsibilities with the group of users. No water charges are assessed. In contrast, the ID usually undertakes more substantial works (though usually spread over a longer period of project implementation), and after completion assumes responsibility for operation and maintenance of these new, or rehabilitated, facilities - with a nominal water charge assessed.

These varied approaches to resource development and management, and the differential outcomes for public and private responsibility, provide a basis for reexamining the State's future actions in support of irrigation. This reexamination is particularly cogent at this time because in the near future the ID is likely to become a full-fledged and specialized irrigation agency and assume a more dominant role in the State's irrigation affairs. Concurrently, there is considerable concern among both policy makers and the technical staff that projects already completed by the ID are not performing as well as planned (similar concerns could be raised about some of the irrigation-related projects of the AD). Actual areas irrigated frequently are much less than planned and erratic water supplies to users result both in much less increase in both agricultural production and farmer income than was expected. While the explanations for these shortcomings are frequently suggested to be technical in nature, there is some recognition that organizational and institutional shortcomings also are present. Among the institutional problems mentioned are limitations in the technical agencies, the changing viability of private water user groups and the lack of involvement of beneficiaries in the projects.

Agency limitations stem from policy and availability of resources. For example, no agency now has responsibility for chak development. Another example relates to user involvement. There are potential advantages (see Chapter I, Section D) of user operation and management of part or all of the irrigation facilities constructed by ID including new and rehabilitated flow and lift schemes. This has been the case for traditional community kuhls for many years and is regularly the situation on AD and RD schemes. Normally, the State would need to provide some assistance to the group in strengthening their local organizational capacity to take on these responsibilities.

There is thus an opportunity to collaborate with the GOHP in this search for a more effective combination of state and private investments and responsibilities for further development and protection of the agricultural land and water resources of the state, and for evolving the desirable institutional arrangements to support this approach. The public policies and agency procedures that will be required to achieve this new institutional configuration are not agreed upon at this time. Indeed they are not all known, thus they cannot be put in place prior to project initiation through various pre-project agreements. Rather, their identification, testing and consideration for application will occur during the life of the project through the various training, research and construction activities that are planned.

A major aim of this project is therefore to improve the capacity of the irrigation-related agencies to plan and implement a stronger irrigation development strategy with particular emphasis on a community-based strategy. The correlated aim is to strengthen the capacity of water user groups to participate in irrigation development through successful interaction with the irrigation agencies assisting them and by mobilization of their own human and financial resources. Concurrent with efforts to enhance community capacities and involvement, and as a means for supporting community responsibility, the irrigation-related agencies, and again especially the ID, will be supported in improving their capacities to produce and implement technically sound irrigation system designs using appropriate agricultural and environmental data. The assumption is that well-engineered systems will be more effectively managed by water user groups than facilities which are technically deficient.

To achieve these purposes, several activities will be supported under the project. First, financial support for the construction of a number of irrigation subprojects will be provided. These subprojects will use the improved technical design processes specified as part of the project agreement including improved water

conveyance systems, control structures and/or water application techniques, as appropriate. They also will be based on new procedures for enhancing community participation and responsibility. Finally, they will be designed and implemented with coordinated inputs from the Agriculture, Forestry and Horticultural Departments.

Second, training for both agency staff and leaders and members of the water user groups will be funded. For the agency staff, training will be concerned with: knowledge regarding improved planning and design methods, community organization and farmer participation, and improved management procedures to incorporate the new technical and social methodologies to be used in the project. For the leaders and members of the water user groups, training will include: technical matters such as developing a more effective arrangement for water distribution, organizational management issues such as improved record-keeping, and discussion of techniques of effective leadership. The project will also support various special studies dealing with both technical and institutional issues. Along with, or as the result of these special studies, action research in selected subprojects also will be undertaken.

Finally, to aid the GOHP in planning and implementing these numerous activities, the project will support technical assistance activities to be provided by a set of resource institutions such as the Himachal Pradesh Agricultural University, polytechnics, appropriate Indian Private Voluntary Organizations, and private consultants supplemented by U.S. technical assistance as needed.

B. Detailed Project Description

1. Project Design

a. Purpose

The purpose of the project is to develop a suitable institutional pattern for hill irrigation development and management incorporating both agency and community investments and responsibilities. To do this, the Project will strengthen agency capacities to provide assistance to irrigation groups and private irrigators in support of their activities for modernizing agricultural and horticultural production, and strengthen the capacity of private irrigation groups to manage their own irrigation affairs and to work with assisting irrigation agencies.

b. Project Outputs

Project outputs include agencies with greater technical skills and increased capacities to successfully assist private irrigators and irrigation groups; stronger and more involved water user groups; better planned and designed minor irrigation works; improved agricultural and horticultural production; public policies and agency procedures that are more supportive of community involvement, responsibility in irrigation development; improved data and information on technical matters such as plant- soil-water relationships, water scheduling procedures and improved water application techniques; a range of socio-economic data regarding water user group formation and socio-economic costs and benefits of irrigation. The state-level policy and implementation committees formed for the implementation of this project will be the institutional nucleus for fully integrated approaches to irrigation development.

c. AID Inputs

AID inputs will consist of loan financing of construction and development costs of a number of subprojects using new approaches as described above, afforestation and erosion control on contiguous watersheds, afforestation and horticultural development for fuel, fiber and new fruit crops on subprojects and for improving the size and capability of agricultural extension supporting irrigation water management and increased agricultural productivity under irrigation. AID will reimburse GOI for two-thirds of the basic cost of facilities except for the costs of procuring land and for identifiable taxes.. Using grant funding, AID will support staff development, training for agency personnel and water user groups, special studies and action research, and technical assistance by Indian and U.S. individuals and institutions.

d. Project Activities

Both the technical and institutional aspects of hill irrigation development must be addressed simultaneously to create irrigation works that perform more effectively. The same is true for works that are both community-managed and agency-assisted. In general, such joint systems are not now operating in Himachal Pradesh. Many agency systems experience poor rates of water utilization and little chak or farm-level development of irrigation facilities occurs. Little is known about what is happening to maintenance on traditional community-owned systems, built and maintained privately at great cost. In sum, effective strategies for using a combination of agency and community resources are not yet in place in the State.

The technical activities of the project will address improvements in project planning, design and implementation. Through special studies and action research, staff development and training, technical assistance and the construction of a limited number of subprojects following new guidelines specified in the project agreement. Enhanced technical capacity will result in delivery to irrigation communities of higher quality facilities for operation and maintenance - thus reducing the burden on those communities and perhaps opening the opportunity for their successful local management.

The institutional activities will address the various public policies that influence the mix of state and community responsibilities for minor irrigation development through special studies and action research that present new approaches and evaluate their results. Training programs, seminars, workshops and travel to other regions, will also be used as a means to examine the desired policy context. Also to be addressed are enhanced capacities of implementing agencies to successfully interact with community groups or to assist with the formation of such groups. These new capacities will be developed through special studies, action research, staff development and training, and technical assistance provided through both Indian and U.S. institutions.

2. Project Elements

Project elements consist of (1) activities such as pilot projects, action research and special studies; professional development largely through training and technical assistance. These elements are integrated in the "Land and Water Management Improvement Program" of the Project and (2) installation of irrigation facilities with improved capability for water delivery and agricultural productivity.

a. Land and Water Management Improvement Program

The purpose of the land and water management improvement program is to provide the information, professional development, demonstration and institutional guidelines required to accomplish the aims and purposes of the Project as described in the various sections of Volume II, Project Analysis. This program will also support a principal element in the Project strategy, that is, study cum demonstration leading to modification of institutional arrangements and agency procedures as appropriate.

Main objectives of this concept are:

a. Improved technical capacity to plan, design, construct, operate and maintain flow and lift irrigation and water harvesting schemes.

b. Optimal user participation through effective organizations in the planning and implementation process and particularly in operation and maintenance.

c. Defining and helping to implement the role of private sector and NGO institutions.

d. Improved management of tributary watersheds especially for water harvesting schemes including participation of villagers in controlling these watersheds and reaping the benefits of increased watershed production.

Suggested approaches to the various program elements have been detailed in the various sections of Volume II.

AID will support, using grant funds, 100 percent of the cost of field studies, professional development and Indian and U.S. technical assistance. In addition, portions of the costs of pilot projects and chak development demonstrations will also be supported. A summary of the grant budget of $4.0 million is contained in the Cost Estimate and Financial Plan Section of Volume I of the Project Paper. The individual items are only representative and will be subject to modification (both content and cost) by agreement of the GOHP (Project Cell) and USAID during the implementation of the Project.

Activities under the land and water management improvement program are divided into field studies, professional development, and pilot projects and demonstrations.

1. Field Studies

Field studies consist of action research and special studies. To advance the project's purposes, three broad types of action research and special studies will be implemented during the life of the Project. These include agronomic, irrigation management and socio-economic, (including institutional) studies. To identify, plan, and implement this work, a set of resource institutions will work closely with the project implementing agencies and the project cell.

In this discussion, the term action research is used as defined in the USAID-supported Irrigation Management and Training Project. Action research has the following characteristics:

"Ideally, action studies involve collaborative learning among farmers, researchers and project staff. They are iterative and involve interventions such as changes in water scheduling, other

management procedures and minor infrastructural improvements subsequently moving to major systems improvements, changes in cropping patterns and agricultural production practices, farmers' incentives, farmers' organizations, incentives for government staff members and organizational structures. Action research sites are live learning laboratories for understanding the problems and potentials of irrigation management and for use in management training."[1/]

In the Himachal Pradesh project, there is need for action research that deals with the following matters, among others:

1. Devising procedures to improve water scheduling and distribution in various government-managed schemes, but especially in lift schemes;

2. Devising a strategy and methodology for farmer responsibility and involvement during kuhl remodeling activities and in the post-construction period of system operation;

3. Testing appropriate nature and level of farmer participation in chak-level development;

4. Examining alternative procedures for forming pump groups composed of small and marginal farmers;

5. Identifying and field testing different forms of water user organizations - perhaps using some modified form of the traditional khooli or newer forms developed along cooperative lines;

6. Improving performance of conveyance, distribution and utilization of irrigation water (see Chapter III, Section E2).
7. Identifying how women can become involved in irrigation activities and participating in benefits (see Chapter IV, Section D)

Insofar as possible engineering, agronomic and socio-economic action research will be integrated and conducted on the same sites.

1/ AID Project Paper, Irrigation Management and Training (386-0484), Volume II, Technical Support Section. 1983, p. 227.

In addition to the action research topics identified above, there is need for data to be collected through a number of special studies. For agronomy and water management, these include developing soil survey capability and utilization, ponding and flow effects on rice yields, improved varieties of crops for hill areas, small watershed hydrology and estimating crop water requirements. There is a need for environmental monitoring as described in Chapter V. In the socio-economic area, a number of issues requiring special studies are likely to arise during the course of the Project. Two can be identified now as of special importance. These are:

1. Integrated studies of a range of traditional kuhl systems which are still operated and managed by the water user groups themselves. The kuhls selected for study should include a range of types, perhaps different physical apparatus, cropping patterns, etc. Needed are socio-technical studies that collect information on the engineering principles and structures being used, the agricultural production patterns that are supported by the system and the organizational arrangements that exist for implementing key system processes such as water distribution, system maintenance and conflict resolution.

2. Socio-economic studies of selected irrigation schemes that provide detailed information on land ownership and tenancy in the command area, investigate the total farming system being operated by the farmers, both within and outside the command area and including both horticulture and animal husbandry. These studies should examine who benefits from irrigation development and through what mechanisms these benefits flow.

In addition, socio-economic baseline surveys as described in Chapter IV will be required.

The H.P. Agricultural University has had experience in agronomic and water management research. Insofar as possible, they will be involved in special studies in these fields. An Indian institution such as the Center for Science and Environment (New Delhi) may provide technical assistance in monitoring a representative sample of subprojects in the different agro-climatic zones of the state for environmental impact, (Chapter V, Section D2). This is included as item 8 in the listing below. There is a need to identify an Indian organization with experience in assisting farmers to strengthen existing local groups or form new ones. An organization experienced in working with the creation of water user groups would be especially appropriate. An early project activity

will be to identify such a group. The task of this organization would be to work in a selected number of existing and new irrigation schemes, both public and private kuhls as well as public lift schemes, assisting in the development of viable water user groups able to assume post-construction responsibility for operation and maintenance assisted by the irrigation agency when required. There are a number of institutions in India qualified to conduct the socio-economic baseline studies and an appropriate one will be selected by the Project Cell collaboratively with USAID. This activity is listed as item 6b in the list below.

As the Project develops, perceptions of research needs and priorities will change so that the suggested field study agenda must be regarded as preliminary. It will be reviewed initially and annually by the Project Cell and USAID and may be modified by joint agreement. In summary, field studies tentatively identified as needed include the following.

1. Small Watershed Hydrology (Ch. III, Section C1a)
2. Integrated Action Research on Conveyance, Distribution and Utilization (Ch. III, Section E1; Ch. VII, Section B2b(i)
3. Crop Water Requirements (Ch. III, Section E1)
4. Soil Survey Unit (Ch. II, Section E1)
5. Crops Research (Ch. II, Section E2)
6. Action Research on User Participation/Social Aspects (Ch. VII, Section B2b(i)
   a. Water Scheduling and Distribution
   b. Farmer Involvement in Kuhl Management
   c. Nature and Level of Farmer Participation
   d. Pump Groups for Small and Marginal Farmers
   e. Alternative Forms of Water User Organizations
   f. Involvement of Women in Irrigation Activities (Ch. IV, Section D)
7. Socio-Economic Baseline Studies (Ch. IV, Section D1)
8. Environmental Monitoring (Ch. V, Section D)

ii. Professional Development

Special staff development and training programs will be organized for personnel drawn from the various State departments included in project implementation and for selected staff of the Himachal Pradesh Agricultural University (HPAU). In general, staff development and training will be directed toward improving knowledge and skills to: (1) Plan and design irrigation facilities; (2) manage and operate irrigation systems; (3) understand and analyze irrigation systems in an integrated manner and (4) involve and work with farmer water user groups.

Special attention will be given to improving the technical knowledge of the engineering field staff on irrigation system design and management. Most of this training can be done in Himachal Pradesh, including various short courses that may be organized through the agencies, or one, or both, of the polytechnic institutes. More advanced training in specialized irrigation topics as required can be provided through programs of several U.S. universities. Training that gives emphasis to the integrated nature of irrigation systems and to issues of irrigation system management also will be organized for staff in Himachal Pradesh. This will include Diagnostic Analysis which will be offered in-country through AID's Water Management Synthesis Project. Other related programs may be offered in-country or in appropriate U.S. universities. These two training programs will be suitable for both agency staff and researchers from the HPAU.

Workshops and seminars to review and explore the issue of farmer participation and formation of farmer groups will be organized to draw on experiences with traditional irrigation systems in Himachal Pradesh, experiences elsewhere in India, other parts of Asia, and the U.S. Appropriate study tours will be organized to observe selected programs in action as with the communal irrigation program of the National Irrigation Administration in the Philippines.

Training activities for leaders and members of private water user groups will also be organized. Major responsibility for this training will be with the to-be-identified Indian organization experienced with farmer organization and participation. Several organizations in the Philippines have been assisting the National Irrigation Administration in developing training materials for use in work with community water user groups there. Both individuals familiar with these programs and the materials developed for training can be used to assist this work in Himachal Pradesh.

<u>In-Country Training</u>: Because of the difficulties of releasing personnel for long-term instruction and the need to proceed expeditiously with implementing new Project criteria and methodologies, one or two week workshops will address these particular concerns. There is need for some more formal basic training on such topics as chak development; irrigation water management including soil-plant-water relationships and integrated project planning (items 6, 12, 13 below) for example. This could be accomplished through long-term (6-10 months) training such as provided at Water and Land Management Institute (WALMI) in Aurangabad. This does not seem practical under this project nor does creating a similar Institute to WALMI in Himachal Pradesh at this time. Tentatively, Project strategy is to meet these needs using

somewhat longer training periods - six weeks to two months. For irrigation water management, U.S. assistance will be provided to train the trainers and an institution such as Indian Institute of Management, Ahmedabad, could provide resident courses relating to integrated project planning and management. In order to build long-term capability, the courses in irrigation water management and integrated project planning should be organized by HPAU or one of the polytechnics. The same topics should be supported by long-term postgraduate training in India of two or three persons, possibly including one from HPAU, at the Water Resources Development and Training Center at Roorkee University and Water Technology Centre at the Indian Agricultural Research Institute, New Delhi (Item 16). Following is a summary of items tentatively identified as desirable for inclusion in the in-country professional development activity:

1. Initial Subproject Design and Implementation (Ch. III, Section B6), 4 Workshops - 2 weeks each - 20 trainees each;

2. Conveyance and Distribution Systems including Closed Systems (Ch. III, Section F), 2 Workshops - 2 weeks each - 20 trainees each;

3. Planning and Design of Lift Facilities (Ch. III, Section F), 6 Workshops - 1 week each - 20 trainees each;

4. Hydrology, Water Requirements, Water Budget (Ch. III, Section E1, F3), 3 Workshops - 1 week each - 20 trainees each;

5. Planning and Design of Water Harvesting Schemes, (Ch. III, Section F), 3 Workshops - 2 weeks each - 15 trainees each;

6. Chak Development (Ch. III, Section F2), 8 Workshops - 3 weeks each - 24 trainees each;

7. Watershed Treatment and Maintenance (Ch. II, Section D), 3 Workshops - 2 weeks each - 15 trainees each;

8. Operation and Maintenance of LIS and FIS (Ch. III, Section F3), 6 Workshops - 1 week each - 20 trainees each;

9. Small Watershed Hydrology (Ch. III, Section F1), 5 Workshops - 2 weeks each - 20 trainees each;

10. Quality Control (Ch. III, Section F), 10 Workshops - 1 week each - 20 trainees each;

11. User Organization, Participation and Social Analysis (Ch. VII, Section B2c), 10 Workshops - 2 weeks each - 20 trainees each;

12. Irrigation Water Management (Ch. III, Section F2, 3)
    - Training of Trainers
      1 Session - 6 weeks - 25 trainers
    - Training of Trainees
      8 Sessions - 4 weeks each - 25 trainees

13. Integrated Project Planning and Management (Ch. VII, Section B2k);
    - Courses at Indian Institute of Management, Ahmedabad
      9 weeks - 20 trainees
      1 week - 25 trainees

14. Economic Analysis (Ch. VI), 1 Workshop - 2 weeks - 20 persons;

15. High Lift Systems, 1 Workshop - 1 week - 20 trainees;

16. Postgraduate Training in Irrigation and Water Resources Planning and Development, 3 trainees - 18 months each;

17. Diagnostic Analysis of each of the three types of Irrigation Systems (Ch. VII, Section B2c), 3 Sessions - 6 weeks - 25 trainees each.

18. Leadership Training for User Groups. To be developed under action research activity, Section B2ai-1.

Illustrative U.S. or International Training: Provision has been made in the grant budget for limited training in the U.S. These courses will normally be from six weeks to two months in length. They will be in selected specialty areas using organized international courses already available insofar as possible. Some study tours will be organized for senior officers also. For budgeting purposes, the following have been tentatively identified (number refers to the same numbered item in the in-country training program above):

4. Hydrology, Water Requirements, Water Budget, 1 trainee - 6 weeks;

6. Chak Development, 4 trainees - 6 weeks each in Irrigation Water Management;

9. Small Watershed Hydrology, 2 trainees - 4 months each;

11. User Organization, Participation and Social Analysis Observation Visits in Asia, 12 persons - 1 months each;

12. Irrigation Water Management, 8 trainees - 6 weeks each;

13. Integrated Project Planning, 10 persons - 4 weeks each;

13. Senior Level Observation Tour, 5 persons - 5 weeks.

Some U.S. training has also been provided for support of field and pilot studies, tentatively estimated as follows:

- Action Research on Conveyance, Distribution and Utilization, 2 trainees - 2 months each;
- New Irrigation Technology, 2 trainees - 2 months each.

Agricultural Extension: By support of new staff costs and training, the capacity of the Agricultural Extension Service to provide better information to individual farmers and farm organizations about rotational water supply, operation and management of field channels, water application and water crop requirements and increased production under irrigated agriculture will be enhanced. The exact lines along which this will be accomplished have not been decided but will be developed during Project implementation. AID loan funds in the amount of $2 million have been budgeted for this activity. Grant funds may be used to support short-term training in-country. The program will need to be coordinated with other workshops as described above under In-Country Training.

iii. Pilot Projects

(1) New Technology

There appear to be a number of potential opportunities to introduce new irrigation technologies in Himachal Pradesh. The principal ones visualized are sprinkle, trickle and hose-basin irrigation. A pilot program for testing these is described in Chapter III, Section D. These methods have advantages over surface irrigation in that water application can be more fully controlled, land reshaping may be avoided or greatly reduced, use of water applied is more efficient, peak labor requirements may be reduced and in some cases at least, costs of operation and maintenance may be less. Overall these methods could be more cost-effective than surface methods under certain conditions. Gravity-fed sprinkler systems are the most favorable types, but pumped systems are not ruled out. Trickle systems appear especially applicable to tree crops, especially on slopes and should be of interest to the state's rapidly expanding fruit industry. Hose-basin irrigation has many of the advantages of sprinkle and trickle but usually requires less capital investment.

Tentatively, ten sites for sprinkle and six each for trickle and hose-basin irrigation are visualized. Sites will be identified by the Implementing Committee collaboratively with USAID. Grant funding will support the cost of equipment and installation; collection and analysis of data; publications, workshops and demonstrations and technical assistance and training. Loan funding may be used for other site development costs.

Plans for administering these pilot projects have not been developed. This issue will need the early attention of the Implementation and Steering Committees. Agencies other than the three principal ones, e.g. Horticulture Department, may be involved as principals for some of these sites.

(2) Development of Integrated Water Harvesting Schemes (Ch. VII, Section B2a)

The objective of this activity is to put in place the institutional capability in an appropriate mix of private and governmental responsibility to develop integrated water harvesting schemes with maximum user participation and responsibility.

The three physical components of water harvesting schemes,the catchment watershed, the storage tank or pond and the irrigation command area are not now planned as an integrated unit. Moreover, the principal concerned people, the users of these resources are only partially involved. Ideally the user, preferably a village or community, should participate in development of an integrated scheme in which they assume responsibility for managing and conserving the resources and sharing benefits including those from the watershed - fuel, fodder, etc. Among the obstacles to overcome are organizing and gaining commitments from participating users and gaining responsibility for development and management of the watershed by them since the watershed may be government or forest land under agency control.

Utilizing the services of a private voluntary agency in collaboration with SC/AD and Forestry, three or four demonstration schemes embodying the foregoing concepts will be developed. Grant funds will be made available for planning and development and such special physical infrastructure as may not be available otherwise. The sites selected normally will be water harvesting subprojects with AD normally providing the tank or pond and normal distribution facilities, supported by loan funding, although, if necessary, sites other than subprojects may be used. Watershed treatment will be worked out with the participants by the contractor with technical collaboration by the Forestry Department and/or SC/AD. Grant funds will also finance demonstrations, workshops and publication of outreach material.

(3) Development cum Demonstration LIS and FIS including Chak Development

A limited number, but a representative set, of lift and flow irrigation schemes having appropriate geographical distribution will be selected to test various development and management approaches. These may be selected from the existing schemes or from new ones. Studies should be initiated as early as practical in order to gain maximum benefit over the Project's life. These will also provide sites for the field studies and for training. Besides testing technical standards and criteria, these studies will include various management alternatives including different forms of user participation. In at least ten cases, studies will include operation and maintenance of the scheme by participating users with such agency technical assistance as may be required. Both new and remodelled kuhls and lift schemes will be included in the set. These may be regarded as precursors to those specified in Section B2a. Chak development is a major activity of the project and demonstrations will be included on but not limited to these sites.

Immediately upon Project implementation, specific criteria and work plans for development cum demonstration sites will be developed by the Project Implementing Committee in collaboration with USAID and the resident U.S. and Indian contractor utilizing the technical assistance of the Project Cell. Approximately one-fourth of the sites should be identified and implemented during the first year of the project; the remainder during the second and third years, as work plans are developed.

Both Indian and U.S. technical assistance, other extraordinary costs of organizing users, data collection, analysis, and outreach activities will be grant funded by AID. Normally, costs of improving physical infrastructure will be included under the loan-funded component of the Project, however, in the early years, if this is not possible, limited grant funding may be used as agreed upon by the Project Implementing Committee and USAID.

iv. Coordination

The management and coordination necessary to carry out the various activities under the Land and Water Management Improvement Program is extremely complex. This function will be carried out through the Project Cell. The Project Implementing Committee, with USAID, may decide that a special LWMIP Wing is needed. Management and coordination responsibilities are both logistic and technical in nature. Among the logistic functions to be carried out are:

Preparation of annual work plans;
Identification, implementation and operation of pilot projects and field studies;
Identification of in-country and U.S. trainees and their posting and support;
Preparing and circulating quarterly reports on the progress of LWMIP;
Ensuring that reports and information are disseminated from field studies and other sources and that policies and procedures reflecting the findings of field studies, pilot projects and technical assistance activities are implemented as appropriate;
Assuring that the training and special studies benefit from the lessons learned through the USAID Irrigation Management and Training Project (386-0484) being implemented in Rajasthan, Gujarat, Madhya Pradesh, Maharashtra and Tamil Nadu;
Organizing, staffing and other arrangements for workshops and training sessions, and field demonstrations.

Technical functions include diagnostic analysis, and planning and monitoring of the field studies and pilot projects. For these, appropriate consulting services will be procured as needed.

Basic establishment costs for the Cell will be the responsibility of GOHP and will be eligible for reimbursement under the loan. Extraordinary costs such as for consultants will be 100 percent reimbursed under the grant.

v. Technical Assistance, Training, Studies and Action Research

Because of the complex nature of the new subproject criteria to be introduced, the development of training programs to reflect and improve these criteria, the field studies, pilot projects and U.S. training; technical assistance to support these activities will be funded under the grant portion of the project. Technical assistance will draw from both Indian and U.S. expertise. These research and technology development activities will be the overall responsibility of the Project Cell, with guidance from the State Level Implementing Committee. The Project Cell will prepare an overall project training plan and a detailed annual plan, to be approved by the State Level Implementing Committee. These plans will be forwarded to the GOI for endorsement and to facilitate collaboration with USAID in implementation of overseas training.

Studies will be undertaken to the maximum extent feasible by institutions in Himachal Pradesh, such as the State University and the polytechnic institutes, on contract with the GOHP. AID financing will be provided on a fixed price basis, through standard GOHP contracting procedure. When suitable capabilities cannot be found in Himachal Pradesh, they will be sought elsewhere in India first, and then, if necessary, outside of India.

Action research will be the overall responsibility of the Project Cell. Direct responsibility for implementation of individual action research case studies will rest with the Irrigation Department circles in which they are located. AID financing will be provided on a cost reimbursement basis.

b. Irrigation Works

The facilities component of the project to be supported primarily by loan funding will involve the planning, design and construction or rehabilitation of several types of minor irrigation facilities over the seven year life of the project. Types of facilities include (1) new or remodelled lift irrigation schemes (LIS), using either surface or ground- water; (2) new or remodelled gravity flow irrigation schemes (FIS); (3) water harvesting schemes and (4) individual-operator or group schemes including shallow tubewells, dug wells equipped with pump sets and water harvesting tanks. Construction elements of the project include headworks, pumps, storage ponds or tanks, control structures, canals, distributaries, watercourses and field channels or pipelines to convey water to fields and land development on individual farms.

Approximately 75 LIS commanding an estimated 10,000 ha and 75 FIS commanding an estimated 5,000 ha will be installed by the ID. As a Project criterion not less than 30 of these 150 subprojects will be remodelling schemes. Chak development will be implemented on an estimated 16,000 ha. under existing schemes. SC/AD will develop an estimated 3,500 ha from dug wells or shallow tubewells and an estimated 4,200 ha from water harvesting ponds or tanks. The Project will also support an estimated 315 schemes for repairs to flow systems under the program of the RD.

Full chak development consisting of installing watercourses and field channels or closed conduits, and land shaping or terracing fields to convey the water from public outlets to individual fields and insure its efficient application to fields will be provided on all subprojects except those done by RD (see Chapter III, Sections C1f, C1f, C4f, C5). Additionally, chak development will be implemented on some existing projects.

Facilities under each subproject will include positive steps to improve environmental conditions and help provide forest resources such as fuel, fodder and timber in the subproject Command and adjacent areas. Nurseries will be supported to provide forest plants for irrigated plantations and private rainfed plantations not under the irrigated command under the Farm and Social Forestry Program. Simple erosion control structrues such as check structures and retaining walls will be provided to further protect areas threatened by gully erosion. Approximately 4,000 ha protected plantations will be developed. Environmental improvement including fairly large-scale afforestation and installation of small engineering control structures will be extended to watersheds serving water supply sources and to areas downslope from kuhls. Approximately 4,000 ha will be thus improved. Species raised under these programs will be primarily fast-growing broad-leaved ones for fodder, fuel and small timber. Specific plans for environmental improvements as described above will be included in each subproject and described in the feasibility report.

Trials for improved temperate and subtropical fruits to be introduced into irrigation Command areas, particularly in subtropical areas will be initiated and nurseries for promising varieties will be supported. These varieties will be introduced on new technology pilot projects and demonstration schemes. Trials and demonstrations will be implemented on private farms. Plantings will also be provided to farmers on subprojects who agree to initiate these crops on a production basis. An estimated 6,500 hectares of such orchards will be planted. Plans and budgeting allowances for such plantings on subprojects will be included in subproject feasibility reports, but should be kept flexible to adapt to results of field trials and demonstrations.

With assistance from the private voluntary organization supported under field studies (Section B2ai), control subprojects in which users will assume responsibility for operation and maintenance of the facilities with GOHP technical assistance will be implemented at users' option in preferably not less than ten subproject LIS and ten subproject FIS by the end of the Third Project Year. If successful, by the end of the Fifth Project Year, this option shall be given to not less than 25 subproject LIS and 25 subproject FIS.

As the results of the pilot projects (Section 2aiii) on new technology, integrated approaches to water harvesting and systems development and management become available, the findings will be applied as expeditiously as possible to regular subprojects.

Construction activities will be planned, designed and constructed under the direction of either the ID, AD or RD depending on the type of facility. Where soil conservation activities are required to be implemented on public lands, the Forestry Department will be involved.

AID loan funds will reimburse GOI for two-thirds of the costs of irrigation works including environmental and horticultural features described above and for cost of nurseries but excluding costs for procurement of land and for identifiable taxes. AID will also exclude reimbursement for land development grant subsidies made to farmers not qualifying as small or marginal. (See Chapter II, Section C5.)