PD-AAZ-209

A.I.D. EVALUATION SUMMARY - PART I

1. BEFORE FILLING OUT THIS FORM, READ THE ATTACHED INSTRUCTIONS.
2. USE LETTER QUALITY TYPE, NOT "DOT MATRIX" TYPE.

IDENTIFICATION DATA

A. Reporting A.I.D. Unit:
Mission or AID/W Office USAID/New Delhi
(ES# _____)

B. Was Evaluation Scheduled In Current FY Annual Evaluation Plan?
Yes [X] Slipped [ ] Ad Hoc [ ]
Evaluation Plan Submission Date: FY ____ Q ____

C. Evaluation Timing
Interim [X] Final [ ]
Ex Post [ ] Other [ ]

D. Activity or Activities Evaluated (List the following information for project(s) or program(s) evaluated; if not applicable, list title and date of the evaluation report.)

Project No.	Project /Program Title	First PROAG or Equivalent (FY)	Most Recent PACD (Mo/Yr)	Planned LOP Cost (000)	Amount Obligated to Date (000)
386-0489	Hill Areas Land and Water Development Project	7/31/84	9/30/91	54,000	52,000

ACTIONS

E. Action Decisions Approved By Mission or AID/W Office Director

Action(s) Required	Name of Officer Responsible for Action	Date Action to be Completed
1. There are excess funds in the project which should be deobligated. An initial $10 million should be deob. in FY89.	R. Bakley, D G.Thompson PRJ	9/30/89
2. A revised methodology for the review and approval of Lift Irrigation Schemes (LIS) should be developed to ensure that no uneconomic LIS are approved in the Future. No additional LIS should be approved by AID until the new review criteria/procedures have been developed and agreed upon	G.Anders NRM	3/31/89
3. A letter should be prepared to inform the GOI and GOHP about the results of the economic studies, including USAID's concern about the economics of the LIS. A meeting should be scheduled with the GOHP to discuss USAID concerns	G.Anders NRM	12/31/88
4. A summary of USAID's analysis of the recurrent cost situation should be sent to GOHP with copy to DEA. This communication should detail the need for a study focussing largely on electricity costs and pricing and for the GOHP to develop a plan for cost recovery. A meeting should be arranged with the GOHP to discuss these issues.	R.Chhabra CO G.Anders NRM	12/31/88
5. A communication to GOHP should be prepared for USAID director and MRC clearance detailing key issues related to the project restructuring and how these will be addressed.	G.Anders NRM	11/30/88

(Attach extra sheet if necessary)

APPROVALS

F. Date Of Mission Or AID/W Office Review Of Evaluation: (Month) November (Day) 2 (Year) 1988

G. Approvals of Evaluation Summary And Action Decisions:

	Project/Program Officer	Representative of Borrower/Grantee	Evaluation Officer	Mission or AID/W Office Director
Name (Typed)	Glenn Anders NRM		John P.Grant DPP/E	Robert N.Bakley,D
Signature	[signature]		[signature]	[signature]
Date	4/10/89		4/7/89	04/17/89

ABSTRACT

H. Evaluation Abstract (Do not exceed the space provided)

The project was designed to improve land and water resources productivity through the introduction of new approaches to land and water development in Himachel Pradesh. The project agreement, signed in 7/84, stipulates that the project would last 7 years until 9/91 during which time it would help create about 23,000 has of new irrigated land and develop improved water management with aforestation, erosion control and horticulture components and introduce community based management of schemes, inter-agency collaboration, and human resources development. To achieve these goals the Mission put $54 Million primarily into irrigation but also into agriculture, forestry, and horticulture in the State under the management of an interdepartmental project cell. The evaluation team, comprised of two U.S. consultants, conducted the midterm evaluation in 4/88 to assess project impact and the need for project restructuring. To evaluate the project the team conducted extensive interviews with the GOHP officials, USAID staff, and beneficiaries and reviewed project documents. The main findings and conclusions follow below :

- Although implementation has been slow initially there is clear evidence of significant impact and progress towards the realization of project potential.
- There are indications of high returns to irrigation in H.P., but the IRRs of high-lift schemes appear questionable due to high capital and recurrent costs and optimistic assumptions on cropping patterns. The IRR's of the tubewell, tank and flow schemes are acceptable, if not robust.
- In order to ensure the economic viability of all irrigation schemes approved in the future the methodology should be improved for the calculation of IRR's and for the review and approval of proposed schemes.
- Given the low charges for water and particularly high operating costs of lift schemes, the recurrent costs to the State will become increasingly burdensome. The State should give additional attention to cost recovery to meet recurrent costs.
- Neither comprehensive technical criteria nor a comprehensive land and water resource plan are used for scheme site selection. Scheme selection should be based on a priority setting planning process that gives greater consideration to technical and economic aspects.
- The substantial management demands of the project are due less to its apparent complexity than to the very limited staffing, technical and institutional resources in the State relative to the project's size; therefore there is a need for support from appropriate technical specialists. Special training and research programs are needed in water management techniques appropriate to hilly areas conditions.
- The project is substantially over-funded given its time frame and size and the experience of the implementing departments' cadre.

COSTS

I. Evaluation Costs

1. Evaluation Team

Name	Affiliation	Contract Number OR TDY Person Days	Contract Cost OR TDY Cost (U.S. $)	Source of Funds
Dr. Michael F. Walter Dr. Ralph J. Edwards	ISPAN ISPAN	ANE-0289-C-00-7044-00	$35,000	PD&S

2. Mission/Office Professional Staff Person-Days (Estimate) 60

3. Borrower/Grantee Professional Staff Person-Days (Estimate) 25

A.I.D. EVALUATION SUMMARY - PART II

SUMMARY

J. Summary of Evaluation Findings, Conclusions and Recommendations (Try not to exceed the three (3) pages provided)
Address the following items:

- Purpose of evaluation and methodology used
- Purpose of activity(ies) evaluated
- Findings and conclusions (relate to questions)
- Principal recommendations
- Lessons learned

Mission or Office:	Date This Summary Prepared:	Title And Date Of Full Evaluation Report:
USAID/New Delhi	March 31, 1989	Review of the Hill Areas Land and Water Development Project

PURPOSE OF THE ACTIVITY

The project's goals are to improve the productivity of land and water resources by introducing new approaches to land and water development in the State of Himachal Pradesh. The projects seeks to create about 23,000 hectares of new irrigated area through the construction of minor and micro schemes in collaboration with the State Department of Irrigation and Public Health (IPH), the Agriculture Department (AD), the Forestry Department (FD) and the Department of Rural Development (RD). In addition to creation of new command areas for irrigation, emphasis was to be placed on chak development and improved water management. To sustain the productivity of the water resources, the project incorporated aforestation, erosion control and horticulture. Critical social and institutional components essential to the achievement of the project's objectives added to this comprehensive approach: inter-agency collaboration; human and institutional development; research and technology adaptation; and community-based management of schemes.

EVALUATION PURPOSE AND METHODOLOGY

The purposes of this midterm project review were: 1) to review the project objectives and components to determine whether they were consistent with the Mission's evolving Program Strategy and realistic given the current staffing capabilities; 2) to identify alternatives for project restructuring which would improve the effectiveness and impact of the project, 3) to assess the project's resource requirement to PACD and assess the potential for possible reprogramming (i.e deobligation) of resources.

The review of the HALWD project was conducted by Drs. M.Walter and J.Edwards in March 1988. It consisted of extensive interviews with the project's resource group in the Mission, Government of Himachal Pradesh officials and farmers benefitting from the irrigation schemes. They visited eight irrigation sites and consulted project documents and other relevant available information on HALWD.

The report raised several issues which could not be easily resolved because of a lack of detailed information. Two major issues related to the economic viability of some of the high lift irrigation schemes that were being proposed and the recurrent costs associated with these schemes. Therefore, two studies were subsequently commissioned to address the concerns raised in the draft report:

HALWD Project: Analysis of Recurrent costs and State Budget by Rajesh Chhabra and Rakesh Duda, USAID/New Delhi

Economic Analysis of Selected Irrigation Systems in Himachal Pradesh: Review of Assumptions and Estimates of Economic Rates of Return by Ramesh Bhatia and Associates, Institute of Economic Growth, Delhi University.

Key Findings from these studies were subsequently incorporated into the final version of the evaluation report.

USAID/New Delhi subsequently questioned certain assumptions of the Bhatia study such as the use of import parity pricing as a basis for analysis. Therefore, a third, in house study was commissioned which largely confirmed the major conclusions of the Bhatia study:

Selected Irrigation Schemes in Himachal Pradesh : An Alternative Economic Analysis by B. Sen.

FINDINGS AND CONCLUSIONS

Achievement and Impact Although implementation has been slow at the start there is clear evidence of significant impact and progress toward realization of the project's objectives. The project has had a major impact on irrigation design in the State. Evaluation of scheme investments, scientific determination of water requirements, distribution system planning, working relationships with users, and establishment of irrigation as a profession are significant changes in the State which have been introduced by the project. The potential also exists for broader, high impact efforts in related watershed forestry and conservation interventions. However, there has been little institutionalization of these changes due to very slow progress in technical training, socio-economic analysis, technology adaption and system research activities.

Economic Viability: Although there are indications of high returns to irrigation in Himachal Pradesh the Internal Rates of Return (IRRs) of some of the schemes appear questionable due to high capital and recurrent costs (particularly for the increasing numbers of high-lift pump systems) and optimistic assumptions about cropping patterns. The evaluation follow-up studies commissioned by USAID/New Delhi - economic analyses by Ramesh Bhatia and Associates and by Dr. Sen (see attachments) confirmed that IRR's of tube well, tank, and flow schemes are consistently above 12 percent, attesting to their economic viability. Many of the high lift pump schemes (which have represented an increasing proportion of the schemes selected under the Project) appear economically justifiable, but they are associated with comparably higher capital and recurrent costs. Economic viability of lift schemes is particularly dependent upon the intensification of cropping and adoption of higher value crops.

Recurrent Costs: Because of the relatively larger number of lift schemes being constructed recurrent costs are expected to be greater than the 10% of capital cost that was estimated in the P.P. Furthermore, given the low charges for water and particularly high operating costs, the recurrent costs to the State of the project investments will become increasingly burdensome. The follow up study conducted by Chhabra and Duda (attached) found that electric charges will account for about 80 percent of total O&M costs on lift schemes. The Government of Himachal Pradesh will have sufficient resources to support the recurrent costs of Lift Irrigation Schemes for another 8-10 years. However, subsequently the GOHP will face a significant liability for replacement of pumps and machinery. GOHP is not taking adequate steps to recover operating costs through user fees and other means.

Site Selection Funds for irrigation development are distributed evenly among ten districts. Sites are proposed locally and then given priority by political representatives/officials. Neither comprehensive technical criteria nor a comprehensive land and water resource plan are used for site selection. There is a need for a more rational system for the selection of more optimal, less difficult sites because site selection is a key factor in determining the viability of individual schemes as well as the returns to AID's overall investment in irrigation in the State.

Farmer Participation : Farmer participation in subproject design and implementation is limited although awareness of the need for such participation has greatly increased and in principal accepted by GOHP officials. Pilot efforts are underway to identify strategies to involve farmers more meaningfully. Farmers traditionally pay very little for use of water and no effort has been made to change this.

Training and Special Studies: Training and TA activities have been initiated but much later in the project than planned. Special study activities on a few topics including baseline studies, have started in recent months.

Project Monitoring and Management: Qualitative and operational monitoring in the field has been given low priority. Currently feedback to the Project Cell leading to learning from experience is minimal because of the limited exposure of Cell staff to the field sites. The USAID Project Officer is overloaded with responsibilities.

Institutional Capacity: Although as a result of this project the budget for irrigation development has increased substantially, the number of professionals involved with irrigation in H.P. has not increased proportionately. Consequently the project is out of proportion to the State institutional capacity to implement it. There is no institution in the State with the capability or mandate to collect and analyze the land and water resource data needed for comprehensive development planning and no institute for engineering technology in the State with the capability to deal with mountainous environments.

Project Funding: This project is substantially over funded given its timeframe and the relatively weak institutional capacity and experience in irrigation development in the State.

RECOMMENDATIONS:

Economic Viability : The evaluation follow up studies by Bhatia and Sen (attached) suggested that in order to ensure the economic viability of all irrigation schemes approved in the future -- particularly lift irrigation schemes -- the methodologies for the calculation of IRR's and for the review and approval of proposed schemes should be improved.

Recurrent Costs : The evaluation follow up study by Chhabra and Duda (attached) suggested that recurrent costs were a critical factor related to economic viability, and should be taken into consideration in the review and approval of irrigation schemes -- particularly for lift irrigation schemes. Additional attention should be given to the question of cost recovery in order to help the State to meet future capital replacement and recurrent costs.

Site Selection: Scheme selection should be based on a priority setting planning process that gives greater consideration to technical and economic aspects even if the process results in an unequal distribution of schemes throughout the State.

Design Criteria: IPH activities should be limited to restoring or providing water as far as the farm turnout. Development below the turnout should be responsibility of farmers with assistance from AD.

Implementation: Information should be collected on any existing or previously existing irrigation Khul (system) and this information should be incorporated into the design of any new schemes. Previously approved IPH schemes should be reviewed for the addition of forestry, horticulture and agriculture components, wherever possible and appropriate; AD should be encouraged to undertake soil conservation activities.

Farmer Involvement : Farmers should be a part of the subproject planning, design and implementation stages. Farmers should be entrusted with the responsibility of O&M of the system below the outlet. Farmers should be required to pay a substantial portion of O&M costs. The Liaison and Co-ordination unit should provide active support in establishing these on a sustained basis.

Training: A broad range training activities (as foreseen in PP for the first two years of project implementation) are critical for professional development of GOHP staff. In-country training programs need to be intensified to the level proposed by USAID to GOHP. Selected professionals should also be sent for overseas training to gain a better perspective of the opportunities and options available for use in developing land and water resources of the State.

Research and Applied Studies: Action research and applied field study activities are required to address problems faced in scheme design related to hydeology, technology adaptation cropping patterns, economic analysis and O&M.

Technical Assistance: Technical assistance on a continuing basis should be provided in the areas of on-farm water management, community based management, watershed management, project monitoring and organization/conduct of training programs.

Project Monitoring: A monitoring capacity of the type envisioned in the PP should be established within the Project Cell which will require staffing by one or more professionals. The monitoring function is to provide, in addition to regular reporting on construction progress and funds expenditures already being obtained by the Cell, constant feedback on the effects of project activities. Technical assistance will be necessary to serve as catalyst to begin this type of monitoring and for implementation of this critical function.

Institutional Strengthening : Consideration should be given to allocating resources to develop an institutional capacity in H.P. to collect and analyze land and water resource data, (including time series data), that could be used for comprehensive planning of development and to train engineers and other technical specialists to deal with technical and resource development in mountainous areas.

Future Implementation Options

Since the project has made significant progress in several areas and has considerable potential for broader institutional and policy changes it should be continued albeit in somewhat refocussed form - at least until its current PACD in 9/91. However, all projections indicate that the project is substantially over funded, and that there will be excess funds available for reprogramming.

Four options have been identified for the remainder of the project :

Option A : For the remaining LOP concentrate on IPH irrigation schemes under current guidelines with no additional activities in agriculture, horticulture, forestry or rural development after September 1988 (App. $25 Million).

Option B : Focus on future choice of sites within PACD which can demonstrate integrated development of watersheds, the upgrading of staff capabilities through training programs and the initial stages of gathering data through research programs. Thereby provide clear demonstration of hilly lands development for at least 20-30 sites (App $35 million)

Option C : Same as option B with a two year extension of PACD to 9/93, in order to more fully institutionalize the process of hilly land development and the adoption of more rational land use patterns. (App. $ 45 Million)

Option D : Same as option C with the addition of a major effort to establish an institute for hilly areas to develop a capacity to carry out both research and training. (App. $50-$54 Million)

The evaluators concluded with respect to these options, that the current commitment to the State and obvious impacts and potential argue for an option which strengthens and extends the project's activities. At the same time, the large number of schemes planned should be reduced and a necessary emphasis placed on the critical elements of planning, training, analyses applied research and feedback monitoring.

Important Note : See the Minutes of the HALWD Evaluation Mission Review Committee (MRC) of November 2, 1988 (attached) for a record of USAID/New Delhi's decisions with respect to major evaluation issues and recommendations. The Mission is proceeding with project restructuring and the specific evaluation recommendations have been noted for guidance in that process.

ATTACHMENTS

K. Attachments (List attachments submitted with this Evaluation Summary, always attach copy of full evaluation report, even if one was submitted earlier; attach studies, surveys, etc. from "on-going" evaluation, if relevant to the evaluation report.)

1. Evaluation Report: Review of the Hill Areas Land and Water Development Project.
2. Minutes of the HALWD Evaluation Mission Review Committee dated November 2, 1988.
3. HALWD Project: Analysis of Recurrent costs and State Budget by Rajesh Chhabra and Rakesh Duda.
4. Economic Analysis of Selected Irrigation Systems in H.P.: Review of Assumptions and Estimates of Economic Rates of Return by Ramesh Bhatia & Associates.
5. Selected Irrigation Schemes in H.P. : An Alternative Economic Analysis by Dr. B. Sen.

COMMENTS

L. Comments By Mission, AID/W Office and Borrower/Grantee On Full Report

Negotiations with the Government of Himachal Pradesh (GOHP) on restructuring the project have been hampered by the fact that the Proag does not require that the schemes be tested for economic viability. Progress on resolving this issue has been slow and somewhat affected our relationship with the GOHP authorities, since we are now holding about $5.0 million in reimbursement as hostage.

On the positive side, Pepsi Cola Company (U.S.) has embarked on a major fruit and vegetables processing project in North India (Chandigarh) with substantial inputs expected from Himachal Pradesh (H.P.). This demand should expedite a change in cropping patterns - from paddy to fruits and vegetables - which will improve the overall project economics.

Furthermore, Himachal Pradesh is a fragile, economically important part of the Himalayan watershed upon which India's largest national hydropower and irrigation grid depends. The project has the potential to improve the GOHP's investment policies and practices for economic, environmentally sound and financially sustainable development of its land and water resources.

MINUTES

HALWD EVALUATION MRC MEETING

NOVEMBER 2, 1988

Summary of Issues Discussed

This MRC focussed on several critical issues identified by the HALWD evaluation and highlighted by Mission reviews of the project. First and foremost was the question of the economic viability of the four kinds of irrigation schemes funded under the project, particularly the highlift schemes. Discussion of this issue centered on an analysis prepared by Dr. Sen on Mr. Bakley's request : "Selected Irrigation Schemes in Himachal Pradesh : An Alternative Economic Analysis". Dr. Sen presented his study findings and there was extensive discussion of such issues as the results of using export parity pricing as a basis for analysis, and the rate of shift in cropping patterns towards vegetables and its implications for the economic viability of the irrigation schemes.

A second, related issue, was the question of site selection, and its relationship to the Economic Rates of Returns (ERRs) of the Irrigation Schemes. The IWR office made a presentation showing a direct linkage between site criteria, such a soils, proximity to roads and markets, and ERRs; the poorest sites have the lowest ERRs. IWR asserted that site selection is perhaps the most critical factor in determining economic viability of the irrigation schemes and noted the importance of working with the State of Himachal Pradesh to introduce a more rational site selection process.

A third issue was recurrent costs and the ability of the GOHP to assume the recurrent cost burden. Discussion of this issue centered around R. Chhabra's and R. Duda's paper "Analysis of Recurrent Costs and State Budget". In his presentation Chhabra indicated that H.P. had enough money in its Non-Plan budget to cover the recurrent costs of the irrigation schemes, even though its actual cost recovery from farmers is minimal. Energy accounts for the majority of recurrent costs -- up to 78% in high lift schemes. Therefore highlift schemes have much higher costs than the other types of schemes; there is a direct relationship between the number of meters of lift and the recurrent cost. Chhabra argued that a new review criteria - recurrent cost per hectare - should be added for lift irrigation schemes. Chhabra indicated that GOHP will face a major problem 8 to 12 years from now replacing the pump machinery because no provision is now being made for the depreciation of this equipment. There was extensive discussion on the need for USAID to work with the GOHP to introduce cost recovery measures with the farmers to help meet such costs as electricity and depreciation of the machinery.

Finally, two additional issues were discussed. One, raised by Mr. Crowley (DPP), was the issue of potential deobligation of funds from the project, and the need for preliminary decision on the amount so that the Mission could inform Washington. Another, raised by Mr. Bakley was the need for a letter from Mr. Anders detailing the issues and next steps in project restructuring.

The section that follows highlights the key decisions reached by the MRC with respect to these issues, and follow up actions agreed upon.

2232E

KEY HALWD MRC DECISIONS AND FOLLOW UP ACTIONS

A. Economic Viability of the Irrigation Schemes

1. The findings of Dr. Sen's Economic Analysis were accepted and he was complimented on a job well done.

2. The MRC concluded that the HALWD project is basically sound economically and should be continued.

3. Given the fact that there is little question about the economic viability of three of the types of irrigation schemes - Flow Irrigation Scheme (FIS), Tank Irrigation Schemes (TIS), and Tubewells - IWR should continue to approve new schemes of these types.

4. While some of the highlift schemes are economically sound, the economic viability of others is questionable. The MRC decided that there was not sufficient reason to stop funding new highlift schemes in the future, and that there was no need to impose a ceiling on the number of meters of lift for future highlift schemes. However, there is a need for a revised methodology for the review and approval of LIS to ensure that no uneconomic LIS are approved in the future. No additional LIS should be approved by AID until the new review criteria/procedures have been developed and agreed upon.

5. The MRC decided that the Agro Economic Research Center in Shimla should be involved in the economic analysis of irrigation schemes in the future. Dr. Sen should go up to Shimla to meet with the Institute and discuss the criteria and parameters for the economic analysis.

6. The MRC concluded that it was important to inform both the GOI and GOHP about the results of our economic analysis, including our concerns about the economics of the LIS schemes. IWR was directed to prepare a letter about the economic issues and to have the draft prepared and ready to circulate for clearance by November 15.

7. A meeting with the GOHP to discuss our concerns should be scheduled before the end of 1988. This meeting should be requested in the same letter to GOHP to be prepared by IWR by November 15.

B. Site Selection

1. The MRC agreed with IWR about the importance of appropriate site selection to the economic viability of the irrigation schemes.

2. The question of whether site selection criteria were to be added, and how this issue would be handled in our communications with the GOI and GOHP was left up to IWR.

C. Recurrent Costs

1. The MRC expressed concern about the high proportion of recurrent costs represented by electric power and the fact that only a nominal effort is being made to recover these costs from the farmers of present. There was similar concern expressed about the fact that the state has no plan to recover the cost of depreciation on the pumps and other machinery in the schemes. The MRC decided that the State has to begin to take into greater account the recurrent electricity costs and the costs of depreciation, and must take steps to initiate increased cost recovery from farmers.

2. The MRC highlighted the need for a good study of the real costs of electric power including the marginal cost of electrical power generation - as a basis for developing a plan for cost recovery (including public financing options). The MRC decided that agreement on this study and a GOHP plan to gradually reduce the subsidy on electricity to farmers should be a precondition to funding of additional lift irrigation schemes. The MRC reiterated the importance of this position in light of AID/W requirements about CPS on sustainability, and the existing covenant in the project on cost recovery.

3. Potential difficulties of pursuing this issue of cost recovery with the GOHP were noted, in light of the State's position to date. However, it was agreed that H.P presented some positive opportunities for a constructive dialogue of this critical issue given its small size, the relatively high proportion of financing we are providing for the irrigation sector, and the excellent records available for farmer water use. It was also noted that the studies of farmer participation being carried out be Walt Coward presented some opportunities for investigating the potential for increased farmer financing of irrigation systems.

4. R. Chhabra (CO) was asked to draft a summary of the recurrent cost situation as we have assessed it to be sent to Mr. Mahapatra (GOHP) with a copy to Mr. Bajaj in DEA. This communication should detail the need for a study focussing largely on electricity costs and pricing, and for the GOHP to develop a plan for cost recovery to help meet its recurrent costs. This communication should be prepared and sent before the end of November.

5. A meeting should be arranged with the GOHP to discuss the study and recurrent cost issues. Initially these topics can be discussed with the GOHP in the same meeting organized to discuss the economic issues.

D. Deobligation

1. The MRC discussed the amount available for deobligation without reaching closure. Mr. Bakley said that $20 Million was a likely amount, although he himself had often used a figure of $25 million. Glenn Anders stated that a deobligation of $10 million would not hurt the project and that even $15 million could be deobligated "without cutting into much meat". However, a $20 million deobligation was more problematic.

2. GOHP sensitivities to deobligation were discussed, and it was agreed that the deobligation could be handled in a phased manner over two or more years (beginning with a possible $10 million in FY89). It was suggested that in order to make the deobligation more palatable to GOHP some of the deobligated funds could be used to cover the WRM&T mortgage in HP.

3. Glenn Anders was directed to try to calculate a reasonable figure for deobligation, in consultation with DPP. This figure was to be given to DPP by November 12 so that DPP could include it in its deobligation/reobligation plans to be communicated to AID/W by November 15. It was agreed that for the purposes of this calculation no extension in PACD should be planned. The Mission might eventually authorize a slight PACD extension of six months to a year but this would be for adjustment purposes only; not for the purpose of utilizing more funds.

E. Project Restructuring

1. Glenn Anders was requested to prepare a letter for Mr. Bakley and MRC clearance by the end of November detailing the key issues to be addressed in the project restructuring (including the agricultural schemes and project cell not discussed in the MRC) and outlining how he planned to proceed.

2231E

Participants in the Meeting

R. Bakley	D	G. Anders	IWR
D. Pfeiffer	DD	N. Banerjee	IWR
C. Crowley	DPP	M. Walter	IWR
T. Mahoney	DPP	L. Nelson	IWR
B. Sen	DPP	M. Snyder	RCO
R. Chhabra	CO	G.Thompson	PRJ
Gary Eidet	CO		

Clearance

J. Grant, DPP		M, Snyder, RCO	
G. Anders,IWR		D. Pfeiffer, DD	**
C. Crowley, DPP		R. Bakley, D	
G. Thompson,PRJ	**		
G. Eidet, CO			

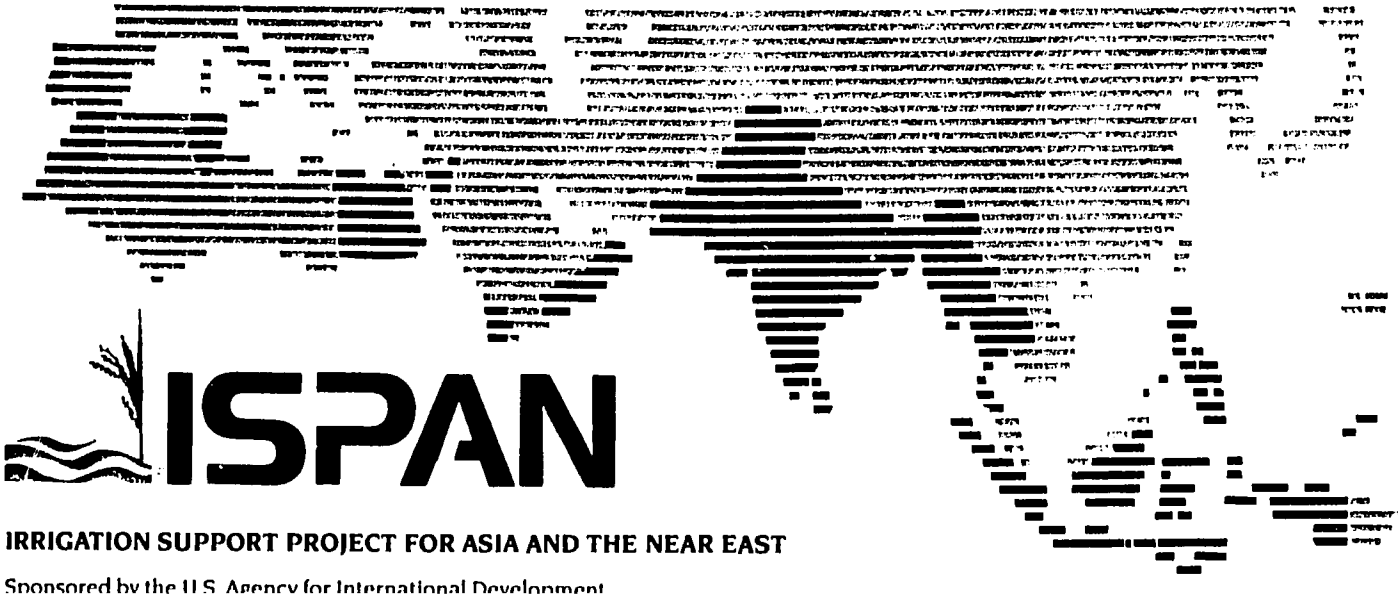
** Initialed on the routing slip.

PD-AAX-805

INDIA
Hill Areas Land and Water Development Project
386-0489

REVIEW OF THE HILL AREAS LAND AND WATER DEVELOPMENT PROJECT

ISPAN ACTIVITY NO. **610A** ISPAN REPORT NO. **3**



ISPAN

IRRIGATION SUPPORT PROJECT FOR ASIA AND THE NEAR EAST

Sponsored by the U.S. Agency for International Development

ISPAN

IRRIGATION SUPPORT PROJECT FOR ASIA AND THE NEAR EAST

ISPAN Technical Support Center
Room 1001
1611 North Kent Street
Arlington, Virginia 22209-2111
U.S.A.
Phone: (703) 243-7911
FAX: (703) 525-9137
TELEX: 276532 ISPAN UR

INTEGRATED IRRIGATION MANAGEMENT RESOURCES

Camp Dresser & McKee International Inc. (Prime Contractor)
CARE
Cornell University
Development Alternatives, Inc.
Harza Engineering Company
International Science and Technology Institute, Inc.
Training Resources Group
The University of Arizona

INDIA
Hill Areas Land and Water Development Project
386-0489

REVIEW OF THE HILL AREAS LAND AND WATER DEVELOPMENT PROJECT

October 1988

by

Dr. Michael F. Walter
and
Dr. Ralph J. Edwards

Prepared for the Office of Irrigation and Water Resources,
U.S. Agency for International Development
New Delhi, India

Irrigation Support Project for Asia and Near East
Contract No. ANE-0289-C-00-7044-00, Project No. 3-7631510
is supported by Asia and Near East Bureau
U.S. Agency for International Development
Washington, DC 20523

17

EXECUTIVE SUMMARY

The Hill Areas Land and Water Development (HALWD) Project has had a major positive impact on irrigation development in the State of Himachal Pradesh and has considerable potential to resolve specific water and land use problems. Several critical actions are required to improve its technical quality and economic viability. The pace of scheme development should not increase and new schemes should be selected with greater emphasis on technical considerations and include watershed planning. Special training and research programs are needed in water management techniques appropriate to hill area conditions and requirements. Successful project implementation and management require the support of a substantial contract team of appropriate technical specialists.

Achievement and Impact

Although implementation has been slow at the start there is clear evidence of significant impact and progress toward realization of the project's potential. The project has had a major impact on irrigation design in the state. Evaluation of scheme investments, scientific determination of water requirements, distribution system planning, working relationships with users, and establishment of irrigation as a profession are significant changes in the state which have been introduced by the project. The potential also exists for broader, high impact efforts in related watershed forestry and conservation interventions. However, there is little institutionalization of these changes due to very slow progress in technical training, socioeconomic analysis, technology adaption and system research activities.

Economic Viability

Although there are indications of high returns to irrigation in Himachal Pradesh, the internal rate of returns (IRRs) of some of the surface water high lift schemes appear questionable due to high capital and recurrent costs (particularly for the increasing numbers of high-lift pump systems). Furthermore, given the low charges for water and particularly high operating costs, the recurrent costs to the State of the project investments will become increasingly burdensome. Three steps may resolve the economic questions: (1) technical selection of

optimal, less difficult sites, (2) increased community/farmer control and responsibility, and (3) ex-post analysis of actual benefit streams.*

Funding Requirements

All projections indicate that the project is substantially over-funded given its timeframe and the size and experience of the implementing departments' cadre. Options for the remainder of the project range from completing as pilots only those schemes already committed (approx. $20 million) to continuing with more schemes in an extended timeframe with concentration on watershed protection and the addition of the development of a major institution (approx. $45 million). The current commitment to the state and the obvious impacts and potential argue strongly for an option which strengthens and extends the project's activities. At the same time, the large number of schemes planned should be reduced and a necessary emphasis placed on the critical elements of planning, training, analyses, applied research and feedback monitoring.

Implementation Capacities

The substantial management demands of the project are due less to its apparent complexity than to the very limited staffing, technical and institutional resources in the State in relation to the project's size and objectives. Successful project implementation will require considerable assistance and support to the State's field staff, Project Cell and universities from a multi-disciplinary team of both U.S. and Indian specialists experienced in resource planning, hydrology, hydraulics, soil conservation, water resources engineering, monitoring/evaluation, in-service training, and rural organizations. Institutional development with these inputs is important. With this supplemental assistance, the project can be managed by the current Irrigation Water Resources and Resource Management staffs.

---

* Note: Follow-up studies carried out by USAID/India and private consultants suggest that the IRRs of tube well, tank, and flow schemes are consistently above 12 percent. Many lift schemes (which are an increasing proportion of the schemes selected under the HALWD Project) also appear economically justifiable, but they are associated with comparably higher capital and recurrent costs. Economic viability of lift schemes is particularly dependent upon farmers' willingness to intensify cropping by adopting higher value crops. Electric charges will account for about 80 percent of total O&M costs on lift schemes. (See Analysis of Recurrent Costs and State Budget by Chhabra and Duda, USAID New Delhi, and Economic Appraisal of Some Selected Irrigation Schemes under USAID Hill Area Land and Water Development Project in Himachal Pradesh by Basawan Sinha, Metaplanners and Management Consultants, Patna. Both documents are appendices to this report.)

TABLE OF CONTENTS

CHAPTER		Page
	ACRONYMS	v
	ACKNOWLEDGMENTS	vii
1.	FINDINGS, RECOMMENDATIONS, AND OPTIONS	1
2.	BACKGROUND	11
	2.1 Project Goals and Objectives	11
	2.2 Project Components	11
	2.3 Compatibility with Mission Strategy	11
3.	PROJECT IMPLEMENTATION	13
	3.1 State Level Implementation Committee	13
	3.2 Project Cell	14
	3.3 District-Level Implementation	15
	3.4 Finances and Expenditures	16
	3.5 Project Management and Monitoring	18
4.	DEPARTMENT ACTIVITIES	19
	4.1 IPH Schemes	19
	4.2 Agricultural, Forestry and Horticulture Activities	26
5.	INTER- AND INTRA-DEPARTMENTAL COORDINATION AND COLLABORATION	29
	5.1 Project Cell	29
	5.2 IPH	29
	5.3 Inter-Departmental Models	29
6.	COMMUNITY-BASED MANAGEMENT	31
7.	HUMAN RESOURCE DEVELOPMENT AND INSTITUTIONAL STRENGTHENING	33
	7.1 General	33
	7.2 Action Training	33
	7.3 Farmer Participation	33
	7.4 Technical Training	34
	7.5 Overseas Training	34
	7.6 Institutions for Training	34
8.	APPLIED RESEARCH AND TECHNOLOGY ADAPTATION	35

20

TABLE OF CONTENTS

APPENDICES		Page
A.	List of Schemes Visited	37
B.	List of GOHP Officers Met	41
C.	Economic Appraisal of Some Selected Irrigation Schemes under USAID Hill Area Land and Water Development Project in Himachal Pradesh	45
D.	Hill Area Land and Water Development Project Analysis of Recurrent Costs and State Budget	69
E.	Observations and Recommendations for Irrigation Master Plans in Himachal Pradesh	73

TABLES		
1.	Funding Requirements for Loan Funds for Each Option	9
2.	Approved Schemes (as of 3/31/88)	16
3.	Indicative Figures for Irrigation Scheme	17
4.	U.S. Funds (loans) committed (as of 3/31/88)	17
5.	Accrued Expenditure of U.S. Funds (loan) as of 3/31/88	17
6.	AD 67 Schemes Approved	26

ACKNOWLEDGMENTS

The review team is extremely grateful to the Government of Himachal Pradesh officials and staff personnel of the Project Cell, Department of Irrigation and Public Health, Agriculture Department, Horticulture Department, Department of Rural Development and the Agricultural Universities for sharing their insight and thoughts on the USAID/GOHP Hill Area Land and Water Development Project. We also appreciate the interest and comments from the USAID mission staff and in particular the help of Glenn Anders, as well as the contributions of John Grant and Sharon Holt. We wish to especially thank N. R. Banerjee for his patient and timeless efforts to provide us information and to assure that our activity was as successful as possible. We also appreciate the many kindnesses he has shown us to make our visit pleasant. Our most clear finding is that Mr. Banerjee is committed to making this the best project possible. We would also like to recognize the excellent work of Rita Soni and Doris Daniels in preparing this report.

ACRONYMS

AD	Agriculture Department
CCA	Cultivable Command Area
CD	Chak Development
FD	Forest Department
FIS	Flow Irrigation Scheme
GCA	Gross Command Area
GOHP	Government of Himachal Pradesh
HALWD	Hill Areas Land and Water Development Project
HD	Horticulture Department
IPH	Irrigation and Public Health
IRR	Internal Rate of Return
IWR	Irrigation Water Resources
LIS	Lift Irrigation Scheme
O&M	Operations and Maintenance
PACD	Project Assistance Completion Date
PIL	Project Implementation Letter
PP	Project Paper
RB	Road and Bridges
RD	Rural Development
RM	Resource Management
SE	Superintending Engineer
SLIC	State Level Implementation Committee
TA	Technical Assistance
TW	Tubewell
USAID	U.S. Agency for International Development
WAPCOS	Water and Power Consultancy Services
WST	Water Storage Tanks

Chapter 1

FINDINGS, RECOMMENDATIONS, AND OPTIONS

FINDINGS

General

1. Although activities in most components are now underway, start-up of the project was delayed more than a year and most emphasis has been placed on construction of schemes and not enough on training, special studies and development of institutional arrangements as planned. Consequently, schemes have been constructed at an accelerated rate, creating significant new irrigation potential. However changes resulting from improved design as a result of planned and required software inputs have not occurred at the anticipated level (exception see 4 and 5 below).

2. Although as a result of this project the budget for irrigation development has increased substantially, the number of professionals involved with irrigation in Himachal Pradesh has not increased proportionally. Consequently the project is out of proportion to the state institutional capacity to implement it.

Scheme Selection

3. Funds for irrigation development are distributed evenly among ten districts. Sites are proposed locally and then given priority by political representatives/officials. Neither comprehensive technical criteria nor a comprehensive land and water resource plan are used for site selection. The potential for technically and economically viable irrigation schemes in the future is yet to be assessed.

Specified Design Criteria

4. The criteria in the Project Paper (PP) requiring calculation of water demand based on estimated crop evapotranspiration is being used and has resulted in a more appropriate and greatly reduced water-to-irrigated-area ratio. This has resulted in more economical designs because delivery canals are not extended beyond the reasonable command area.

5. The criteria in the PP requiring calculation of internal rates of return (IRRs) for each scheme are being followed for the Irrigation and Public Health (IPH) minor schemes. Proposed schemes have ben disapproved primarily because the estimated cost per hectare exceeded the values given in the PP and because the calculated IRR values were less than 12 percent. Projects have also been rejected on technical grounds such as inadequate water supply.

6. The stated PP requirement of farmer participation in subproject design and implementation is seldom met although awareness of the need for such participation has greatly increased and in principle accepted by Government of Himachal Pradesh (GOHP) officials. Although typically farmers are advised that an irrigation scheme is to be built, no farmer input into subproject design has been sought. In some cases farmers were unaware that anything was going to happen until construction started. Pilot efforts are underway to identify strategies to involve farmers more meaningfully.

Implementation

7. Where flow schemes are being developed there is generally some type of khul already in existence. In such cases for IPH schemes, O&M responsibilities are taken over by the government. The design for rehabilitation of existing khuls typically includes major expansion of the command area. Preproject analysis of existing khuls has not been done to determine the potential of existing local organizations, the impact of new development on existing water rights and the like. Potential for greater cooperation between farmer groups and IPH has not yet been exploited. Farmers traditionally pay very little for use of water.

8. The proportion of IPH lift to flow schemes is higher than projected in the PP. High lift schemes are common and associated with relatively high capital and recurrent costs. In some cases the cost of bringing power to the site is a significant portion of the total capital costs. Electricity is heavily subsidized which reduces the direct operating costs of lift schemes to the project. The economic feasibility of high lift irrigation schemes is more problematic than for flow or tubewell schemes.

9. Development of irrigation activities by Agriculture Department (AD) has been slow with only 67 schemes approved and underway. AD staff express a preference to do soil conservation which is a more normal activity for them. Clearly AD, based on performance to date, will not be able to put into place by the Project Assistance Completion Date (PACD) more then a fraction (probably on the order of 15-20 percent) of the some 2000 schemes envisioned in the PP.

Training, Technical Assistance, and Special Studies

10. Training and technical assistance (TA) activities have been initiated but are proceeding very slowly. A major field training and study effort supported by US and Indian specialists is necessary if the objectives related to comprehensive development, agro-ecological stability, and community-based management are to be met. Support and coordination of training and technical assistance will require a full time management unit in Himachal Pradesh.

11. Special study activities on a few topics, including baseline studies, have started in recent months. Action research must be given much greater

emphasis if scheme designs are to be adapted to the hill areas of Himachal Pradesh in a manner that is technically sound, economically viable and socially acceptable. Particular focus must be given to issues of hydrology (e.g., water supply, silt loads, erosion), lower cost technologies, economic analysis, recurrent costs, community-based management, and comprehensive resource planning. Several existing state institutions can assist in special study activities but do not have the capacity or responsibility to carry out most of the required activities by themselves.

Project Monitoring and Management

12. Operational monitoring in the field has been given low priority. Proper monitoring providing feedback on a regular, continuing basis on the effects of project activities will require one or more staff in Himachal Pradesh dedicated full time to this activity. Currently feedback to the Cell leading to learning from experience is minimal because of the very limited exposure of Cell staff to the field sites.

13. The USAID project officer is overloaded with responsibilities and must receive assistance through more and better field-level assistance and help in identifying and implementing TA and research activities. To implement the integrated resource management component, the project officer should be teamed with someone from the Resource Management Office.

Integrated Inter-Departmental Efforts

14. Coordination and cooperation at the district level seems to work well between IPH and Forest Development (FD). At the State level various Secretaries discuss project-related issues and the SLIC meets when needed to give official approvals. The Project Cell operates on a self-contained basis and is not, thus far, a vehicle for inter-departmental cooperation.

    To achieve better inter-departmental cooperation at the State level, a Technical Appraisal Committee represented by CE/Project Cell, Director/AD, Chief Conservator of Forest, Director/Horticulture should be established. This committee should regularly review the planning processes for selection of Schemes, appraisal/approval of designs and estimates of subprojects, prescribe guidelines, and monitor the progress of project development activities throughout the State. Other members (e.g. Engineer-in-chief, Zonal Chief Engineer, SE/Planning and Monitoring of IPH) as appropriate should also be represented in this committee.

15. The concept of an integrated approach to development and management of a watershed as a resource unit needs to be introduced and institutionalized. The only apparent coordinated approach to date is the addition of FD activities to 21 previously approved IPH schemes. These generally have low budget levels, sufficient only for a partial response to watershed protection.

Recurrent Costs

16. Because of the relatively larger number of lift schemes being constructed we expect recurrent costs to be greater than the cost estimated in the P.P. Current scheme development decisions could place heavy demands on future State recurrent budgets for operation and maintenance.*

Institutional Capacity

17. There is no institution in the State with the capability or mandate to collect and analyze the land and water resource data needed for comprehensive development planning.

18. There is no institute for engineering technology in the State (or any other of the Himalayan States) with the capability to deal with mountainous environments.

---

* Note: The USAID follow-up study carried out by Chhabra and Duda found that the State has made budgetary provision for recurrent costs in its non-plan budget through 1994. (See Appendix D).

RECOMMENDATIONS

Site Selection

1. Scheme selection should be based on a priority-setting planning process that gives greater consideration to technical and economic aspects even if the process results in an unequal distribution of schemes throughout the state.

2. Selection of future schemes should focus, to the extent possible, on watersheds, within which:

   - IPH would construct/upgrade an irrigation scheme requiring relatively low costs, or if high cost, demonstrated high benefits,

   - The Forest Department would undertake slope protection activities both above and below the Cultivatable Command Area (CCA) as needed,

   - The Horticulture Department (HD) would bring in horticulture crops within the Gross Command Area (GCA),

   - The Agriculture Department (AD) would carry out soil conservation and extension efforts with the farmers in the watershed.

3. Where groundwater is readily available, IPH and AD should be encouraged to continue with tubewell schemes.

Design Criteria

1. IPH activities should be limited to restoring or providing water as far as the farm turnout. Development below the turnout should be the responsibility of farmers with assistance from AD. Consideration should be given to the provision of farm credit for land development. The IPH should cooperate with farmers in establishing water distribution infrastructure and rotational schedules to be operated by farmer groups.

Implementation

1. Data should be collected on the physical, operational and organizational characteristics and water rights of any existing or previously existing irrigation khul and this information should be incorporated into the new scheme design.

2. Previously approved IPH schemes should be reviewed for the addition of forestry, horticulture, and agriculture components, wherever possible and appropriate.

3. AD should be encouraged to undertake soil conservation activities primarily within selected watersheds, with approval on a case-by-case basis for micro irrigation and other work in a limited number of other locations.

4. Farmers should be actively involved in the subproject planning, design and implementation stages. Farmers should be entrusted with the responsibility of O&M of the system below the outlet. They should also be encouraged to protect/manage the watershed and headworks and other works of the system above the outlet. Farmers should be required to pay a substantial portion of O&M costs.

   The Liaison and Coordination Unit should provide active support in establishing these on a sustained basis.

Training

1. A broad range training activities (as foreseen in PP for the first two years of project implementation) are critical for professional development of GOHP staff. These should receive priority and start not later than October 1988.

2. In-country training programs (e.g., action training, short technical courses on farmers participation/involvement, etc.), although initiated, need to be intensified to the level proposed by USAID to GOHP. The training should be conducted in the field (in Himachal Pradesh) on actual locations, but will probably require instructors from outside Himachal Pradesh.

3. Selected professionals should also be sent for overseas training to gain a better perspective of the opportunities and options available for use in developing land and water resources of the State.

Research and Applied Studies

1. Action research and applied field study activities are required to address problems that are being faced in scheme design related to hydrology, technology adaptation, cropping patterns, economic analysis, and O&M. These activities in some cases will include systematic review of currently developed schemes. These studies will require assistance from individuals and institutions outside of Himachal Pradesh.

Project Monitoring and Technical Assistance

1. A monitoring capacity of the type envisioned in the PP should be established within the Project Cell which will require staffing with one or more professionals at the executive engineer level. The monitoring function is to provide, in addition to regular reporting on construction progress and funds expenditures already being obtained by the Cell, constant feedback on the effects of project activities on 1) improved agricultural and horticultural production; 2) slope and watershed protection and stabilization; 3) operation and maintenance of irrigation delivery systems; and 4) the involvement of farmers and communities in the management and use of irrigation resources. Technical assistance will be necessary to serve as a catalyst to begin this type of monitoring and for implementation of this critical function.

2. Technical assistance on a continuing basis, some resident in Himachal Pradesh, should be provided in the areas of on-farm water management, community-based management, watershed management, project monitoring and organization/conduct of training and research programs. It is understood that the first three specialists are to be provided under the existing contract with Sheladia. The latter two should be provided in a manner similar to the "Liaison Coordination Unit" being used for the Madhya Pradesh Minor Irrigation Project. The Liaison Coordination Unit would serve both in a catalytic role to help get monitoring and training activities functioning and provide resource persons in guiding the organization and implementation of these two activities.

Project Management and Fund Disbursement

1. For well-coordinated and high-quality project management, it is necessary to develop the monitoring and training capabilities within the project cell and establish a technical resources group of expert consultants which can provide technical assistance and support to project cell staff. This will eventually reduce the work load of the USAID Project manager as capacity develops within the project cell. Given the recommended broader view of HALWD towards integrated water management, there should be more coordination between IWR and RM within USAID.

Institutional Strengthening

1. Consideration should be given to allocating resources to develop an institutional capacity in Himachal Pradesh to collect and analyze land and water resource data (including time series data) that could be used for comprehensive planning of development.

2. Consideration should be given to allocating resources to develop an institutional capacity to train engineers and other technical specialists to deal with technical and resource development in mountainous areas.

OPTIONS

1. The following options describe possible scenarios for the further implementation of HALWD. It is assumed that the grant of $4 million will be required for essential training and research no matter which path is chosen for the project. The table below provides general guidance as to probable levels of loan funds required by each Department to carry out the project under each different option.

2. It is the judgement of the review team that the project has made significant beginnings in several areas and that it should be continued until at least its current PACD. We feel that the completion of previously planned but, as yet, unprovided research and training along with a change in the focus for site selection will permit the construction and implementation of a significant number of sites that can both fulfill the original intent of the project and serve as living demonstrations of viable approaches to development and management of hilly areas. The review team favors moving toward attainment of the original project objectives albeit at a somewhat reduced number of sites. However, it may also be possible to focus only on development of a limited number of irrigation facilities for the remainder of the Project with no further attempt to attain the other objectives of the Project.

Option A

For the remaining life of the project concentrate on IPH irrigation schemes under current guidelines with no additional activities in agriculture, horticulture, forestry or rural development after September, 1988.

Option B

Adopt the recommendations in this review which center on future choice of sites which can demonstrate integrated development of watersheds, the upgrading of staff capacities through training programs and the initial stages of gathering basic data through research programs. Even with the PACD unchanged at 9/91 we believe that sufficient progress can be made in the 3-1/2 years remaining to provide a clear demonstration of hilly lands development on at least 20-30 sites.

Option C

This option is Option B with a two-year extension of the PACD to 9/93. This would give sufficient time to more fully institutionalize the process of hilly land development and the adoption of more rational land use patterns in such areas.

21

Option D

This is essentially the same as Option C with the addition of a major effort to establish an institute for hilly areas to develop a capacity to carry out both research anu training. The addition of such an institute would represent a significant addition to the original concept of the project and would require assistance well beyond the PACD. The team is unable to provide an estimate for the probable costs of such an institute but suggest a range of $5-10 million.

Table 1

Funding Requirements for Loan Funds for Each Option
(in $ Mil)

	Option A	Option B	Option C	Option D
PACD	9/91	9/91	9/93	9/93
No. of IPH Schemes	187	150	210	210
IPH	$16.3	$13.9	$18.7	$18.7
CELL	1.8	1.8	1.8	1.8
AD	1.0	4.2	6.4	6.4
RD	0.5	1.3	1.3	1.3
HD	0	2.2	3.0	3.0
FD	1.0	7.0	10.0	10.0
Total Loan	$20.6	$30.4	$41.2	$41.2
Hill Land Inst.				5-10
Grant	4.0	4.0	4.0	4.0

Assumptions

1. No construction sub-project to be approved less than one year prior to PACD to permit sufficient time for completion.

2. Number of IPH schemes are approximately 90 approved at present with an additional 100 to be approved under Option A, 50 additional under B, and an additional 120 under Options C and D.

3. IPH schemes are assumed to remain at the current average level of $87,000 per scheme.

4. AD schemes are assumed to remain at the current average level of $11,000 per scheme with 200 schemes completed under Option B and 400 schemes under Options C and D.

5. HD and RD are continued at the PP budget levels.

6. FD - the cost of each scheme is increased from the current level of $11,000 to $70,000 to allow more complete development than is currently possible. They will be carried out on 2/3 of all IPH schemes. (Tubewell schemes will not need FD work since steep slopes are not normally a concern).

Chapter 2

BACKGROUND

2.1 Project Goals and Objectives

The Project has two broad goals of improving land and water resources and introducing new approaches to land and water development.

2.2 Project Components

The HALWD project is to create about 23,000 hectares of new irrigated area. Of the total, 15,000 hectares are to be in minor schemes built by IPH; 7,700 in micro schemes constructed by AD; and about 2,000 in currently existing Rural Development Khuls. In addition to the creation of new command areas, emphasis was to be placed on chak development including improved water management. The project contains components for afforestation, erosion control and horticulture.

In addition to the components aimed directly at physically improving land and water resources other components of a less direct nature are considered essential to the success of the overall project. These components included coordination of agency support, human and institutional development, research and technology adaptation, and community-based management of schemes.

2.3 Compatibility with Mission Strategy

The HALWD project was conceived as a comprehensive program to integrate land and water development but with a clear focus and emphasis on irrigation. Forestry, agricultural, and horticulture activities were all seen an supportive and protective of the irrigation system investment. The current HALWD approach gives more importance to balanced and integrated land and water resources development. Present Mission strategy would be more apt to view watershed management activities holistically rather than only to protect the irrigation investments.

Many of the design criteria in the PP and much of the technical assistance focuses on providing reliable water to the turnout level. These efforts are consistent with an emphasis on "looking upstream" or main system management, although the small scale of the schemes suggests that reliable delivery may not be as problematic as it is with the medium and large Indian schemes.

The mission has attempted to develop a disbursement strategy based primarily on performance criteria rather than just completion of construction. The HALWD Project uses such a performance-based disbursement process.

Chapter 3

PROJECT IMPLEMENTATION

3.1 State Level Implementation Committee

The implementation plan was designed such that high level decisions were to be taken and coordination done by the State Level Implementation Committee (SLIC) made up of administrative Secretaries of the concerned Departments. SLIC is responsible for approving work plans and budgets, assuring that adequate staff are deployed, that quality control is maintained, and addressing issues related to effective institutional arrangements and feedback from lessons learned from studies and project experiences.

The Land and Water Development Cell (Project cell) was established to provide technical and administrative support to the State Level Implementing Committee. The Project Cell is to prepare guidelines, review scheme proposals, and monitor project implementation. It is also responsible for assessing training needs and coordination of special studies and programs for technology adaptation.

The actual planning and design of schemes is to be done through existing units under the administrative control of the various Departments.

Sub-project committees are responsible for the detailed work plan for each scheme which is to include a calendar of operations and identification of opportunities for community-based participation.

Actual implementation of the project was delayed 12 or 18 months from the schedule in the project paper. Perhaps more significant however, the items listed in the schedule for project implementation have not been carried out in the order planned. The project was designed such that special studies, technical assistance, and training would be given heavy emphasis early in the project so that the results of these would be most effective later in the project when scheme development was at its peak. Unfortunately, all three of the above components have been delayed. Several baseline studies and applied research activities have been identified or undertaken within the last six months. The first U.S. technical assistance team began to provide input to the project only recently. Some in-country training has been done and 10 to 15 staff will be sent for training outside of India in the next few months.

The SLIC has met an average of three or four times per year to approve budgets and work plans but has not been able to deal in general and in a continuing manner with matters related to staffing, monitoring, and feedback of lessons learned. The Project Cell has provided technical and administrative assistance to the districts. Most staff time in the Cell is devoted to review and modification of scheme plans submitted by the district level staff.

3.2 Project Cell

The functional location of the Project Cell within IPH does influence inter-department coordination in the sense that Departments other than IPH tend not to give the HALWD Project high priority. The executive engineers in the Cell feel, in particular, that district personnel from other Departments do not give the emphasis necessary to the project to assure that complete and quality information is sent to the Cell. They feel that often the most junior staff are assigned the task of collecting data and doing initial designs.

The approval process for schemes, training, staffing and other matters have caused the Secretaries representing the various Departments to communicate about irrigation issues much more than they did prior to the project.

The staffing of the Cell seems to have been done on the basis of perceived needs, with most of the need being to design and implement schemes. The prescribed technical and economic design criteria required that the Cell include IPH design engineers and a few staff from the other involved departments. The staffing of the Cell is not yet at the level prescribed in the project paper. The three executive engineers are pivotal to most of the Cell's activities. These three do the design reviews and modifications before sending schemes to the Chief Engineer for approval. They have divided the state among themselves so that each has about three districts. Each of the Executive Engineers also carry duel roles that were anticipated in the PP to be assigned to separate units within the Cell. These roles include monitoring, training, and feedback of special studies and lessons learned from implementation. The three executive engineers state frankly that they prefer design activities and feel that the other required activities dilute their effectiveness. Our assessment suggests that attention to non design activities is minimal.

The non-engineering group is somewhat isolated from the IPH engineers. There seems to be a minimal amount of interaction between the agricultural, forestry, and rural development people and the IPH staff. Each seems to have a fairly well defined role in the design of schemes and therefore each person does his task and passes the results on to the executive engineer responsible for that scheme. We found the non engineering staff, in general, to be less pressed for time than the executive engineers.

A mechanism has been created in the Cell to sensitize the IPH staff to issues of soil conservation and agricultural production. IPH has itself, developed a somewhat broader view of irrigation because of the other departmental staff in the Cell. However the operation of the Cell does not optimize the potential for cross-fertilization of ideas. The engineers, more or less, assign agronomic issues to the agriculture staff without taking a lot of time to interact with these people in systematically reviewing at designs. Even with these limitations however, it is clear that the engineers in the Cell have developed a greater appreciation for irrigation as a component of an agricultural system not just a hydraulic system in isolation. Unfortunately none of the Cell staff routinely visit the field to learn from scheme implementation experience, however there are plans to begin doing so.

36

The Cell was conceived to have two superintending engineers with a compliment of staff under them but only one SE has been appointed. The lone SE has little time to devote to monitoring, evaluation, and training activities. A public relations officer was to be appointed to look after activities involving beneficiary participation. This hasn't yet happened and there does not seem to be plans to create such a position. Separate units to be headed by executive engineers were to be created to deal with monitoring, training, and technology adaptation. These units have not been created.

In summary, the cell staffing is such that it can review field designs and recommend modifications to them. We believe that the engineering and other inputs are carefully reviewed. Monitoring, Evaluation and training activities are given low priority probably due to staff limitations. In general, the Cell staff do things right but there is same question as to whether they are doing the right things.

3.3 District-Level Implementation

Scheme development and other departmental activities at the district level are conducted much as they had been before the USAID project with a few important differences. The HALWD projects require different and more rigorous economic and technical criteria which are being followed in the districts. These criteria tend to be followed "to the letter" but not necessarily in spirit. The broader spin-offs from the required water demand calculations in terms of understanding the agricultural system more completely have not yet occurred to the desired level, because there has been little follow-up to the initial training for doing these calculations. In the same way, the IRRs are seen as end products and not as a first step toward broader understanding of economic considerations.

The interagency coordination at the district level seems quite good. We saw a number of schemes involving both Forestry and IPH. We did not find the AD integrated into IPH schemes, except in the case of collection of soil survey data. We were told numerous times that the USAID project did provide a forum for interagency communication and interaction.

The most profound change at the district level was the increase in funding available to IPH and AD. Funds available to do irrigation development increased in some cases more that five fold with very little increase in departmental staff. Most staff of both IPH and AD at the district level felt that staff limitations were the greatest bottleneck to more rapid development.

Some training at the district level has occurred but this was not comprehensive nor sustained enough to make a major impact. Personnel associated with the project said that they saw a need for more training, particularly in the technical aspects of design. The general feeling at the district level is that farmer participation is important but there is little in-depth understanding of what form this might take or how department activities might be changed to improve local involvement. Some of the district engineers felt that farmers should not be contacted until after construction of the main conveyance structures because they would only serve to slow progress. There was in some

cases, the acceptance that the HALWD schemes would result in IPH assuming O& responsibilities that were, at least in part, formerly with the local community A great deal more effort is needed at the district level to institutionaliz approaches to planning, design, and construction that will optimize farme involvement and mobilize local resources.

3.4 Finances and Expenditures

The following table indicates the status, as of 3/31/88, of the numbers an types of activities which have been approved for use of Project loan funding an for which earmarking and commitment has been done. They are divided among th various Departments involved with a further division for IPH into type o irrigation schemes.

Table 2

APPROVED SCHEMES
(as of 3/31/88)

	IPH						
PIL NO.	FIS	LIS	TW	CD	AG	RD	FD
4/7	3	6	4				
8				6	19	2	
9/15	3	9	14				
14							3
16				12	36	5	
21*	4	13	13				
22							10
25					12		
27							8
	10	28	31	18	67	7	21

Subtotal IPH 87

For the subprojects indicated above, the following table provides indicative figures for the cost and size of the various irrigation schemes. FD activities are not included since they are carried out in conjunction with the above type of schemes and do not represent a different type of irrigated area.

*Detailed designs and estimates of these schemes have yet to be approved, only the preliminary/initial appraisals have been approved.

Table 3

INDICATIVE FIGURES FOR IRRIGATION SCHEMES

Type	Cost (Lac Rs)	Size (Has)
TW	8.4	30-40
LIS	28-30	50-100
FIS	18-30	50-100
AG	1.2	6-7
RD	0.6	50

The following tables indicate the amount of loan funds, by participating organization, that have been committed and accrued through 3/31/88, including the percentage of Planned Budget for LOP and the percentage accrued of the amounts committed.

Table 4

U.S. FUNDS (Loan) COMMITTED
(as of 3/31/88)

	IPH	AG	RD	FD	HD	Proj. Cell	Proj. Total
Budget($ Mil)	30.24	12.44	1.32	3.00	3.00	In IPH	50.00
Committed($ Mil)	7.85	0.73	0.02	0.33	0.00	0.69	9.62
Committed(%)	28.00	6.00	1.50	11.00	0.00	In IPH	19.20

Table 5

ACCRUED EXPENDITURE OF U.S. FUNDS (Loan)
(as of 3/31/88)
in $000

	IPH	AG	DR	FD	HD	Proj. Cell	Proj. Total
Accrued* ($000)	3,670	540	20	160	0	240	4,640
As % of Budget	13	4	2	5	0	In IPH	9.3
As % of Committed	46	74	100	48	0	35	48.2

* This figure is accrued expenditures to date including both disbursed and undisbursed funds.

34

Grant funds for the project have not been shown here in a detailed breakdown as for loan funds per above. As of 3/31/88 approximately 38.6 percent of Total Budget grant funds have been committed and 11.7 percent have been accrued.

3.5 Project Management and Monitoring

According to the Project Paper the Project Cell was to have two Superintending Engineers dividing responsibilities for subproject design, project implementation, monitoring and training. To date only one Superintending Engineer has been assigned and only the design functions of the Cell are fully operational. The Project Cell obtains progress reports on construction activities and on expenditure of funds through regular IPH channels. The Chief Engineer/Project Director and the Superintending Engineer have each made several trips to the field to verify progress and discuss design questions. However the three Executive Engineers who are responsible for the review of all materials received from the District level and the preparation of final subproject proposals have made only three field trips among them (one hasn't been out at all). There are four AD and FD staff assigned directly to the Cell who review and correct, if necessary, the agriculture aspects of subproject proposals (primarily before project and after project cropping patterns and yields for calculation of water requirements and IRR's) and forestry aspects of certain subprojects. Visits to the field on either design or implementation aspects of the Project by AD and FD staff in the cell are rare.

The lack of institutional capacity in the Project Cell for monitoring of qualitative aspects of project activities or for organizing and managing training and research activities have placed an undue burden on the USAID Project Manager, particularly in view of the large number of potential sites scattered through a terrain where access is difficult and time-consuming. In addition to the normal spot checks in the field to verify physical progress and fund expenditures the USAID manager has essentially taken on all of the missing management aspects of the Project Cell indicated above. Without his inputs there would basically be no research or training taking place and very little understanding or information about the qualitative aspects of the project.

Chapter 4

DEPARTMENT ACTIVITIES

4.1 IPH Schemes

There have been 87 HALWD schemes approved for IPH. Of these 31 have been tubewells, 28 lift systems, 10 flow systems and 18 chak development. The tubewell schemes are typically 30 to 40 hectares while the flow and lift schemes are in the range of 50 to 100 hectares. IPH has assumed technical responsibility for any major rehabilitation of the seven approved RD schemes. Details of approved schemes are given in the Table 2 in section 3.4 above.

Site Selection

The scheme site are initially determined by community request and then given priority on a political basis. Basically, project funds are divided evenly between ten districts and then further allocated to specific political divisions within each district. It remains unclear what technical criteria other than very general ones of distance from electric sources, height of lift, or water and land availability are used at this initial phase of selecting scheme sites but presumably some local judgement, including that of district IPH staff, is input into the decisions. Master plans were completed for each subdistrict in the early 1980s but we found no evidence of these being used to assist in site selection.

The selection process has resulted in a higher proportion of lift schemes being selected as compared to gravity diversions than was projected in the Project Paper. This is, in part, because of the distribution of funds to the ten districts, some of which have only relatively difficult sites from which to choose. The lift schemes also have a somewhat smaller command area than anticipated.

We feel that the current selection process does not lead to the best sites from a technical or economic point of view. On the other hand, we are unable to find any comprehensive state plans that identify the physical resources on which irrigation site selection could be based. Without this information it is difficult to judge the relative technical or economic improvement that could be made by a more technically oriented selection process. Master plans were developed for all subdistricts. These, however, have not been updated since the mid-1970s. The two master plans we reviewed seemed to contain a great deal of information and detail, particularly on existing schemes and water sources. No effort was made to give priority to proposed schemes or to coordinate the plans at levels above the subdistrict. Water rights data are not included in the master plans.

In summary, the site selection, though initiated by local individuals and communities, is given priority by political concerns with technical and economic criteria used to screen out unacceptable schemes. This process has lead to more lift schemes than anticipated (potential economic and environmental concerns discussed later) and schemes of somewhat smaller commands than expected

(potential management concerns due to larger number of schemes). No comprehensive plan has been developed for the irrigation potential at the state level. Technical criteria for selection are being discussed that would discourage selection of some pump systems, especially those with high lifts or very long electric supply lines.

Technical Aspects

Design: Once a candidate scheme site has been selected an initial design is developed by the district IPH staff which typically include an assistant engineer supervised by an executive and superintending engineer. A design once approved at the various levels up to the circle is forwarded to the Project Cell where it is reviewed and approved, modified or rejected. If modified it goes back to the district for another iteration. If approved, the design is formalized with blueprints, typed report etc. and passed on the Chief Engineer for approval and solicitation of construction bids. The design includes engineering, agronomic and economic analyses.

The engineering design criteria specified in the HALWD project is considerably more rigorous than what had been used by IPH previously. Two important purposes for the specified USAID project criteria were 1) to more accurately correlate cultivatable command area (CCA) with water supply and 2) bridge the gap between the main water supply system and the on-farm use of the water.

Criteria to achieve the first purpose included rigorous analysis of crop water requirements and other agronomic factors (e.g. soils) instead of the traditional use of a generalized water duty (e.g. 1 cubic foot per second per 150 acres). Every indication suggests that although the analysis is data intensive and time consuming it has produced several very positive results. First the command areas, in general, have been reduced relative to supply from the traditional approach. In the judgement of both Indian and expatriate irrigation professionals, the new designs are more appropriate and cost effective. Second, the rigor required to do the analysis has raised the level of professionalism of the engineering staff. Third, (and very much related to the second purpose of the criteria i.e. bridge the main system/on farm gap) engineers have begun to understand irrigation systems as agricultural production systems and not just as hydraulic systems.

The second purpose was to develop a design process that both encouraged the engineer to design for agricultural production and integrated the farm community at all levels of planning, design and implementation of the project. No process has been institutionalized to fully integrate farmer participation into all levels of design and implementation (though they may be involved in site selection). In general significant farmer participation is sought only after the main supply and delivery system has been designed and constructed. The project, however, is making progress toward the goal of achieving community

42

participation. There are numerous indications that 1) it is being taken seriously by GOHP officials, 2) in some cases it is beginning to be thought of as an important component following the recent TA on the topic and emphasis given it by USAID staff and 3) IPH can provide significant assistance to existing locally managed systems without "taking them over" (e.g. assistance to Rural Development Khuls). Nevertheless, we are concerned that the technologies being designed into many of the schemes may be inconsistent with local management.

In our judgement, although the design analysis for water requirements is fairly rigorous, it is based in some cases on a fairly weak data base, particularly anticipated cropping patterns and time series data. Water supply is often determined on the basis of a few measurements during a low flow period in one or two years only. We found no use of rainfall-runoff analysis as a means of developing a longer time series data set (presumably rainfall data are more available and somewhat more transferable than runoff data). A number of the lift schemes have been constructed on perennial streams or rivers where low flow is not likely to limit supply. However, even these systems suffer from a lack of data on stream sediment loads and flood frequency levels.

Although the procedures are followed, the results may not be as accurate as expected because many of the data that are input into the procedures are themselves only approximate. We questioned several of the design engineers, "have the new design criteria for water demand improved design?" The answer was always yes, and the reason given was always that the water duty was reduced from the former 1 cusec per 60 hectares to a more accurate 1 cusec per 35 hectares, in some cases only 30. The benefits of the rigorous approach to calculating water requirements have been realized but perhaps now a set of improved water duties associated with several typical cropping patterns and soil types could be adopted in place of the rigor of calculating water requirement at each site. There is as yet no empirical evidence from the newly constructed projects that the "new duty" is better than the old one, but experience elsewhere and the logic of the approach would suggest the new designs are more appropriate.

The HALWD Project design criteria attempt to provide a more comprehensive systems approach than currently exists but the IPH staff are still biased toward the hydraulic system. Before the HALWD project, the IPH staff concentrated on design of hydraulic lift systems for public water supply. It is likely that the IPH engineering orientation and familiarity with lift systems has biased them towards lift irrigation systems with a heavy emphasis on the hydraulic component of the total irrigation system. Our brief examination of the systems designed to date, together with a review of staff expertise, suggests that the most serious problems are not with the technical hydraulic design (with the exception of silt concerns on some lift systems) but rather with the hydrologic design, water distribution and management, and controlled drainage aspects.

Chak Development: The PP placed considerable emphasis on chak development, including land leveling, bunding, terracing and the like. This emphasis was possibly based on the belief that unless such development took place farmers would not use the water and thus the potential of the irrigation scheme would not be realized. We believe that in general professionals have changed their ideas on this as government development at the chak level has a very negative impact of further penetrating the government physical infrastructure even deeper into the community. This almost totally discourages local resource mobilization. Management assistance in chak development in the small Himachal Pradesh commands does not seem us to be practical.

IPH has defined chak development to be the extension of field channels from the chak turnout to individual fields. This we were told is done in consultation with farmers. In our view, the government chak development component of the project should be reviewed and probably dropped, except in those cases where it is required to assure environmental stability.

Typically much of the land in the scheme commands was already terraced for rainfed crops. In some cases where there had been an existing Khul, land was developed for irrigation use. We saw no cases where farmers had developed fields for irrigation following construction of an IPH system. Certainly on farm development was not occurring rapidly but even the oldest schemes we visited had been in operation for only a few seasons.

The officials we talked to expressed concern that farmers were not making use of the potential created for them and that they would have to be taught to do so. Two concerns expressed by individual farmers were that 1) if they used the irrigation water from IPH systems the water use fee would be raised and 2) they would develop their fields only after they were assured reliable water delivery.

Operation: Water distribution schedules are not normally developed during project design but only after the scheme is constructed. Pumps on lift schemes are designed to operate only at peak demand for 16 hours per day. Storage tanks are designed for four to six hours of temporary storage. Distributary canals are sized on the basis of one to one-half cusec depending on the command area to be served. None of the above criteria are designed with an operational system in mind but each will influence the operational systems that are possible. Although we did not review them, we were told that two schemes had operational plans developed by the IPH.

Presumably in both the IPH and AD schemes farmer will be responsible for developing a plan for water distribution. We found that no particular thought had been given to the interface between the government operated main systems and the farmer operated chaks on the IPH schemes. The turnouts on the schemes we visited were designed as open/closed pipe inface. This suggest that IPH will have to operate on a rotational schedule but little information is available on how

farmers will be involved in decisions concerning rotation schedules. The schemes are very vulnerable to farmer interference once water is delivered into the main canal.

Economic Aspects

The implications of the new design approach are very significant due to of the requirement for each scheme to have an IRR of 12 percent or greater. Because the new designs often result in a four-fold reduction in the expected irrigable area, it is more difficult to economically justify projects (Appendix C). Perhaps even more importantly the actual cost of schemes is reduced since "excessive" distribution canals are not constructed.

The AID mission provided a three day course on the procedure for calculating IRRs. Although this initial activity was modest and definitely needs additional follow up, it did have a very significant and positive impact on irrigation design in the state. Consideration of benefits and costs of individual schemes has been institutionalized and while additional training is needed to refine the process and quality input data are generally lacking, the process is taken seriously and results of economic analyses are used for project approval. Many of the necessary input data, such as crop yields under irrigated conditions, are difficult to find. The after-project crop pattern and yields selected for the IRR analyses seem rather optimistic.

The economic viability and long term sustainability of the project irrigation schemes relate to the technologies adopted and the environmental conditions. The viability of some of the high lift schemes seems particularly problematic, because of expected high recurrent costs and environmental problems resulting from uncontrolled drainage from some steep command slopes. One executive engineer told us that about five years ago a policy decision was taken that no lift schemes of over 150 meters would be constructed except under unusual circumstances. The reason given was the high cost of such systems although no formal benefit cost analyses were done before the initiation of the AID project. High lift schemes, a few over 150 meters, have been approved under the HALWD project. We can anticipate that more lift schemes, some with over 150 meters lifts, will be planned in the future as sites for flow and lower lift schemes in some districts become more difficult to locate. One constraint on IPH scheme site selection is access to a road. Where as the community-managed AD and RD projects may be located in rather remote areas, the IPH schemes are generally not. A second constraint is access to electric power. The cost of bringing an electric transmission line to the site of a lift scheme can be a major portion of the total capital cost of the project.

Recurrent costs of the schemes, particularly the IPH lift schemes, should be a major concern for the long-term viability of the project (Appendix D). All operation and maintenance costs of the IPH schemes is now assumed by the government. The project paper estimated recurrent costs for O&M at 10 percent of the capital costs. This estimate was based on an expectation of a higher portion of systems being gravity flow schemes than are being constructed. Based on the project paper estimates the recurrent costs on 30 million dollars invested in irrigation would be 3 million dollars, the bulk of this borne by the

government. We judge that this figure is probably low, in part because of the higher percentage of IPH lift schemes being built than expected. IPH estimates of typical operational costs for existing lift schemes are 4000 to 5000 Rupees per year per hectare. Estimates of AID staff who interviewed engineers on one lift scheme are 8000 Rs. per hectare per year for both operation and maintenance. These estimates would be even higher if the heavy subsidy to electricity was removed. A study of two HALWD lift systems by the Institute for Economic Growth estimated recurrent cost at 5000 to 6000 Rs/year. On the other hand the estimated benefits to farmers from the few existing operational systems are generally much greater than 8000 Rs. per hectare per year. In some cases where vegetable seeds and other high value crops are being grown the farmers are receiving returns reportedly over 20,000 Rs. per hectare per year. A recent study by the USAID/India controller's office says that the state will have the budget to meet even the relatively high projected recurrent costs through 1994.

Intuitively we feel that some of the very high lift schemes are probably not going to meet the economic criteria in the long run. Case studies by both the Institute for Economic Growth and IIM/Ahmedabad indicate that while flow and tubewell schemes are potentially very economic, only about half of the four lift schemes meet the 12 percent IRR criteria. Some simple criteria that require certain projects to be specially scrutinized might be helpful. These criteria could include limitations on the elevation to which water could be lifted or the distance from existing electric power to the site. There has to be some flexibility, however, or such fixed criteria become distorted resulting in selection of even less desirable schemes. On the benefit site, more consideration needs to be given to site-specific land resources, markets, and farmer experience.

The proportion of schemes considered under the project is increasingly toward lift technologies. The project paper estimated an equal number of lift and flow schemes. The number of approved schemes thus far, not including the tubewells is about 70 percent lift and 30 percent flow. A letter from the former Chief Engineer of the project Cell suggests that this ratio will tilt more and more toward the lift schemes in the future because of a general lack of good sites for flow systems. Without a comprehensive land and water resources plan for the state we are unable to judge whether or not good flow sites are available (Appendix E). We have been unable to determine the basis on which the original project paper projections were based.

Lift Schemes

As mentioned above the site selection process has lead to far more lift systems being chosen than anticipated in the project paper. Several of the first projects selected that are now under construction, have extraordinarily high lifts (e.g. over 150 m). Intuitively, we expect that the cost of such systems, especially when recurrent operation and maintenance are considered, will be extraordinarily high.

A second aspect of the lift schemes that has increased the cost of such systems above expectations is the need for relatively long electric transmission lines. Construction of three to five kilometers of line to a site is not uncommon and

some few transmission lines have been even longer. The cost of one kilometer of transmission line is on the order of $15,000. Therefore, if five kilometers of line are needed to supply a lift for a system with a 50 hectare command, the added capital cost alone for the transmission line is $1,000 to $1,500 per hectare, a major portion of the total anticipated construction capital cost in the project paper. The project officer has been pressing the GOHP to institute a selection criteria that limits the length of electric transmission line necessary and/or pay for the transmission line out of non project funds.

A third economic concern, relating particularly to the lift systems, is that of recurrent costs. The project paper estimated operation and maintenance costs at 10 percent of the total capital costs. We anticipate the O&M costs of lift systems to be higher than this projected average figure which was based on a different mix of lift and gravity systems than has resulted. Furthermore, the operational costs of pumps are somewhat confusing because of the high subsidy to electric power. This electric subsidy not only biases the selection of lift systems but may also encourage over-pumping of irrigation water.

Finally the lift systems pose an environmental concern that is associated with the subsidized cost of pump operation but also a whole complex set of other influencing factors. The concern is this: water is pumped to an elevated and often undeveloped or under developed command area. The distribution net work ultimately discharges a concentrated stream of water (e.g. 30 l/s) onto the command. Depending on the degree to which the fields have been developed (e.g. bunding, land leveling) and the management capabilities, capacities and incentives of the farmers, this water may be used or simply run off. If it runs off the command area, this concentrated flow in some cases, has very high potential to cause serious soil erosion problems.

It is common in India to substitute excess irrigation water for management inputs and costly land development necessary to use water efficiently. Therefore, if water is relatively cheap it will be used in excess and thus runoff of drainage water can be expected. Since electricity is highly subsidized and in many cases water flow in supply streams are far in excess of pumping capacity, it seems reasonable to expect excess water usage. In any case, unless farmers are required to pay a major portion of recurrent costs they will press to have excess water pumped.

We are concerned that the design and implementation of some of these lift systems together with incentives to pump water in excess of what can be utilized will lead to severe soil erosion cases. Attention must be paid to both better designs that assure land development and stable drainage networks and management incentives that encourage reduced recurrent costs and less over-pumping.

IPH Staff Capacity and Constraints

The prevailing opinion seems to be that public health (domestic water supply) concerns will continue to be given priority over those related to irrigation. The reasons for this seem to relate to the tradition of IPH placing emphasis on public health. Although the Decade of water, which has focussed the IPH on domestic water supply ends in 1991, the general feeling is that water supply

needs will continue to require a high level of input even after 1991. Most IPH officials and staff we talked with expected that irrigation and public health would be separated but not for several years. The separation is delayed in part because of the anticipated expense of extra staff and a shortage of accommodations. Because most of the engineers appear to have a bias toward public health work, the irrigation group after the split might initially include primarily the more junior staff.

4.2 Agricultural, Forestry and Horticulture Activities

Site Selection and Technical Aspects

Many of the comments above on site selection and design aspects for the IPH schemes appear to apply equally to AD schemes. However the command areas (CCA) under the Agriculture Department are usually (although not always) considerably smaller than those under the Irrigation Department. The AD schemes approved thus far are of six different types characterized by the type or source of water as shown below. These divide into small CCA's and those with large CCA's.

Table 6

AD 67 SCHEMES APPROVED

TYPE	NO.	AVE SIZE (Has)	RANGE (Has)
Wells (Sh/Dg)	10	5.5	3.6-11
WST	26	5.3	2.9-10
FIS	17	7.0	2.5-14
LIS	2	10.0	8-12
TW	6	40.0	25-47
FIS (Repair)	6	64.0	5.8-179

Avg. small system	6.65 ha
Avg. large system	40 ha

The small CCA's obtain water from: Water Supply Tanks (26 schemes), Flow Irrigation Systems (17), Shallow or Dug Wells, (10) and Lift Irrigation Systems (2). These small systems under AD have CCA's that average 6.6 ha in size with a range from 2.5 to 14 ha. The large systems approved for AD are either supplied from a Tubewell (6) or represent repair to an existing FIS (6). Tubewell systems average 40 ha in size with a range of 25-47 ha. Existing FIS's being repaired average 64 ha in size with an extremely wide range from 5.8 to 179 ha. The large systems approved under AD seem to represent an overlap with IPH and RD. It is not readily apparent why such schemes are being done by Agriculture instead of by IPH/RD.

Forestry Department components, primarily watershed protection above the irrigation command site, have been approved for FD action on 21 schemes under

construction by IPH. This coordination of efforts is in accordance with the original objectives of the project. However these 21 schemes seem to be the only examples of inter-departmental cooperation that are in effect thus far in the project.

To date no activities by the Horticulture Department have received approval for project funding. However our field visit to Himachal Pradesh indicated that HD is working quite actively on developing activities for approval. In the areas visited Himachal Pradesh representatives had paid field visits to the farmers where they seemed to have at least some credibility. Several HD schemes are likely to reach the approval/execution stage in the near future.

This was not the case for representatives from AD, particularly from Extension, who had seldom, if ever been in touch with the farmers to whom we talked. As might be expected, there has been no movement in the use of Extension activities under Agriculture. It would appear that Ag Extension should be considered as a "downstream" activity that cannot take place until a water delivery system is in place, but after which production will then most probably be improved with or without project intervention and/or funding.

Watershed Erosion Control

Forestry Department activities in watershed protection above the irrigation command site, have been approved for several IPH schemes. In general the FD activities seem to cover rather limited portions of the slopes, usually only the areas with the greatest erosion problems which present a threat to the irrigation infrastructure. In general, sufficient funds have not been provided through the Project to permit installation of erosion control measures for the entire watershed. Furthermore the control measures being used are largely concentrated on check dams and the planting of some trees. There seems to be no effort underway on project sites for more comprehensive control programs using trees, shrubs and grass species designed to help prevent sheet erosion as well as the more obvious gully erosion. Such more comprehensive protection programs will clearly require a greater allocation of funds to FD than seems to be the case to date.

Marketing and Extension

Clearly, availability to markets is an incentive for farmers to develop fields in irrigation commands and move to higher value crops. But, in some cases, markets develop or improve because of the crop production. Once irrigation water is available on a regular, sustained basis it appears that the farmers, themselves, are prepared to proceed with necessary efforts leading to improved production levels with or without project intervention and/or funding. Both IPH and AD officials stated time after time that the farmers would not permit either Department to undertake "land development" or "land improvement" activities on the farmers' lands. At the same time numerous examples were cited of farmer initiative in applying new techniques and varieties and changing to new crops as irrigation became available and as the farmers were able to observe changes being made and increases being realized by other farmers in similar areas.

49

Likewise, for a shift to new crops such as vegetables and vegetable seeds, marketing would not appear to be a major constraint, although some locations clearly have better access to existing or potential markets than others. A market infrastructure seems to develop from the private sector when crops become available to be marketed. In the case of vegetable seeds the market may be a key initiator of such production with companies contacting and arranging with farmers to produce seed on a contract basis.

Scope, Integration and Necessity of Various Activities

The Review Team is recommending a focus for future sub-projects on an integrated approach to watershed development and management. As such, the necessity for various activities by all concerned Departments and their integration into a common approach is evident. The scope and type of activity by each Department will be determined by the particular requirements of chosen sites. For example, a site developed around a tubewell irrigation scheme by IPH is not likely to require soil conservation and stabilization efforts by FD but would have roles for AD and HD.

Chapter 6

COMMUNITY-BASED MANAGEMENT

The concept of community-based management is not yet pervasive in the HALWD schemes. The situation before the USAID project was to have RD and AD schemes locally managed and IPH schemes operated and maintained by the government. Basically that is still the situation in Himachal Pradesh although there is a general recognition that farmer participation is necessary to distribute water and that at some point in the development process involvement of farmers is necessary. Farmers in Himachal Pradesh have traditionally paid almost no water charges.

A technical assistance activity has been initiated in several schemes starting with a collective meeting of farmers and concerned government agencies. Similar meetings have now been conducted under the leadership of the Chief Engineer in ten other schemes. These meetings have all occurred after construction of the irrigation main system. Plans are now being made to follow up on these initial meetings by encouraging farmers at the chak level to organize and function as collective groups.

The need was identified by a recent TA activity for two staff persons to deal specifically with farm-based management. One is to be an experienced Indian sociologist the other an experienced field assistant. The field assistant position has been filled. The sociologist is needed to provide support in the Cell for identifying and adapting approaches to design that provide for community-based management. This position is still vacant.

An action research effort to identify and develop new strategies for operational procedures that effectively involve farmers has been initiated on one RD and two IPH schemes. All of these schemes have been constructed and emphasis is being placed on outlet groups. Results from this action research could be available for guidance in other schemes within one year or less.

We observed three flow schemes in the field and reviewed plans for development of several others. All of these schemes had at least some pre-existing irrigation physical infrastructure. In the case of the IPH schemes this infrastructure was upgraded and O&M responsibilities assumed by the government. Those schemes designed by the AD formally remained the responsibility of the local community. However, because the command had been increased the group of cooperating farmers was different than before the new schemes were constructed. We are uncertain as to how much attention is being given to water rights issues that surely are important locally when the area served by a water source is expanded.

Chapter 5

INTER- AND INTRA-DEPARTMENTAL COORDINATION AND COLLABORATION

5.1 Project Cell

The structure of the project is such that the HALWD Cell is administratively located in IPH under the Secretary of Public Works. Therefore all activities under the project must ultimately be approved by the IPH Chief Engineer. There are representatives of all the concerned departments in the Cell but they are more or less on loan to the IPH. The result of this is that IPH has developed a capability to deal with irrigation design on a broader basis and include agricultural considerations more effectively.

5.2 IPH

IPH is a department that is concerned with both public health and irrigation. Originally the staff of Public Works were moved in and out of irrigation, public health, and roads and bridges pretty much at random. A separation between Road and Bridges (RB) and IPH is nearly complete. In fact only a very few individuals have moved from IPH to RB in the past three years. There seems to be a commitment to keep these two cadres separate in the future. The regular movement between positions at three year intervals in public health and irrigation still occurs and probably will for at least the next three to five years.

Although in general the order of preference is for engineers to work in RB, public health, and irrigation, there were a number of engineers who said they preferred irrigation because the work was more scientific. The Secretary of Public Health said he felt an important aspect of overseas training was that it gave engineers a more professional feeling about the worth of working in irrigation.

5.3 Inter-Departmental Models

This project deals broadly with land and water resources and therefore cuts across the responsibilities of many departments. On any given scheme however, the fewer departments involved the less will be the need for complex and time consuming inter departmental coordination. We observed a number of schemes where IPH and Forestry, Rural Development, and/or Horticulture had coordinated their efforts. Agriculture seemed to be more involved with the micro schemes under its jurisdiction. Activities that can be effectively conducted between two or three departments will probably be more efficient than those where all project departments are involved.

Chapter 7

HUMAN RESOURCE DEVELOPMENT AND INSTITUTIONAL STRENGTHENING

7.1 General

Training was considered to be an essential early component of the project in order to expand the capability of engineers and others involved in the irrigation sector. Many of the involved engineers are young and have very limited irrigation experience. To date 10 to 12 short training courses have been offered in Himachal Pradesh to about 200 participants. These courses are a start but much more emphasis must be given to this component of the project. The quantity of training taking place is far less than anticipated in the PP and much less than is needed to assure that this complex project will succeed.

Expatriate technical assistance for training has been provided on a limited number of topics including the initial action training, farmer participation, and in several of the courses under the leadership of Water and Power Consultancy Services (WAPCOS). A number of these activities are expected to continue at an accelerated pace in the future including those listed below.

7.2 Action Training

The purpose of the action training program is to strengthen collaboration and coordination among the concerned departments, to ensure effective farmer involvement, and to improve the overall technical process used. This activity is field oriented and focuses on in-service training using in an inter-departmental team approach. The first phase of this activity was used to develop a plan for monitoring and a model for scheme assessment, among other things. A follow-on program has been proposed that must be reviewed by project personnel so that continued implementation will take place. Our impression is that the next critical phase of the action training must include specific training on critical technical design concerns and continued development of approaches to farmer involvement.

7.3 Farmer Participation

The initial meetings between farmers and agency personnel were arranged with the assistance of an expatriate experienced in approaches to farmer participation. These were held in a pilot session at two or three sites where schemes had been constructed. The Chief Engineer of the project Cell subsequently held at least one farmer meeting in each of the ten participating districts. It is expected that at the district level the leadership will now begin to hold similar meetings at each scheme site.

Follow up to the initial farmer meetings in terms of organizing farmers into user groups that will begin to participate in the scheme management has started in two schemes but will need to be expanded, this will require outside assistance from the Project Cell. Farmer involvement will vary from scheme to

scheme depending on the type of technology, number of farmers, relationship between farmers, type of cropping and so forth. Therefore different participatory approaches will have to be tried to determine which is best for each situation. These training efforts will be supported by an action research project that is now underway at three sites.

7.4 Technical Training

A spin off of the action research effort has been the identification of a technical training program for IPH engineers that focuses on selected problems in irrigation design and management. This program will be conducted in the field by selected Indian engineering experts with the assistance on a US irrigation engineer with special expertise in training. Problems that have been identified for this training include design of intake structures for lift schemes, design of water distribution and application systems for steep lands, design of intake structures for water diversion, and water control in main canals.

In addition to the above technical training program there are plans to station an irrigation expert in Himachal Pradesh within the next few months whose primary role will be technical training but who will also coordinate training and TA activities. This individual will be able to provide direct technical assistance as well as provide the link to identify and access other needed technical assistance. In addition to the specialist stationed in Himachal Pradesh there is a contract with a US-based consulting firm to provide sixteen additional months of short term technical training.

7.5 Overseas Training

Only four individuals have been sent abroad for study and specialized training but there are plans to send about 10 more before fall 1988. Exposure to different irrigation technologies, approaches to design, methods of monitoring, approaches to research, and new training methods are essential inputs of a major irrigation development project aimed at new and innovative approaches. Such exposure can only result from encouraging professionals to experience these innovations in other parts of the world.

7.6 Institutions for Training

The universities in Himachal Pradesh can provide limited support for irrigation training and some facilities. These institutions, however, are not staffed or equipped to carry a major component of training for this project. Either these institutions will need some direct support to allow them to accommodate an irrigation training program or other facilities and staff will need to be developed for this purpose. The topical responsibilities of the two universities do not place high priority on engineering or water resources technologies. Therefore it might be desirable to explore opportunities to begin to develop an institution with specific focus on mountain engineering technologies and/or hill area land and water resource management.

41

Chapter 8

APPLIED RESEARCH AND TECHNOLOGY ADAPTATION

Applied research activities under the HALWD project have recently begun with both Palampur and Solan Universities initiating baseline socioeconomic studies. In addition to these Palampur University is doing a study on seepage and Solan one on trickle irrigation. An action research study was started in December with assistance from a research US consultant on identifying and developing options for community-based irrigation management.

A number of important applied and action research topics were identified in the PP and others through project implementation that have not yet been initiated. These include hydrologic studies to determine water supply, soil erosion, and flood frequencies. Action research is needed to optimize cropping patterns, identify promising new technologies and understand the complex set of relationships among and between government and farmer groups. Scheme operational options have received very little attention but ultimately will profoundly influence the equity, productivity, and environmental stability of the schemes.

Experience to date suggests that lower cost diversion structures might be structurally sound and yet meet the needs of some IPH flow schemes. Design options need to be field tested to verify that these lower cost structures will in fact perform up to expectations. Design options for dealing with fluctuating water levels and high silt loads need to be studied in the field on a trial basis to identify the most cost effective designs for the HALWD lift schemes. Along with a procedure and resources to collect and analyze hydrologic streamflow data, better procedures are needed to estimate supply wherever such time series data are not available. Better and more reliable procedures need to be developed to predict irrigation intensity and cropping patterns after scheme development, and to relate actual demand with actual supply on a monthly basis. This development requires that careful analysis be done of the development to date as well as to initiate action research on these topics.

There is tremendous scope for monitoring competed schemes for the purpose of learning, especially as related to project economics, verification of design assumptions and identification of technical and social problems.

Adaptation of new irrigation technologies is being tried in a few areas, particularly the use of sprinkler application techniques. Demonstration sites and technical handbooks were envisioned in the PP as methods to extend the lessons learned from the applied studies. No activities to extend lessons learned and to provide valuable feedback have been undertaken.

Appendix A

LIST OF SCHEMES VISITED

56

Appendix A

LIST OF SCHEMES VISITED

Sundernagar

1. LIS Sai Bhardwan (IPH)
2. LIS Bahlvalley Medium Irrigation (State System)

Mandi

1. LIS Gumanoo (IPH)
2. Tank Irrigation Scheme Talyhar (AD)

Kullu

1. FIS Targali Kuhl (IPH)

Bilaspur

1. LIS Neri Jamli (IPH)

Solan

1. LIS Bhud (IPH)

Shimla

1. Panog (AD)

Appendix B

LIST OF GOHP OFFICERS MET

68

Appendix B

LIST OF GOHP OFFICERS MET

Shimla

1. Commissioner, IPH
2. Commissioner, Agriculture
3. Chief Engineer, Project Cell
4. Superintending Engineer, Project Cell
5. Director Agriculture
6. Executive Engineers, Project Cell
7. Deputy Director, Horticulture, Project Cell

Sundernagar

1. Superintending Engineer, IPH
2. Executive Engineers, IPH (Sundernagar and Baggi)
3. Assistant Engineers, IPH (Construction, Tubewells and Design)
4. Assistant Soil Conservation Officer, Mandi
5. Assistant Soil Conservation Officer, Sundernagar (in charge of soil surveys)

Kullu/Aut

1. Superintending Engineer, IPH
2. Executive Engineer, IPH
3. Executive Engineer, Design
4. Divisional Forest Officer, Seraj Division
5. Assistant Engineer, IPH

Appendix C

ECONOMIC APPRAISAL OF SOME SELECTED IRRIGATION SCHEMES UNDER USAID HILL AREA LAND AND WATER DEVELOPMENT PROJECT IN HIMACHAL PRADESH

by Basawan Sinha

Metaplanners and Management Consultants
Patna
September 1988

Executive Summary

60

ECONOMIC APPRAISAL OF SOME SELECTED IRRIGATION SCHEMES UNDER USAID HILL AREA LAND & WATER DEVELOPMENT PROJECT IN H.P.

Executive Summary

1. BACKGROUND

The United States Agency for International Development (USAID) is assisting the Government of Himachal Pradesh in its efforts directed towards rapid development of irrigated agriculture in the State under the Hill Area Land and Water Development Project (HALWD). The USAID intends to introduce new approaches to land and water management, as well as to support initiative in developing its land and water resources. It is a Seven Year Programme under which approximately 150 minor and 2000 micro Irrigation systems with emphasis on irrigation planning and design, integrated upstream development, on-farm development works, users involvement, and associated support of human and institutional capabilities. The Minor Irrigation schemes planned comprise deep-drilled tubewells, Lift irrigation from rivers, Small reservoirs (tanks), and Diversion (flow) Irrigation works. Some of the schemes included in the programme are reported to be under execution.

2. SCOPE & OBJECTIVE

USAID, NEW DELHI under Purchase Order No. 386-0249-0-00-&223-00 dated July 15, 1988 intrusted the job pertaining to estimation of the internal Rate of Return (IRR) of approximately eight small-scale irrigation proposals of which, two are high

lift pumping systems, two are gravity-flow stream diversion systems, two are tubewell pumping systems, and two are small storage or tank systems. It was also stipulated in the statement of work that the contractor will clearly state in his report the assumptions used in the IRR Analysis, will carry out Sensitivity Analysis for some important variables and will also carry out an analysis using shadow prices for traded commodities, viz. electricity and water based on values of alternative uses (if known).

3. SELECTION OF EIGHT SCHEMES

The following eight projects were selected in consultation with Shri N.R. Banerjee of USAID for estimation of IRR:

I. Tubewell Irrigation

1. Dhakeri Scheme in Solan District
2. Gugwara Scheme in Una District

II. High-Lift Irrigation

1. Bhaura Scheme in Kangra District
2. Neoli Therman Scheme in Kullu District

III. Storage Tank Irrigation

1. Gurla Scheme in Shimla District
2. Ropa-Buda Scheme in Mandi District.

IV. Flow Irrigation Scheme

1. Bari Kulwara Scheme in Mandi District
2. Jond Bhajanu Scheme in Shimla District

These eight schemes comprise all the four types of irrigation works, are located in six districts of the State spread over three out of four Agro-Climatic Zones of Himachal Pradesh. And yet it would not be prudent to claim that the results of the instant study on the above mentioned individual schemes will be straight away applied to all schemes of corresponding type and size located elsewhere in the state because the soil characteristics, cropping pattern, consumers preference, design and the cost of the engineering structures with its appurtenent works, developmental prospects, etc. vary significantly in the hilly terrain especially of the type met within the hilly State of Himachal Pradesh.

3. An Overview on Parameters of Project Proposals:

After obtaining the data and informations contained in the project reports and estimates of the above mentioned eight schemes, a thorough analysis of the various parameters relevant to calculation of IRR was done by a team of experts in the fields of economics, agro-economics, water resources development and management, and other professionals and sub-professionals.

The salient features having bearing on estimation of IRR noted are:

3.1 The existing cropping intensities in the command areas of all the eight selected schemes were very high, about 200% in un-irrigated condition.

3.2 Proposed irrigation intensities were more or less the same as the cropping intensities in pre-irrigation condition. In other words, the gross cropped areas (GCA) in with and without irrigation situation were equal.

3.3 Shift in cropping pattern from unirrigated to irrigated agriculture as proposed was largely in favour of cash crops, mainly vegetables in both Kharif and Rabi seasons.

3.4 Vegetables are grown in the command areas of Lift irrigation scheme)LIS), Kullu (2.03% in Kharif and 1.02% in Rabi), Una Tubewell scheme (6.34% in Rabi); Shimla Tank Scheme (11.11% in Kharif, 11.11% in Rabi and 11.11% Patato); and Mandi Flow Irrigation Scheme (0.87% aid). No vegetable is grown in command area of other four schemes.

3.5 The project estimates prepared were in detail so far as engineering works were concerned but how the choice was made in favour of the proposed structure

had not been given in the report. It was also not clear as to why costly piped water supply was provided in the Flow Irrigation Scheme. From the Project Reports it was also not clear as to whether Soil surveys and irrigability classification were conducted by the project authorities.

3.6 The project report did not contain discussions on and the basis of proposed cropping pattern, irrigation intensities, crop yields etc.

4. FIELD VISITS AND COLLECTION OF RELEVANT DATA & INFORMATIONS

As stated above, the project reports lacked in presentation of details relevant to irrigated agriculture envisaged in the proposals. In such an Area or Regional approach to planning for land and water resources development through a number of small size schemes, dotted over the in patches of cultivable lands of the hilly terrain, it would be too much to expect that for each individual minor irrigation scheme, elaborate details or determination of irrigation intensities, crop-yield rates, farm cost, etc. will be made available. But, at least such a presentation on each agro-climatic Zone and on each type of scheme should have been made. These being not there, attempts were made to obtain as much as could be available from secondary sources.

A team of experts was deputed for this. The following offices/departments were contacted for collecting data on crop parameters-cropping pattern, crop yields and prices. The offices visited were :-

1. Agro-Economic Research Centre, H.P. University, Shimla.
2. Directorate of Agriculture, Govt. of H.P.
3. Directorate of Land Records, Govt. of H.P.
4. Directorate of Economics and Statistics, Govt. of H.P.
5. Office of the Chief Engineer (Irg.), Govt. of H.P.
6. State Planning Board.

Data on cost of production of different field crops, horticultural crops, growth of agricultural development in different districts of H.P., market infrastructure, present methods of disposal of crop and horticulture produce practised by the farmers etc., were collected from the Agro- Economic Research Centre, Shimla. In addition an important document obtained was an unpublished Ph.D. thesis on various aspects of vegetable production and marketing of vegetable crops in some of the selected districts of Himachal Pradesh. This study is based on a well defined stratified during the course of data collection under the comprehensive cost of cultivation scheme (CCS).

In course of visit to the Directorate of Agriculture, data on various aspects of crop cultivation specially the information relating to estimation of crop yields on the basis of crop cutting surveys were collected. In the course of discussion with Dr. Mittal, Economist, Directorate of Agriculture, it was revealed that separate yield estimates for irrigated and unirrigated yields of various crops were not available. The cyclostyled sheets issued by Dr. Mittal on the results of crop cutting experiments did not contain separate yield estimates for irrigated and unirrigated crops. Package of practices issued by the H.P. Krishi Vishwa Vidyalaya every year for Kharif and Rabi season was found more useful in this aspect.

An important source of document that is, Season and Crop Report (ASCR) which give detailed information on various aspects of agricultural production districtwise, cropping pattern, crop yields, farm harvest prices was obtained from the Directorate of Land records. Their report provides two types of yield estimates - the standard yield and the current yield but does not distinguish between the irrigated and unirrigated crop yield. The intensive search for relevant data revealed that the ASCR was perhaps the only source of information in the State which provides such detailed estimates of various crop parameters at the district level. The latest Season and Crop Report available is for the year 1984-85.

For time-series data on growth of agriculture in H.P. as also on various other aspects of agricultural economy, irrigation, infrastructure, etc., the Directorate of Economics & Statistics was contacted and various publications providing requisite information both at the district level as well as State level were collected.

To collect data on policy parameters the Plan documents of the Govt. of H.P. were collected. The document provides useful information not only in respect of the current state of affairs of various sectors of the Himachal's economy but also provides useful information on the priority areas of development in the State. It provides information on irrigation, crops, infrastructural development, etc.

The office of the Chief Engineer, Irrigation was also visited by the Team to collect information on the growth of irrigation and performance reports on different types of irrigation schemes. The officials over there were not aware of any Ex-post evaluation having been carried out ever on any irrigation project in the State.

The Team members had also informal discussions with a number of people who had intimate knowledge of agricultural economy of the State. Some of these people were in fact practising farmers and provided useful information on various technical aspects of crop cultivation in the State.

The visits of the team to various offices at Shimla, and some project sites, their discussions with knowledgeable professionals and farmers and the reports as well as other publications collected were found in objective assessment of the situation and in adopting pragmatic approach in economic analysis of the proposed schemes. It would not be an exaggeration to claim that in the situation obtaining nothing more could be collected and/or ascertained through extended field visits.

5. REVIEW OF RELEVANT PARAMETERS

This report presents the results of economic evaluation of eight small scale irrigation projects in Himachal Pradesh which are included under the HALWD project of the USAID. The report begins with a review of assumptions contained in the Project Reports suggested modification therein gives estimates of shadow prices for major outputs and inputs and provides a range of estimates of economic rate of return (ERR) under alternative assumptions.

The assumptions made in the project reports on various parameters are reviewed in the light of existing crop situation, relevant information/data from published and unpublished reports and discussions with experts and knowledgeable farmers in the field. Data on cost of production of different field crops, horticultural crops in different districts of Himachal Pradesh, market infrastructures, present methods

of disposal of crop and horticultural produce were collected from the Agro- Economic Research Centre, Directorate of Economics and Statistics, Directorate of Agriculture, Directorate of Land Records and State Planning Board. Since vegetable crops are very important components of benefits of these irrigation projects. Projects and not even secondary data were available on this, unpublished Ph.D. thesis was referred to for detailed information on various aspects of vegetable prices, yields, marketing practices etc. Based on these reports, observations and discussion the cropping pattern, yield levels, crop outflow prices have been modified and adjusted in subsequent economic analysis. Specifically the area under vegetables: Yield flows and prices used in the report reflect the existing area, marketability conditions given the fact that existing cropping intensity of 200% does not increase under irrigated conditions, the project proposals envisaged a major shift from cereals to cash crops, particularly vegetables. This shift has been moderated to some extent keeping in view the subsistence nature of farming, present level of vegetable cultivation, emphasis on growing vegetables in the State all over through an intensive Vegetable Cultivation programme and market-ability condition. The existing cropping pattern, the pattern envisaged in the project proposal, and

the pattern adopted in the report for economic appraisal are given in Table 1.1.2 of the Report. To illustrate the basis of modification, the cases of a few lift irrigation, tubewell and flow irrigation schemes appear worthwhile. In case of L.I.S., Kangra, the existing area under Cereals is 92.5% of the Gross Cropped Area (GCA). In the project proposal it was brought down to 67.5%. This has been increased to 72.5% in this report. Similarly, in case of Kullu L.I.S., the existing area under Cereals was brought down from 43.34% to 20.31% in the project proposals. This has been increased to 39.58% in this report for economic evaluation. So far vegetables are concerned, similar adjustments had to be made. In case of Kangra L.I. Scheme, there is no vegetable cultivation at present but 20% of the G.C.A. was proposed in the project proposals. This has been moderated to 15%. In L.I.S. Kullu, under existing conditions of 3.05% of G.C.A. is under vegetables and 45.18% under orchards. In the project proposals area under vegetabl was increased from 3.05% to 26.89%. Keeping the area under orchards unchanged, this has been moderated to 9.14% under vegetables and area under orchard has been kept intact. In case of Solan T.W. Scheme, the project proposals envisaged 22.29% of G.C.A., under vegetables against NIL area under existing conditions. This has been moderated to 13.43%. Similarly, in F.I.S., Shimla area under vegetables plus

potato has been kept at 39.72% against 49.69% proposed in the project proposals and 26.77% under existing conditions. All these will show that while objective of intensifying vegetable cultivation in the hill State has been the guiding factor in determining, crop intensities, the need for sustaining the pace of food production has not been lost sight of.

6. APPROACH TO ECONOMIC ANALYSIS

Economic Rates of Return (ERRs) for the eight projects have been calculated by estimating benefits and costs of the project using shadow prices for major outputs and inputs. The benefits of the project are essentially identified with direct primary benefits while indirect and induced effects of the project could not be incorporated due to lack of information. Similarly, only the direct costs have been considered and indirect costs including externalities and environmental impacts could not be quantified in short time available for the project and due to the fact that the individual schemes under appraisal were too small for any such meaningful analysis. Of course, a passing reference has been made in the report drawing attention towards preserving the fertility of the thin mantle of soil generally met with in hilly tarrain. The direct benefits of a project have been calculated as the value of the incremental

net farm income defined as "With project" minus "Without Project" i.e. the entire increase in net value added under "With Project" condition over that under "Without Project" condition is due to or attributable to irrigation.

Since in a developing country such as India, the prices of foodgrains and other agricultural commodities, major agricultural inputs (fertilizers, diesel oil, electricity) and components of project costs (cement, steel, unskilled labour) are "administered prices", these do not reflect their true social value or opportunity costs. Shadow prices for major outputs and inputs have been estimated as follows:

(i) Traded or tradable commodities (foodgrains, fertilizers, sugar) have been valued at c.i.f. or f.o.b. prices adjusted for the shadow exchange rate and domestic transport costs;

(ii) For the non-traded outputs (vegetables, apples) shadow prices are equated to the "consumers willingness to pay" as reflected by the market prices for these commodities;

(iii) Non-traded inputs (e.g. electricity) have been valued in terms of long-term marginal cost of supply. Cost of supply after taking into account the transmission and distribution losses.

Using these criteria, the estimated shadow prices for paddy are about 45 per cent higher than its market price while the shadow prices for wheat, barley and oilseeds are 74 per cent higher than their corresponding market prices. The estimated shadow prices for introgenous fertilizer and phosphatic fertilizers are 27 per cent and 13 per cent higher than their market prices, respectively. The estimated shadow price of electricity is almost 107 per cent higher than the tariff rate used in the tubewell and lift irrigation schemes. Given the resources and short time available for the project, it was not possible to estimate shadow wage rates for unskilled labour in each project region. A notional value of 0.4 has been used to convert the wage cost at market prices into wage cost at shadow prices. The possibilities of higher shadow wage rates have been considered through sensitivity analysis of capital costs. Since, estimation of shadow exchange rate and opportunity cost of capital were outside the scope of this project, notional values currently used in the Planning Commission for appraisal of projects have been adopted. A premium of 25 per cent on foreign exchange has been used to reflect its scarcity value i.e., a shadow price of Rs. 17.5 per U.S. dollar, as compared with the official exchange rate of Rs. 14 per U.S. dollar, The opportunity cost of capital in the Indian economy has been taken as 12 per cent. Sensitivity analysis

has been performed with respect to shadow exchange rate, capital costs, electricity price and value of output.

The results of using these shadow prices are that, except in the case of L.I.S. Kullu, the ERR at shadow prices is higher than the IRR at market prices. In Kullu, since orchards account for about 56 per cent of the total net benefit (where shadow price is considered equal to the market prices), the use of shadow prices on the benefit side does not increase the value of benefits while the use of shadow price for electricity almost doubles the O&M costs. These aspects are discussed in detail later.

7. ECONOMIC RATES OF RETURN

Economic Rates of Return or the Internal Rates of Return for all the eight projects have been calculated. One section has been devoted to each project. The IRRs for each project, one on market price and the other on shadow prices of inputs and outputs have been calculated. The results are as under:

PROJECT	IRR IN MARKET PRICE SOLUTION	IRR ON SHADOW PRICE SOLUTION
TW at Una	18.37%	26.0%
TW in Solan	15.38%	16.60%
L.I.S. in Kangra	20.32%	23.42%
L.I.S. in KULLU	11.71%	4.9%
Tank in Shimla	13.59%	21.0%
Tank in Mandi	22.9%	31.0%
F.I.S. in Mandi	13.45%	14.56%
F.I.S. in Shimla	20.3%	24.2%

It would be seen that in all cases except in case of Lift irrigation scheme in Kullu district the IRR in shadow price solution is more than that in market price solution. The details of IRR calculation in Table 3.2.4 show that (a) the net benefits increase from Rs. 10.85 lacs in market price solution to Rs. 12.78 lacs in shadow price solution; (b) O & M cost increases from Rs. 5.6 lacs to Rs. 9.94 lacs per annum; (c) it is mainly because of over 70% increase in the O & M cost that the IRR in shadow price solution is so low. This was inevitable because the project involves very high head lift consuming more electrical energy which was charged at subsidised rates in the market price solution. The real cost of energy being much more,

16

the value of O & M costs at shadow prices has gone up substantially. There are two lift irrigation schemes, one in Kangra involving a lift of 138.0 metres, and another in Kullu involving a lift of 151.0 metres, both having almost equal C.C.A. But, in Kangra L.I.S. the O & M cost at shadow prices is only Rs. 6.93 lacs as against Rs. 9.96 lacs in case of Kullu L.I. Scheme. This difference is mainly due to higher energy consumption in Kulu L.I.S., because the unit rates of energy are the same in both cases.

Some other factors also have caused lower value of IRR in Kullu L.I.Scheme. About 45% of G.C.A. is under horticulture which is reported to yield net annual benefits much less than that of the vegetables. Besides, the area under orchards is not available for raising more than one crop in the year. The capital cost of Kullu L.I. Scheme is also relatively higher than that of Kangra L.I. Scheme. The incidence of cost per hac. is Rs. 18,126.0 in Kullu L.I.S. as against Rs. 15,955.0 for the other L.I. Scheme. The incidence of cost in case of Kullu L.I.S will go up further if it is calculated reckoning the area under orchards as a single crop and not double crop as it has been done according to standard practices in agricultural economics.

The unit rate of Rs. 1.14 per KWH as adopted in shadow price solution could in no case be considered high because

it is almost the same as the actual cost incurred by Himachal State Electricity Board. It would not be out of place to mention here that in the Bihar Tubewell Project, 1986 (aided by the World Bank) a rate of Rs. 1.03 per unit had been adopted though the subsidised rates charged was only Re. 0.34 per unit.

The results of ERR estimation indicated that out of eight proposals under review, the following four needed to be carefully examined through sensitivity tests.

i) T.W. Scheme in Solan District

ii) L.I. Scheme in Kullu District

iii) Tank Scheme in Mandi District

iv) F.I. Scheme in Mandi District

RESULTS OF SENSITIVITY ANALYSES

Results of Sensitivity Analysis are presented in Section 6 of the Report. The conclusion drawn from the analysis as conducted has been that the L.I. Scheme in Kullu district and the T.W. Scheme in Solan district need further analysis specially with respect to level of benefits and shadow price of power. The other six schemes appear to be economically viable within expected range of uncertainties. The Tank Scheme in Shimla and F.I. Scheme in Mandi no doubt yield lower values of IRR (10.8% and 7.9% respectively when

tested for 25% reduction in gross value of output combined with 25% increase in capital cost, but since area under vegetable is not much higher than what exists under irrigated condition, there be no apprehension of fall in the value of outputs. In the case of F.I.S., Mandi the area under cash crops has also been substantially moderated for economic analysis, there should be no apprehension for 25% fall in the benefits. All the same, the F.I. Scheme, Mandi yields first 12% IRR when tested for 25% rise in capital alone. Therefore, there remains the need for closer watch on the capital cost.

The other two types of schemes are (i) the T.W. Scheme in Solan district and (ii) the L.I. Scheme in Kullu district in which use of electric power plays main role, especially in OMR costs. The IRR of T.W. S. in Solan decreases to 12% when tested for 10% decrease in net benefits, drops down to 4.4% from 16.6% when tested for 25% fall in gross value of output (GVO) but increases to 20.9% when tested for 10% increase in GVO. The ERR decreases to 14.8% (from 16.6%) in case of 33% increase in shadow price of electricity, and to 13.7% when tested for 25% increase in capital cost. Thus, this project is highly sensitive to GVO. In this scheme, the chance of 10% fall in GVO cannot be altogether ruled out because 43.43% GCA is now included under vegetables

19

against NIL in pre-project condition. But, even then the ERR equals the cut-off value of 12%. The L.I.S. in Kullu is the most critical case because the IRR is first 4.9% in the base case and when tested for 10% increases in the GVO, it rises to 7.0% only. As stated earlier, about 54.32% of the GCA is already vegetables (9.14%) and orchards (45%) and as such prospects of increase in GVO through increasing area under cash crops is rather bleak. However, the economics of orchards which are reported to be yielding higher value of benefits than that from vegetables and is the most dominant crops in the command of the scheme deserves further in-depth study if the decision is in favour of considering it for approval.

SOME OTHER ASPECTS OF INTEREST

Incidence of Irrigation Costs

The incidence of capital cost of tubewell scheme varies Rs. 22,780/- to Rs. 24,430/- per hectare of cultivated command area (CCA) while for the L.I.S. it varies from Rs. 31,640/- to Rs. 35,090/- per hactare. Except for F.I.S., Mandi where it is Rs. 18,120/- per hactare, in all others, the range is more or less the same as in T.W. and L.I.S. schemes. Since cropping intensity is taken as 200 per cent, the incidence cost per hactare of gross cropped area gets

reduced by one-half. Using a discount rate of 12% and 30 years life, the annualized capital costs are around Rs. 1,550/- per hactare (of GCA) for tubewell schemes and around Rs. 2,000/- to Rs. 2,200/- per hactare for lift irrigation schemes. The incidence of O & M costs at shadow prices is around Rs. 2,700/- per hactare of cropped area for tubewell projects. Thus, annual costs are of the order of Rs. 4,250/- per hactare of cropped area in tubewell schemes. In the case of L.I.S. the incidence of O & M costs at shadow prices Rs. 3,460/- per hactare for Kangra and Rs. 5,020/- per hactare for Kullu. This gives an incidence of annual costs of Rs. 5,460/- to Rs. 7,220/- per cropped hactare under lift irrigation schemes. Thus, even if only annual O & M costs have to be recovered from the farmer, the irrigation charges would have to be of the order of Rs. 3,500/- to Rs. 5,000/- per hactare for L.I.S. and Rs. 2,700/- per hactare for tubewell schemes.

REPLACEMENT LIFESPAN OF EQUIPMENT

The Project Reports estimate that the lifespan of pumping machinery will be 15 years. Accordingly there has been one replacement of machinery in a project life of 30 years. This has been adopted as such in the economic analysis. However, generally the replacement lifespan of pumping units in large size tubewells is taken as 10 years, that of the well as 10 years and that of the pumphouse and distribution chamber

as 20 years. Although taking two replacements of pumping units in the 30 years lifespan of the project may affect the ERR marginally, this factor may have to be taken into account in some projects.

Appendix D

SUMMARY OF OBSERVATIONS: HILL AREA LAND AND WATER DEVELOPMENT PROJECT ANALYSIS OF RECURRENT COSTS AND STATE BUDGET

by

Rajesh Chhabra
Office of the Controller
and
Rakesh Duda
Office of Projects
USAID/New Delhi

SUMMARY OF OBSERVATIONS

OBSERVATIONS:

I. Based upon review of the old State sector Lift Irrigation Schemes (LIS), State budget and cost records, it can be concluded that the GOHP will have sufficient resources to support the recurrent costs of LIS (head not to exceed 150 meters) for another 8-10 years. After 8-10 years GOHP will have to face a huge liability for replacement of Pump & Machinery. The conclusion for sufficient State resources is based upon the trend of actual expenditures vis-a-vis budget provisions since 1983-84.(Refer para 4.0)

II The energy charges per hectare for LIS increase substantially beyond a head of 150 meters for lift irrigation schemes. (Refer para 3.2.1)

III Energy charges stand out to be the major cost parameter of the recurrent cost. Energy costs account for 70% of the average recurrent costs (including depreciation) and 78% of the average recurrent costs if depreciation is excluded. (Refer para 3.2.1)

IV The maintenance and operation costs of schemes are budgeted under the "Non Plan" budget. The state budgeting is not based on the maintenance cost of irrigation schemes but on the actual expenditure incurred in the previous year adjusted for inflation and the additional area brought under irrigation.

V Over the last four years the cumulative actual expenditure of maintenance and repairs for minor irrigation schemes has exceeded the budget estimates by only 0.6%. (Refer para 4.1)

VI The budgeted amount for repair and maintenance for the year 1987-88 falls short of the anticipated actual by only 7% (Refer para 4.2)

VII As against the original budget estimate of Rs 29 million for repair and maintenance in the year 1988-89 the actual expenditure is expected to be Rs37.5 Million. However, as has been happening in the past the budget estimates will be revised (in Sept-Oct'88) to take care of the shortfall.(Refer para 4.2)

SUGGESTIONS:

I IRR should not be the sole criteria for the selection of lift irrigation schemes. It is suggested that additional criteria like a) capital cost per hectare should not exceed Rs32,000 and (b) the projected recurrent cost should not exceed Rs3,600 (excluding depreciation) per hectare, should be incorporated for AID-financed schemes. (Refer para 3.2.2)

II The minimum coverage of CCA under the LIS and FIS should be prescribed.

III LIS's with a head of more than a 100 meters should have a greater [illegible]

Appendix E

OBSERVATIONS AND RECOMMENDATIONS FOR
IRRIGATION MASTER PLANS IN HIMACHAL PRADESH

Observations and Recommendations for Irrigation Master Plans in Himachal Pradesh

Prepared by
Mike Walter and N.R. Banerjee.

The following discussion of H.P. irrigation master plans is based on a two-day visit by M.Walter, J.Grant, and N.R. Banerjee. We looked at two master plans (that for the the Rohru subdistrict of Shimla in great detail) and talked with ID officials who participated in preparing the plans.

H.P. had a master planning division within IPH until about 1983 when it was abolished because the task had been completed for all subdistricts in the state. It is not clear what uses, if any, were ever made of the master plans. Planning was done over a nine year period starting in about 1970. It was done at the subdistrict level and no further aggregation or compilation has been done.

The master plans were developed by two ID staff in each subdistrict, one junior engineer and one surveyor, spending an extended time on site in each subdistrict. These planners would contact local panchayats to determine the location of potential irrigation schemes as well as existing community and government systems.

The master plans appear to be fairly comprehensive in many respects. They include a listing of existing systems, some details about those systems (e.g. command area, water source, length of conveyance canal), and a map showing their locations. The map is relatively detailed with a scale of about 1 to 1500. A rough analysis has been done of the cost and benefit of each proposed system which, of course, includes anticipated cropping patterns.

Not included in the master plans we saw are any detailed soil survey, data on water rights, or local farmer organization.

Illustrative of the type of information in the master plans is that for Rohru subdistrict.

Total area	22,000 hectares
Cultivated area	15,000 hectares
Additional area that could be cultivated	7,500 hectares
Irrigated area	810 hectares
Community	600 hectares
Government	210 hectares
Potential irrigated area	7,500 hectares
Flow schemes	5,000 hectares
Lift schemes	2,500 hectares

Economic analysis was done for each scheme and then catagorized in summary form as follows:

	B/C Ratio
Flow schemes	20:1
Lift 0-150 m	4:1
Lift 151-300 m	3:1
Lift 301-700 m	2:1

No other priority ordering of schemes was done although each scheme could have been ranked by economic factors such as B/C ratio, total cost, or cost per hectare.

In our opinion, the potentially most useful component of the master plans are the detailed information and mapping of community and other existing and potential schemes.

By way of general discussion, a few aspects of the master plans and comments made about them seem particularly enlightening. These include:

- Master plans are rarely referred to in selecting new schemes; never as the initial starting point. In Solan, no master plan could be located at the district office.

- The Rohru subdistrict (one of nine in Shimla which is one of ten districts under the AID project) master plan identified 58 potential flow schemes (as of about 1976) with a cumulative command area of about 5000 hectares (the target for the new schemes under USAID HALWD project is 15000 hectares).

- The Solan Executive Engineer estimated that 25 to 30 schemes with potential command areas of 50 hectares each and lifts of 40 - 80 m could be constructed in his area.

- Potential sources and areas included in the master plan were first decided upon in consultation with the local Pradhan. They were not initially identified by an analysis of the local natural resources.

- There is a notion that the goal is to irrigate all earmarked areas so that it does not matter which scheme is developed first (e.g. there is no need for a master plan for setting priorities or economic planning)

We were impressed by the master plans we saw and encouraged that if master planning as an ongoing process was established in H.P. it could be very useful in developing a rational long range strategy. It must, however, be done in such a way that it complements rather than competes with the established practices for selecting schemes with heavy involvement by local representatives.

This might be done effectively through one or several of the following options:

- A Master Planning Unit could be developed at the state level to act as an advisory body. Such a unit would have primary responsibility of familiarizing itself of the natural resources of the state and opportunities for environmentally sound exploitation of these. An analysis of water resource development potential based on the physical environment, available markets, and the like would aid state and administrative officials in setting an irrigation development strategy. Such a unit might initially evaluate potential schemes, including primarily those in the existing Master Plans, to determine priority in selection of the most cost effective system in the state.

- A Master Planning Division could be reestablished within the IPH with a somewhat more forceful role than the unit mentioned above. In support of the AID HALWD Project, the short term task of this division would be to use information available in the existing Master Plans together with any necessary supplemental data to give clearance for any proposed scheme with certification that no other technically and economically viable schemes are feasible for serving the area or using the water source proposed. Supplemental information would include local water rights. The detailed planning and investigation works for the proposed scheme would only be taken up thereafter.

  In the long term, such a division would assume the role of continually updating the subdistrict plans on district and state levels. The resources and opportunities of a state as highly variable as H.P. cannot be optimized unless this analysis is done at the state level and development is coordinated so as to give priority to the best schemes.

- With or without either of the above groups, a natural resources survey unit is required. Such a unit would be responsible for quantifying and identifying the land and water resources of the state. With new technologies for monitoring, remote sensing, taxonomy, and the like, such a unit could provide invaluable information for environmentally and economically sound development.

Immediate steps should be taken by the Cell to use the Master Plans that are available. These plans can be utilized by the Project Cell to identify and give priority to the potential irrigation schemes, which are technically and economically feasible on a statewide basis. The Cell could design a certification similar to that discussed above. Final selection of schemes will be done from this list thus prepared. H.P. seems to have a mind set toward appraising and building irrigation schemes. Soon, however, it must divert some attention from the pre-occupation with individual irrigation schemes to a broader irrigation strategy based on national policies. This strategy must be statewide, not just subdistrictwise.

A state irrigation planning approach will be based on needs and possibilities only after an analysis of different irrigation options including future land and water use possibilities. Such an analysis will lead to selection of only the best choices of schemes for a given area. The state needs to back off and take a broader view of its irrigation sector, and maybe all of its water resources.

XD-AAZ-209-A
61002

HILL AREAS LAND AND WATER DEVELOPMENT PROJECT

ANALYSIS OF RECURRENT COSTS AND STATE BUDGET

RAJESH CHHABRA
OFFICE OF THE CONTROLLER

RAKESH DUDA
OFFICE OF PROJECTS

USAID
NEW DELHI

July 1988

94

SUMMARY OF OBSERVATIONS

OBSERVATIONS:

I. Based upon review of the old State sector Lift Irrigation Schemes (LIS), State budget and cost records, it can be concluded that the GOHP will have sufficient resources to support the recurrent costs of LIS (head not to exceed 150 meters) for another 8-10 years. After 8-10 years GOHP will have to face a huge liability for replacement of Pump & Machinery. The conclusion for sufficient State resources is based upon the trend of actual expenditures vis-a-vis budget provisions since 1983-84.(Refer para 4.0)

II The energy charges per hectare for LIS increase substantially beyond a head of 150 meters for lift irrigation schemes. (Refer para 3.2.1)

III Energy charges stand out to be the major cost parameter of the recurrent cost. Energy costs account for 70% of the average recurrent costs (including depreciation) and 78% of the average recurrent costs if depreciation is excluded. (Refer para 3.2.1)

IV The maintenance and operation costs of schemes are budgeted under the "Non Plan" budget. The state budgeting is not based on the maintenance cost of irrigation schemes but on the actual expenditure incurred in the previous year adjusted for inflation and the additional area brought under irrigation.

V Over the last four years the cumulative actual expenditure of maintenance and repairs for minor irrigation schemes has exceeded the budget estimates by only 0.6%. (Refer para 4.1)

VI The budgeted amount for repair and maintenance for the year 1987-88 falls short of the anticipated actual by only 7% (Refer para 4.2)

VII As against the original budget estimate of Rs 29 million for repair and maintenance in the year 1988-89 the actual expenditure is expected to be Rs37.5 Million. However, as has been happening in the past the budget estimates will be revised (in Sept-Oct'88) to take care of the shortfall.(Refer para 4.2)

SUGGESTIONS:

I IRR should not be the sole criteria for the selection of lift irrigation schemes. It is suggested that additional criteria like a) capital cost per hectare should not exceed Rs32,000 and (b) the projected recurrent cost should not exceed Rs3,600 (excluding depreciation) per hectare, should be incorporated for AID-financed schemes. (Refer para 3.2.2)

II The minimum coverage of CCA under the LIS and FIS should be prescribed.

III LIS's with a head of more than a 100 meters should have a greater coverage to offset the higher recurrent costs.

1. PURPOSE:

In the evaluation of the HALWD Project carried out in March, 1988 it was observed that the IRR of many of the schemes was questionable particularly in the case of high lift irrigation scheme. It was also observed that given the low water charges and the high recurrent cost the project investment will become increasingly burdensome.

This study has been undertaken for the following specific purposes in light of the above observation in the evaluation report.

1.1 Recurrent Cost Analysis: To analyse the recurrent costs for the operation and maintenance of the lift irrigation schemes categorized by their head and suggest additional indicators other than the IRR that in used, as a criteria for the selection of scheme.

1.2 State Budget Analysis: To review the non-plan budget of the Irrigation and Public Health Department to determine the provisions made for meeting the recurrent costs of the lift irrigation schemes under the HALWD Project and also to forecast the budget provisions required for meeting these costs in the future.

2. BACKGROUND:

As a result of the hilly terrain of alomost the entire state of Himachal Pradesh the lift irrigation system is one of the important means of irrigation. Although the flow irrigation (FI) system has an economic advantage over the LI, it cannot be put to use at places where the source of water is at a lower elevation than the area to be irrigated.

As a result of the topography of the area a significant man-made effort goes in for the building up of a system by which water is pumped up to a higher elevation and made to run down through a well determined path to irrigate agricultural fields.

Lift irrigation is being used in the state for quite a few years. The head of the system depends on the terrain of the area and also the area to be covered under the scheme. The State Government, after the HALWD project was taken up, have stopped taking up LI schemes from the state budget. All new schemes that are coming up are under the Project.

Pumping water up an elevation of a hundred meters or more is no doubt a very expensive proposition with an equally expensive operation and maintenance costs. But, the fact that emerges is that in view of the limited scope of the not so expensive means of irrigation, such as the flow irrigation, and the topography of the state, the Government have little choice other than to go in for LIS. This is a major policy issue and is beyond the scope of this review. What is of primary concern here is that as the Government is providing irrigation water at a nominal price, and this price has no relevance to the recurrent cost incurred, it becomes necessary to clearly set forth the parameters that should guide in the selection of the schemes. The other area of concern is the review of the budgetary provisions for the recurrent cost of the schemes under the project.

A field trip was undertaken by the authors of the report to look into the various costs, both estimated as well as actual, to arrive at the recurrent costs for the schemes of different levels of head.. Based on this an analysis was carried out to determine the total operational and maintenance budget for the AID financed schemes.

3. RECURRENT COST ANALYSIS :

3.1 Cost Parameters:

3.1.1 After extensive discussions with Mr. S.K.Gautam, Chief Engineer and Mr. G.C.Gupta, Superintending Engineer in the Project Cell of the Irrigation Department (ID) the following cost parameters of recurrent costs were agreed to:

a) Establishment Cost: To include only the wages of the daily wagers who directly work for the maintenance and operation of the irrigation equipment and civil works of the scheme.

b) Energy Charges: There are two dimensions to this cost parameter. First is the variable charge of approximately 55 paise per unit and the second is a fixed charge called the "annual demand charge" on the idle machinery. However, there is information that the State Electricity Board has stopped taking the annual demand charges after protracted representations by the Irrigation Department.

c) Maintenance Charges/Depreciation: Most of the USAID supported irrigation schemes are new and thus the actual data does not reflect the true picture of repair cost borne by the schemes. Therefore, it was agreed that combined effect of repairs and depreciation will be reflected in the recurrent cost analysis at the following rates:

- Civil Works	@ 2.0%
- Rising Main	@ 3.5%
- Pump & Machinery	@ 6.5%

d) Indirect salaries: Salaries paid at the Division/Circle level to the Irrigation Department staff.

Theoretically, the interest on the capital costs should also be a cost parameter for recurrent costs, but as the funds are provided by the State Government without charging any interest, this cost parameter has been neglected.

3.1.2 It is a good commercial practice to provide for depreciation on the fixed assets and it was also necessary for the purposes of "recurrent cost analysis" to assess the recurrent costs of the selected schemes, with depreciation as a cost parameter. However, it would be appreciated that the GOI and state budgeting is expenditure based and thus does not allow any reserves or provisions to be created for expenditure in future. In other words the amount budgeted should be disbursed (not accrued or expended) in the same budgeting year. Thus, the state budget rightly excludes depreciation as part of the "Non Plan" budget. GOHP budget will face a huge liability for repairs and replacement of machinery after about 10-12 years as most of the pumps and machinery installed in the state sector and USAID schemes from 1986 thru 1988 will then fall due for replacement. As of now, GOHP has faced negligible liability in terms of replacement of machinery because most of the state sector schemes were also initiated in 1979-80.

However, the GOHP liability for recurrent costs upto the PACD will be nominal and this would mostly pertain to energy charges and very low percentage of repairs element. Thus, for the purpose of assessing the GOHP provision for recurrent costs of Lift Irrigation Schemes (existing and proposed), the depreciation as a recurrent cost parameter has also been excluded. Instead of depreciation, repairs have been taken into account at the following rates:

- Civil Works	@ 1.0 %
- Rising Main	@ 0.25%
- Pump & Machinery	@ 2.5 %

The above mentioned rates for repairs have been prescribed by GOI under their circular# C.E-PW-PH-Maintenance/87-7423-32 dated August 1,1987 (rates prescribed for water supply schemes).

3.1.3 No depreciation has been provided on the cost of power line. The initial investment in the powerline is borne by the ID. It is the responsibility of the State Electricity Board (SEB) to provide for maintenance and replacement of the powerlines. The ID is not required to pay any amount for maintenance of the power lines, although it might be included in the energy charges, which are paid to SEB at the commercial rates (no subsidy by SEB to ID).

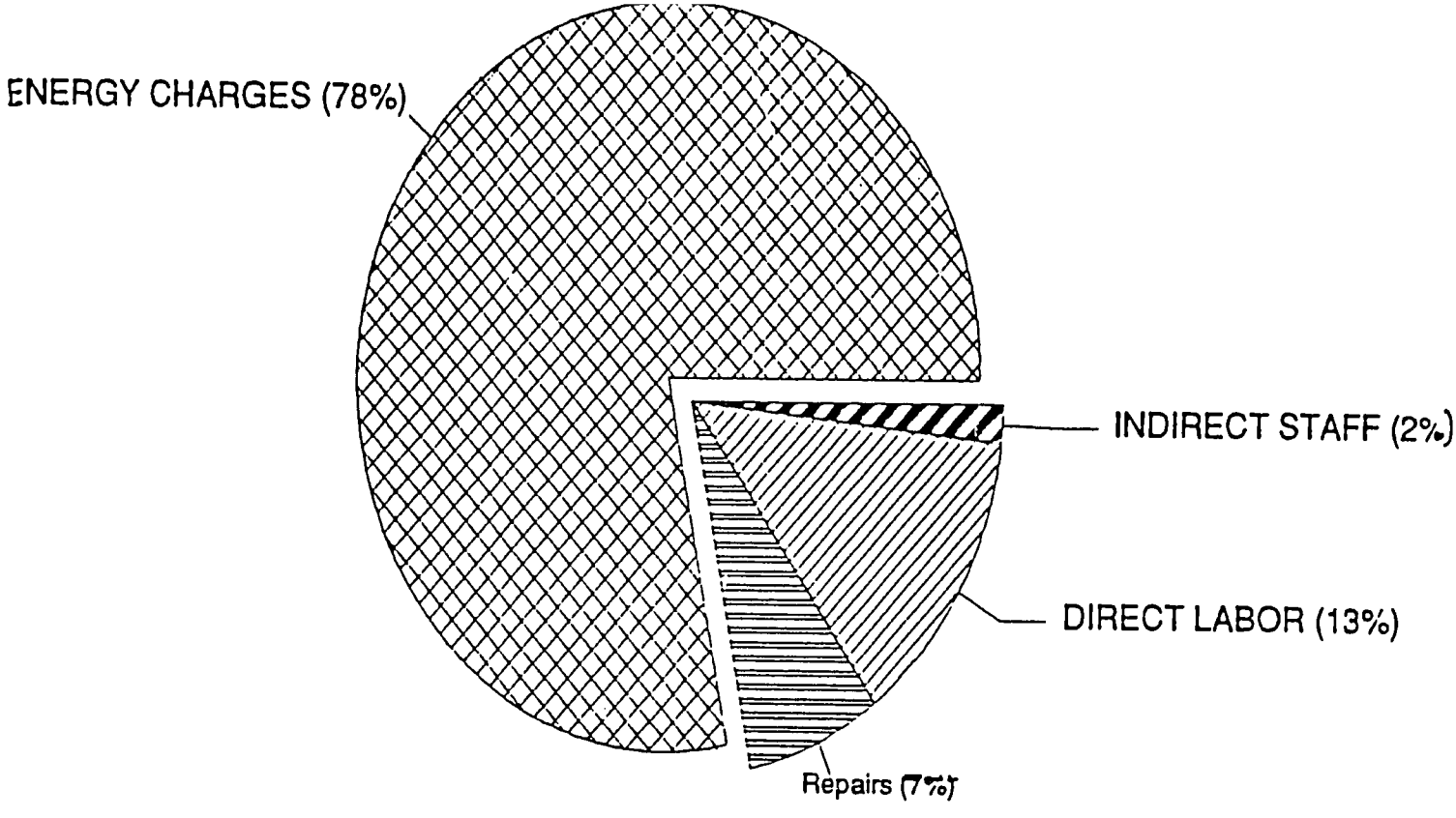
3.1.4 Salaries of the Project Cell and the IPH HQ at Shimla have not been apportioned to the maintenance and operation cost of the schemes. After discussions with the staff of Project Cell, it was concluded that their staff along with IPH staff were involved only upto the construction part of the irrigation schemes. The maintenance of irrigation schemes is being exclusively handled at the Circle and Division levels of the Irrigation Department.

3.2 OBSERVATIONS/CONCLUSIONS:

3.2.1 Attachment 'A' summarizes the recurrent cost analysis of the eight schemes selected (4 LIS and 4 TW) for the purpose of this analysis. The observations in the attachment are summarized as follows:

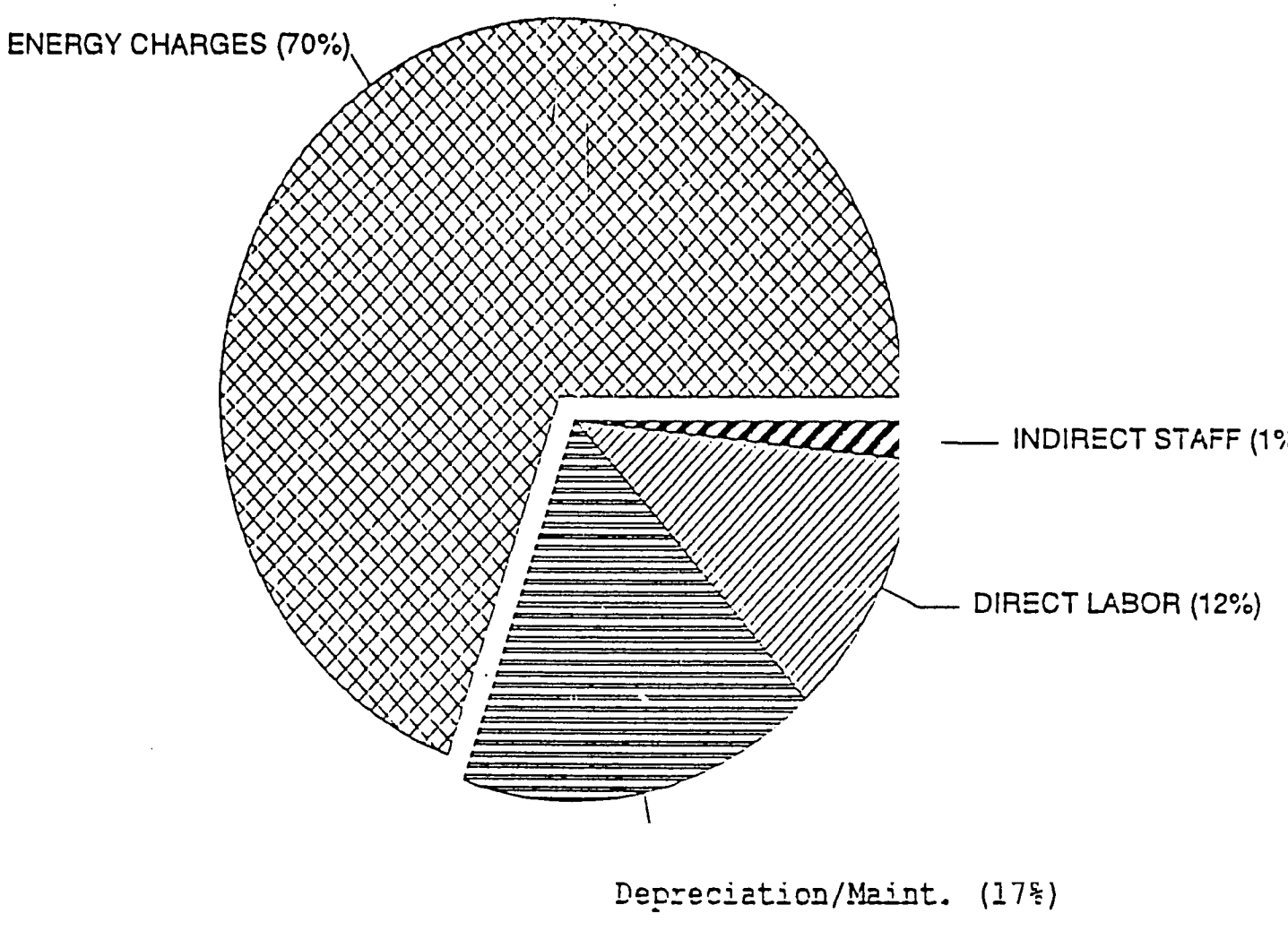
RECURRENT COST PARAMETERS

EXCLUDING DEPRECIATION



RECURRENT COST PARAMETERS

INCLUDING DEPRECIATION



Cost Parameters	Cost per Hectare-Rs	% (incl Depri.)	% (excl Depri.)
A. Capital Cost	27,149	-	-
B. Recurrent Costs			
Energy Charges	2,817	69.96%	78.46%
Depreciation/Maint.	687	17.06%	-
Direct Labor	466	11.58%	12.99%
Indirect Staff	57	1.40%	1.58%
Total Recurrent Cost (Including Depreciation)	4,027	100.00%	-
Repairs/Maintenance	250		6.97%
Total Recurrent Cost (Excluding Depreciation)	3,590		100.00%

Energy charges clearly stand out to be the major cost parameter of the recurrent cost. The effect of the head of lift irrigation schemes on the energy charges can be analyzed as follows:

Scheme	Head	Energy Charges Per Hectare (Rs)	Capital Cost Per Hectare (Rs)
Basal Basola	42.25 meters	1,410	23,597
Sai Bhardwan	62.57 meters	2,685	27,812
Ghatti Nagchela	I-24.02 meters II-52.31 mts	2,097	27,323
Neri Jamli	I - 10.87 mts II-237.89 mts	4,769	26,510

It may be noted from the above mentioned cost details that the energy charges take a big leap for the Lift Irrigation Schemes which are above 150 meters. (there are only few completed LIS under HALWD and further the limited availability of time restricted the sample size). There is only one LIS approved by USAID, which has a lift of more than 155 meters i.e.; Neri Jamli and there are 3 schemes with a lift between 150 and 155 meters. Not much variation was observed for the capital cost per hectare among the 8 schemes reviewed with head ranging from 42.25 meters to 237.89 meters.

Prima facie it seems that high lift schemes (i.e., substantially over 150 meters) are motivated more by the social objective rather than the economic returns. In one of the state sector LIS, it was observed that State had spent almost Rs 55,929 per hectare (excluding chak development costs, which is approx. Rs.14,437 per hectare in addition to the capital cost) with current CCA of only 32 hectares. The actual recurrent cost of the scheme (including depreciation) worked out to Rs. 8,568 per hectare per year. (Ref: Panesh Kanda LIS, Shimla Division, Head-285 meters). Total collection from farmers under this scheme during the year 1987-88 was approx. Rs. 350/- and even this meagre collection goes into the State treasury and not to the irrigation department.

3.2.2 IRR, although a very good indicator of financial viability of any activity has its limitations in terms of unrealistic assumptions, inflated benefits etc. IRR is better suited for prioritizing 2 or 3 options worked out on the same set of assumptions. The sole criteria for selection of an irrigation scheme under HALWD project that is IRR greater than 12%, it is suggested that efforts be made to negotiate additional criteria for LIS like:

a) Capital cost per hectare not to exceed Rs. 32,000/- per hectare.

b) Projected recurrent costs per hectare not to exceed Rs.3600 (excluding depreciation) per hectare per year.

The above limitations will probably keep the maximum lift below 150 meters and will also ensure that the schemes are cost effective in terms of capital invested and future recurring liability.

3.2.3 Although the scheme at Badhera has an IRR as high as 20.72 % and even the head is only 73.72 meters, but this scheme will have recurrent cost as high as Rs.5,503 per hectare as against the scheme of Ghatti Nagchela with a head of 152.31 meters and having a recurrent cost liability of only Rs.3,262 per hectare. The reason for this difference is that the Badhera scheme is catering to only 15 hectares. Thus, even lower coverage in terms of CCA can be a cause for high recurrent costs. Therefore, it is suggested that the following steps may be considered with regard to coverage:

a) Prescribe minimum coverage under lift and flow irrigation schemes; and
b) Link lift schemes over 100 meters with higher coverage to offset the effect of higher recurrent costs of such schemes.

3.2.4 The recurrent costs of LIS stand no comparison with FIS, because the gravitational force in the latter substitutes expensive energy charges and further even the element of repairs is negligible. Thus, the cost parameters for operating flow irrigation schemes are a) direct labor (approx. 50% of LIS labor costs); and b) Depreciation and repairs on civil works and distribution system. The recurrent cost of a flow irrigation schemes will average aprrox. Rs.700-800 per hectare (includes depreciation) against an average recurrent costs of Rs 4,000 per hectare (includes depreciation) for lift irrigation schemes. The capital cost of flow irrigation scheme may average Rs. 20,000 (includes chak development) against Rs. 30,000 for lift irrigation schemes.

4.0 STATE BUDGET ANALYSIS:

4.1 The maintenance and operation cost of the irrigation schemes are budgeted under "Non-Plan" budget with a very negligible amount under "Plan" portion. The "Plan" budget usually comprises of the

capital costs for irrigation schemes. Upto 1987-88 GOHP had also included certain maintenance costs in the "Plan" budget, however effective 1988-89 GOI has clearly instructed GOHP to exclude maintenance costs from the "Plan" budget. The State budgeting of maintenance costs is not based upon the number of operational irrigation schemes but is based upon the past year actuals adjusted for inflation and additional area brought under irrigation. GOHP budgeting norms for maintenance of irrigation schemes are very low. IPH recommendation to the ninth finance commission for maintenance costs are Rs. 289 per hectare for gravity schemes and Rs. 1,023 per hectare for lift irrigation schemes. The ID meets its higher maintenance cost as against the lower budget provisions, the reply was that they make use of other budget line items like repairs of irrigation schemes due to natural calamities etc. Detailed in attachment 'B' is a comparison of the budget provisions and the actual expenditure incurred by the irrigation department since 1983-84 under "Non-Plan" for operations and maintenance of minor irrigation schemes.

The budget v/s actual comparison can be summarized as follows:

Year	Budget Amount	Actual Expend.	Shortfall/Excess Provision
	(Rs in millions)		
1983-84	12.500	12.336	1.3%
1984-85	13.085	14.546	-11.2%
1985-86	19.839	19.260	2.9%
1986-87	24.330	23.998	1.4%
TOTAL	69.754	70.140	- 0.6%

It may be noted that in the past four years the actual expenditure for maintenance and repairs have exceeded the budget estimates by only 0.6%. However, the Irrigation Department has a practice of submitting a revised budget estimate in the latter half of the

fiscal year, and which is usually accepted by GOHP subject to fund availability. The revised budget estimates incorporate the additional fund requirements due to unforeseen circumstances.

4.2 The budget estimates for 1987-88 and 1988-89 under "Non-Plan" budget for maintenance and operation of minor irrigation schemes are as follows:

Type of Scheme	Original Estimate 1987-88	Revised Estimate 1987-88	Difference	Original Estimate 1988-89
	(Rs in millions)			
Lift Irr. Scheme	13.487	15.087	11.9%	14.162
Flow Irr. Scheme	6.176	6.676	8.1%	8.748
Tube Well	5.823	6.423	10.3%	6.114
TOTAL	25.486	28.186	10.6%	29.024

The revised budget estimate for 1988-89 is due in September-October 1988. The actual expenditure during the year 1986-87 was Rs 24 million and another 1,686 ha of CCA was irrigated during the same year. Breakdown of 1,686 ha into FIS and LIS is not available, thus using 2:1 PP ratio and average maintenance cost of recurrent cost analysis above (i.e., Rs 3,600 per hectare for LIS and Rs 230 for FIS), the combined average recurrent cost of LIS and FIS works out to Rs. 2,476 per hectare. Thus, additional requirement for 1987-88 is Rs 4.2 million, (i.e., Rs 2,476*1686 ha) adding an escalation of 7%, the actual expenditure during 1987-88 will be approx. Rs 30.2 million. The budgeted figure during 1987-88 is short by only 7% i.e., just the value of the escalation. However, as stated in para 4.1 above, the GOHP has been able to meet the cost overruns and, leaving unforeseen circumstances, should be able to do so in the future also.

ATTACHMENT A

SUMMARY STATEMENT FOR RECURRENT COST ANALYSIS FOR LIS/IW

DISTRICT	SCHEME	HECTARAGE	HEAD	ESTIMATED COST (Rs)	ACTUAL COST (Rs)	ENERGY CHARGES (Rs)	DEPRECIATION/ MAINTENANCE (Rs)	DIRECT LABOR (Rs)	INDIRECT STAFF (Rs)	RECURRENT COST (Rs) (INCL DEPRI)	REPAIRS (Rs)	RECURRENT COST (Rs) (EXCL DEPRI)
Bilaspur	Meri Jamli LIS	105	I-10.07 meters II-237.09 meters	2,700,000	2,703,500	500,724	92,059	30,600	15,000	638,383	30,650	[illegible]
				Civil works	(1,127,725)							
				R/Main	(671,050)							
				Pump & Mach	(706,925)							
				Power Line	(275,000)							
Mandi	Sai Dhardwan LIS	227	62.57 meters	5,770,400	6,313,260	609,546	148,588	47,800	4,700	810,634	57,550	[illegible]
				Civil works	(4,055,721)							
				R/Main	(902,085)							
				Pump & Mach	(263,091)							
				Power Line	(212,363)							
Mandi	Ghalli Nagchala LIS	124	I-24.02meters II-152.31meters	3,075,000	3,300,000	260,073	84,173	57,677	2,600	404,525	29,034	[illegible]
				Civil works	(1,779,414)							
				R/Main	(760,527)							
				Pump & Mach	(333,632)							
				Power Line	(506,425)							
Una	Basal Basola LIS	30	42.25 meters	731,270	707,905	42,300	16,540	32,670	2,405	93,915	7,244	[illegible]
				Civil works	(507,012)							
				R/Main	(43,500)							
				Pump & Mach	(47,796)							
				Power Line	(25,577)							

DISTRICT	SCHEME	HECTARAGE	HEAD	ESTIMATED COST (Rs)	ACTUAL COST (Rs)	ENERGY CHARGES (Rs)	DEPRECIATION/ MAINTENANCE (Rs)	DIRECT LABOUR (Rs)	INDIRECT STAFF (Rs)	RECURRENT COST (Rs) (INCL DEPRI)	REPAIRS (Rs)	RECURRENT COST (Rs) (EXCL DEPRI)
Una	Dadhera	15	73.72 meters	420,460	417,320	43,792	10,829	26,730	1,202	82,553	3,805	75,[illegible]
				Civil works	(237,306)							
				R/Main	(82,797)							
				Pump & Mach	(47,000)							
				Power Line	(48,217)							
Una	Makroh	31	71.04 meters	746,370	707,000	75,168	16,116	26,730	2,485	120,477	6,377	11[illegible]
				Civil works	(454,047)							
				R/Main	(77,326)							
				Pump & Mach	(66,600)							
				Power Line	(109,025)							
Una	Samnal	32	72.64 meters	860,300	860,360	77,305	21,591	32,670	2,565	134,131	6,816	11[illegible]
				Civil works	(449,137)							
				R/Main	(230,335)							
				Pump & Mach	(69,946)							
				Power Line	(110,940)							
Una	Dalubi	39.60	74.06 meters	1,216,350	1,211,027	91,790	24,727	26,730	3,181	146,428	10,542	1[illegible]
				Civil works	(884,632)							
				R/Main	(70,300)							
				Pump & Mach	(59,590)							
				Power Line	(177,305)							
	TOTAL	603.60			Rs. 16,307,172	Rs. 1,700,698	Rs. 414,623	Rs. 281,607	Rs. 34,138	Rs. 2,431,068	Rs. 151,122	Rs. 2,1[illegible]
	PER HECTARE COST				Rs. 27,147	Rs. 2,817	Rs. 687	Rs. 466	Rs. 57	Rs. 4,027	Rs. 250	Rs. 3,[illegible]

Attachment B

BUDGETED AND ACTUAL EXPENDITURE UNDER "NON-PLAN" FOR MAINTAINENCE ON MINOR IRRIGATION SCHEMES

(Rs in Millions)

	1983-84			1984-85			1985-86			1986-87		
	Budget	Actual	Diff	Budget	Acutal	Diff	Budget	Actual	Diff	Budget	Actual	Diff
LIS	7.2	6.578	0.86%	7.485	8.090	- 8.08%	10.859	10.654	1.88%	12.902	12.689	1.65%
FIS	2.9	2.942	-1.44%	3.000	3.111	- 3.70%	4.650	4.115	11.50%	5.882	5.050	14.14%
TW	2.4	2.816	-17.33%	2.600	3.345	-28.65%	4.330	4.491	-3.72%	5.546	6.259	-12.85%
	12.5	12.336	1.31%	13.085	14.546	-11.16%	19.839	19.260	2.92%	24.330	23.998	1.36%

ATTACHMENT C

GOHP BUDGET PROVISIONS FOR HALWD PROJECT

YEAR	HECTARAGE		RATE PER HECTARE		EXPENDITURE			RECURRENT COST	
	ID	CD	ID	CD	ID	CD	TOTAL	RATE PER HECTARE (RS 000,000)	RECURRENT COST (RS 000,000)
ACTUALS			(RS 000,000)			(RS 000,000)			
1985-86	.25	105					10.521		
1986-87	1.150	2.001					41.453		
1987-88	1.800	1.650					65.546	0.00248 *	
PROJECTIONS									
1988-89	2.000	2.000	0.02053 **	0.00880 ***	41.066	17.600	58.666	0.00272	14
1989-90	2.500	5.000	0.02259	0.00968	56.466	48.400	104.866	0.00300	22
1990-91	2.500	5.000	0.02484	0.01065	62.112	53.240	115.352	0.00330	33
1991-92	2.500	6.000	0.02733	0.01171	68.324	70.277	138.600	0.00363	45
1992-93	2.525	6.000	0.03006	0.01288	75.907	77.304	153.212	0.00399	60
1993-94 (6 MONTHS)	0	3.244	0.03157	0.01353	0.000	43.886	43.886	0.00417	4[illegible]
TOTAL (Rs)	15.000	31.000			303.875	310.707	732.102		226.441

ESTIMATED CAPITAL COST $52.293

CAPITAL COST PLANNED IN THE FP $45.620

NOTE: See attached notes

NOTES:

i) COHF had planned the project targets with a premise that a two year extension will be approved by USAID. As the targets are not available for HALWD without extension, it is presumed that the targets will not be accelerated.

ii) Inflation factor @ 10% has been used for calculating rate per hectare.

iii) In the first three years of the project the majority of schemes completed are LIS. As of the day of the visit only 2-3 flow irrigation schemes were completed as against +30 of LIS. Thus, the fourth year is expected to give a mix of schemes more skewed towards FIS to achieve the PP ratio of 2:1 for LIS & FIS.

* 10,000 ha for LIS @ Rs.3,600 per hectare (Average Recurrent Cost)
5,000 ha for FIS @ Rs.230 per hectare (Average Recurrent Cost)
Total Cost = Rs.37.2 million
Cost per hectare = Rs.2,476 per hectare i.e., 37.2 million/15,000 ha

** Estimated average capital cost rate as of 1987-88 is:
a) Irrigation Schemes:
LIS - Rs.22,000 (Excluding Chak Development)
FIS - Rs.12,000 (Excluding Chak Development)

Total Project Capital Costs:

LIS 10,000 * Rs.22,000	=	Rs 220 million
FIS 5,000 * 12,000	=	Rs 60 million
TOTAL		Rs 280 million

Cost per hectare	Rs 18,667
Inflation @ 10% (1988-89)	Rs.20,533

*** b) Chak Development
Cost of chak development is approx. Rs.8,000 per hectare for 1987-88
Using inflation factor @ 10% Cost of chak development = Rs.8,800 per hectare.

XD-AAZ-209-B

ECONOMIC ANALYSIS OF SELECTED IRRIGATION SYSTEMS IN HIMACHAL PRADESH : REVIEW OF ASSUMPTIONS AND ESTIMATES OF ECONOMIC RATE OF RETURN

SUBMITTED TO

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT
NEW DELHI

UNDER HILL AREA LAND AND WATER DEVELOPMENT
PROJECT

BY

BASAWAN SINHA
FORMERLY ENGINEER-IN-CHIEF, BIHAR
DIRECTOR, METAPLANNERS AND MANAGEMENT CONSULTANTS
PATNA

SEPTEMBER 1988

108

CONTENTS

SECTION		PAGE
	EXECUTIVE SUMMARY	I
	INTRODUCTION	1
1	REVIEW OF SELECT PARAMETERS OF PROJECT REPORTS	8
1.1	REVIEW OF CROP PARAMETERS	8
1.2	INPUT COST AND FARM RETURN	26
1.3	INCIDENCE OF CAPITAL COST	31
1.4	REVIEW OF INTERNAL RATE OF RETURN	35
1.5	ESTIMATES OF SHADOW PRIES	41
1.6	PARAMETERS FOR SENSITIVITY ANALYSIS	52
2	ECONOMIC RATES OF RETURN FOR TUBEWELL PROJECT	
2.1	SOLAN	55
2.2	UNA	63
3	ECONOMIC RATES OF RETURN FOR LIFT IRRIGATION SCHEMES	
3.1	KANGRA	71
3.2	KULLU	79
4	ECONOMIC RATES OF RETURN FOR TANK IRRIGATION SCHEMES	
4.1	SHIMLA	88
4.2	MANDI	91
5	ECONOMIC RATES OF RETURN FOR FLOW IRRIGATION SCHEMES	
5.1	MANDI	102
5.2	SHIMLA	108

A C K N O W L E D G E M E N T S

The valuable guidance and suggestions made during the course of the study and preparation of this report by Mr. G.E. Anders, Chief of IWR; Mr. D. Wendel, Deputy Chief; Dr. M.F. Walter, Adviser; Dr. B. Sen, Economist; and Mr. N.R. Banerjee, Project Officer of Irrigation Water Resources Division, USAID, New Delhi is gratefully acknowledged. Dr. Ramesh Bhatia, Mr. R P.S. Malik and Dr. R.K. Sharma were kind enough to advise on various aspects relating to economics and agro-economics as also in economic analysis methodology. But for their help and c.operation it would have been difficult to complete the work in such a short time and upto desired standard. Their contribution in this effort is gratefully acknowledged. Mr. Narinder Singh provided efficient computational assistance for which he deserves special thanks.

BASAWAN SINHA

ECONOMIC APPRAISAL OF SOME SELECTED IRRIGATION SCHEMES UNDER USAID HILL AREA LAND & WATER DEVELOPMENT PROJECT IN H.P.

Executive Summary

1. BACKGROUND

The United States Agency for International Development (USAID) is assisting the Government of Himachal Pradesh in its efforts directed towards rapid development of irrigated agriculture in the State under the Hill Area Land and Water Development Project (HALWD). The USAID intends to introduce new approaches to land and water management, as well as to support initiative in developing its land and water resources. It is a Seven Year Programme under which approximately 150 minor and 2000 micro Irrigation systems with emphasis on Irrigation planning and design, integrated upstream development, on-farm development works, users involvement, and associated support of human and institutional capabilities. The Minor Irrigation schemes planned comprise deep-drilled tubewells, Lift irrigation from rivers, Small reservoirs (tanks), and Diversion (flow) Irrigation works. Some of the schemes included in the programme are reported to be under execution.

2. SCOPE & OBJECTIVE

USAID, NEW DELHI under Purchase Order No. 386-0249-0-00-&223-00 dated July 15, 1988 intrusted the Job pertaining to estimation of the internal Rate of Return (IRR) of approximately eight small-scale irrigation proposals of which, two are high

lift pumping systems, two are gravity-flow stream diversion systems, two are tubewell pumping systems, and two are small storage or tank systems. It was also stipulated in the statement of work that the contractor will clearly state in his report the assumptions used in the IRR Analysis, will carry out Sensitivity Analysis for some important variables and will also carry out an analysis usings shadow prices for traded commodities, viz. electricity and water? based on values of alternative uses (if known).

3. SELECTION OF EIGHT SCHEMES.

The following eight projects were selected in consultation with Shri N.R. Banerjee of USAID for estimation of IRR:

I. Tubewell Irrigation

1. Dhakeri Scheme in Solan District
2. Gugwara Scheme in Una District

II. High-Lift Irrigation

1. Bhawra Scheme in Kangra District
2. Neoli Therman Scheme in Kullu District

III. Storage Tank Irrigation

1. Gurla Scheme in Shimla District
2. Ropa-Buda Scheme in Mandi District.

IV. Flow Irrigation Scheme

1. Bari Kulwar Scheme in Mandi District
2. Nandpur Scheme in Shimla

These eight schemes comprise all the four types of Irrigation works, are located in six districts of the State spread over three out of four Agro-Climatic Zones of Himachal Pradesh. And yet it would not be prudent to claim that the results of the instant study on the above mentioned individual schemes will be straight away applied to all schemes of corresponding type and size located elsewhere in the state because the soil characteristics, cropping pattern, consumers preference, design and the cost of the engineering structures with its appurtenent works, developmental prospects, etc. vary significantly in the hilly terrain especially of the type met within the hilly State of Himachal Pradesh.

3. An Overview on Parameters of Project Proposals:

After obtaining the data and informations contained in the project reports and estimates of the above mentioned eight schemes, a thorough analysis of the various parameters relevant to calculation of IRR was done by a team of experts in the fields of economics, agro-economics, water resources development and management, and other professionals and sub-professionals. This is presented in Section-I of the report.

The salient features having bearing on estimation of IRR noted are:

3.1 The existing cropping intensities in the command areas of all the eight selected schemes were very high, about 200% in un-irrigated condition.

3.2 Proposed irrigation intensities were more or less the same as the cropping intensities in pre-irrigation condition. In other words, the gross cropped areas (GCA) in with and without irrigation situation were equal.

3.3 Shift in cropping pattern from unirrigated to irrigated agriculture as proposed was largely in favour of cash crops, mainly vegetables in both Kharif and Rabi seasons.

3.4 Vegetables are grown in the command areas of Lift irrigation scheme)LIS), Kullu (2.03% in Kharif and 1.02% in Rabi), Una Tubewell scheme (6.34% in Rabi); Shimla Tank Scheme (11.11% in Kharif, 11.11% in Rabi and 11.11% Patato); and Mandi Flow Irrigation Scheme (0.87% aid). No vegetable is grown in command area of other four schemes.

3.5 The project estimates prepared were in detail so far as engineering works were concerned but how the choice was made in favour of the proposed structure

had not been given in the report. It was also not clear as to why costly piped water supply was provided in the Flow Irrigation Scheme. From the Project Reports it was also not clear as to whether Soil surveys and irrigability classification were conducted by the project authorities.

3.6 The project report did not contain discussions on and the basis of proposed cropping pattern, irrigation intensities, crop yields etc.

4. FIELD VISITS AND COLLECTION OF RELEVANT DATA & INFORMATIONS

As stated above, the project reports lacked in presentation of details relevant to irrigated agriculture envisaged in the proposals. In such an Area or Regional approach to planning for land and water resources development through a number of small size schemes, dotted over the in patches of cultivable lands of the hilly terrain, it would be too much to expect that for each individual minor irrigation scheme, elaborate details or determination of irrigation intensities crop-yield rates, farm cost, etc. will be made available. But, at least such a presentation on each agro-climatic Zone and on each type of scheme should have been made. These being not there, attempts were made to obtain as much as could be available from secondary sources.

A team of experts was deputed for this. The following offices/departments were contacted for collecting data on crop parameters-cropping pattern, crop yields and prices. The offices visited were :-

1. Agro-Economic Research Centre, H.P. University, Shimla.
2. Directorate of Agriculture, Govt. of H.P.
3. Directorate of Land Records, Govt. of H.P.
4. Directorate of Economics and Statistics, Govt. of H.P.
5. Office of the Chief Engineer (IIrg.), Govt. of H.P.
6. State Planning Board.

Data on cost of production of different field crops, horticultural crops, growth of agricultural development in different districts of H.P., market infrastructure, present methods of disposal of crop and horticulture produce practised by the farmers etc., were collected from the Agricultural Economics Research Centre, Shimla. In addition an important document obtained was an unpublished Ph.D. thesis on various aspects of vegetable production and marketing of vegetable crops in some of the selected districts of Himachal Pradesh. This study is based on a well defined stratified during the course of data collection under the comprehensive

116

In course of visit to the Directorate of Agriculture data on various aspects of crop cultivation specially the information relating to estimation of crop yields on the basis of crop cutting surveys were collected. In the course of discussion with Dr. Mittal, Economist, Directorate of Agriculture it was revealed that separate yield estimates for irrigated and unirrigated yields of various crops were not available. The cyclostyled sheets issued by Dr. Mittal on the results of crop cutting experiments did not contain separate yield estimates for irrigated and unirrigated crops. Package of practices issued by the H.P. Krishi Vishwa Vidyalaya every year for Kharif and Rabi season was found more useful in this aspect.

An important source of documents that is, Season and Crop Report (ASCR) which give detailed information on various aspects of agricultural production districtwise, cropping pattern, crop yields, farm harvest prices was obtained from the Directorate of Land records. Their report provides two types of yield estimates - the standard yield and the current yield but does not distinguish between the irrigated and unirrigated crop yield. The intensive search for relevant data revealed that the ASCR was perhaps the only source of information in the State which provides such detailed estimates of various crop parameters at the district level. The latest Season and Crop Report available is for the year 1984-85

For time-series data on growth of agriculture in H.P. as also on various other aspects of agricultural economy, irrigation, infrastructure, etc., the Directorate of Economics & Statistics was contacted and various publications providing requisite information both at the district level as well as State level were collected.

To collect data on policy parameters the Plan documents of the Govt. of H.P. were collected. The document provides useful information not only in respect of the current state of affairs of various sectors of the Himachal's economy but also provides useful information on the priority areas of development in the State. It provides information on irrigation, crops, infrastructural development, etc.

The office of the Chief Engineer, Irrigation was also visited by the Team to collect information on the growth of irrigation and performance reports on different types of irrigation schemes. The officials over there were not aware of any Ex-post evaluation having been carried out ever on any irrigation project in the State.

The Team members had also informal discussions with a number of people who had intimate knowledge of agricultural economy of the State. Some of these people were in fact practising farmers and provided useful information on various

The visits of the team to various offices at Shimla, and some project sites, their discussions with knowledgeable professionals and farmers and the reports as well as other publications collected were found in objective assessment of the situation and in adopting pragmatic approach in economic analysis of the proposed schemes. It would not be an exaggeration to claim that in the situation obtaining nothing more could be collected and/or ascertained through extended field visits.

5. REVIEW OF RELEVANT PARAMETERS

This report presents the results of economic evaluation of eight small scale irrigation projects in Himachal Pradesh which are included under the HALWD project of the USAID. The report begins with a review of assumptions contained in the Project Reports suggested modification therein gives estimates of shadow prices for major outputs and inputs and provides a range of estimates of economic rate of return (ERR) under alternative assumptions.

The assumptions made in the project reports on various parameters are reviewed in the light of existing crop situation, relevant information/data from published and unpublished reports and discussions with experts and knowledgeable farmers in the field. Data on cost of production of different field crops horticultural crops in different districts of

of disposal of crop and horticultural produce were collected from the Agriculture Economic Research Centre, Directorate of Economics and Statistics, Directorate of Agriculture, Directorate of Land Records and State Planning Board. Since vegetable crops are very important components of benefits of these irrigation projects. Projects and not even secondary data were available on this, unpublished Ph.D. thesis was referred to for detailed information on various aspects of vegetable prices, yields, marketing practices etc. Based on these reports, observations and discussion the cropping pattern, yield levels, crop outflow prices have been modified and adjusted in subsequent economic analysis. Specifically the area under vegetables: Yield flows and prices used in the report reflect the existing area, marketability conditions given the fact that existing cropping intensity of 200% does not increase under irrigated conditions, the project proposals envisaged a major shift from cereals to cash crops, particularly vegetables. This shift has been moderated to some extent keeping in view the subsistence nature of farming, present level of vegetable cultivation, emphasis on growing vegetables in the State all over through an intensive Vegetable Cultivation programme and market-ability condition. The eixsting cropping pattern, the pattern envisaged in the project proposal, and

the pattern adopted in the report for economic appraisal are given in Table 1.1.2 of the Report. To illustrate the basis of modification, the cases of a few lift irrigation, tubewell and flow irrigation schemes appear worthwhile. In case of L.I.S., Kangra, the existing area under Cereals is 92.5% of the Gross Cropped Area (GCA). In the project proposal it was brought down to 67.5%. This has been increased to 72.5% in this report. Similarly, in case of Kullu L.I.S., the existing area under Cereals was brought down from 43.34% to 20.31% in the project proposals. This has been increased to 39.58% in this report for economic evaluation. So far vegetables are concerned, similar adjustments had to be made. In case of Kangra L.I. Scheme, there is no vegetable cultivation at present but 20% of the G.C.A. was proposed in the project proposals. This has been moderated to 15%. In L.I.S. Kullu, under existing conditions of 3.05% of G.C.A. is under vegetables and 45.18% under orchards. In the project proposals area under vegetable was increased from 3.05% to 26.89%. Keeping the area under orchards unchanged. This has been moderated to 9.14% under vegetables and area under orchard has been kept intacts. In case of Solan T.W. Scheme, the project proposals envisaged 22.29% of G.C.A., under vegetables against NIL area under existing conditions. This has been moderated to 13.43%. Similarly, in F.I.S., Shimla area under vegetables plus

potato has been kept at 39.72% against 49.69% proposed in the project proposals and 26.77% under existing conditions. All these will show that while objective of intensifying vegetable cultivation in the hill State has been the guiding factor in determining, crop intensities, the need for sustaining the pace of food production has not been lost sight of.

6. APPROACH TO ECONOMIC ANALYSIS

Economic Rates of Return (ERRs) for the eight projects have been calculated by estimating benefits and costs of the project using shadow prices for major outputs and inputs. The benefits of the project are essentially identified with direct primary benefits while indirect and induced effects of the project could not be incorporated due to lack of information. Similarly, only the direct costs have been considered and indirect costs including externalities and environmental impacts could not be quantified in short time available for the project and due to the fact that the individual schemes under appraisal were too small for any such meaningful analysis. Of course, a passing reference has been made in the report drawing attention towards preserving the fertility of the thin mantle of soil generally met with in hilly tarrain. The direct benefits of a project have been calculated as the value of the incremental

net farm income defined as "With project" minus "Without Project" i.e. the entire increase in net value added under "With Project" condition over that under "Without Project" condition is due to or attributable to irrigation.

Since in a developing country such as India, the prices of foodgrains and other agricultural commodities, major agricultural inputs (fertilizers, diesel oil, electricity) and components of project costs (cement, steel, unskilled labour) are "administered prices", these do not reflect their true social value or opportunity costs. Shadow prices for major outputs and inputs have been estimated as follows:

(i) Traded or tradable commodities (foodgrains, fertilizers, sugar) have been valued at c.i.f. or f.o.b. prices adjusted for the shadow exchange rate and domestic transport costs;

(ii) For the non-traded outputs (vegetables, apples) shadow prices are equated to the "consumers willingness to pay" as reflected by the market prices for these commodities;

(iii) Non-traded inputs (e.g. electricity) have been valued in terms of long-term marginal cost of supply. Cost of supply after taking into account the transmission and distribution losses.

Using these criteria, the estimated shadow prices for paddy are about 45 per cent higher than its market price while the shadow prices for wheat, barley and oilseeds are 74 per cent higher than their corresponding market prices. The estimated shadow prices for introgenous fertilizer and phosphatic fertilizers are 27 per cent and 13 per cent higher than their market prices, respectively. The estimated shadow price of electricity is almost 107 per cent higher than the tariff rate used in the tubewell and lift irrigation schemes. Given the resources and short time available for the project, it was not possible to estimate shadow wage rates for unskilled labour in each project region. A notional value of 0.4 has been used to convert the wage cost at market prices into wage cost at shadow prices. The possibilities of higher shadow wage rates have been considered through sensitivity analysis of capital costs. Since, estimation of shadow exchange rate and opportunity cost of capital were outside the scope of this project, notional values currently used in the Planning Commission for appraisal of projects have been adopted. A premium of 25 per cent on foreign exchange has been used to reflect its scarcity value i.e., a shadow price of Rs. 17.5 per U.S. dollar, as compared with the official exchange rate of Rs. 14 per U.S. dollar, The opportunity cost of capital in the Indian economy has been taken as 12 per cent. Sensitivity analysis

has been performed with respect to shadow exchange rate, capital costs, electricity price and value of output.

The results of using these shadow prices are that, except in the case of L.I.S. Kullu, the ERR at shadow prices is higher than the IRR at market prices. In Kullu, since orchards account for about 56 per cent of the total net benefit (where shadow price is considered equal to the market prices), the use of shadow prices on the benefit side does not increase the value of benefits while the use of shadow price for electricity almost doubles the O&M costs. These aspects are discussed in detail later.

7. ECONOMIC RATES OF RETURN

Economic Rates of Return or the Internal Rates of Return for all the eight projects have been calculated. One section has been devoted to each project. The IRRs for each project, one on market price and the other on shadow prices of inputs and outputs have been calculated. The results are as under:

PROJECT	IRR IN MARKET PRICE SOLUTION	IRR ON SHADOW PRICE SOLUTION
TW at Una	18.37%	26.0%
TW in Solan	15.38%	16.60%
L.I.S. in Kangra	20.32%	23.42%
L.I.S. in KULLU	11.71%	4.9%
Tank in Shimla	13.59%	21.0%
Tank in Mandi	22.9%	31.0%
F.I.S. in Mandi	13.45%	14.56%
F.I.S. in Shimla	20.3%	24.2%

It would be seen that in all cases except in case of Lift irrigation scheme in Kullu district the IRR in shadow price solution is more than that in market price solution. The details of IRR calculation in Table 3.2.4 show that (a) the net benefits increase from Rs. 10.85 lacs in market price solution to Rs. 12.78 lacs in shadow price solution; (b) O & M cost increases from Rs. 5.6 lacs to Rs. 9.94 lacs per annum; (c) it is mainly because of over 70% increase in the O & M cost that the IRR in shadow price solution is so low. This was inevitable because the project involves very high head lift consuming more electrical energy which was charged at subsidised rates in the market price solution. The real cost of energy being much more,

the value of O & M costs at shadow prices has gone up substantially. There are two lift irrigation schemes, one in Kangra involving a lift of 138.0 metres, and another in Kullu involving a lift of 151.0 metres, both having almost equal C.C.A. But, in Kangra L.I.S. the O & M cost at shadow prices is only Rs. 6.93 lacs as against Rs. 9.96 lacs in case of Kullu L.I. Scheme. This difference is mainly due to higher energy consumption in Kulu L.I.S., because the unit rates of energy are the same in both cases.

Some other factors also have caused lower value of IRR in Kullu L.I.Scheme. About 45% of G.C.A. is under horticulture which is reported to yield net annual benefits much less than that of the vegetables. Besides, the area under orchards is not available for raising more than one crop in the year. The capital cost of Kullu L.I. Scheme is also relatively higher than that of Kangra L.I. Scheme. The incidence of cost per hac. is Rs. 18,126.0 in Kullu L.I.S. as against Rs. 15,955.0 for the other L.I. Scheme. The incidence of cost in case of Kullu L.I.S will go up further if it is calculated reckoning the area under orchards as a single crop and not double crop as it has been done according to standard practices in agricultural economics.

The unit rate of Rs. 1.14 per KWH as adopted in shadow price solution could in no case be considered high because

it is almost the same as the actual cost incurred by Himachal State Electricity Board. It would not be out of place to mention here that in the Bihar Tubewell Project, 1986 (aided by the World Bank) a rate of Rs. 1.03 per unit had been adopted though the subsidised rates charged was only Re. 0.34 per unit.

The results of ERR estimation indicated that out of eight proposals under review, the following four needed to be carefully examined through sensitivity tests.

i) T.W. Scheme in Solan District
ii) L.I. Scheme in Kullu District
iii) Tank Scheme in Mandi District
iv) F.I. Scheme in Mandi District

RESULTS OF SENSITIVITY ANALYSES

Results of Sensitivity Analysis are presented in Section 6 of the Report. The conclusion drawn from the analysis as conducted has been that the L.I. Scheme in Kullu district and the T.W. Scheme in Solan district need further analysis specially with respect to level of benefits and shadow price of power. The other six schemes appear to be economically viable within expected range of uncertainties. The Tank Scheme in Shimla and F.I. Scheme in Mandi no doubt yield lower values of IRR (10.8% and 7.9% respectively when

tested for 25% reduction in gross value of output combined with 25% increase in capital cost, but since area under vegetable is not much higher than what exists under irrigated condition, there be no apprehension of fall in the value of outputs. In the case of F.I.S., Mandi the area under cash crops has also been substantially moderated for economic analysis, there should be no apprehension for 25% fall in the benefits. All the same, the F.I. Scheme, Mandi yields first 12% IRR when tested for 25% rise in capital alone. Therefore, there remains the need for closer watch on the capital cost.

The other two types of schemes are (i) the T.W. Scheme in Solan district and (ii) the L.I. Scheme in Kullu district in which use of electric power plays main role, especially in OMR costs. The IRR of T.W. S. in Solan decreases to 12% when tested for 10% decrease in net benefits, drops down to 4.4% from 16.6% when tested for 25% fall in gross value of output (GVO) but increases to 20.9% when tested for 10% increase in GVO. The ERR decreases to 14.8% (from 16.6%) in case of 33% increase in shadow price of electricity, and to 13.7% when tested for 25% increase in capital cost. Thus, this project is highly sensitive to GVO. In this scheme, the chance of 10% fall in GVO cannot be altogether ruled out because 43.43% GCA is now included under vegetables

against NIL in pre-project condition. But, even then the ERR equals the cut-off value of 12%. The L.I.S. in Kullu is the most critical case because the IRR is first 4.9% in the base case and when tested for 10% increases in the GVO, it rises to 7.0% only. As stated earlier, about 54.32% of the GCA is already vegetables (9.14%) and orchards (45%) and as such prospects of increase in GVO through increasing area under cash crops is rather bleak. However, the economics of orchards which are reported to be yielding higher value of benefits than that from vegetables and is the most dominant crops in the command of the scheme deserves further in-depth study if the decision is in favour of considering it for approval.

SOME OTHER ASPECTS OF INTEREST

Incidence of Irrigation Costs

The incidence of capital cost of tubewell scheme varies Rs. 22,780/- to Rs. 24,430/- per hectare of cultivated command area (CCA) while for the L.I.S. it varies from Rs. 31,640/- to Rs. 35,090/-. per hactare. Except for F.I.S., Mandi where it is Rs. 18,120/- per hactare, in all others, the range is more or less the same as in T.W. and L.I.S. schemes. Since cropping intensity is taken as 200 per cent, the incidence cost per hactare of gross corpped area gets

reduced by one-half. Using a discount rate of 12% and 30 years life, the annualized capital costs are around Rs. 1,550/- per hactare (of GCA) for tubewell schemes and around Rs. 2,000/- to Rs. 2,200/- per hactare for lift irrigation schemes. The incidence of O & M costs at shadow prices is around Rs. 2,700/- per hactare of cropped area for tubewell projects. Thus, annual costs are of the order of Rs. 4,250/- per hactare of cropped area in tubewell schemes. In the case of L.I.S. the incidence of O & M costs at shadow prices Rs. 3,460/- per hactare for Kangra and Rs. 5,020/- per hactare for Kullu. This gives an incidence of annual costs of Rs. 5,460/- to Rs. 7,220/- per cropped hactare under lift irrigation schemes. Thus, even if only annual O & M costs have to be recovered from the farmer, the irrigation charges would have to be of the order of Rs. 3,500/- to Rs. 5,000/- per hactare for L.I.S. and Rs. 2,700/- per hactare for tubewell schemes.

REPLACEMENT LIFESPAN OF EQUIPMENT

The Project Reports estimate that the lifespan of pumping machinery will be 15 years. Accordingly there has been one replacement of machinery in a project life of 30 years. This has been adopted as such in the economic analysis. However, generally the replacement lifespan of pumping units in large size tubewells is taken as 10 years, that of the well as 10 years and that of the pumphouse and distribution chamber

as 20 years. Although taking two replacements of pumping units in the 30 years lifespan of the project may affect the ERR marginally, this factor may have to be taken into account in some projects.

INTRODUCTION

The State of Himachal Pradesh covering a vast area of 5,567,300 hectares is located in the North-West region of the country and lies in the lap of Himalayas comprising mountainous zones from low altitude of 350 metres to alpine heights of 6975 metres above msl. It extends between latitude 30°22' 44"N to 33° 12' 40"N and longtitude 75° 45' 55"E to 79° 04' 20"E. The rainfall varies from 350 mm to 3800 mm.

Due to hilly terrain, the economy of the State is predominantly agriculture. Of the total reporting area of 3215 thousand hectares in 1984-85 the net sown area was just 18 per cent and gross cropped area 31 per cent. The small and medium farmers predominate the agricultural scene with an average size of holding of 0.6 hectares. The average intensity of cropping during the year was 170.4. Maize and paddy in Kharif and Wheat in Rabi are the important cereal crops of the State accounting for almost 81 per cent of the gross cropped area.

On the basis of latitude, temperature, topography, rainfall and humidity, the State has been divided into following four agro climatic zones[1] :

1. For a detailed description of these zones, see Negi, G.C., "Development of Agriculture in Himachal Pradesh".

1. Sub-mountain and Low Hills Sub-tropical Zone;

2. Mid Hills and Sub-humid Zone;

3. High Hills Temperate Wet Zone;

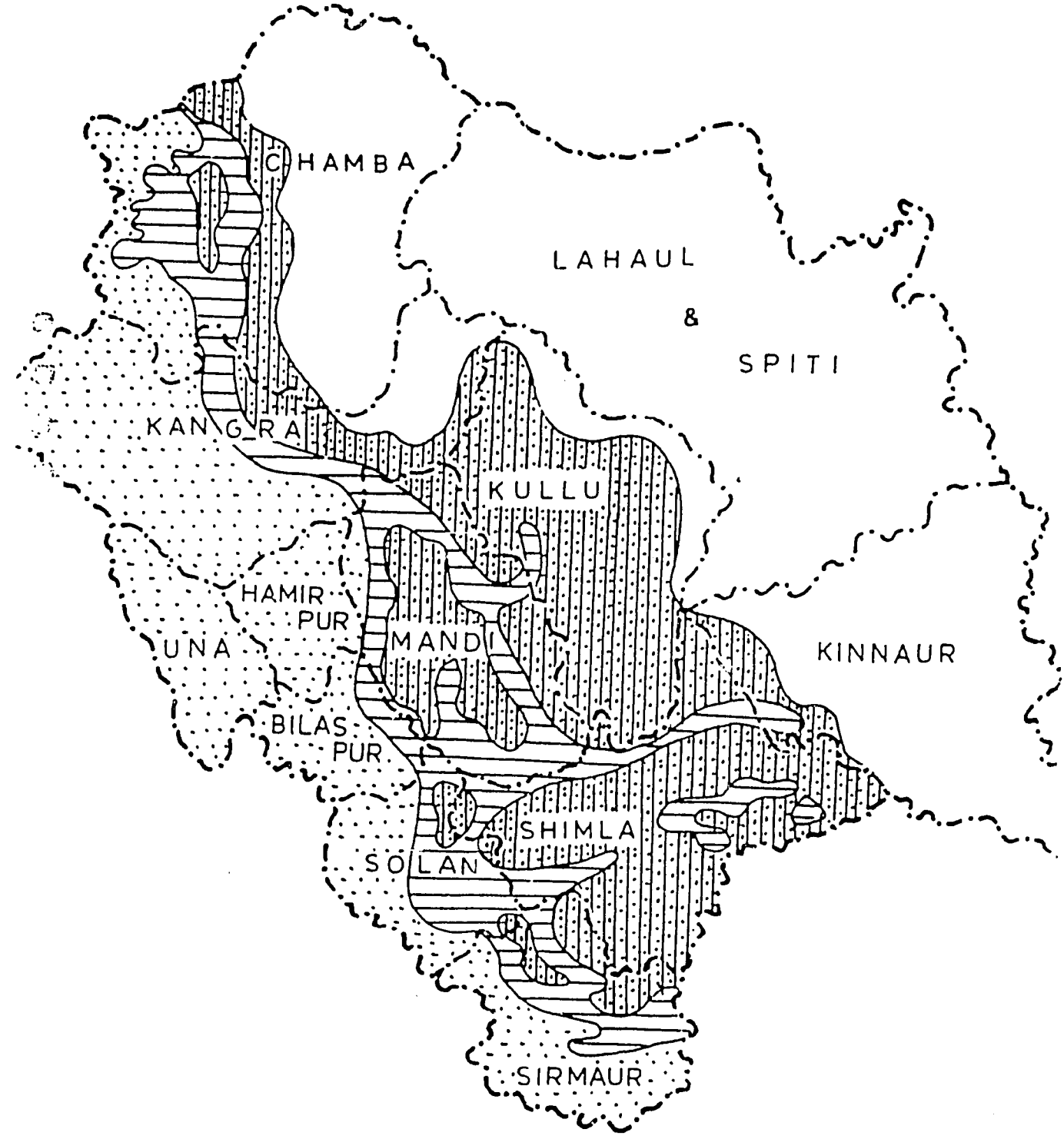
4. High Hills Temperate Dry Zone.

The broad division of the State into these zones is also depicted in the Map (attached).

Owing to peculiar agro-climatic conditions, the mountainous nature of tracks and pattern of land holding, extensive cultivation is not possible. Due to prevalence of traditional methods of cultivation, the average crop yields have been low as compared to yield levels realised in neighbouring States/areas. In 1984-85, the average yield levels realised in respect of the three important cereal crops - Maize, Rice and Wheat were 1897 kg., 1237 kg. and 696 kg per hectare. Under the given physical and climatic conditions, the only way to increase agricultural production and productivity is through intensive cultivation of available cultivated land. Among other constraints inhibiting intensive cultivation in the State is the lack of assured irrigation facilities.

During 1984-85, the net area irrigated to net sown area in the State was just 16.4 per cent while the proportion of gross area irrigated to gross area sown was slightly higher at 17.10 per cent. The proportion of area irrigated to area sown under the three important

AGRO-CLIMATIC ZONES OF HIMACHAL PRADESH



SUB-MONTANE AND LOW HILLS SUB-TROPICAL

MID HILLS SUB-HUMID

HIGH HILLS TEMPERATE WET

crops was 12.7 per cent for Maize, 30:5 per cent for Paddy and 38.5 per cent for Wheat. The State thus offers considerable scope for increasing agricultural production through provision of assured irrigation facilities.

The Government of Himachal Pradesh has been actively engaged in the development of irrigation facilities in the State. Due to peculiar conditions of the State, major and medium sources of irrigation are not practicable and minor and small scale irrigation is the only answer. Of the 95 thousand hectares of net irrigated area in the State during 1984-85, 88.2 per cent was irrigated by Kuhls, 7.6 per cent by canals, 0.8 per cent by tanks and 3.4 per cent by wells and tubewells. Upto March 1987, the State had an irrigation infrastructure of 221 Lift Irrigation Schemes, 378 Flow Irrigation Schemes and 88 Tubewells.

To supplement the efforts of the State Government in its endeavour to develop irrigation facilities in the State, the United States Agency for International Development (USAID) under its Hill Area Land and Water Development Project (HALWD) is assisting the State Government in its efforts. Under the HALWD project the USAID intends to introduce new approaches to land and water management, as well as to support State initiative in developing its land and water resources. It is a seven year effort to

develop approximately 150 minor and 2000 micro irrigation systems with emphasis on irrigation planning and design with integrated upstream development, farm levels works and user involvement and associated support of human and institutional capabilities.

This report presents detailed review of the assumptions made in eight small scale irrigation proposals submitted by USAID Project Cell in Shimla. The report deals with the following specific objectives :

1. Review of the assumptions contained in the Project Reports about the cropping pattern, crop yields, prices etc.
2. To calculate Internal Rate of Returns using the market prices as well as shadow prices for inputs and outputs.
3. To sensitivity test the IRR analysis with respect to changes in capital costs, operating and maintenance cost, output prices and changes in cropping patterns.

The eight project proposals involve four types of small irrigation systems, two each of (i) tubewell pumping system, (ii) high lift pumping system, (iii) small storage or tank system, and (iv) gravity flow stream diversion system. The details of the specific projects and their geographical locations are given in

Table 1 and are also depicted in the agro-climatic zone map. It will thus be seen that both the tubewell and one high lift irrigation schemes are located in Sub-mountain and Low Hills Sub-tropical Zone, one each of high lift, storage tank and flow irrigation are in High Hills Temperate Wet Zone and one each of tank irrigation and flow irrigation are located in Mid Hills Sub-humid Zone. In the High Hill Temperate Dry Zone none of these irrigation schemes is located.

TABLE 1 : DESCRITION OF PROJECTS UNDER REVIEW

Type of Project	Location (Village district)	CCA (Hects)	Agro-Climatic Zone
1. Tubewell (TW)	Dhakeri, Solan.	54.00	Sub-Mountain and Low Hill Sub-Tropical
	Gugwara, Una.	42.00	Sub-Mountain and Low Hill Sub-Tropical
2. High Lift Irrigation (LIS)	Bhaura, Kangra.	100.00	Sub-Mountain and Low Hill Sub-Tropical
	Neoli Therman, Kullu.	98.50	High Hills Temperate Wet
3. Storage Tank (TI)	Gurla, Shimla.	9.00	High Hills Temperate Wet
	Ropa-Buda, Mandi.	5.50	Mid Hills Sub Humid
4. Flow Irrigation (FIS)	Bari Kulwara, Mandi.	57.18	Mid Hills Sub Humid
	Nandpur, Shimla.	100.36	High Hills Temperate Wet

OUTLINE OF THE REPORT

The report is divided into six sections. In Section 1, we review the assumptions regarding the existing cropping pattern, crop yields, prices etc. as used in the project reports. This is followed by a description of the shadow price calculations and the details of sensitivity analysis carried out in the subsequent sections of the report. Sections 2 to 5 deal separately with each of the four types of irrigation schemes under review viz., Tubewell, High Lift Irrigation, Tank Irrigation and Flow Irrigation Scheme. In Section 6, we present the results of sensitivity analysis for all the four types of irrigation schemes.

SECTION 1

In this section we present a brief review of the crop parameters - cropping pattern, crop yields and output prices - as used in the various project reports and present our observations on these parameters. This is followed by a summary of the crop input cost and net benefits per hectare in the 'existing' as well as 'with project' conditions. The incidence of capital cost per hectare are presented thereafter followed by a review of IRR as presented in the project reports. The methodology of estimating shadow prices for various inputs and outputs is discussed alongwith the estimates used in this study. The parameter values chosen for sensitivity analysis are also described in this section.

1.1 Review of Crop Parameters

1.1.1 Cropping Pattern

We present in Table 1.1.1 the project-wise details of the 'existing' and 'with project' cropping pattern as given in the project reports. The comparative figures presented reveal considerable shifts in cropping pattern in all the locations with the availability of irrigation facilities. The proportion of area under 'cereal' crops (Paddy, Maize, Wheat and Barley) in all the project areas, except TW Solan, declines with the availability of irrigation while that under vegetables and potatoes

TABLE: 1.1.1 (Contd)

Crop	TI, Shimla		TI, Mandi		FIS, Mandi		FIS, Shimla	
	E	P	E	P	E	P	E	P
ddy			15.45	26.37	21.14	9.64	7.47	7.47
ize	27.78	22.22	34.55	18.18	28.86	24.23	11.96	4.98
eat	38.89	27.78	50.00	44.55	43.72	8.17	18.43	19.93
rley							7.47	2.49
lses (Kharif)						8.03	9.96	4.98
lses (Rabi)						8.03		
lseeds (Kharif)								
lseeds (Rabi)		11.11					17.94	10.46
lseeds (Zaid)						8.17		
getables (Kharif)	11.11	11.11		5.45		4.02	7.65	17.62
getables (Rabi)	11.11	11.11				4.02	6.17	17.12
getables (Zaid)								
tato	11.11	16.67			0.87	16.06	12.95	14.95
garcane								
chard								
dder (Kharif)								
dder (Rabi)				5.45	2.62	9.63		
llow					2.79			
tal	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
A (Hec)	18.00	18.00	11.00	11.00	114.36	124.54	200.72	200.72

Note-
E - Existing
P - Proposed

TABLE 1.1.1 EXISTING (E) AND PROPOSED (P) CROPPING PATTERN (%) AS PER PROJECT REPORTS

Crop	LIS, Kangra		LIS, Kullu		TW, Solan		TW, Una	
	E	P	E	P	E	P	E	P
dy	10.00	30.00		5.08			8.04	5.47
ze	37.50	7.50	20.30	2.54	27.11	27.11	25.00	17.71
at	45.00	30.00	17.77	10.15	36.15	36.15	25.00	18.75
ley			7.60	2.54				
ses (Kharif)		2.50	5.08	5.08	13.85	4.52	7.68	7.29
ses (Rabi)	2.50		1.02	2.54	3.01	3.01	6.52	3.12
seeds (Kharif)					4.52	4.52	1.78	
seeds (Rabi)	5.00	7.50			8.44	2.40	2.14	6.25
seeds (Zaid)								3.12
etables (Kharif)		10.00	2.03	14.72		13.85		8.59
etables (Rabi)		10.00	1.02	12.17		8.44	6.34	10.16
etables (Zaid)								4.69
tato								4.69
jargane							10.00	6.25
hard			45.18	45.18				
lder (Kharif)							2.50	1.56
lder (Rabi)		2.50					5.00	2.35
llow					6.92			
tal	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
A (Hec)	200.00	200.00	197.00	197.00	108.00	108.00	84.00	96.00

(Contd.)

increases. The area under pulses and oilseeds show a mixed trend - in some locations the proportionate area under these crops increase, in some it declines while in others it remains unchanged.

In the 'cereals' group, the proportion of area under Maize and Wheat generally declines under the 'proposed' cropping pattern as compared to the 'existing' one in all the locations except in TW, Solan, where the proportionate area under these crops do not change, and FIS, Shimla, where the proportionate area under wheat slightly increases. In two of the eight locations (LIS, Kullu and FIS, Shimla) where Barley is cultivated, the proportionate area under Barley also declines. Paddy is cultivated in five of the eight project areas under the existing cropping pattern. With the availability of irrigation its cultivation extends to six locations. However, the proportionate area under Paddy in two of the five locations (TW, Una and FIS, Mandi) declines after availability of irrigation; in two others (LIS, Kangra and TI, Mandi) it increases while in FIS, Shimla the proportionate area under Paddy remains unaltered.

Pulses are currently cultivated in six of the eight project areas. With the availability of irrigation, the proportionate area under Pulses increases in LIS, Kullu and FIS, Mandi; declines in TW, Solan, TW, Una and FIS, Shimla; while in LIS, Kangra it remains unchanged. Similarly in six of the eight locations where oilseeds

are currently cultivated, the proportionate area under oilseeds increases in LIS, Kanga, TW, Una, TI, Shimla and FIS, Mandi while that in TW, Solan and FIS, Shimla it declines under 'with project' conditions.

The proportionate area under Vegetable Crops in all the project locations, except TI, Shimla, substantially increases in the 'proposed' cropping pattern over the 'existing' conditions. Even those project areas (LIS, Kangra, TW, Solan, TI, Mandi and FIS, Mandi), where vegetables are not currently cultivated, show significant shifts in favour of vegetable cultivation with the availability of irrigation. The area under Potatoes in all the four locations, where these are cultivated, is significantly higher under proposed cropping pattern as compared to the existing one.

Of the remaining crops, the proportionate area under sugarcane, which is cultivated only in TW, Una, declines after availability of irrigation, while that under orchards in LIS, Kullu remain at the same level. The cultivation of fodder crops, currently cultivated in TW, Una and FIS, Mandi, extends to two other project locations (LIS, Kangra and TI, Mandi) after the availability of irrigation.

Although the Project Reports contain very good data-base on technical and engineering assumptions, they do not provide adequate information on agroeconomic and

economic parameters used in the analysis. A perusal of the various project reports does not enable one to gather any information on the probable reasons for differentials in the magnitude of area shifts under different crops either in a specific project location or across different project locations. Even within those districts (Shimla and Mandi) where two projects (one each of TI and FIS) are located, there is no similarity in either the cropping pattern or the area shifts as a result of availability of irrigation. We assume such differentials to be the result of diffences in soil-agro-climatic donditions between specific project locations.

Due to small size of holding and poor resource base of a majority of farm households, the agriculture in the State is generally of subsistence nature,though the conducive agro-climatic conditions prevailing in the State offer considerable scope for cultivation of commercial crops such as potato, vegetables, ginger etc., specially during the off-season. With the availability of irrigation one would generally expect a decline in the area under cereal crops and increase in area under cash crops. The shifts in cropping pattern reported under 'existing' and 'with project' conditions in the project reports also broadly follow this trend. Within the cereals group, in Kharif one would expect a shift from rainfed Maize to irrigated Maize and irrigated paddy while in Rabi the expected movement of area will be

from rainfed wheat and Barley to irrigated Wheat. The magnitude of such shifts, however, will vary depending on theagro climatic conditions prevailing at the location of the project as well as on economic parameters. In addition, one of the major considerations for shift in favour of paddy cultivation is the reliability of availability of adequate water. Examining the magnitudes of area shifts suggested in the project report in the light of these observations, we broadly tend to agree with the magnitudes envisaged with minor modifications except in the case of FIS, Mandi where we expect a significantly higher proportion of area under wheat.

Apart from the above, the major shifts in cropping pattern envisaged in the project reports relate to shifts of cropping pattern in favour of vegetable crops. While cultivation of vegetables is highly remunerative in comparison to the cereal crops, in practice the scope for any large scale growth of cultivation of vegetable crops is limited on account of economic factors. In a recent study[1] carried out in the State, it was revealed that the three important constraints in the way of vegetable cultivation in Himachal Pradesh are : (i) lack of irrigation, (ii) weather fluctuations and (iii) incidence of pests. However, along with these problems the major

1. A Study of Economics of Vegetable Production in Himachal Pradesh, Ph.D. Thesis, submitted to the University of Meerut, Meerut, (1986).

constraints on expansion of area relates to vegetable marketing. A very large proportion of sampled vegetable growers cited non-availability and/or high cost of transport, lack of storage facilities, inadequate development of local markets and high variation in market prices of vegetables as the important constraining factors in increasing the area under vegetable cultivation.

Thus while non-availability of assured irrigation is one of the important factors constraining vegetable cultivation in the State, its role in bringing about any large scale changes in the cropping pattern in favour of vegetables cultivation need not be over emphasised unless corrective steps are simultaneously taken to improve other aspects of vegetable cultivation and marketing. Similar experiences have also been borne out by experiences of irrigation development in other areas/ regions in the State as well as other parts of the country For example, in the course of our field visit to the site of Tubewell Project at Dhakeri in district Solan, we visited a neighbouring village Kasroli which already has adequate irrigation facilities. On discussions with knowledgeable farmers it was revealed that though irrigation was available, only a few farmers were cultivating vegetables and that too on a very small portion of their land. The farmers attributed small size of holding, wide fluctuations in yields and prices of vegetables as the limiting factors even though from marketing point of

border of Ropar district of Punjab State and only about 50 kms. from Chandigarh.

Summing up, thus, with the availability of irrigation it is reasonable to expect a shift in favour of cultivation of more remunerative crops such as vegetables, however, in practical the magnitude of such shifts envisaged in some of the project reports may not be realised. A careful examination of the individual project reports in the light of above arguments lead us to believe that in general the expected shifts in favour of vegetable crops may be around 10 per cent of the net sown area in Kharif and around 10 to 15 per cent in Rabi, though the actual figures may vary from project to project. The expected shifts in favour of vegetable crops as reported in the project reports under LIS Kangra, TI Shimla and FIS Mandi appear to be reasonable while those envisaged under LIS Kullu, TW Shimla and Una and FIS, Shimla appear to be on higher side. We expect the area under vegetables in TW Solan to be 13.43 per cent against 22.20 per cent in the project report, in TW Una to be 17.85 per cent instead of 23.44 per cent and in FIS, Shimla to be 24.77 per cent in place of 34.74 per cent envisaged in the project report.

The details of revised cropping pattern as used by us in our subsequent IRR calculations for each of the eight project locations are shown in Appendix Tables 1.1 to 1.9 and are summarised in Table 1.1.2.

TABLE: 1.1.2 PERCENTAGE OF AREA PROPOSED (P) AND ACTUALLY USED (U) UNDER IMPORTANT CROPS

	LIS				TW				TI				FIS			
	Kangra		Kullu		Solan		Una		Shimla		Mandi		Mandi		Shimla	
	P	U	P	U	P	U	P	U	P	U	P	U	P	U	P	U
ly	30.00	32.50	5.08	10.15	-	-	5.47	6.26	-	-	26.37	25.00	9.64	9.64	7.47	9.97
e	7.50	10.00	2.54	8.12	27.11	35.96	17.71	20.24	22.22	22.22	18.18	17.25	24.23	24.23	4.98	7.47
t	30.00	30.00	10.15	17.77	36.15	36.15	18.75	21.43	27.78	27.78	44.55	42.24	8.17	23.44	19.93	24.91
- les	20.00	15.00	26.89	9.14*	22.29	13.43	23.44	17.85	22.22	22.22	5.45	10.34	8.04	8.02	34.74	24.77
to							4.69	5.36	16.66	16.66			16.06	8.03	14.95	14.95

*This comes to 16.67 per cent of the area cultivated under field crops (i.e. excluding Orchards).

Note: (P) has been taken from various project reports under 'with project' conditions.

(U) indicates the percentage area of each crop as used in this report.

For details see Appendix Tables 1.1 to 1.9

1.1.2 Crop Yields

We present in Table 1.1.3 the project-wise - crop-wise details of the 'existing' and 'with project' crop yields as given in the eight project reports. A perusal of the yield figures presented would reveal that existing crop yields in respect of major crops varied between 15 to 18 q for paddy, between 16 to 18 q for maize and between 12 to 15 q for wheat in various project locations. The 'with project' yields of these crops at all the locations has been respectively taken at 50, 30 and 30q for paddy, maize and wheat excepting Shimla where 'with project' yield of paddy has been taken at 35 quintals. In the case of vegetable crops the crop yields have been aimed at levels varying between 100 to 200 quintals per hectare. It would thus appear that the projected yield levels assumed in the project reports have been kept immune from being influenced by either the differences in agro-climatic conditions prevailing in different project locations or by the source of irrigation.

The estimates on crop yields of various crops in different districts of the State are available from the Annual Season and Crop Report (ASCR). The ASCR, however, does not distinguish between the yield levels of irrigated

TABLE: 1.13 CROP YIELDS OF IMPORTANT CROPS [illegible]
AND WITH PROJECT (P) AS PER PROJECT REPORTS

Crop	TW				LIS				TI				FIS			
	Solan		Una		Kangra		Kullu		Shimla		Mandi		Mandi		Shimla	
	E	P	E	P	E	P	E	P	E	P	E	P	E	P	E	P
Paddy	-	-	15	50	18	50	-	50			18	50	18	50	18	50
Maize	18	30	18	30	18	30	16	30	16	25	18	30	18	30	20	30
Wheat	15	30	12	30	12	30	12	30	14	30	12	30	12	30	15	30
Barley							13	27							16	27
Mash	5	5.5			5	5.5								5	6	7
Gram	6	10		10										5		
Sarson	4	4.5	4	4.5	4					8					4	12
Sugarcane			275	400												
Potato									80	90			100	150	60	150
Tomato		200				200				150					70	200
Beans						150										
Capsicum						120										
Cauliflower		200				200										
Ladies Finger												150				
Onion		200												200		
Peas										120		100				80
Cabbage															55	100
Fodder			275	400		400						400	250	400		

and unirrigated crop.[1] Two types of yield estimates are however, provided - one is referred to as the 'Standard Yield' and the other is 'actually realised'. The latest ASCR relates to the year 1984-85.

For the purpose of comparison of the yield levels reported in the project reports under 'existing' conditions with the actually realised yield levels we take the higher of the 'standard' and 'actually realised' yield levels from ASCR. A comparison of the yield levels from the two sources reveal that while in general the figures tally for most of the crops, the yield levels used for wheat and pulses in the project report for 'existing' conditions are generally 30 to 35 per cent higher than actually realised in the district.

To comment on the yield levels projected for 'with project' conditions in the project reports, we consider

1. Estimates of crop yields in respect of some of the important crops are also available from the results of crop cutting experiments. Such estimates, however, also do not distinguish between the yield levels obtained in irri. and unirr. plots. Although data on State level estimates of crop-yields for a few important crops under irrigated and unirrigated conditions are available, however, their statistical validity has been questioned by the organisation publishing the data (see, 'Area and Production of Principal Crops in India', Directorate of Economics and Statistics, Ministry of Agricultural, New Delhi).

the current level of actually realised yields of different crop, the level of increase in fertiliser consumption envisaged in the reports, the yield levels prevailing under assured irrigated conditions in neighbouring areas/States, the maximum yield levels that have been achieved under experimental conditions and such other information available from other published and unpublished sources. The broad set of assumptions used by us in projecting the yield levels of various crops under 'with project' conditions differ somewhat between different crops. We describe below the procedure for arriving at a set of yield levels, for some of the important crops, under 'with project' conditions.

Paddy

The maximum currently realised yield levels reported in the State vary from 12 quintals in Una to about 25 quintals in Mandi and Shimla district. The 'with project' yield envisaged in the project reports for all the project locations is 50 quintals per hectare. In the neighbouring State of Punjab, Ludhiana is the most prosperous agricultural district. In this district, the main Kharif crop is paddy and the three year average (1983-84 to 1985-86) yield realised in the district was 54 quintals. In a recent study[1] on fertiliser consumption

1. Malik,R.P.S., "Regionwise Cropwise Fertiliser Consumption : A Study of Punjab", Agricultural Economics

it was reported that in the zone comprising Ludhiana, the average fertilizer dose acually applied to paddy by farmers was 222 kg. N, 24 Kg P, 6 Kg. K per hectare which is much higher than the one recommended by the scientists. The experimental yield level reported for this crop is 65 quintals with recommended dose of fertilizer. Thus in the actual field conditions the farmers by using much more than the recommended doses of fertilizers and cultivating under assured irrigated conditions are not able to realise the experimental yield levels.

Contrasting now the Ludhiana conditions with those prevailing in different districts of the State, it is observed that the current level of average fertiliser use on paddy in Himachal Pradesh is 22, 1, 1 which is expected to increase to the recommended level of 90, 40, 40 under 'with project' conditions. Even if assured irrigation is available and recommended levels of fertiliser dosage are used it seems rather difficult to achieve yield level of 50 quintals at all project locations. It is considered reasonable to expect that the yield levels with application of recommended doses of fertiliser under assured irrigation will increase the yield by 100 per cent over the currently prevailing yield levels. The yield levels thus worked out for different project locations vary from 25 to 50 quintals per hectare. These yield levels have been used in our subsequent analysis.

Maize

The yield level of maize reported under the 'existing' conditions in various project reports vary between 16 to 18 quintals per hectare while that proposed under 'with project' conditions in all the project locations has been taken at 30 quintals per hectare except TI Shimla where it has been taken at 25 quintals. The actually realised yield levels as per season and Crop Report vary between 17 and 22 quintals per hectare in different districts of the State. The current level of fertiliser use in Maize is 33, 5, 3 which is expected to rise to 90, 45, 30 under 'with project' conditions. Given the already fairly high levels of realised yield and the anticipated increase in fertiliser dosage with availability of irrigation, it seems reasonable to assume that the yield levels would rise to the levels as envisaged in the reports under 'with project' conditions.

Wheat

The yield level of wheat under the 'existing' conditions in various project reports have been taken between 12 and 15 quintals per hectare. The proposed yield levels under 'with project' conditions have been taken at 30 quintals in all the project locations. The actually realised yield level for wheat vary between 7 quintals in Solan to 15 quintals in Kullu. The current level of fertiliser consumption in wheat (12, 5, 3) is

expected to rise to (120, 60, 30) when irrigation is made available.

The three year average level of wheat yield realised in Ludhiana work out to about 38 quintals per hectare. The average fertiliser dosage used in Ludhiana are 109, 60, 8. The recommended yield levels as per package of practices is about 47 quintals per hectare.

A comparison of the fertiliser doses and yield levels realised and proposed in Himachal Pradesh and those actually prevailing in Ludhiana, Punjab would lead one to believe that the proposed 30 quintal/hectare yield level can be realised after the irrigation is made available. In our subsequent analysis, we therefore take yield level of 30 quintals per hectare for wheat at all locations.

Vegetables

The vegetable cultivation under the 'existing' conditions is not widespread. With the availability of irrigation, the vegetable cultivation is expected to be extended to all the project locations. The project reports do not give much information on the 'existing' yield levels of various vegetable crops prevailing in various project locations since there is either nil or very small area currently under vegetables. The data on yield levels of various vegetable crops is also not reported in any of the major statistical publications

of the State. Even the ASCR does not provide information on yield levels of various vegetable crops.

Under the defined data availability constraints, we have resorted to the study on vegetable production and marketing, referred to earlier, which provides a fairly good estimate of the yield levels of four important vegetable crops - Peas, Tomatoes, Cauliflower and Capsicum - based on a statistically randomly selected sample of vegetable cultivators. The estimated yields of these vegetable crops work out to 18, 81, 73 and 68 quintals per hectare respectively. Between 39 and 69 per cent of the sown area under these crops was irrigated and about 71 per cent of the vegetable area was fertilised. On our discussions with some knowledgeable farmers it was gathered that the yield level estimated for Peas was somewhat lower and this they attributed to unfavourable weather conditions and/or incidence of pest.

Assuming the estimated figures as representing the current level of yields obtainable in the State, under full irrigation coupled with recommended doses of fertilisers and plant protection measures one can expect the yield levels to almost double the existing levels. To correct for under-estimation of existing yield level of Peas, one can expect the yield level of Peas to increase three times this level. The yield level of Peas thus work out to 55 quintals, Tomato 150 quintals

for two tubewell projects differ considerably - it is 29.80 for TW Solan against 16.43 for Una. In the case of two LIS projects the IRR's do not differ substantially (20.31 for Kangra and 22.06 for Kullu). Of the two FIS, the IRR for Shimla project at 33.34 per cent is much higher than that of Mandi project which is 25.23 per cent. The IRR's in all the projects have been computed at market prices of inputs and outputs.

Limitations of IRR Estimates

It may be noted that the Internal Rates of Return calculated in the Project Reports are based on the following assumptions :

i. The benefits of the project are essentially identified with direct primary benefits while indirect and induced effects during the construction or operation of the project have not been included.[1] Similarly, only the direct costs have been considered and indirect costs including externalities and environmental impacts have been ignored.

ii. The direct benefits of a project have been calculated as the value of the incremental net farm income

1. For a detailed discussion of these questions as well as various aspects of Social Benefit Cost Analysis of Irrigation Projects, reference may be made to the book by Basawan Sinha and Ramesh Bhatia : Economic Appraisal of Irrigation Projects in India, Agricole Publishing Academy, New Delhi, 1982.

defined as "With Project" minus "Without Project" net farm income excluding water charges. This means that the entire increase in net value added under "With Project" condition over that under "Without Project" condition is due to or attributable to irrigation project.

iii. In calculating value of crop output as well as farm-level costs and projects costs, market prices of these commodities have been used. It is well known that in a developing country such as India, the prices of foodgrains and other agricultural products, major agricultural inputs (e.g., fertilizers) and components of project costs (e.g. cement, steel, electricity) are "administered prices" and these do not reflect their true social value or opportunity costs. Hence use of these prices for valuation of outputs and inputs does not reflect the real benefits and costs (of the project) from the viewpoint of society. This requires that benefits and costs be estimated at "shadow prices" rather than at market prices.

iv. In the case of unskilled labour, the government interventions such as 'minimum wage' legislation mean that project wage rates are higher than the opportunity cost of labour in alternative employment. In such a situation, the use of "shadow wage rate" would not only reflect the real costs of unskilled labour but would also incorporate the employment objective in the process of selection of projects. Similarly, the official exchange

rate does not reflect the true cost of using or earning (saving) foreign exchange. There is need for using a premium on foreign exchange to reflect the scarcity value of foreign currency saved as a consequence of the project or used directly or indirectly in the project.

v. The IRRs calculated in the Projects do not provide results of any sensitivity analysis with respect to plausible variations in some of the assumptions made in the valuation of benefits and costs. Since every benefit-cost analysis requires forecasting of the future behaviour of the variables which enter the stream of benefits and costs, there is an element of uncertainty in the values of IRR calculated. Sensitivity analysis may be performed with respect to values of important parameters (e.g. crops yields, output and input prices) in order to judge the robustness of the IRR values.

vi. The IRR does not give any explicit weights to the distribution of benefits among various categories of farmers. This could be done by putting a premium on benefits going to small and marginal farmers. Similarly, explicit weights could also be given to benefits going to a particular region in the State.

Indirect Benefits and Indirect Costs

Although the secondary (backward-linked and forward-linked induced) effects of an irrigation project

are quite widespread over time and space, these effects are rather difficult to quantify. In order to avoid selection of an uneconomic project on the basis of over-estimated indirect benefits, it is considered necessary to calculate the B/C ratio with only direct (primary) benefits and direct costs. The indirect effects of the project may be mentioned along with this B/C ratio or may be incorporated in another B/C ratio which takes into account both direct and indirect effects. However, due to non-availability of data, the ERR calculation in this report have been confined to direct benefits only.

Indirect costs of irrigation may include ecological damage affecting the sustainability of agriculture over time, water-logging and water-borne diseases etc. In the case of Himachal Pradesh, it is very important to understand, and quantify if possible, the likely ecological damage to the agro-eco system of hill agriculture arising out of heavy irrigation.[1] It is understood that the top soil in Himachal Pradesh farms is rather thin and it is necessary to speculate on the effects that irrigated crops such as paddy, wheat and vegetables may have on the long term sustainability of agriculture in the State. Such an analysis needs to be done for each project for a few agro-ecological climatic zones before any long term decisions

1. As discussed in Sinha and Bhatia (1982, pp. 176-178), there are conceptual problems in estimation of benefits from an irrigation project. In the absence of an international market for irrigation water, recourse is usually taken to value irrigation water indirectly i.e., in terms of the value of agricultural commodities and by products obtained from the use of water.

on irrigation projects are taken. It has not been possible to attempt any discussion on these ecological aspects in this Report on account of non-availability of any meaningful studies in the short period (four weeks) available to us.

Incremental Benefits due to Irrigation

As mentioned earlier, the IRRs calculated in the project reports, the entire increase in net value added under 'with project' conditions over that under 'without project' conditions has been attributable to the irrigation project. This may not be the case if positive interaction factors with respect to other inputs such as HYV seeds and fertilizers are taken into account. In the absence of any detailed information on water response functions at different levels of other inputs, it has not been possible to separate out the effect of irrigation water from the effects of using other inputs. This aspect has been partly covered by estimating the response of ERR to a reduction in value of output (by 10 per cent and 25 per cent) under Sensitivity Analysis.

16. Estimation of Shadow Prices

The criteria for estimation for shadow pricesfor outputs and inputs are as follows :

1. For details, see Sinha and Bhatia (1982, pp. 148-168).

i. Traded or tradable commodities have been valued at c.i.f. or f.o.b prices adjusted for the shadow exchange rate and domestic transport costs;

ii. Non-traded outputs have been valued at 'consumers' willingness to pay; and

iii. Non-traded inputs have been valued in terms of long-term marginal cost of supply.

Besides commodity shadow prices estimated as described above, notional values for shadow exchange rate, shadow price of unskilled labour and opportunity cost of capital[1] have been used. These are based on the values currently used by the Planning Commission for appraisal of projects.

Tradeable/Traded Commodities

In this category, the major commodities are Rice, Wheat, Maize, Sugar, Oilseeds, Nitrogenous, Phosphatic and Potassic fertilizers, Cement and steel. Table 1.5.1 gives details of the estimates of shadow prices for these commodities.

Major foodgrains are treated as traded commodity on the margin implying that if this project were not

1. It is considered beyond the scope of this study to actually estimate these shadow prices.

undertaken, the entire output of foodgrains would have been imported from abroad. The cost to the society of importing these commodities would depend upon :

i. the C.I.F. price of importing the commodity as projected for a future year, say 1995;

ii. the estimated shadow price of foreign exchange which would adequately reflect the opportunity cost of using this scarce resources; and

iii. the transport cost of moving these foodgrains from the port to the consuming centre including storage costs and losses. (Actually, it would be the difference in transport cost of moving foodgrains from a surplus state in the absence of the project).

Table 1.5.1 shows that rice (paddy), wheat, maize, nitrogenous fertilisers, phosphatic fertilisers and potassic fertilisers have been considered importable at the margin.

Sugar has been considered a potential export and the shadow price for sugarcane is based on this assumption. The c.i.f. prices for imports are based on the projected prices (for 1955) as estimated by the World

Bank in terms of constant (1986) dollars. It is assumed that these prices will prevail over the 30 year life of the project. It is further assumed that changes in prices of outputs and inputs will cancel out the effects of each other and the results of ERR calculations will not be influenced in any particular direction.

For example, for wheat, the estimated f.o.b. price is US $ 135 at the source of supply to which US $ 25 is added to account for international shipping and handling. This estimated c.i.f. price of US $ 160 is converted into rupees using a 25 per cent premium on foreign exchange over an official exchange rate of Rs. 14 per US $. Thus, at the estimated shadow price of foreign exchange at Rs. 17.5 per cent US $, the c.i.f. price for wheat is Rs. 2800. To this, we have added Rs. 680 per ton to account for domestic transport and processing cost.[1] The resulting estimate of shadow price at the farm is Rs. 3480 per ton or Rs. 3.48 per kg. The corresponding estimate for paddy is Rs. 3600 per tonne and for Maize is Rs. 2780 per tonne. The shadow prices for pulses and oilseeds have been derived by multiplying their market prices by the same ratio as that estimated for the shadow price of wheat to its market price.

1. This would depend upon the net effect on transport of foodgrains under the conditions of 'with' and 'without' project.

TABLE: 1.5.1 CALCULATION OF SHADOW PRICES FOR MAJOR OUTPUTS & INPUTS

	OUTPUT				INPUTS		
	Paddy	Wheat	Maize	Sugarcane	Nitrogen	Phosphate	Potash
A. Import Price (1995) US $/ton	141.4	135	95	44	361	315	138
B. International Shipping and Handling U.S. $/ton	7.4	25	25	-	33	33	33
C. CIF/FOB Price U.S. $/ton	149	160	120	44	394	348	171
D. CIF/FOB Price (assuming a Foreign exchange Premium of 25% and an official exchange rate of Rs.14 per US $)	2607	2800	2100		6895	6090	2992
E. Transport and Processing cost in Domestic Market	453	680	680		750	750	600
F. Shadow price at the Farm (Rs./ton)	3060	3480	2780		7645	6840	3592

Notes:
(1) Import prices are from IBRD, 1987.
(2) The Price of Paddy is taken as 2/3 of the price of Rice.
(3) Price of Sugarcane has been calculated assuming that a ton of sugarcane yields 84.6 Kgs of sugar. It has been further assumed that the bagasse available from sugarcane compensates for the manufacturing costs of sugar. Price of sugar $ 524/ton. It is assumed that India is a net importer of foodgrains and a net exporter of sugar.
(4) Price of Urea (45%N) for 1995 is estimated $ 166/ton, while the price of TSP (45%P) is estimated $ 145/ton, and price of muriate of Potash (MOP, 60%K) is estimated $ 83/ton.

The shadow price for nitrogenous fertilizers is estimated from the c.i.f. price of US $ 394 per tonne of nitrogen. The equivalent price (c.i.f) in rupees is Rs. 6895 after taking a premium of 25 per cent for foreign exchange. The shadow price at the farm level is estimated at Rs. 7.645 per kg. of N. The corresponding prices for other fertilizers are Rs. 6.84 per kg. of P_2O_5 and Rs. 3.592 per kg. of K.

The shadow prices for cement and steel have been estimated by giving a premium of 25 per cent on market prices assuming that under conditions of decontrolled system of market prices, these are equal to c.i.f or f.o.b. prices as the case may be.

Shadow Prices for Non-tradeable Outputs

The major non-tradeable output commodities are vegetables such as tomatoes, beans, peas, cauliflower etc. For these commodities, the shadow prices are to be equated to the 'consumers' willingness to pay. Since markets in these commodities are not controlled, free market prices, in fact, reflect the consumers' willingness to pay. Hence, we have used market prices to reflect shadow prices for vegetables.

Shadow Price of Electricity

In four projects where electricity is used for lifting/pumping water, the cost of electricity-use accounts

for a major share of operation and maintenance (O&M) costs. In all these projects, electricity has been priced at Rs. 0.55 per kwh. It is well known that the price of electricity, particularly in rural areas, is subsidized on account of socio-economic objectives of promoting agricultural development and providing electricity for lighting at prices which people can afford. According to a Planning Commission Report (1988)[1], the estimated losses of eleven[2] State Electricity Boards (excluding Himachal Pradesh) on account of supply of electricity to the agricultural sector for 1987-88 were Rs. 21 billion (approximately US $ 1.5 billion).

In Himachal Pradesh, the State Electricity Board incurred a loss of Rs. 435 million in 1987-88 since the estimated revenue receipts at Rs. 0.64 per kwh were around 60 per cent of the average cost of operation estimated at Rs. 1.14 per kwh. It may be noted that unit cost of operation in Himachal Pradesh is the third-highest (after Assam and Bihar) in the country. This is mainly on account of O&M costs and high interest charges.

1. Planning Commission : Annual Report on the Working of State Electricity Boards and Electricity Departments, Power and Energy Division, Government of India, April 1988 (Annexure 16).

2. These data relate to these States where agricultural load forms a significant proportion of the total. Since electricity consumption for agriculture is only 3 per cent of the total in Himachal Pradesh, these details are not given.

Thus, it may be seen that the price of electricity (Rs. 0.55 per kwh) used in the four projects evaluated here is rather low; almost one-half of the average cost of generation. This would be much lower compared with the actual cost of supplying power to the rural areas due to high transmission and distribution losses (estimated at 22 per cent in the case of Himachal Pradesh). However, it was not possible to adjust the unit cost of generation for distribution losses on account of non-availability of information. Since agriculture accounts only 3 per cent of the total electricity consumption, this adjustment is not considered necessary. Thus, it is assumed that the unit cost of supply of electricity (Rs. 1.14/kwh sold which takes into account the transmission and distribution losses) reflects the economic cost of providing electricity to rural areas. Thus, we have taken Rs. 1.14 as the shadow price of electricity used in the four irrigation projects being analysed here.[1]

In order to reflect the long term trends (1995 and beyond) in shadow price of electricity, we need to

---

1. In the short-run, it may be tempting to equate the shadow price of electricity to its marginal product in alternative use in the context of overall power shortages. Even here, if the users find it economic to invest in captive power generation, the shadow price would equal the cost of diesel generation which is estimated to be at least Rs. 2 per kwh. However, this could not be taken as the long term prices.

while in the case of wheat the prices reported in the ASCR and project reports tally. For the p rpose of analysis we have used a price of Rs. 210 for paddy, Rs. 157 for maize and Rs. 200 for wheat. Similar procedures have been used for deriving the prices of other crops.

In the case of vegetable crops, the ASCR does not give any price data. For obtaining the estimates of farm gate prices of vegetables we use the estimates provided by the vegetable production and marketing study referred to above. According to the estimates provided by this study the prices of Peas prevailing were of the order of Rs. 292 per quintal, of Tomato Rs. 252 per quintal, of Cauliflower Rs. 300 and Capsicum Rs. 197 per quintal. The prices of Peas, Tomato and Cauliflower as used in the project reports are Rs. 150, Rs. 200 and Rs. 200 per quintal respectively. The prices of the above vegetable crops used in the project report are thus lower than actually realised by the farmers. We have therefore used the higher of the two sets of prices. For other vegetable crops for which estimates of prices from any other source were not available we have used the prices given in the project reports. The set of market prices used in our subsequent analysis are presented in Table 1.1.4.

1.2 Input Costs and Farm Returns

Table 1.2.1 gives the per hectare value of gross

and Cauliflower and Capsicum at 140 quintals each. These yield levels thus have been taken to represent the 'with project' yields in our subsequent analysis.

The set of yield levels for various crops as used in our subsequent analysis are presented in Appendix Tables 1.2 to 1.8.

1.1.3 Prices of Crop Output

We present in Appendix Table 1.10 a summary of prices of main products of different crops as used in the various project reports. It may be mentioned that the prices used under 'existing' as well as 'with project' conditions are the same. A perusal of the figures presented would reveal that for all the crops in all the project locations the same prices have been used, exception being paddy price in Kullu and paddy and barley price in Shimla. It is thus implicit that quality of the product does not differ as between different project locations and uniform prices prevail all over the State.

The ASCR referred to above also provides information on farm gate prices of various important crops in the State. A comparison of the prices used in the project reports with those reported in the ASCR would reveal that against a price of Rs. 212 for paddy reported in the ASCR the price used in the project report is Rs. 150. In the case of Maize prevailing farm gate price was around Rs. 160 as against Rs. 180 used in the project report

TABLE 1.1.4 MARKET PRICES OF MAIN PRODUCTS OF VARIOUS CROPS

Crop	As used Prices/Quintal	As per Project Report Price/quintel
Paddy	210	150
Wheat	200	200
Maize	157	180
Barley	168	160-175
Mash	600	600
Gram	600	450
Sarson	600	600
Sugarcane	20	
Potato	100	100
Tomato	252	200
Beans	150	150
Capsicum	197	-
Cabbage	225	100
Peas	292	150
Cauliflower	300	200
Onion	80	80
Ladies finger	100	100
Carrot	80	80
Radish	80	80
Turnip	80	80
Mix Vegetables	120	120
Berseem	15	15

TABLE: 1.2.1 INPUT COSTS AND RETURNS PER HA OF GCA AS PER PROJECT REPORTS

oject	Existing				With Project				Per Cent Change			
	G.R	I.C.	N.R.	G.R/I.C	G.R.	I.C.	N.R.	GR/IC	GR	IC	NR	GR/IC
olan	3111	1634	1477	1.90	11083	3293	7790	3.36	256	102	427	77
na	3840	1925	1915	1.99	9618	3387	6231	2.84	150	76	225	43
Kangra	3149	1871	1278	1.68	10900	3576	7324	3.05	246	91	473	82
Kullu	3104*	1703*	1401*	1.82*	12221*	3311*	8910*	3.69*	294	94	536	103
Shimla	4747	2692	2055	1.76	9497	3806	5691	2.49	100	41	177	41
Mandi	3162	2011	1151	1.57	7643	3314	4329	2.30	142	65	276	46
Mandi	3213	1929	1284	1.67	7901	3722	4179	2.12	146	93	225	27
Shimla	4306	2180	2126	1.98	12226	3576	8650	3.42	184	64	307	73

Notes: G.R. - Gross Returns
I.C. - Input Cost
N.R. - Net Returns
* - Orchard Excluded

returns, input cost and net returns under the 'existing' as well as 'with project' conditions as given in the project reports. It will be seen that under the 'existing' conditions the gross returns, input cost and net returns per hectare in Shimla district (TI, FIS) are higher than the other project locations. After the availability of irrigation, the gross returns increase substantially in all the project locations. The increases in gross returns under TW and LIS are generally higher than that observed in TI and FIS. The increases in gross returns in TW Solan and Una are of the order of 256 and 150 per cent; in LIS Kangra and Kullu of 246 and 294 per cent while in TI Shimla and Mandi 100 and 142 per cent and in FIS Mandi and Shimla 146 and 184 per cent respectively.

After the availability of irrigation the input cost per hectare does not differ as between different project locations. The increase in input cost over the existing level in TW and LIS project locations is, however, generally higher than that under TI and FIS. The magnitude of increase in input cost in the former two schemes is on an average around 90 per cent as compared to about 65 per cent increase in the latter two schemes.

The net returns also increase substantially after the availability of irrigation. The pattern of net returns realised reveal that net returns are generally

higher in TW and LIS schemes as compared to TI and FIS, except FIS Shimla where net returns compare favourably with those realised in LIS. The net returns in TW and LIS scheme vary between Rs. 6231 to Rs.8910 per hectare in comparison to Rs. 4179 to Rs. 5691 realised for TI and FIS (excepting FIS, Shimla).

The table also gives the output/input ratios for all the eight project locations. In the case of output/input ratios also the same pattern holds - the output/input ratios are generally higher under TW and LIS as compared to TI and FIS, excluding FIS, Shimla. The returns per unit of input vary between 2.84 to 3.36 under TW and LIS as compared to 2.12 to 2.49 under TI and FIS (excluding FIS, Shimla).

It will thus be seen that gross return, net returns and output-input ratios under TW and LIS projects is generally higher than that under TI and FIS. Given that the crop yields expected after availability of irrigation, level of input use for different crops and prices prevailing for different inputs and outputs across different project locations are almost uniform, the differences in benefits of irrigation across different projects could be attributed to the differences in cropping pattern. While the area under cereal crops under the 'with project' conditions do not differ significantly across projects, the area under vegetables differ substantially. While under all the LIS and TW projects around 20 per cent of

vegetable cultivation, in TI Shimla about 20 per cent, in TI Mandi about 5 per cent, FIS Mandi about 8 per cent and FIS Shimla around 35 per cent of the area is proposed to be cultivated with vegetables.

1.3 Incidence of Capital Cost

Table 1.3.1 gives a summary of the incidence of capital cost per hectare of CCA in each of the project locations. It will be seen that the capital cost per hectare of CCA under LIS is higher than any other type of scheme being considered. The per hectare capital cost of LIS Kangra and Kullu respectively is of the order of Rs. 31640 and Rs. 35090 respectively. The cost per hectare under TW and TI is almost the same varying between Rs. 22000 and Rs. 25000 per hectare. While the per hectare cost under FIS Mandi is the lowest of all the schemes at Rs. 18120 that of FIS, Shimla compare favourably with LIS at Rs. 31290 per hectare.

We present in Table 1.3.2 the share of pumping equipment and power supply in the total capital cost at market prices. It will be seen that in TW projects at Solan and Una, the share of pumping equipment work out to about 14 per cent while that in LIS Kangra and Kullu it is 18 per cent. We also present in Table 13.3 abstract of capital cost of supplying power to the four projects.

TABLE: 1.3.1 INCIDENCE OF CAPITAL COST PER HECTARE

Project	Total Capital Cost (000)	CCA (Hectares)	Capital Cost/CCA (000)
TW, Solan	1230	54.00	22.78
TW, Una	1026	42.00	24.43
LIS, Kangra	3164	100.00	31.64
LIS, Kullu	3456	98.50	35.09
TI, Shimla	229	9.00	25.44
TI, Mandi	132	5.50	24.00
FIS, Mandi	1036	57.18	18.12
FIS, Shimla	3140	100.36	31.29

Table 1.3.2 : Shares of Power Supply and Pumping Equipment Costs in Total Capital Cost (At Market Prices)

(Rs' 000)

Item	TW Solan	TW Una	LIS Kangra	LIS Kullu
1. Pumping Equipment	199 (13)	140 (14)	604 (18)	640 (18)
2. Supply of Power	81 (5)	100 (10)	618 (20)	674 (20)
3. Total Capital cost	1508 (100)	1026 (100)	3163 (100)	3456 (100)

Note : Figures in Parentheses are Percentage to Total Capital Cost.

Table : 1.3.3 : Abstract of Capital Cost of Supply in Power (S.O.P.)

Unit - Rs

Item	TW Solan	TW Una	LIS Kangra	LIS Kullu
Cost of HT Line	15930	45385	93945	100000
Cost of Sub Station/ Transformer	44900	33015	279535	400000
Cost of Service Cable	4000		29680	125000
Cost of Street Light/ Telephone Line	-	-	55355	
Sub Total	64830	78400	458515	625000
Departmental Charges (@ 25 per cent)	16208	19600	114628	-
Other charges	-	425	-	-
Total	81038	98425	573143	625000

1.4 Review of IRR Estimated in Project Reports

Table 1.4.1 gives the transition coefficients assumed in the various project reports. The table also gives the computed value of IRR as per the project reports. The transition coefficients assumed for different projects differ, but in a majority of the projects the full benefits are realised in six years. In the case of TW projects at Solan and Una, against the 'zero' transition coefficient used for year 1, we expect a coefficient of 0.4 which we expect to rise to 0.6 in second year, 0.8 in third year, 0.9 in fourth year and full benefits are expected in the fifth year. On the contrary, in the case of LIS projects we expect the benefits to start a little later. In the LIS Kangra and Kullu, the project reports respectively assume a transition coefficient of 0.24 and 0.48 in the first and 0.64 and 0.68 in the second year. We, however, assume a 'zero' transition coefficient for the first year and 0.3 for the second year in both the projects. The transition coefficient assumed for third, fourth and fifth years respectively have been taken at 0.5, 0.7 and 0.9 and the full benefits are ssumed to be realised in the sixth year.

The project reports do not give figures of calculated IRR for Tank Irrigation Schemes at Shimla and Mandi. The IRR of other projects vary between 16.43 per cent for TW Una and 33.34 per cent for FIS, Shimla. The IRR

TABLE: 1.4.1 TRANSITION COEFFICIENTS AND IRR AS PER PROJECT REPORTS

Project	Transition Coefficients Year 1	2	3	4	5	6	7	IRR (%)
TW Solan	0	0.60	0.70	0.80	0.90	1.00	-	29.80
TW Una	-	0.12	0.62	0.72	0.82	0.92	1.00	16.43
LIS Kangra	0.24	0.64	0.74	0.84	1.00	1.00		20.31
LIS Kullu	0.48	0.68	0.78	0.88	0.98	1.00		22.06
TI Shimla								
TI Mandi								
FIS Mandi	0.30	0.65	0.75	0.85	0.95	1.00		25.23
FIS Shimla	0.48	0.83	0.88	0.93	0.98	1.00		33.34

project the increases (in real terms) in the cost of capital, cost of fuels and O&M. According to the Planning Commission data, the unit cost of operation in Himachal Pradesh, which was Rs. 0.59 per kwh in 1980-81, increased to Rs. 1.14 per kwh in 1987-88 an increase of 94 per cent over seven years. This increase of 94 per cent is in current prices and contains, partly, the influence of inflation. Since, on account of hydro-power, fuel costs in Himachal Pradesh do not increase, a major part of the increase may reflect real cost increases. In the absence of any information on this, we have taken two levels of shadow prices of electricity in our sensitivity analysis : (i) 33 per cent increase in constant (1988) prices as well as (ii) 100 per cent increase in constant (1988) prices. It is expected that this range will reflect the two extremes of likely price changes over time.

Shadow Price of Foreign Exchange

A number of methodologies have been proposed for estimating the shadow price of foreign exchange. These include use of economy-wise programming models, estimation of Domestic Resource Costs and average rate of tariff etc. It is outside the scope of this study to estimate a range of values for shadow price of foreign exchange. Hence, a notional figure of 25 per cent premium implying Rs. 17.5 per US $ has been used in base calculations. This is the figure which is being used by the

Planning Commission in evaluating projects. We have also used a figure of 50 per cent premium on foreign exchange (Rs. 21 for US $) in one of the sensitivity analysis.

Shadow Price for Unskilled Labour

The estimation of shadow price of unskilled labour requires detailed information on opportunity cost of labour in alternative employment, premium on savings and cost of migration etc. Such data for different project regions were not available.[1] Hence, a notional ratio of 0.4 has been applied to the estimated cost of unskilled labour at market prices to derive the estimate for wage costs at shadow prices. This ratio has been applied to the components of unskilled labour in capital costs of each project, O&M costs and unskilled hired labour component of farm level costs. The sensitivity analysis with respect to shadow wage rate has been attempted indirectly through sensitivity analysis in capital costs and net benefits. Since unskilled labour component accounts for 6 to 22 per cent of the project capital costs, it was not considered necessary to do separate sensitivity analysis with respect to shadow wage rate.

Estimation of Economic Rate of Return

The shadow prices of output and inputs (for farm

1. For a detailed methodology for calculation of shadow wage rate and estimates for another region, see Sinha and Bhatia, 1987, p. 161.

level costs) are used to estimated annual net value of benefits due to irrigation. These annual benefits, combined with transition coefficients discussed earlier, give estimated values of benefits for the first six to seven years. It is assumed that constant annual benefits will be available for the remaining period of the project life (i.e., upto 30 years). On the cost side, capital costs are incurred in the first two or three years while in four projects, pumping machinery is replaced after 15 years. Operation and Maintenance costs are treated as constant over the life of the project except in the case of electricity charges which vary with level of output in the first five years. The present values of stream of benefits and costs are calculated for at varying discount rates. In most cases, to begin with,net present value (NPV)* is calculated for 15 per cent discount rate. This rate is varied parametrically to arrive at that rate of discount at which NPV is zero. This is the estimate of Economic Rate of Return. For the sake of comparison, values of Internal Rate of Return (IRR) using market prices have also been calculated and displayed alongwith ERRS.

* Net Present Value (NPV = P(B) - P(C) - P(I)

where,

P(B) is present value of benefits
P(C) is present value of O&M costs, and
P(I) is present value of capital costs.

Shadow Price Multipliers for Major Outputs and Inputs

Table 1.5.2 brings together the estimated values of shadow price for major outputs and inputs. The shadow price multipliers (ratio of shadow price to market price) are also given. The multiplier for paddy is 1.46 while for wheat and maize, the multipliers are 1.74 and 1.77 respectively. The multipliers for fertilizers are between 1.13 and 1.27.

1.6 Sensitivity Analysis

Since crop yields, output prices and input prices cannot be forecast with accuracy, it becomes important to study the effects of variations in these parameter values. We have carried out the following Sensitivity Analysis :

i. Economic Rate of Return assuming 50 per cent premium on foreign exchange;

ii. Changes in O&M costs in particular 33 per cent and 100 per cent increase in shadow price of electricity;

iii. Changes in capital cost assuming : (a) that the supply of power will require HT line for a distance which is three times the distance taken in the project, and (b) a 25 per cent increase in total capital cost;

TABLE 1.5.2 ESTIMATES OF SHADOW PRICE AND IMPLIED MULTIPLIERS FOR MAJOR OUTPUTS AND INPUTS

(Rs. per Quintal (100 kg)

	Market Price	Shadow Price	Shadow Price Multiplier		Market Price	Shadow Price	Shadow Price Multiplier
1	2	3	3÷2		4	5	5 ÷ 4
OUTPUTS				INPUTS (Rs. per Kg of Nutrient)			
Paddy	210	306	1.46				
Wheat	200	348	1.74	Nitrogenous Fertilizer	6	7.645	1.27
Maize	157	278	1.77				
Barley	168	292	1.74				
Oilseed	600	1044	1.74	Phosphatic Fertilizer	6	6.8	1.13
Pulses (Mash)	600	1044	1.74				
Gram	600	1044	1.74				
Berseem	15	15	1.00	Potassic Fertilizer	3	3.59	1.20
Mustard	600	1044	1.74				
Sugarcane	20	52	2.60				
Tomato	252	252	1.00	Electricity (Rs/Kwh)	0.55	1.14	2.07
Beans	150	150	1.00				
Capsicum	197	197	1.00				
Cabbage	225	225	1.00				
Peas	292	292	1.00				
Cauliflower	300	300	1.00				
Onion	80	80	1.00				
Vegetables (Ladies Finger)	100	100	1.00				
Carrot	80	80	1.00				
Turnip	80	80	1.00				
Potato	100	100	1.00				
Veg Mix	120	120	1.00				

Table 1.5.3 : A Comparison of Net Benefits, Capital Costs and O and M Costs of Eight Projects (At Shadow Prices)

Items	Units	Twin Solan	Twin Una	LIS in Kangra	LIS in Kullu	TI in Simla	TI in Mandi	FIS Simla	FIS Mandi
C C A	Ha	54	42	100	98.50	9	5.50	100.36	57.18
G C A	Ha	108	84	200	197	18	11.60	200.72	124.54
Net Benefits	'000	581	54	1738	1278	60	62	928	194
Net Benefits per hectare	Rs	5380	6430	8690	6487 (16494)	3330	5340	4400	1560
Capital Cost	Rs'000	1540	1007	3187	3561	225	135	3011	974
Capital Cost per hectare	Rs	14259	11984	15935	18076	12500	11638	150001	7821
O and M Cost	Rs'000	288	227	693	994	8	5.20	75	21
O and M cost per hectare	Rs	2670	2700	3470	5050	440	450	360	170
Electricity Cost per hectare	Rs	2,150	2,190	2,890	4,370	NA	NA	NA	NA
Other O and M cost per hectare	Rs	520	510	580	680	NA	NA	NA	NA

NA - Not available

Notes : 1. Per Ha. benefits and costs have been calculated using GCA.

2. For Kullu, the figure in bracket shows the net benefit per hectare per net area and not per net area.

3. Sources : As in Section 3,4,5,6.

188

iv. Changes in value of output by : (a) reducing gross value of output by 25 per cent and 10 per cent, and (b) reducing the output of wheat to reflect non-availability of power or non-availability of water during November, which is the month of peak water requirements;

v. Increase in capital cost (by 25 per cent) coupled with decrease in gross value of output (by 10 per cent, 25 per cent); and

vi. Increase in gross value of output (by 10 per cent and 25 per cent) along with a 100 per cent increase in shadow price of electricity.

SECTION 2

2.1 Economic Rate of Return (ERR) for the Tubewell Project in Solan

In this section we present the results of the estimates of Economic Rate of Return (ERR), using the shadow prices discussed earlier, for the tubewell project at Dhakeri in tehsil Nalagarh of Solan district.

2.1.1 Estimates of Benefits

Table 2.2.1 presents details of Net Value of Benefits for the irrigation project which are taken as equal to the economic value of the incremental net farm income defined as With Irrigation Project (WIP) minus Without Irrigation Project (WOP). Net farm income is defined here as the difference between Gross Value of Produce (Crop output plus by product) and Farm Level Costs (excluding irrigation charges, taxes etc.). Under conditions of Without Irrigation gross value of output is estimated at Rs. 0.326 million, about 90 per cent of which is the value of crop output, using market prices. The estimated value of Farm Level Costs is Rs. 0.177 million giving an estimate of Rs. 0.149 million as the Net Value of Produce at Market Prices. The details of crop-wise area, yield, prices, input costs are given in the Appendix Tables 2.1 to 2.8. At shadow prices, gross

TABLE 2.1.1 ESTIMATES OF NET VALUE OF BENEFITS WITHOUT AND WITH IRRIGATION FOR TUBEWELL PROJECT IN SOLAN

(In thousand rupees)

	WITHOUT IRRIGATION(1)		WITH IRRIGATION		DIFFERENCE (1 - 2)	
	At Market Prices	At Shadow Prices	At Market Prices	At Shadow Prices	At Market Prices	At Shadow Prices
A. Gross Value of Agri. Prod.						
Value of Crop Output	290	507	867	1229		
Value of By Prod.	36	36	72	72		
Sub Total	326	543	939	1301		
B. Costs of Cultivation for Farm Level Costs						
Seeds	19	19	23	23		
Human Labour	50	22	76	33		
Manures & Fertilisers	58	62	183	206		
Bullock Labour	48	48	59	59		
Inc./Pesti.	2	2	9	9		
Sub Total	177	151	350	327		
Net Value Produced (A - B)	149	392	589	974	440	582

Notes: 1. For details see Appendix Tables 2.1 to 2.8.

value of crop output is considerably higher at Rs. 0.5 million while the Farm Level Costs are lower (by about 10 per cent on account of shadow price of labour). This gives an estimate of Rs. 0.390 for the Net Value of Produce at Shadow Prices.

The gross value of agricultural output under conditions of "With Irrigation" is Rs. 1.301 million using shadow prices. The Farm Level Costs are estimated at Rs. 0.33 million giving an estimate of Net Value of Produce at Rs. 0.97 million. Thus, the estimated Net Value of Benefit is Rs. 0.581 million (Rs. 0.971 - Rs. 0.390 million).

As discussed earlier, this is taken as the estimate of the direct benefit due to or arising as a result of the proposed irrigation project. This gives a net value of benefit of Rs. 5380 per ha of gross cropped area when outputs and inputs are valued at shadow prices.

Project Capital Costs

Table 2.1.2 gives detailed estimates of various components of the project capital costs in terms of major commodities, machinery and unskilled labour. Cement and Steel, two items where shadow prices are estimated to be higher than market prices account for about one-third of the total costs. Supply of electric power (i.e. HT line and transformer) account for Rs. 81000 which is only 5 per

TABLE 2•1•2 PROJECT CAPITAL COSTS FOR TUBEWELL PROJECT IN SOLAN

	Cost at Market Prices	Multiplier for Shadow Prices	Cost at Shadow Prices
Cement	230	1•25	288
Steel	256	1•25	320
Machinery	261	1•00	261
Unskilled Labour	150	0•40	60
Admin charges	170	1•00	170
Others	441	1•00	441
Total	1508		1540

cent of the total cost. Pumping machinery, at Rs. 199000 accounts for 13 per cent of the total. Unskilled labour cost is about 10 per cent of the total.which reduces to around 4 per cent when shadow price of unskilled labour is used. The costs of cement and steel increase to around Rs. 0.6 million when 25 premium is used to reflect the premium on foreign exchange. Thus, on balance, the estimated project capital cost is taken as Rs. 1.545 million whc;h is equal to Rs. 14300 per ha of gross cropped area. Sensitivity analysis has been done for (i) 50 per cent premium on foreign exchange which will raise the shadow price of cement and steel and (ii) by increasing the distance (from 0.38 km to 1.0 km) for which the HT line is required. These results are given later.

Operation and Maintenance (O&M) Costs

The estimated values of different components of O&M costs are given in Table 2.1.3. At market prices, electricity accounts for about two-thirds of the O&M costs. As discussed earlier (Section 1.5), the shadow price of electricity is estimated as Rs. 1.138 per kwh giving a shadow price multiplier of 2.07 (since the market price is Rs. 0.55/kwh). Maintenance charges for civil works, rising main and pumping machinery are about 20 per cent of the total. Establishment charges are estimated at Rs. 25000 per annum. It is assumed that an average coefficient of 0.8 will reflect the share of unskilled labour

TABLE 2.1.3 OPERATING AND MAINTENANCE COSTS FOR TUBEWELL PROJECT IN SOLAN

(Rs. Thousands/Year)

	Cost at Market Prices	Shadow Price Multiplier	Cost at Shadow Prices
1. Electricity			
- Demand charges	13	-	-
- Electricity charges @ Rs.0.55/ Kwh assuming 2906 hours/year	99	-	-
	112	2.07	232
2. Maintenance Charges			
- Civil works @ 2%	5	1.00	5
- Rising main & distribution @ 3.5% on Rs.5.1 lakhs	18	1.00	18
- Pumping Machinery @ 6.5% on Rs.2 lakhs	13	1.00	13
3. Establishment Charges	25	0.80	20
	173		288

Source: Project Report

(Chowkidar, lamporder etc.) in the establishment charges. The estimated O&M costs, at shadow prices, are Rs. 288000 per annum or Rs.2667 per ha.

Estimate of ERR

Table 2.1.4 brings together the estimated values of benefits and costs for calculating ERR. At market prices, the IRR is calculated at 15.375 per cent. It may be noted that annual net benefit are distributed over the first four years according to transition coefficient discussed earlier. It is further assumed (as in the project report) that the entire pumping machinery costing Rs. 199000 (minus Rs. 20000 received as scrap value) is incurred again in the year 16. Since the life of the project is taken as 30 years, annual benefits as received earlier, continue to be available upto the year 30. We have accepted this assumption even though some other components of the project (rising main, channels etc.) may also be so damaged as to reduce project life or require major maintenance expenditures.

The present value of benefits at shadow prices is Rs. 3.227 million while the present value (PV) of O&M costs is Rs. 1.66 million. With the PV of project capital cost at Rs. 1.42 million, the Net Present Value (NPV) at 15 per cent discount rate is Rs. 0.146 million. The estimated value of ERR at shadow prices is 16.6 per cent which is higher than the estimated rate of 12 per cent

TABLE 2.1.4 CALCULATION OF BENEFIT COST RATIO FOR TUBEWELL PROJECT IN SOLAN AT MARKET PRICES (M.P) AND SHADOW PRICES (S.P)

(Rs. in thousand)

Year	Discount Factor at 15% Discount Rate	Net Benefit MP	Net Benefit SP	O & M MP	O & M SP	Project Cost MP	Project Cost SP	Rate of Discount 15% P.V. N.B. MP	P.V. N.B. SP	PV, C&M MP	PV, C&M SP	PV, P.Cost MP	PV, P.Cost SP
0	1.0	0	0	0	0	433	444	0	0	0	0	433	444
1	0.8696	176	232	106	149	1075	1096	153	202	92	130	935	953
2	0.7561	264	349	128	195			200	264	97	147		
3	0.6575	352	465	151	246			231	306	99	162		
4	0.5717	396	523	162	265			226	299	93	152		
5	0.4972	440	581	173	288			219	289	86	143		
6	0.4323	440	581	173	288			190	251	75	125		
7	0.3759	440	581	173	288			165	218	65	108		
8-15	1.6869	440	581	173	288			742	980	292	486		
16	0.1069	440	581	173	288	199-20	199-20	47	62	18	31	19	19
17 to 30	0.6133	440	581	173	288			270	356	106	177		
								2443	3227	1023	1661	1387	1416

Net Present Value at 15 per cent = 2443-1023-1387 = 33***

Net Present Value at 16 per cent = 2278-956-1377 = -55

IRR = 15.375 per cent

Net Present Value at 15 per cent = 3227-1661-1416 = 150***

Net Present Value at 17 per cent = 2813 - 1451-1399= - 37

IRR = 16.596 per cent

used as the opportunity cost of capital by the Planning Commission. This value shows that under the assumptions of output yields and prices, input prices and estimated project costs the proposed investment in a tubewell at Dhakeri Village in Solan district is economic from the viewpoint of society. The robustness of this conclusion is tested under the Sensitivity Analysis described subsequently in Section 6.

2.2 Economic Rate of Return for Tubewell Project in UNA

The results on Economic Rate of Return (ERR) for tubewell project in Una, using the shadow prices of various inputs and outputs are described below :

2.2.1 Estimation of Benefits

We present in Table 2.2.1 the details of the Net Value of Benefits for the tubewell project in Una. As discussed earlier the Net Benefits have been taken as the economic value of the incremental net farm income without and with project. The net farm income represents the gross value of output minus farm level cost, excluding irrigation charges, taxes etc. At the exist-ng level of farming conditions without irrigation, the gross value of crop output is estimated at Rs. 0.276 million at market prices. The estimated value of cost of inputs work out to Rs. 0.155 million, giving a net value of crop output

TABLE 2.2.1 ESTIMATES OF NET VALUE OF BENEFITS WITHOUT AND WITH IRRIGATION FOR TUBEWELL PROJECT IN UNA DISTRICT

(Rs. in thousands)

	WITHOUT IRRIGATION (X)		WITH IRRIGATION (Y)		DIFFERENCE (Y - X)	
	At Market Price	At Shadow Price	At Market Price	At Shadow Price	At Market Price	At Shadow Price
A. Gross Value of Agri. Prod.						
Value of Crop Output	271	336				
Value of By Product	5	5				
Sub Total	276	341	782	1013		
B. Cost of Cultivation						
Seeds	23	23				
Human Labour	51	22				
Manures & Fertilisers	42	44				
Bullock Labour	40	40				
Ins./Pesticides	-	-				
Sub Total	156	127	278	260		
C. Net Value Produced (A - B)	120	214	504	753	384	539

at Rs. 0.121 million at market prices. Using the shadow prices, the gross value of output work out to Rs. 0.341 million of which the farm level costs work out to Rs. 0.128 million giving a net value of Rs. 0.213 million at shadow prices.

Under 'with project' condition, using shadow prices, the gross value of output work out to Rs. 1.013 million, the value of farm level cost at Rs. 0.260 million, giving a net value of Rs. 0.753 million. Thus the estimated net value of benefits due to or arising out of the proposed tubewell project work out to Rs. 0.540 million (0.753 - 0.213) at shadow prices. Converted into per hectare, the net value of benefits at shadow prices work out to Rs. 6435 per hectare of gross cropped area.

2.2.2 Capital Cost of Project

Table 2.2.2 gives detailed estimates of different components of capital cost, separately for major commodities, machinery and unskilled labour. Cement and steel, whose shadow prices are higher than market prices, account for about 32 of the total capital cost. Supply of Power (SOP) account for Rs. 0.1 million, just 10 per cent of the total cost and pumping machinery for 20 per cent. The cost of unskilled labour at shadow prices work out Rs. 0.06 million which is 6 per cent of the estimated total capital cost of the project. Using a premium of 25 per cent on foreign exchange, the cost of cement and steel increase to Rs. 0.325 million. Thus the estimated cost of the

TABLE 2.2.2

CAPITAL COSTS OF TUBEWELL PROJECT IN UNA DISTRICT

(Rs. Thousands)

	Cost at Market Prices	Shadow Price Multiplier	Cost at Shadow Prices
Cement	200	1.25	250
Steel	60	1.25	75
Machinery	280	1.00	280
Unskilled Labour	140	0.40	56
Others	225	1.00	225
Admin charges	121	1.00	121
	1026		1007

TABLE: 2.2.3

TIME-PATTERN OF CAPITAL COSTS AND O & M COSTS FOR TUBEWELL PROJECT AT UMA

Year	Capital Costs		O & M Costs	
	Market Prices	Shadow Prices	Market Prices	Shadow Prices
0	400	394	0	0
1	626	613	106	120
2	0	0	124	156
3	0	0	141	191
4	0	0	149	209
5	0	0	158	227
6-15	0	0	158	227
16	140-20	140-20	158	227
17-30			158	227

TABLE: 2.24 CALCULATION OF BENEFIT COST RATIO FOR TUBEWELL PROJECT, UHA

(Rs. in thousands)

Year	Net Benefit		O & M		Proj Cost		17% Discount Rate			26% Discount Rate		
	MP	SP	MP	SP	MP	SP	PV, NB MP	PV, O&M MP	PV, P.cost MP	PV, NB SP	PV, O&M, SP	PV, P.Cost SP
0	0	0	0	0	400	394	0	0	400	0	0	394
1	153	216	106	120	626	613	131	91	535	171	95	487
2	230	324	124	156			168	91		204	98	
3	306	432	141	191			191	88		216	95	
4	345	486	149	209			184	80		193	83	
5	383	540	158	227			175	72		170	71	
6-15	383	540	158	227			814	336		589	248	
16	383	540	158	227	140-20	140-20	31	13	10	13	6	3
17-30	383	540	158	227			162	67		49	21	
							1856	838	945	1605	717	884

MP: 1856-838-945 = 73 17%

1546-705-928 = -87 20%

IRR = 18.37

SP: 2180-952-914 = 314 20%

1765-784-896 = 85 24%

1682-750-891 = 41 25%

1605-717-884 = 4 26%

SECTION 3

3.1 Economic Rate of Return (ERR) for the Lift Irrigation Scheme in Kangra District

In this section we present the results of the estimates of Economic Rate of Return (ERR), using the shadow price, discussed earlier, for the tubewell project at Bhaura in tehsil Palampur of Kangra district.

3.1.1 Estimates of Benefits

Table 3.1.1 presents details of Net Value of Benefits for the irrigation project which are taken as equal to the economic value of the incremental net farm income defined as With Irrigation Project (WIP) minus Without Irrigation Project (WOP). Net farm income is defined here as the difference between Gross Value of Produce (crop output plus by product) and Farm Level Costs (excluding irrigation charges, taxes etc.). Under conditions of Without Irrigation gross value of output is estimated at Rs. 0.620 million, about 88 per cent of which is the value of crop output using market prices. The estimated value of Farm Level Costs are Rs. 0.397 million, giving an estimate of Rs. 0.223 million as the annual Net Value of Produce at Market Prices. The details of crop-wise area, yield, prices, input costs are given in the Appendix Tables 3.1 to 3.4.

At shadow prices, gross value of crop output is considerably higher at Rs. 0.98 million while the Farm Level costs are the same as under market prices because an increase in fertiliser costs is nullified by a decrease in the cost of unskilled labour. This gives an estimate of Rs. 0.583 million for the Net Value of Produce at Shadow Prices.

The gross value of agricultural output under conditions of "With Irrigation" is Rs. 2.96 million using Shadow Prices. The Farm Level Costs are estimated at Rs. 0.64 million giving an estimate of Net Value of Produce at Rs. 2.32 million. Thus, the estimated Net Value of Benefit is Rs. 1.74 million (Rs. 2.32 million minus Rs. 0.58 million). As discussed earlier, this is taken as the estimate of the direct benefit due to or arising is a result of the proposed irrigation project. This gives a net value of benefit of Rs. 8700 per hectare of gross cropped area. Outputs and inputs are valued at shadow prices. This level of net value of benefit is higher than in other project (.e.g. tubewells in Solan and Una) because almost two-thirds of the crop area here is devoted to paddy and wheat where net value of benefit is higher than in Maize.

3.1.2 Project Capital Costs

Table 3.1.2 gives detailed estimates of various components of the project capital costs (market prices)

TABLE 3.1.2

CAPITAL COSTS OF LIFT IRRIGATION SCHEME IN KANERA DISTRICT

(Rs.'000)

	Cost at Market Price (MP)	Shadow Price Multiplier	Cost at Shadow Price (SP)
Cement	180	1.25	225
Steel	347	1.25	225
Machinery	884	1.00	884
Unskilled Labour	184	0.40	76
Others	994	1.00	994
Admin Charges	574	1.00	574
Total	3163		3187

TABLE: 3.1.4 CALCULATION OF BENEFIT COST RATIO FOR LIFT IRRIGATION SCHEME IN KANGRA

Year	Net Benefit		O&M		P.Cost		15% Discount Rate						25% Discount Rate					
							P.V. N.B.		PV. O&M		P.V. P.Cost		P.V. N.B.		P.V. O&M		PV. P.Cost	
	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP
0	0	0	0	0	633	639	0	0	0	0	633	639	0	0	0	0	633	639
1	0	0	0	0	1581	1591	0	0	0	0	1375	1383	0	0	0	0	1265	1273
2	385	521	207	288	949	957	291	394	157	218	718	724	246	333	132	184	607	612
3	642	869	263	404			422	571	173	266			329	445	135	207		
4	899	1217	318	520			514	696	182	297			368	498	130	213		
5	1156	1564	374	635			575	778	186	316			379	512	123	208		
6	1284	1738	402	693			555	751	174	300			337	456	105	182		
7 to 15	1284	1738	402	693			2649	3585	829	1430			1166	1578	365	629		
16	1284	1738	402	693	504	504	137	186	43	74	61	61	36	49	11	20	16	16
17-30	1284	1738	402	693			787	1066	247	425			138	187	43	75		
							5930	8027	1991	3326	2787	2707	2999	4058	1044	1718	2521	2543

MP: 4087-1399-2640 = 48 at 20% discount rate

3990-1238-2591 = -100 21%

IRR = 20.324

SP: 8027-3326-2707 = 1894***

4058-1728-2540 = - 200 At 25% Discount Rate.

4568-1924-2590 = 54 At 23% Discount Rate.

IRR = 23.42

TABLE 3.1.3

YEARWISE BREAK-UP OF CAPITAL COST AND O & M COST FOR LIS IN KANGRA DISTRICT

Year	Year-wise Break-up of Project Outlay (M.P.)	At Shadow Price	O & M (M.P.)	O & M (S.P.)
0	633	639	0	0
1	1581	1591	0	0
2	949	957	207	268
3			263	404
4			318	520
5			374	635
6			402	693
7-15			402	693
16	604-30	604-30	402	693
17-30			402	693

TABLE: 3.21 ESTIMATES OF NET VALUE OF BENEFITS WITHOUT AND WITH IRRIGATION FOR LIFT IRRIATION SCHEME IN KULLU DISTRICT

(Rs. in Thousands)

	WITHOUT IRRIGATION (X)		WITH IRRIGATION (Y)		DIFFERENCE (Y - X)	
	At Market Price	At Shadow Price	At Market Price	At Shadow Price	At Market Price	At Sha Price
A. Gross value of Agri. Prod.						
Value of Crop Output	286	475	747	1095		
Value of By Product	37	37	84	84		
Sub Total	323	512	831	1179		
B. Costs of Cultivation						
Seeds	61	61				
Human Labour	61	24				
Manures & Fertilizer	48	50				
Bullock Labour	53	53				
Ins./Pesticides	1	1				
Sub Total	184	189	341	314		
C. Net Value Produced from crops (A - B)	139	323	490	865	351	544
D. Net Value of Produce from orchards	742	742	1476	1476	734	734
E. Grand Total	881	1065	1966	2341	1085	1276

of Rs. 1.545 million to farmers. IRR works out to 22.06 per cent of the total net benefit Rs. 0.8 million (52 per cent) would come from crop production and Rs. 0.734 million from orchards. The net benefits from orchard are expected to result from doubling of net returns per gross hectare (from Rs. 16674 to Rs. 33168) . In the case of crop production 91 per cent of the net benefit would come from the doubling of yield of vegetables and also the increase in gross area under vegetables from existing 6 hectares to 53 hectares. The vegetables would occupy 49 per cent of gross cropped area. Crop intensity would remain unchanged at the existing level of 200 per cent.

The net returns to farmers given in the project report have been estimated without considering the cost of irrigation as per gross hectare annualised. The cost of irrigation roughly work out to Rs. 5483. The annual cost of electricity alone comes to Rs. 212 per gross cropped hectare. If the irrigation cost is to be met by farmers, net benefit to farmers get reduced to Rs. 2359 per gross hectare. The realisation of irrigation cost of this order from farmers would not be an easy task. Besides, as indicated earlier, the actual increases in area under vegetables and crop yield would be much lower than the estimates given in the project report.

3.2.2 Estimates of Benefits

Table 3.2.1 presents details of net value of

Rs. 1.178 million with irrigation (i.e. by 130 per cent) while net returns go up from Rs. 0.32 million to Rs. 0.864 million. Net benefits from crop production work out to Rs. 0.54 million as against Rs. 0.35 million at market prices. The total net benefits from the project including Rs. 0.734 million from orchard amount to Rs. 1.239 million. Here again orchard accounts for the bulk (59 per cent) of total net benefits.

3.2.3 Estimates of Project Costs

Tables 3.2.2 and 3.2.3 respectively give detailed estimates of various components of capital and O&M costs of the project. The cost of electric power, steel and machinery account for 19.5 per cent, 19.8 per cent and 20 per cent of the total capital costs of Rs. 34.56 lakhs at market prices. As is to be expected, the cost of cement, steel and machinery are higher at shadow prices. However, because of lower shadow price of unskilled labour, the total capital cost at shadow prices is only marginally higher (3 per cent) as compared with capital cost at market prices. The capital cost per gross hectare work out to Rs. 17543.

Annual O&M costs at market prices amount to Rs. 0.56 million (Rs. 2842 per gross hectare). Electricity accounts for 74 per cent of total O&M costs. At shadow prices O&M costs go upto Rs. 0.994 million because the shadow price of electricity is assumed to be 207 per

benefits of the project estimated on the basis of modified crop pattern and crop yields. For reasons mentioned earlier, gross area under vegetables would increase by only 200 per cent as against 783 per cent assumed in the project report. Likewise the increase in vegetable yield would be somewhat lower (100 per cent as against 140 per cent estimated in the project report). In the absence of data on inputs and output of orchard, the net returns assumed in the project report have been kept unchanged. However, the doubling of net returns from orchard assumed in the project report is not likely to materialise.

At market prices annual crop output without irrigation works out to Rs. 0.322 million while net returns amount to Rs. 0.138 million. The corresponding values for benefits with irrigation based on modified crop pattern and yields work out to Rs. 0.83 million and Rs. 0.489 million, respectively. Net benefit from crop production come to Rs. 3,51 lakh as against Rs. 8.11 lakhs estimated in the project report. If we add net benefit of Rs. 7.3 lakhs from orchard, the total annual net benefit of the project works out to Rs. 1.084 million (Rs. 5507 per gross hectare) orchard accounts for 68 per cent of total net benefit. The net benefit would be lower if the assumption regarding the doubling of net returns from orchard does not materialise.

At shadow prices, the gross value of crop output increases from Rs. 0.512 million without irrigation to

TABLE 3.2.4 ESTIMATION OF ERR FOR LIS IN KULLU AT MARKET PRICES (MP) AND SHADOW PRICES (SP)

Year	Net Value of Benefits: From Orchard	Net Value of Benefits: From Crop Output MP	Net Value of Benefits: From Crop Output SP	Net Benefit MP	Net Benefit SP	O &M MP	O &M SP	Project cost MP	Project cost SP	6% Discount Rate: PV, N.B SP	6% Discount Rate: PV, O&M SP	6% Discount Rate: PV C.Cost SP	10% Discount: PV N.B MP	10% Discount: PV, C&M MP	10% Discount: PV, C, Cost MP	12% Discount Rate: PV, NB MP	12% Discount Rate: PV, C&M MP	12% Discount Rate: PV, Capital cost MP
0	8	0	0	8	8	0	0	691	714	8	0	714	8	0	691	8	0	691
1	100	0	0	100	100	0	0	1728	1780	94	0	1679	91	0	1571	89	0	1543
2	110	105	163	215	273	269	391	1037	1067	243	348	954	178	222	857	171	214	827
3	375	176	273	551	648	352	564			544	474		414	264		392	251	
4	558	246	381	804	939	435	736			744	583		549	297		511	276	
5	734	316	490	1050	1224	518	908			915	679		652	322		596	294	
6-15	734	351	544	1085	1278	560	994			7029	5467		4140	2137		3479	1795	
16	734	351	544	1085	1278	560	994	640-64	640-64	503	391	227	236	122	125	177	91	94
17-30	734	351	544	1085	1278	560	994			4676	3637		1732	894		1173	605	
										14756	11579	3570	8000	4258	3244	6596	3526	3155

MARKET PRICES

NPV at 10% : 8000-4258-3244 = 498

NPV at 12% : 6596-3526-3155 = - 85

IRR = 11.71

SHADOW PRICES

NPV at 6% : 14756-11579-3570 = - 403

NPV at 5% : 16755-13135-3651 = - 31

cent higher than its market price. This gives the O&M costs at Rs. 5045 per gross cropped hectare.

3.2.4 Estimates of ERR

'able 3.2.4 brings together estimated value of benefits and costs for estimation of IRR. The estimates have been worked out according to the methodology described earlier. At market prices the IRR is estimated at 11.7 per cent. The ERR using shadow prices of outputs and inputs is 4.9 per cent. This value of ERR is lower than the estimated opportunity cost of capital at 12 per cent. This is partly because (a) the area under vegetables assumed in our analysis is much lower than that assumed in the project report and (b) the area under food crops where shadow price is much higher than market prices, (c) the cost of electricity in Kullu is Rs. 5045 per ha compared with Rs. 4420/ha for another LIS project in Kangra district, and (d) capital cost per ha is Rs. 18126 compared with Rs. 15955/ha for the other LIS project.

SECTION 4

4.1 Water Storage Tank Irrigation Project, Village Churla/Bamto (Distrct Shimla)

This project involves construction of a storage tank and water distribution system for utilising water from a nallha for irrigating 6 and 8 hectares respectively in Kharif and Rabi out of the 9 net sown hectares in the village. The capital cost of the project is estimated to be Rs. 2.29 lakh and annual O&M expenses come to Rs. 6795. Capital and O&M cost per hectare work out to Rs. 12711 and Rs. 727 respectively.

According to the project report the project gives a benefit cost ratio of 1.49 : 1 (The report does give estimates of IRR). The total net benefits accruing to farmers work out to Rs. 65445 (Rs. 3636 per GCH). The gross value of crops output would go up by 100 per cent while net returns would increase by 176 per cent. These benefits would be due to considerable increase in crop yields. Significantly, the project report envisages relatively small changes in crop pattern. In particular, area under vegetables is kept unchanged at the existing level of 4 hectares (22 per cent of GCA). However, additional yield from vegetables (114 per cent in Kharif and 140 per cent in Rabi) gives additional net returns of Rs. 46845 which account for 72 per cent of total net benefit of Rs. 65445 from the project.

The cost of irrigation per GCH work out to Rs. 2506. If irrigation cost is met by farmers, net benefits get reduced to Rs. 1130 per gross cropped hectare.

4.1.1 Estimates of Net Benefits

Table 4.1.1 presents estimated net values of benefits from the project on the basis of modified yield of vegetables. At market prices, gross value of output come to Rs. 83,000 without project and Rs. 1,48,000 with project, showing an increase of 78 per cent. The corresponding values for net returns work out to Rs. 35,000 to Rs. 82,000 (i.e., increase of 134 per cent). Net benefits from the project come to Rs. 47,000 (Rs. 2611 per gross hectare). Thus net benefits are about 28 per cent lower as compared with project report estimates.

At shadow prices, gross value of crop output increases from Rs. 1,07,000 to Rs. 1,87,000 (+75 per cent) and net returns from Rs. 65,000 to Rs. 1,25,000 (+92 per cent). Net benefits from the project work out to Rs. 60,000 (Rs. 3333 per gross hectare). Here again net benefit at shadow prices are more than net benefits at market prices.

4.2.1 Estimates of Project Costs

The estimates of project costs are presented in

The cost of irrigation per GCH work out to Rs. 2506. If irrigation cost is met by farmers, net benefits get reduced to Rs. 1130 per gross cropped hectare.

4.1.1 Estimates of Net Benefits

Table 4.1.1 presents estimated net values of benefits from the project on the basis of modified yield of vegetables. At market prices, gross value of output come to Rs. 83,000 without project and Rs. 1,48,000 with project, showing an increase of 78 per cent. The corresponding values for net returns work out to Rs. 35,000 to Rs. 82,000 (i.e., increase of 134 per cent). Net benefits from the project come to Rs. 47,000 (Rs. 2611 per gross hectare). Thus net benefits are about 28 per cent lower as compared with project report estimates.

At shadow prices, gross value of crop output increases from Rs. 1,07,000 to Rs. 1,87,000 (+75 per cent) and net returns from Rs. 65,000 to Rs. 1,25,000 (+92 per cent). Net benefits from the project work out to Rs. 60,000 (Rs. 3333 per gross hectare). Here again net benefit at shadow prices are more than net benefits at market prices.

4.2.1 Estimates of Project Costs

The estimates of project costs are presented in

TABLE 4.1.1 ESTIMATES OF NET VALUE OF BENEFITS WITHOUT AND WITH IRRIGATION FOR TANK IRRIGATION SCHEME - SIMLA

	Without Irrigation		With Irrigation		With - Without	
	At Market Prices	At Shadow Prices	At Market Prices	At Shadow Prices	At Market Prices	At Shadow Prices
A. Gross Value of Agri. Production						
Value of Crop Output	77	101	140	179		
Value of By Prod.	6	6	8	8		
Sub Total	83	107	148	187		
B. Costs of Cultivation or Farm Level Costs						
Seeds	12	12	14	14		
Human Labour	12	5	14	6		
Manures & Fertilizers	13	14	27	31		
Bullock Labour	10	10	10	10		
Ins./Pesti.	1	1	1	1		
Sub Total	48	42	66	62		
Net Value Produced (A-B)	35	65	82	125	47	60

Tables 4.1.2 and 4.1.3. It may be noted that at market prices, steel, cement and machinery together account for 52 per cent of total capital costs. Their share goes up at shadow prices because of their higher cost at shadow prices and lower shadow prices of unskilled labour on balance capital costs are slightly lower at shadow prices.

O&M costs are Rs. 14,000 at market prices and Rs. 8000 at shadow prices.

4.3.1 Estimates of ERR

Table 4.1.4 gives estimated values of benefits, costs and IRR. At market prices, IRR is estimated at 13.5 per cent while at shadow prices IRR comes to 21 per cent. The IRR at shadow prices is much higher than the estimated opportunity cost of capital, used by the Planning Commission. Thus, the proposed investment on the project is economic on social considerations, provided that the costs of irrigation are largely met by farmers.

4.2 Tank Irrigation Project, Village Ropan-Badu (District Mandi)

This project involves the construction of a small tank and water distribution system for utilisation of water from a perrenial nallah for irrigating 4.6 hectares in Kharif and 5.20 hectares in Rabi, out of 5.5 hectares of net sown area in the village. The total cost of the

TABLE 4.1.2 PROJECT CAPITAL COST FOR TANK IRRIGATION SCHEME - SHIMLA

	Cost at Market Price	Shadow Price multiplier	Cost at Shadow Price
Cement	30	1.25	38
Steel	70	1.25	88
Machinery	20	1.00	20
Unskilled Labour	50	0.40	20
Admin charges	40	1.00	40
Others	19	1.00	19
TOTAL	229		225

TABLE 4.1.3 PROJECT CAPITAL COST FOR TANK IRRIGATION SCHEME - SHILA

	O & M		Year-wise breakup of Project Outlay	
	IP	CP	IP	CP
0	0	0	100	99
1	6	4	129	126
2	10	6	0	0
3	13	7	0	0
4	14	8	0	0
5 to 40	14	8	0	0

project is relatively small, namely 1.32 lakh of capital expenditure and Rs. 9160 of annual O&M expenses. However, capital cost per gross cropped hectare (GCH) is quite substantial (Rs. 1379).

The project report envisages considerable increase in per GCH gross output (158 per cent), net returns (234 per cent), and total net benefits (Rs. 3100) after the introduction of irrigation. The total net benefit is estimated to be Rs. 35969. The benefit cost ratio works out to 1.5:1 (The project report does not give estimates of IRR). The net benefit of Rs. 35969 is expected to result from the shifts in crop pattern (specially the introduction of vegetables on 1.2 hectares and considerable increases in crop yield assumed in the report. About 39 per cent of net benefits would accrue from vegetables which give a very high net return per hectare (Rs. 11588) to the farmer. If the cost of irrigation is to be met by farmers, the net benefits get reduced to Rs. 717 per gross cropped hectare.

4.2.1 Estimates of Benefits

Table 4.2.1 presents details of net value of benefits of the project on the basis of modified yield of vegetables (crop pattern suggested in the project report is taken to be realistic). At market prices, annual gross crop output without and with irrigation respectively work

WITH IRRIGATION SCHEME FOR TANK IRRIGATION SCHEME - MANDI

	Without Irrigation		WITH IRRIGATION		WITH-WITHOUT	
	At Market Prices	At Shadow Prices	At Market Prices	At Shadow Prices	At Market Prices	At Shad Prices
A. Gross Value of Agri. Prod:						
Value of Crop Output	31	51				
Value of By Product	5	5				
Sub Total	36	56	95	134		
B. Costs of Cultivation or Farm Level Costs						
Human Labour	7	4				
Seeds	2	2				
Manures & Fertilizers	7	8				
Bullock Labour	6	6				
Ins./Pesti.		-				
Sub-Total	22	20	39	36		
Net Value Produced (A-B)	14	36	56	98	42	62

out to Rs. 35900 and Rs. 94700. The annual net benefit from the project comes to Rs. 42000 (Rs. 3600 per gross hectare). At shadow prices, the gross crop output increases by 139 per cent while net returns go up by 172 per cent. The net benefit from the project comes to Rs. 62000 (Rs. 5345 per gross hectare) which is 48 per cent more as compared with net benefit at market prices.

4.2.2 Estimates of Project Costs

Tables 4.2.2 and 4.2.3 respectively give estimates of various components of project costs. Cement and steel account for about 45 per cent of the project cost. Machinery at Rs. 20000 accounts for about 7.5 per cent of the total. The share of unskilled labour in the total project cost is about 15 per cent which gets reduced to about 6.6 per cent when shadow price of labour is used. The share of cement and steel increases to 55 per cent when 25 per cent premium on foreign exchange is used.

The estimated values of different components of O&M costs are given in Table 4.2.3. At market prices, maintenance charges on account of labour account for nearly 76 per cent of the total maintenance cost.

4.2.3 Estimates of ERR

Table 4.2.4 brings together the estimated values of benefits and costs for calculating ERR. At market prices

TABLE 4.2.2 PROJECT CAPITAL COSTS FOR TANK IRRIGATION SCHEME - MADI

	Cost at Market Prices	Multiplier for Shadow Prices	Cost at Shadow Prices
Cement	40	1.25	50
Steel	20	1.25	25
Machinery	10	1.00	10
Labour	20	0.40	8
Admin charges	20	1.00	20
Others	22	1.00	22
TOTAL	132		135

TABLE 4.2.3 TIME PATTERN OF CAPITAL COST AND O & M COST FOR THE IRRIGATION SCHEME- MANDI

	Yearwise Breakup of Project Outlay		O & M	
	M.P.	S.P.	M.P.	S.P.
0	32	33	0	0
1	100	102	3	2
2	0	0	5	3
3	0	0	7	4
4	0	0	9.2	5.2
5-40	0	0	9.2	5.2

TABLE 4.2.4 CALCULATION OF BENEFIT COST RATIO FOR TANK IRRIGATION, HAITI

	B.B.		O & M		Project Cost		23% B.B., O&M		Project Cost	30% B.B. O&M		Project Cost
	IP	SP	IP	SP	IP	SP	IP	SP	IP	SP	SP	SP
0	0	0	0	0	32	33	0	0	32	0	0	33
1	14	20	3	2	100	102	11	2	81	15	1	78
2	22	33	5	3	0	0	15	3		20	2	
3	32	48	7	4	0	0	17	4		22	2	
4	42	62	9.2	5.2	0	0	18	4		22	2	
5-10	42	62	9.2	5.2	0	0	80	18		72	6	
							141	31	113	151	13	111

IP: 141-31-113 = - 3 -25%

IRR = 22.9%

SP: 151-13-112 = 26 30%

IRR = 31%

SECTION 5

5.1 Flow Irrigation Project, Sundernagar (District Mandi)

Project Profile

Water from a perrenial nallah is to be utilised to irrigate 47.18 hectares (both in Kharif and Rabi) out of 57.18 net sown hectares in the village. The irrigation intensity would be 183 per cent. According to the project report, the net benefit from the project would be about Rs. 0.378 million. IRR is estimated as 25.23 per cent. Here again, bulk (68 per cent) of net benefits are due to increase in area from 1 hectare to 30 hectare and yield of vegetables (including potatoe) assumed in the project report. Net benefit per gross hectare come to Rs. 3037. If cost of irrigation (viz., Rs. 1425) is met by farmers, net benefit would be 47 per cent lower (Rs. 1612 per gross hectare).

5.1.1 Estimates of Benefits

Table 5.1.1 presents details about net value of benefits of the estimated on the basis of modified crop pattern and crop yield. At market prices, the gross value of crop output and net returns increase from Rs. 0.319 million to Rs. 0.699 million and from Rs. 0.108 million to Rs. 0.298 million respectively. The net returns per

the IRR comes to 22.9 per cent. The present value of benefits at shadow prices work out to Rs. 0.151 million while the present value of O&M costs is Rs. 0.013 million. With the present value of capital cost at Rs. 0.112 million, the NPV at 30 per cent discount rate work out to Rs. 0.026 million. The estimated value of ERR at shadow prices work out at 31 per cent which is higher than the opportunity cost of capital which is taken as 12 per cent.

TABLE 5.1.2 PROJECT CAPITAL COST FOR FLOW IRRIGATION SCHEME - MANDI

	Cost at Market Price	Shadow Price Multiplier	Cost at Shadow Price
Cement	150	1.25	188
Steel	90	1.25	113
Machinery	125	1.00	125
Unskilled Labour	205	0.40	82
Admin charges	135	1.00	135
Others	331	1.00	331
	1036		974

TABLE 5.1.3 PROJECT CAPITAL COST FOR FLOW IRRIGATION SCHEME - MANDI

	Yearwise Breakup of Project Outlay		O & M	
	MP	SP	MP	SP
0	450	426	0	0
1	586	548	0	0
2	0	0	13	8
3	0	0	19	12
4	0	0	26	17
5	0	0	29	19
6 to 50	0	0	32.5	21

TABLE 5.1.4 BENEFIT COST RATIO FOR FLOW IRRIGATION SCHEME - HAITI

	Net Benefit		O&M		Project Cost		13% Discount Rate						15% Discount Rate					
							Net Benefit		O & M		Project Cost		Net Benefit		O & M		Project Cost	
	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP
0	0	0	0	0	450	426	0	0	0	0	450	426	0	0	0	0	450	426
1	0	0	0	0	586	548	0	0	0	0	519	485	0	0	0	0	510	477
2	76	78	13	8	0	0	59	61	10	6			57	59	10	6		
3	114	116	19	12	0	0	79	80	13	8			75	76	12	8		
4	152	155	26	17	0	0	93	95	16	10			87	89	15	10		
5	171	175	29	19	0	0	93	95	16	10			85	87	14	9		
6 to 50	190	194	32.5	21	0	0	910	929	156	101			629	642	108	69		
							1234	1260	211	135	969	911	933	953	159	102	960	903

MP: 1234-211-969 = 54 13%

933-159-960 = -186 15%

IRR = 13.45

SP: 1260-135-911 = 208 13%

953-102-903 = -64 15%

IRR = 14.56

cent used as the opportunity cost of capital by the Planning Commission.

5.2 Flow Irrigation Project, Jond Bhajanu (Shimla District)

The project involves utilisation of water from Sarali Nallah for irrigating 90.3 hectare out of 100.36 hectares of net sown hectares in the village. The irrigation intensity would be 180 per cent.

According to the project report, the annual net benefits from the project would be Rs. 1.31 million. At market prices, IRR is estimated at 33.34 per cent. This substantial benefit would mainly come from 155 per cent increase in area and substantial increase in yield of vegetables. Altogether vegetables account for 77 per cent of net benefits while another 15 per cent would come from potatoes. Vegetables would provide 74 per cent of the additional gross value of output after introduction of irrigation. The net benefit per gross hectare works out to Rs. 6526. If the cost of irrigation is to be met by farmers, net benefits would decline to Rs. 3824 per gross hectare.

5.2.1 Estimates of Beneifts

The estimated benefits of the project based on realistic increase in area and yield of vegetables, are

presented in Table 5.2.1 (area under vegetables is assumed to be 49.72 hectares which is 29 per cent less than the area assumed in the project report). At market prices the gross value of crop output and net returns would increase by 106 per cent and 154 per cent respectively. The net benefit amounts to Rs. 0.83 million (Rs. 4153 per gross hectare) as against Rs. 1.31 million as shown in the project report).

At shadow prices, gross value of crop output and net returns respectively increase from Rs. 1.39 to Rs. 2.55 million (+ 83 per cent) and from Rs. 0.99 to Rs. 1.92 million (+ 93 per cent). The net benefit from the project work out to Rs. 0.93 million which is 12 per cent more as compared with net benefits at market prices.

5.2.2 Estimates of Project Costs

The estimates of capital and O&M costs are presented in Tables 5.2.2 and 5.2.3 respectively. The capital costs amount to Rs. 3.14 million at market prices and Rs. 3.02 million at shadow prices (Rs. 15622 and Rs. 15050 per gross hectares respectively). The annual O&M costs are Rs. 0.103 million and Rs. 0.75 million at market and shadow prices respectively. The cost of unskilled labour accounts for 48 per cent of O&M cost at market prices and 27 per cent at shadow prices. O&M cost per gross hectare come to Rs. 512 at market prices and Rs. 373 at shadow prices.

TABLE 5.2.1 ESTIMATES OF NET VALUE OF BENEFITS WITHOUT AND WITH IRRIGATION FOR FLOW IRRIGATION SCHEME - SHIMLA

	Without I					
	At Market Prices					
A. Gross Value of Agri. Production:						
Value of Crop Output	955	1347				
Value of By Product	49	49				
Sub Total	1004	1396	2078	2554		
B. Costs of Cultivation or Farm Level Costs						
Seeds	55	55	64	64		
Human Labour	164	66	187	75		
Manures & Fertilizers	97	127	289	319		
Bullock Labour	145	145	156	156		
Ins./Pesti.	3	3	11	11		
Sub Total	464	396	707	625		
Net Value Produced (A-B)	540	1000	1371	1929	831	929

TABLE 5.2.2 PROJECT CAPITAL COSTS FOR FLOW IRRIGATION SCHEME - SHIMLA

	Cost at Market Prices	Multiplier for shadow price	Cost at Shadow prices
Cement	203	1.25	254
Steel	300	1.25	375
Machinery	260	1.00	260
Unskilled Labour	425	0.40	170
Admin. charges	410	1.00	410
Others (Incl. Pipes)	1542	1.00	1542
Total	3140		3011

TABLE 5.2.3 **TIME PATTERN OF CAPITAL COST AND O & M COSTS FOR TECH IRRIGATION SCHEME - SHEMLA**

	Yearwise Breakup of Project Cutlay		O & M	
	M.P.	S.P.	M.P.	S.P.
0	1019	977	0	0
1	1021	1557	30	22
2	500	477	51	37
3	0	0	70	51
4	0	0	80	58
5	0	0	90	66
6	0	0	103	75
7 to 50	0	0	103	75

5.2.4 Estimates of ERR

Table 5.2.4 gives estimated values of benefits, costs and IRR. It may be noted that IRR at market prices comes to 20 per cent while at shadow prices ERR is 23 per cent. Although estimated ERR is much lower than IRR given in the project report, it is considerably higher as compared with the estimated opportunity cost of capital used by the Planning Commission. Here again, the estimated benefits from the project would be realised only if the expected increase in area and yield of vegetables materialises.

TABLE 5.2.4 CALCULATION OF BENEFIT COST RATIO FOR FLOW IRRIGATION SCHEME - SIMLA

	Net Benefits		O & M Costs		Project Costs		21% Discount Rate					
							Net Benefits		O & M Costs		Project Cost	
	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP	MP	SP
0	0	0	0	0	1019	977	0	0	0	0	1019	977
1	249	278	30	22	1621	1559	206	230	25	18	1340	1287
2	416	464	51	37	500	477	284	317	35	25	342	326
3	582	650	70	51	0	0	329	367	40	29		
4	665	742	80	58	0	0	310	346	37	27		
5	748	835	90	66	0	0	288	322	35	25		
6	831	928	103	75	0	0	265	296	33	24		
7-50	831	928	103	75	0	0	1261	1408	156	114		
							2943	3286	361	262	2701	2590

MP: 2943-361-2701 = -119 21%

IRR 20.1

SP: 3286-262-2602= 422 21%

ERR 24.2

SECTION 6

Table 6.1 present the result of various sensitivity analysis carried out in the study.

For the tubewell project in Solan, the ERR is quite robust with respect to changes in cost parameters. When 33 per cent increase in shadow price of electricity is taken the ERR is 14.8 per cent compared with the base case of 16.6 per cent. When higher capital costs of power supply are considered (to reflect three times the distance i.e., 1.0 km of HT line), the ERR is 16 per cent. Even when a 25 per cent increase in Project Capital Cost is taken, the ERR is 13.7 per cent i.e. higher than the opportunity cost of capital (12 per cent). The use of 50 per cent premium on foreign exchange (instead of 25 per cent) increases the ERR to 17.3 per cent.

However, as expected, the ERR is very sensitive to reduction in gross value of output (GVO). A 25 per cent reduction in GVO brings down the ERR from 16.6 per cent to 4.4 per cent. A reduction of 25 per cent in GVO coupled with an increase of 25 per cent Project Capital Cost brings the ERR down to 2.47 per cent. However, when 25 per cent reduction in wheat output is taken (to reflect shortage of power or water in the peak month of November).

Similar results are seen for the tubewell project in Una where the ERR continues to be higher than 20 per cent except when the GVO is reduced by 25 per cent

(ERR is 12 per cent) and when GVO is reduced by 25 per cent coupled with 25 per cent increase in Capital Cost (ERR is 9.5 per cent).

The Lift Irrigation Scheme at Kangra also has fairly high ERR (around 20 per cent) for cases where capital costs and O&M costs are increased. Here, ERR at 13.4 per cent is higher than 12 per cent even when 25 per cent reduction in GVO is considered. It is 10.4 per cent only when 25 per cent reduction in GVO is coupled with 25 per cent increase in capital cost.

The LIS in Kullu continues to show low ERR as anticipated. An increase of 33 per ent in shadow price of electricity reduces the ERR to less than 2 per cent. (The Net Present Value at 2 per cent discount rate is Rs. -4.0 million). The increase in Project Capital Cost by 25 per cent results in the ERR coming down to 4.5 per cent. Similarly, in Kullu ERR is less than 2 per ent (NPV is Rs. -5.59 million at 2 per cent discount rate) when 25 per cent reduction in GVO is considered.

An increase in GVO by 10 per cent increase the ERR, as expected. Even under this assumption, the ERR for Lift Irrigation Scheme at Kullu is only 7 per cent (i.e. less than 12 per cent taken as the opportunity cost of capital).

An increase in shadow price of electricity by 100 per cent affects the ERR significantly in the case

of LIS at Kullu and Tubewell at Solan. The ERR for tubewell at Solan reduces significantly (is less than 2 per cent), NPV is Rs. -0.435 million from the base case of 16.63 per cent when a 100 per cent increase in shadow price of electricity is taken.

Thus the results of sensitivity analysis show that, under the assumptions used in this study the Tubewell Project in Una and LIS in Kangra seem to be profitable from the viewpoint of the economy. For LIS at Kullu and Tubewell in Solan, there is need for further analyses specially with respect to level of benefits and shadow price of power.

As given in Table 6.2 in the Tank Irrigation Scheme, Mandi, a 25 per cent increase in capital cost reduces the ERR to 30 per cent, while a 25 per cent reduction in GVO brings it further down to 25 per cent. A 25 per cent increase in capital cost accompanied by a 25 per cent reduction in GVO brings down the ERR to 20.4 per cent.

The ERR for Tank Irrigation Scheme, Shimla decreases to 17.6 per cent with a 25 per cent increase in GVO. The combined effect of increased capital cost and reduction in GVO further lowers the ERR to 10.8 per cent.

The sensitivity analysis for Flow Irrigation Scheme, Mandi reveals that ERR declines to 12 per cent

when the capital cost is raised by 25 per cent and to 9.8 per cent when the GVO is reduced by similar percentage. The joint effect of the shift in the two parameters results in a further lowering of ERR to 7.9 per cent.

In TIS, Shimla, a 25 per cent increase in capital cost reduces the ERR to 19.7 per cent, while a 25 per cent reduction in GVO brings it down to 16.5 per cent. A simultaneous change of 25 per cent increase in capital cost and a 25 per cent reduction in value of output brings down the ERR to 13.8 per cent. Thus, we see that under most of the cases where benefits are lower or capital costs are higher, the ERR is higher than 12 per cent which is taken as the opportunity cost of capital. These results show that the economic profitability of these projects is rather robust in the context of possible changes in crop yields, prices or project costs.

APPENDIX

CROPPING PATTERN AS USED IN THIS REPORT (%)

Crop	LIS		TW		TI		FIS	
	Kangra	Kullu	Solan	Una	Shimla	Mandi	Mandi	Shimla
Paddy	32.50	10.15		6.26		25.00	9.64	9.97
Maize (Irr)	10.00	8.12	35.96	17.86	22.22	9.49	24.23	7.47
Maize (RF)				2.38		7.76		
Wheat (Irr)	30.00	17.77	36.15	21.43	22.22	34.48	23.44	25.91
Wheat (RF)					5.56	7.76		
Barley		2.54						
Barley (RF)								2.49
Mash (Irr)								2.49
Mash (RF)	2.50						8.03	
Gram (Irr)			3.01	3.57				
Gram (RF)							8.03	
Rajmah (RF)								
Unspecified Pulses (Kharif) (Irr)		5.08		5.36				2.49
Unspecified Pulses (Kharif) (RF)			4.52	2.98				
Unspecified Pulses (Rabi)		2.02						
Sarson (Irr)				1.78	11.11			7.97
Sarson (RF)	7.50		2.41					
Toria				3.57			8.17	
Lentil (RF)								2.49
Unspecified Oilseeds (Kharif)			4.52					
Unspecified Oilseeds (Rabi)								
Sugarcane				7.14				
Orchard		45.18						
Potato (Irr)				5.36			8.03	14.95
Potato (RF)					16.66			
Beans	2.50							
Capsicum	1.25							
Cauliflower	2.50		4.62	4.46				
Cabbage	2.50							2.49
Onion			1.33				4.01	
Ladies Finger						5.17		
Peas (Irr)	5.00			5.36	11.11			19.79
Peas (RF)						5.17		
Turnip (Irr)			1.03					
Turnip (RF)				2.38				

(Contd.)

TABLE: (Contd.)

Crop	LIS		TW		TI		FIS	
	Kangra	Kullu	Solan	Una	Shimla	Mandi	Mandi	Shimla
Tomato	1.25		2.01	2.68	5.56			2.49
Carrot (Irr)			2.78					
Carrot (RF)				1.19				
Raddish (RF)				1.78				
Unspecified Vegetables (Kharif)		4.06	1.66		5.56		4.01	
Unspecified Vegetables (Rabi)		5.08						
Fodder (Kharif)				1.78				
Fodder (Rabi)	2.50			2.68		5.17	2.41	
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
GCA (Ha)	200.00	197.00	108.00	84.00	18.00	11.60	124.54	200.72

APPENDIX TABLE: 1.2; DETAILS ABOUT AREA & YIELD

LIS, BHAURA, KANGRA

Units Area - Hectares
Yield - Qtl/hec.

Crop	Area			Yield (Main Product)			
	Existing	With Project (A)	With Project (B)	Existing	Maximum Realised	With Project (A)	With Project (B)
Paddy	20	60	66	18	19.89	50	40
Maize	75	15	20	18	17.23	30	30
Wheat	90	60	60	12	9.07	30	30
Mash (RF)	5	5	5	5	2.50	5.50	5.50
Sarson (RF)	10	15	15	4	N.A.	4.50	4.50
Tomato	-	5	2.50	-	81.00	200	160
Beans	-	10	5.00	-	N.A.	150	150
Capsicum	-	5	2.50	-	68.00	120	100
Cauliflower	-	5	5	-	73.00	200	140
Cabbage	-	5	5	-	N.A.	200	140
Peas	-	10	10	-	18.00	120	55
Berseem	-	5	5	-	N.A.	400	400
CCA	100	100	100				
GCA	200	200	200				
Cropping Intensity (%)	200	200	200				
Irrigation Intensity (%)		180	180				

NOTES: (A) - As per Project Report

(B) - As used in this Report.

APPENDIX TABLE: 1.3 DETAILS ABOUT AREA & YIELD

LIS, NEOLI THERMAN, KULLU

Units Area - Hectares
Yield - Qtl/hec.

Crop	Area			Yield (Main Product)			
	Existing	With Project (A)	With Project (B)	Existing	Maximum Realised	With Project (A)	With Project (B)
Paddy	-	10.00	20.00	-	20.08	50	40
Maize	40	5.00	16.00	16	21.63	30	30
Wheat	35	20.00	35.00	12	15.47	30	30
Barley	15	5.00	5.00	13	15.82	27	27
Pulses (Kharif)	10	10.00	10.00	5	2.50	8	6
Pulses (Rabi)	2	5.00	4.00	4	3.75	8	8
Vegetables (Kharif)	4	29.00	8.00	50	-	150	100
Vegetables (Rabi)	2	24.00	10.00	40	-	150	100
Orchard	44.50	44.50	44.50				
CCA	98.50	98.50	98.50				
GCA	197.00	197.00	197.00				
Cropping Intensity (%)	200	200	200				
Irrigation Intensity (%)		200	200				

NOTES (A) - As per Project Report (B) - As used in this Report.

TW, DHAKERI, SOLAN

Units Area - Hectares
Yield - Qtl/Hec.

Crop	Area			Yield (Main Product)			
	Existing	With Project (A)	With Project (B)	Existing	Maximum Realised	With Project (A)	With Project (B)
Maize	29.28	29.28	38.84	18	21.78	30	30
Wheat	39.04	39.04	39.04	15	7.13	30	30
Pulses (Kharif) (RF)	14.96	4.88	4.88	5	4.43	5.50	5.50
Gram	3.25	3.25	3.25	6	4.05	10	8
Oilseeds (Kharif)	4.88	4.88	4.88	4	-	12	8
Sarson (RF)	9.11	2.60	2.60	4	-	4.50	4.50
Tomato	-	6.00	2.17	-	81	200	160
Onion	-	4.00	1.44	-	-	200	140
Cauliflower	-	5.00	5.00	-	73	200	140
Turnip	-	1.11	1.11	-	-	250	125
Carrot	-	3.00	3.00	-	-	200	140
Mix Vegetable (Kharif)	-	4.96	1.79	-	-	150	100
Fallow (Kharif)	4.88	-	-	-			
Fallow (Rabi)	2.60	-	-	-			
CCA	54.00	54.00	54				
GCA	100.52	108.00	108.00				
Cropping Intensity (%)	186	200	200				
Irrigation Intensity (%)		186	186				

APPENDIX TABLE: 1.6 DETAILS ABOUT AREA & YIELD

TI, GURLA, SHIMLA

Units Area - Hectares
Yield - Qtl/Hec.

Crop	AREA			Yield (Main Product)			
	Existing	With Project (A)	With Project (B)	Existing	Maximum Realised	With Project (A)	With Project (B)
Maize	5	4	4	16	17.15	25	25
Wheat (Irr)		4	4	-	8.70	30	30
Wheat (RF)	7	1	1	14		15	13
Sarson		2	2		-	8	8
Vegetable (Kharif)	2	1	1	70	-	150	100
Potato (RF)	2	3	3	80	35.04	90	90
Vegetable (Rabi)	2	-	-	50	-	-	-
Peas	-	2	2	-	18	120	55
Tomato	-	1	1	-	81	150	150
CCA	9	9	9				
GCA	18	18	18				
Cropping Intensity (%)	200	200	200				
Irrigation Intensity (%)		156	156				

APPENDIX TABLE: 1.7

DETAILS ABOUT AREA & YIELD

TI, ROPA BUDA, MANDI

Units Area - Hectares
Yield - Qtl/Hec.

Crop	Area			Yield (main Product)			
	Existing	With Project (A)	With Project (B)	Existing	Maximum Realised	With Project (A)	With Project (B)
Paddy	1.70	2.90	2.90	18	24.69	50	50
Maize (Irr)		1.10	1.10		19.50	30	30
Maize (RF)	3.80	0.90	0.90	18		19	19
Wheat (Irr)		4.00	4.00			30	30
Wheat (RF)	5.50	0.90	0.90	12	12	13	13
Bhindi		0.60	0.60		N.A.	150	100
Peas (RF)		0.60	0.60		18	100	55
Berseem	-	0.60	0.60			400	400
CCA	5.50	5.50	5.50				
GCA	11.00	11.60	11.60				
Cropping Intensity (%)	200	211	211				
Irrigation Intensity (%)		167	167				

APPENDIX TABLE: 1.8

DETAILS ABOUT AREA & YIELD

FIS, BARI KULWARA, MANDI

Units Area - Hectares
Yield - Qtl/Hec.

Crop	Area			Yield (Main Product)			
	Existing	With Project (A)	With Project (B)	Existing	Maximum Realised	With Project (A)	With Project (B)
Paddy	24.18	12.00	12.00	18	24.69	50	50
Maize	33.00	30.18	30.18	18	19.50	30	30
Wheat	50.00	10.18	29.18	12	12	30	30
Mash (RF)		10.00	10		3.74	5	5
Gram (RF)		10.00	10		5.34	5	5
Toria		10.18	10.18			8	6
Mix Vegetable (Kharif)		5.00	5.00			150	100
Potato	1.00	20.00	10	100		150	150
Onion		5.00	5			200	140
Berseem	3.00	12.00	3	250		400	400
Fallow (Rabi)	3.18						
CCA	57.18	57.18	57.18				
GCA	114.36	124.54	124.54				
Cropping Intensity (%)	200	218	218				
Irrigation Intensity (%)		183	183				

APPENDIX TABLE: 1.9 DETAILS ABOUT AREA & YIELD

FIS, NANDPUR, SHIMLA

Units Area - Hectares
Yield - Qtl/hec.

Crop	AREA			Yield (Main Product)			
	Existing	With Project (A)	With Project (B)	Existing	Maximum Realised	With Project (A)	With Project (B)
Paddy	15	15	20	18	24.69	35	35
Maize	24	10	15	20	17.15	30	30
Wheat	37	40	50	16	8.70	30	30
Barley (RF)	15	5	5	16	11.02	18	18
Mash (RF)	10	5	5	6	3.23	7	7
Rajmah (RF)	10	5	5	6		7	7
Lentil (RF)	10	5	5	4		5	5
Sarson	26	16	16	4		8	8
Potato	26	30	30	60		150	150
Cabbage	1	5	5	55		100	100
Tomato	1.20	10	5	70	81	260	160
Peas (Kharif)	13.16	20.36	15.36	45	18	130	55
Peas (Rabi)	12.36	34.36	24.36	50	18	80	55
CCA	100.36	100.36	100.36				
GCA	200.72	200.72	200.72				
Cropping Intensity (%)	200	200	200				
Irrigation Intensity (%)		180	180				

APPENDIX TABLE: 1.10 OUTPUT PRICES OF IMPORTANT CROPS AS PER PROJECT REPORTS (Rs/Qtl)

Crop	TI		LIS		TI		FIS	
	Solan	Una	Kangra	Kullu	Shimla	Mandi	Mandi	Shimla
Paddy	150	150	150	160		150	150	200
Maize	180	180	180	180		180	180	180
Wheat	200	200	200	200	200	200	200	200
Barley				160				175
Mash			600	600			600	600
Gram	450	450					450	
Sarson	600	600	600		600			600
Sugarcane								
Potato								
Tomato	200		200		200	200	100	100
Beans			150					200
Capsicum								
Cauliflower	200		200		200	200		
Ladies Finger						100		
Onion	80						80	
Peas		150	150		150	150		150
Cabbage						100		
Fodder		15	15				15	

APPENDIX TABLE 2.1

TOTAL FARM LEVEL COSTS FOR TUBEWELL IRRIGATION PROJECT IN SOLAN AT MARKET PRICES

WITHOUT IRRIGATION

(Rs.)

	Seed	Compost	Fertilizer N.	Fertilizer P.	Fertilizer K.	N.P.K	Human Labour	Bullock Labour	Insecticide	Total	& NPK Compost
Kharif											
Maize	1757	14640	10541	7027	-	17568	19325	15811	-	69101	32208
Til	244	488	-	-	-	-	1464	1757	-	3953	488
Mash	3590	-	898	1795	898	3591	4488	5386	1496	18551	3591
Rabi											
Wheat	11712	19520	-	-	-	-	21082	21082	-	73396	19520
Gram	975	813	-	-	-	-	975	1170	163	4096	813
Sarson	729	1367	-	-	-	-	2732	3280	-	8108	1367
Total	19007	36828	11439	8822	898	21159	50066	48486	1659	177205	57987

APPENDIX TABLE: 2.2 TOTAL FARM LEVEL COSTS FOR TUBEWELL PROJECT IN SOLAN WITH IRRIGATION AT MARKET PRICES

WITH IRRIGATION (In Rupees)

	Seed	Compost	Fertilizers N	Fertilizers P	Fertilizers K	Fertilizers NPK	Human Labour	Bullock Labour	Ins./ Pesti.	Total	NPK + Compost
Kharif											
Maize	2330	19420	27965	13982	4661	46608	32626	23304	1942	126230	66028
Oilseeds	3294	-	586	1757	586	2929	1757	1757	244	9981	2929
Tomato	271	2713	781	391	195	1367	2604	1302	434	8691	4080
Onion	634	1440	778	518	130	1426	1210	864	144	5718	2866
Veg. Mix	179	1790	644	322	161	1127	1718	1074	269	6157	2917
Pulses	1171	-	293	878	146	1317	1464	1757	488	6197	1317
Rabi											
Wheat	11712	39040	28109	14054	3514	45677	23424	21082	3904	144839	84717
Gram	975	-	390	780	195	1365	1170	1170	325	5005	1365
Sarson	208	650	-	-	-	-	780	936	-	2574	650
Cauliflower	1315	5000	4500	1800	450	6750	6000	3000	1000	23065	11750
Turnip	167	555	333	266	133	732	799	666	111	3030	1287
Carrot	945	1500	900	720	360	1980	2160	1800	300	8685	3480
Grand Total	23201	72108	65279	35468	10531	111278	75712	58712	9161	350172	183386

APPENDIX TABLE 2.3 FARM LEVEL COSTS (AT MARKET PRICES) FOR TUBEWELL PROJECT IN SOLAN

(Rs./Hectare)

		Seed	Compost	Fertilizer N.	Fertilizer P.	Fertilizer K.	NPK	Hired Labour	Bullock Labour	Insecticide	Total
Kharif											
Maize I	WT	60	500	360	240	-	600	660	540	-	2360
I	W	60	500	720	360	120	1200	840	600	50	3250
Til	WT	50	100	-	-	-	-	300	360	-	810
Mash	WT	240	-	60	120	60	240	300	360	100	1240
Oilseeds	W	675	-	120	360	120	600	360	360	50	2045
Tomato	W	125	1250	360	180	90	630	1200	600	200	4005
Onion	W	440	1000	540	360	90	990	840	600	100	3970
Other Mixed	W	100	1000	360	180	90	630	960	600	150	3440
Pulses(R.F)	W	240	-	60	180	30	270	300	360	100	1270
Rabi											
Wheat I	WT	300	500	-	-	-	-	540	540	-	1880
I	W	300	1000	720	360	90	1170	600	540	100	3710
Gram I	WT	300	250	-	-	-	-	300	360	50	1260
I	W	300	-	120	240	60	420	360	360	100	1540
Sarson I	WT	80	150	-	-	-	-	300	360	-	890
I	W	80	250	-	-	-	-	300	360	-	990
Cauliflower	W	263	1000	900	360	90	1350	1200	600	200	4613
Tarrip	W	150	500	300	240	120	660	720	600	100	2730
Carrot	W	315	500	300	240	120	660	720	600	100	2895

WT: Without Irrigation W: With Irrigation

APPENDIX TABLE: 2.4 TOTAL FARM LEVEL COSTS FOR TUBEWELL PROJECT IN SOLAN WITHOUT IRRIGATION AT SHADOW PRICES

WITHOUT IRRIGATION

(in Rupees)

	Seed	Compost	Fertilizers N	P	K	N.P.K.	Human Labour	Bullock Labour	Insecticide	Total	NPK + Compost
Maize	1757	14640	13431	7495	-	20926	7730	15811	-	61520	35566
Til	244	488	-	-	-	-	586	1757	-	3124	488
Mash	3590	-	1144	1915	1075	4134	2154	5386	1496	16554	4134
Wheat	11712	19520	-	-	-	-	8432	21082	-	61464	19520
Gram	975	813	-	-	-	-	468	1170	163	3544	813
Sarson	729	1367	-	-	-	-	1312	3280	-	6562	1367
Total	19007	36828	14575	9410	1075	25060	20682	48486	1659	152768	61888

APPENDIX TABLE: 2.5 TOTAL FARM LEVEL COSTS FOR TUBEWELL PROJECT IN SOLAN WITH IRRIGATION AT SHADOW PRICES

WITH IRRIGATION (In Rupees)

	Seed	Compost	Fertilizers N	Fertilizers P	Fertilizers K	Fertilizers NPK	Human Labour	Bullock Labour	Ins./ Pesti.	Total	NPK + Compost
Kharif											
Maize	2330	19420	35631	14914	5578	56123	13050	23304	1942	117279	75543
Oilseeds	3294	-	747	1874	701	3322	703	1757	244	9380	3322
Tomato	271	2713	995	417	233	1645	1042	1302	434	7495	4358
Onion	634	1440	991	553	156	1700	484	864	144	5307	3140
Veg Mix	179	1790	821	343	193	1357	687	1074	269	5415	3147
Pulses	1171	-	373	937	175	1485	586	1757	488	5536	1485
Rabi											
Wheat	11712	39040	35816	14990	4204	55010	19730	21082	3904	140913	94050
Gram	975	-	497	832	233	1562	468	1170	325	4540	1562
Sarson	208	650	-	-	-	-	312	936	-	2133	650
Cauliflower	1315	5000	5734	1920	539	8193	2400	3000	1000	21112	13193
Turnip	167	555	424	284	159	867	320	666	111	2713	1422
Carrot	945	1500	1147	768	431	2346	864	1800	300	7828	3846
Grand Total	23201	72108	83176	37832	12602	133610	30646	58712	9161	329651	205718

		Seed	Compost	Fertilizer N	Fertilizer P	Fertilizer K	NPK	Human Labour	Bullock Labour	Insecticide	Total
Kharif											
Maize X	WT	60	500	459	256	-	715	286	540	-	2101
X	W	60	500	917	384	144	1445	365	600	50	3020
Til	WT	50	100	-	-	-	-	130	360	-	640
Mash	WT	240	-	76	128	72	276	130	360	100	1106
Oilseed	W	675	-	153	384	144	681	156	360	50	1922
Tomato	W	125	1250	459	192	108	759	521	600	200	3455
Onion	W	440	1000	688	384	108	1180	365	600	100	3685
Other Mixed	W	100	1000	459	192	108	759	417	600	150	3026
Pulses(RF)	W	240	-	76	192	36	304	130	360	100	1134
Rabi											
Wheat X	WT	300	500	-	-	-	-	234	540	-	1574
X	W	300	1000	917	384	108	1409	260	540	100	3609
Gram X	WT	300	250	-	-	-	-	130	360	50	1090
X	W	300	-	153	256	72	481	156	360	100	1397
Sarson X	WT	80	150	-	-	-	-	130	360	-	720
X	W	80	250	-	-	-	-	130	360	-	820
Cauliflower	W	263	1000	1147	384	108	1639	521	600	200	4223
Turnip	W	150	500	382	256	144	782	312	600	100	2444
Carrot	W	315	500	382	256	144	782	312	600	100	2609

APPENDIX TABLE: 2.7 ESTIMATION OF BENEFITS (WITHOUT IRRIGATION) FOR TUBEWELL PROJECT IN SOLAN AT MARKET & SHADOW PRICES

CROPS	MAIN PRODUCT							BY PRODUCT		
	Crop Area (Hec)	Yield (Qtl/H.)	Total Amount (Qtls)	Market Prices (Rs/Qtls)	Shadow Prices (Rs./Qtls)	Total Value (Rs.'000) At Market Price	Total Value (Rs.'000) At Shadow Prices	Qtls/Hec.	Rate Rs./H	Total Value (Rs.'000)
Kharif										
Maize	29.28	18	527.04	157	278	82.75	146.52	18	270	8.0
Til	4.88	4	19.52	600	1044	11.71	20.38	-	-	-
Mash	14.96	5	74.80	600	1044	44.88	78.09	5	75	1.0
Total	49.12									9.0
Rabi										
Wheat	39.04	15	585.60	200	348	117.12	203.79	22	660	26.0
Gram	3.25	6	19.50	600	1044	11.70	20.36	6	150	0.5
Sarson	9.11	4	36.44	600	1044	21.86	38.04	4	60	0.5
Total	51.40									27.0
GRAND TOTAL	100.52					290	507			36.0

APPENDIX TABLE: 2.8

ESTIMATION OF BENEFITS (WITH IRRIGATION) FOR TUBEWELL PROJECT IN SOLAN

CROP	MAIN-PRODUCT							BY-PRODUCT		
	Crop Area (H.)	Yield (Qtl/H)	Total Amount (Qtl)	Market Price (Rs./Qtl)	Value at Market Price (Rs.'000)	Shadow Price (Rs.)	Value at Shadow Price (Rs.'000)	Market Price (Rs./Qtl)	Yield Qty (Qtls/H.)	Value of By Product (Rs.'000)
Kharif										
Maize	38.84	30	1165	157	183	278	324	15	30	17.4
Oilseeds	4.88	8	39	600	23	1044	41	15	8	0.5
Tomato	2.17	160	347	252	87	252	87	-	-	-
Onion	1.44	140	202	80	16	80	16	-	-	-
Pulses	4.88	5.5	27	600	16	1044	28	15	5.5	0.4
Mix. Veg.	1.79	140	251	120	30	120	30	-	-	-
Total	54.00									
Rabi										
Wheat	39.04	30	1171	200	234	348	408	30	45	53.0
Gram	3.25	8	26	600	16	1044	27	25	8	0.5
Mustard	2.60	4.5	12	600	7	1044	13	15	4.5	0.2
Cauliflower	5.00	140	700	300	210	300	210	-	-	-
Turnip	1.11	125	139	80	11	80	11	-	-	-
Carrot	3.00	140	420	80	34	80	34	-	-	-
Total	54.00									
GRAND TOTAL ('000 Rs.)					867		1229			72

Appendix Table 3.1

LIS, PALAMPUR, DISTT. KANGRA

FARM LEVEL COST AT " MARKET PRICES" AND SHADOW PRICES (SP)

WITHOUT IRRIGATION

Area	FERTILIZER						(Rs.)				
	Seed	Compost	N.	P.	K.	N.P.K.	Human Labour	Bullock Labour	Ins./ Pesti	Total	NPK + Compost
Kharif											
Maize	4500	18750	45000	9000	2250	56250	54000	40500	3750	177750	
Paddy	2400	5000	4800	2400	600	7800	16800	10800	1000	43800	
Mash	1200	750	-	-	-	-	1500	1800	500	5750	
Rabi											
Wheat	27000	45000	-	-	-	-	48600	40500	-	161100	
Sarson	800	1000	-	-	-	-	3000	3600	-	8400	
Total MP	35900	70500	93000	11400	2850	64050	123900	97200	5250	396800	134550
Total SP	35900	70500	118497	12160	3410	134067	53773	97200	5250	396690	205567

142

LIS, PALAMPUR, DISTT. KANGRA

Crop	WITHOUT IRRIGATION							BY PRODUCT		
	Crop Area (Hect)	Yield (Qtl/H.)	Total Amount (Qtls)	Market Price (Rs./Qtl)	Value at Market Price Rs.('000)	Shadow Prices (Rs./Qtls)	Value at Shadow Price (Rs.'000)	Qtls/H.	Amount Rs./H.	Total Amount (Rs.)
Kharif										
Maize	75	18	1350	157	211.90	278.00	375.30			270x75
Paddy	20	18	360	210	75.60	306.00	110.20			405x20
Mash	5	5	25	600	15.00	1044.00	26.10			75x5
Rabi										
Wheat	90	12	1080	200	216.00	348.00	375.84			540x90
Sarson	10	4	40	600	24.00	348.00	13.90			60x10
					542.50		901.30			77,925

Appendix Table 3.3

LIS, PALAMPUR, DISTT. KANGRA

TOTAL FARM LEVEL COST AT " MARKET PRICES AND SHADOW PRICES (SP)

WITH IRRIGATION

(Rs.)

Area	Seed	Compost	FERTILISER N.	P.	K.	N.P.K.	Human Labour	Bullock Labour	Ins./ pesti	TOTAL	NPK + Compos
Kharif											
Maize	1200	10000	14400	7200	2400	24000	16800	12000	1000	65000	
Paddy	7800	32500	35100	15600	7800	58500	85800	58500	6500	249600	
Tomato	313	3125	900	450	225	1575	3000	1500	500	10013	
Beans	6375	6250	1500	3000	750	5250	4200	3000	1000	26075	
Capsicum	1250	3125	1500	1125	375	3000	2400	1500	375	11650	
Mash (RF)	1200	1500	-	-	-	-	1500	1800	500	6500	
Rabi											
Wheat	18000	60000	43200	21600	5400	70200	36000	32400	6000	222600	
Barseem	1250	5000	1500	1800	-	3300	3000	1500	250	14300	
Cauliflower	1050	5000	4500	1800	450	6750	6000	3000	1250	23050	
Cabbage	280	6250	1800	1800	450	4050	4800	3000	1250	19630	
Peas	6000	10000	3000	3600	1800	8400	8400	6000	2000	40800	
Sarson (RF)	1200	3750	-	-	-	-	4500	5400	-	14850	
Total MP	45918	146500	107400	57975	19650	185025	176400	129600	20625	704068	331525
Total SP	45918	146500	136845	61840	23514	222199	76558	129600	20625	641400	368699

Appendix Table 3.4

LIS, PALAMPUR, DISTT. KANGRA

Crop	WITH IRRIGATION							BY PRODUCT		
	6 Crop Area (Hect.)	8 Yield (Qtl/H)	Market Price (Rs./Qtl)	Total Amount (Qtl)	Shadow Prices (Rs./Qtl)	Value Rs.('000) at MP	Value Rs.('000) at SP	Qtls/H	Rs./H	Total Amount (Rs.)
Kharif										
Maize	20	30	157	600	278	94.20	166.80			
Paddy	65	40	210	2700	306	567.00	826.20			450x20
Tomato	2.5	160	252	400	252	100.80	100.80			1125x65
Beans	5	150	150	750	150	112.50	112.50			-
Capsicum	2.5	100	197	250	197	49.25	49.25			-
Mash (RF)	5	5.5	600	27.5	1044	165.00	287.10			-
Rabi										83x5
Wheat	60	30	200	1800	348	360.00	626.40			
Barseem	5	400	15	2000	15	30.00	30.00			1350x60
Cauliflower	5	140	300	700	300	210.00	210.00			-
Cabbage	5	140	225	700	225	157.50	157.50			-
Peas	10	55	292	550	292	160.60	160.60			-
Sarson (R.F)	15	4.5	600	67.5	1044	40.50	70.47			-
						2047.00	2798.00			68x15
										1,63,880

XP-AAZ-209-C

SELECTED IRRIGATION SCHEMES IN HIMACHAL PRADESH:

AN ALTERNATIVE ECONOMIC ANALYSIS

B. SEN

DEVELOPMENT PLANNING & PROGRAMMING

OCTOBER 27, 1988

267

1. Introduction

This report takes a second look at eight minor irrigation schemes in Himachal Pradesh already examined by Basawan Sinha 1/, and presents the results of an alternative economic analysis. It builds on Sinha's work and mostly follows his assumptions and procedure. The point of departure for this analysis is the pricing of crop output. While Sinha uses import parity prices for foodgrain and somewhat arbitrary prices for oilseeds, the alternative analysis makes uses of export parity pricing for traded cereals and a Foodgrain Conversion factor for nontraded cereals and pulses. Since this procedural difference significantly influences the results of the analysis, it is appropriate to start with a brief account of the rationale for the procedure.

2. Shadow Pricing of Crop Output

Two methods are available for shadow pricing of traded agricultural commodities: (a) import parity pricing and (b)

1/ Basawan Sinha, Economic Analysis of Selected Irrigation Systems in Himachal Pradesh: Review of Assumptions and Estimates of Economic Rate of Return, September 1988. The scheme analysed are: 2 tubewell schemes in Solan and Una; 2 lift irrigation schemes in Kangra and Kullu; 2 tank irrigation schemes in Shimla and Mandi; and 2 flow irrigation schemes in Mandi and Shimla districts.

export parity pricing. The first is used when a country is a net importer of foodgrain, the second when it is a net exporter of foodgrain. Sinha takes major foodgrains as tradeable/traded commodities at the margin "implying that if the project were not undertaken, the entire output of foodgrain would have to be imported from abroad"(p.43). Following this assumption, he derives import parity prices for the grain crops and uses these prices to estimate the benefit streams from the schemes. However, the Hill Area Land and Water Development Project (HALWD) is designed to develop irrigation on only about 22700 hectares; abd perhaps 60% of the newly irrigated area would be under grain crops. Production from this small area is unlikely to make any material difference to the overall supply of foodgrain in India; and from the viewpoint of import substitution the role of the project is about as broad as it is long.

3. But there are other important considerations. India is self-sufficient in foodgrain. The Seventh Plan says so. India manages to produce a surplus over consumption in normal years and puts it up in storage. She also exports some wheat and rice albeit in small quantities.

Looking ahead in the decade of the 1990s, as the IBRD projections show, India is likely to be a net exporter of foodgrain. It is therefore more approrpiate now to use export parity pricing for traded commodities in economic analysis of agricultural projects, and this report does so. Sinha takes all cereals, sugar and oilseeds to be traded/tradeable commodities. While in a broad sense all commodities are tradeable, very few are traded internationally. In this Report, we have taken only rice and wheat among cereals and sugar among cash crops to be traded commoditiees. The derivation of economic (shadow) prices for these commodities is shown in Annex Tables 1-3.

4. When the market prices of only wheat and rice are adjusted on the basis of global prices, the relative prices of all foodgrains get disturbed. To restore the relative price structure, a common practice is to adjust the market prices of other non-traded foodgrain by a Foodgrain Conversion Factor (FCF). In this analysis we have used an FCF of 1.08 to derive the economic prices of all non-traded foodgrains.[2/]

2/ See Annex Table 4 for the derivation of FCF.

Unadjusted market prices of all other non-traded commodities, such as oilseeds and vegetables, have been taken to represent true social costs of production. The results of these adjustments are summarized in Table 1 entitled "Summary of Prices for Economic Analysis." The multipliers for traded commodities in this table are all smaller than those used by Sinha.[3/] The largest multiplier of 1.53 concerns sugar price while the least one, 0.86, relates to paddy. It is interesting to note that the economic prices derived here are generally very close to the market prices of crops.

5. Shadow Pricing of Inputs

This report follows the shadow input prices developed by Sinha. Thus human labor wages have been shadow priced at 40% of the market wages; electricity at Rs.1.14 per unit; the nutrients Nitrogen, Phosphate and Potash at Rs.7.6, Rs.6.8 and Rs.3.6 per kilogram respectively.

3/ Compare Sinha, P.53.

Table 1

SUMMARY OF PRICES FOR ECONOMIC ANALYSIS

CROPS	MARKET PRICE (RS./T)	ECONOMIC PRICE(RS./T)		MULTIPLIER	
		A1/	B2/	A1/	B2/
Paddy	2100	3060	1796	1.46	0.86
Wheat	2000	3480	2136	1.74	1.07
Maize	1570	2780	1696	1.77	1.08
Barley	1680	2920	1814	1.74	1.08
Oilseed	6000	10440	6000	1.74	1.00
Pulses	6000	10440	6480	1.74	1.08
Berseem	150	150	150	1.00	1.00
Sugarcane	200	520	306	2.60	1.53
Tomato	2520	2520	2520	1.00	1.00
Beans	1500	1500	1500	1.00	1.00
Capsicum	1970	1970	1970	1.00	1.00
Cabbage	2250	2250	2250	1.00	1.00
Peas	2920	2920	2920	1.00	1.00
Cauliflower	3000	3000	3000	1.00	1.00
Onion	800	800	800	1.00	1.00
	800	800	800	1.00	1.00
Carrot	800	800	800	1.00	1.00
Turnip	800	800	800	1.00	1.00
Potato	1000	1000	1000	1.00	1.00
Other Vegetables	1000	1000	1000	1.00	1.00
INPUTS					
Nitrogen (N) (Rs./Kg)	6	7.6	7.6	1.27	1.27
Phosphate (P_2O_5)	6	6.8	6.8	1.13	1.13
Potash (K)	3	3.6	3.6	1.20	1.20
Electricity (Rs/KWH)	0.55		1.14	2.07	2.07

1/ From Sinha
2/ This Report

2083E(3)

272

6. Capital Costs

There is some uncertainty about the estimates of capital costs developed by Sinha. His estimates of capital cost at shadow prices for four schemes (one tubewell scheme at Una, one tank scheme at Mandi, and two flow schemes at Mandi and Shimla) vary between 94 and 98 percent of capital cost at market prices; estimates for four other schemes including the two high lift schemes are slightly higher-varying between 0.7 percent and 3.0 percent above the costs estimated at market prices. What is particularly puzzling is that the cost of supply of power does not show up explicitly in Sinha's tables on project capital costs.[4/] Despite this uncertainty we have chosen to use Sinha's estimates of capital costs of the projects for the base-case solutions. However, a sensitivity test has been carried out assuming that capital costs are 33% more than those estimated for base-case solutions.

4/ See, for instance, discussion in Sinha on page 83 and the Table on Page 84.

7. Projected Cropping Patterns

Sinha assumes that the rates of diversification envisaged in the original project plans are not feasible except in the cases of Shimla Tank Irrigation and Mandi Flow Irrigation Schemes. Sinha has therefore altered the "With Project" cropping pattern in 6 cases, by raising the proportion of area under cereals while reducing that under vegetables. His arguments for doing so are: holdings are small; farmers are subsistence-oriented; risks of weather fluctuation, incidence of pest/diseases and lack of development of transport and communications would come in the way of growth in area under vegetables. We believe that these arguments are not appropriate to the HALWD, and that the changes made in the projected cropping pattern run against the spirit of the project itself.

The fact that holdings in Himachal Pradesh are small does not mean that operators are subsistence farmers, or that even if they were, they would not be rational. There is enough evidence by now that small operators respond to opportunities and adopt innovations that are profitable. It is true that irrigation, though most important, alone is not enough to induce a diversified cropping pattern; but roads transporttion

and markets have developed remarkably well in Himachal Pradesh in the last 40 years or so. In fact, the only justification for a traditional "With Project" cropping pattern could be that the culturable command areas (CCA) of the schemes are located in isolated, inaccessible areas not adequately served by roads. But Sinha has not shown that to be the case.

An important goal of HALWD is to introduce a shift in the cropping pattern from grain crops toward a more diversified agriculture in which a varying proportion of the CCA would be planted to vegetables. The designers were convinced of the enormous scope for a diversified agriculture in Himachal, but they did not lay down the proportion of cropping pattern that should be allocated to vegetables. Obviously, the propotion would depend upon local conditions. In the 8 schemes analysed here, the share of vegetables in the With Project cropping pattern proposed in the original project plan varies between 5.45% and 34.7%. Looking ahead, prospects for a rapid and substantial change in the cropping pattern in Himachal appear to be bright for three reasons: (1) The IDA horticultural development project in the northwestern states, including Himachal, would remove some of the constraints in the areas of storage,

processing, distribution and marketing. (2) The demand-pull exerted by the PEPSICO project which needs raw material from the northwestern states including Himachal. (3) The import of high quality and hybrid vegetable seeds made possible by a recent change in the GOI policy.

For the base-case in this report we take cropping pattern as modified by Sinha, but we run a sensitivity test later assuming that the cropping patterns are those originally proposed by the project cell in the project plan.

8. Base-Case Results

Apart from changes mentioned above with regard to output prices, all other assumptions made in Sinha's work (including those about foreign exchange premium and transition coefficients) have been retained in the analysis of the base case.

Estimates of net value added (that is, gross value of production less farm level costs) with and without project for the 8 minor schemes at economic (shadow) prices are presented in Table 2. For comparison, the Table also displays the estimates prepared by Sinha. Thus, our estimate of net value added with project in the case of Tubewell Scheme (TW) at Solan is Rs.645 thousand as against Sinha's estimate of Rs.974 thousand. In all cases, our estimates of net value added with project are smaller than Sinha's. Estimates of net value added Without Project too follow the same pattern. Sinha's estimates are higher because he uses import parity prices. The derivation of the net value added with and without project for each scheme is shown in Annex Table 3.

Estimates of Net Returns with Project (that is, Net Value Added With Project minus Net Value Added Without Project) are compared with Sinha's estimates in Table 3. Here too the expectation is that our estimates of Net Return with Project should be smaller than Sinha's, because of the differences in output pricing. The results are according to expectation for TW Solan, TW Una, LIS Kangra, LIS Kullu and TI Mandi; but they

Table 2

COMPARISON OF NET VALUE ADDED
WITH AND WITHOUT PROJECT (ECONOMIC PRICES)

(Rs.000)

	WITHOUT PROJECT		WITH PROJECT	
	A	B	A	B
Tubewell, Solan	392	194	974	645
Tubewell, Una	214	211	753	642
Lift Scheme, Kangra	582	288	2321	1503
Lift Scheme, Kullu	1065	877	2341	1995
Tank Scheme, Shimla	65	38	125	108
Tank Scheme, Mandi	36	16	98	56
Flow Scheme, Mandi	345	209	594	513
Flow Scheme, Shimla	1000	615	1929	1545

A. From Sinha
B. This Report

Table 3

COMPARISON OF NET RETURNS WITH PROJECT
AT MARKET AND ECONOMIC PRICES

(Rs.000)

SCHEME	NET INCREMENTAL RETURNS AT MARKET PRICES	ECONOMIC PRICES A	ECONOMIC PRICES B
Tubewell Project, Solan	440	582	451
Tubewell Project, Una	384	539	431
Lift Irrigation Scheme, Kangra	1278	1738	1215
Lift Irrigation Scheme, Kullu	1085	1276	1168
Tank Irrigation Scheme, Shimla	47	60	70
Tank Irrigation Scheme, Mandi	42	62	40
Flow Irrigation Scheme, Mandi	190	249	304
Flow Irrigation Scheme, Shimla	831	929	930

A. From Sinha
B. This Report

7241B(1)

are not, in regard to TI Shimla, FIS Mandi and FIS Shimla. Our estimate of Net Return With Project for TI Shimla is Rs. 70 thousand whereas Sinha's is Rs. 60 thousand; our estimate for FIS Mandi is Rs. 304 thousand while Sinha's is Rs. 249 thousand; the two estimates are about equal for FIS Shimla. It turns out that Sinha's estimates for at least two schemes contain computational errors.* But for these errors, his estimates would have been higher than ours in all cases.

The estimates of economic rate of return (ERR) for each of the eight schemes are shown in Table 4. ERR in two out of eight schemes are below 12 percent, these two schemes are: TW Solan with ERR of 8.6%, and LIS Kullu with ERR of less than 1.0%. ERR in the case of LIS Kangra is 12.4%-just above the required rate of return. In all cases, except two, our estimates of ERR are lower than Sinha's. The two exceptions are those for which computational errors have been identified-that is TI Shimla and FIS Mandi. The case of LIS Kullu is somewhat bizarre: its recurrent cost as estimated by Sinha is about 85%

---

* If these errors are corrected, then Sinha's estimate of Net Return With Project would be Rs.80 thousand (instead of Rs. 60 thousand) for Solan, and Rs.427 thousand (instead of Rs.249 thousand) for FIS Mandi. Though it has not been checked, there might be similar errors in his estimate for FIS Shimla.

Table 4

ESTIMATES OF ECONOMIC RATE OF RETURN

	A (%)	B (%)
Tubewell, Solan	16.6	8.6
Tubewell, Una	26.0	17.2
Lift Scheme, Kangra	23.4	12.4
Lift Scheme, Kullu	4.9	1.0
Tank Scheme, Shimla	21.0	25.0
Tank Scheme, Mandi	30.0	23.3
Flow Scheme, Mandi	14.6	21.5
Flow Scheme, Shimla	24.2	22.7

A. Estimated in Sinha
B. Estimated in this report

7241B(20)

of the estimated Net Return With Project; on top of that, its projected cropping pattern has been so altered by Sinha that the benefits from this project barely cover the costs. In the case of LIS Kangra, the recurrent cost is substantial but not as high as in LIS Kullu; it is about 57% of the Net Return With Project. Consequently, investment in this project is likely to yield just about 12% rate of return. In the case of TW Solan, the recurrent cost is about 64% of the estimated Net Return With Project; this factor has affected the ERR in this case which is only 8.6%. The conclusion that needs to be drawn is that the size of the recurrent costs is crucial for the economic viability of the lift and tubewell schemes in Himachal Pradesh.

9. Sensitivity Tests

Two tests have been carried out by changing two parameters of the base-cases. First, capital costs in the base-cases have been assumed to rise by 33%, all other assumptions remaining the same. Second, in addition to the rise in capital cost, the cropping patterns have been assumed to be those projected in the project reports. The results are summarized in Table 5.

Table 5

SUMMARY OF SESITIVITY ANALYSIS

	Economic Rate of Return (%)		
	Base/Case	I 1/	II 2/
Lift Scheme, Kullu	1.0	1.0	11.1
Lift Scheme, Kangra	12.4	9.3	18.1
Tubewell Scheme, Solan	8.6	5.6	14.6
Tubewell Scheme, Una	17.2	12.8	16.2
Tank Scheme, Shimla	25.0	19.2	19.2
Tank Scheme, Mandi	23.3	17.7	17.7
Flow Scheme, Mandi	21.5	17.0	17.4
Flow Scheme, Shimla	22.7	18.7	33.8

1/ Pricing of cereals, as in base case, based on export parity price; capital cost assumed to increase 33%

2/ As in footnote 1 above; cropping pattern assumed to be as given in project proposal

7241B(19)

I. In the event of a rise in capital costs by 33%, the estimated ERRs become smaller than those in the base-case solutions-by about 3 to 5.5 percentage points. Three schemes yield ERRs that are less than 12%: LIS Kullu, TW Solan, and LIS Kangra; interestingly, in the base-case LIS Kangra gave an ERR of 12.4%. ERR for TW Una declines from 17.2% to 12.8%. In all other cases ERR is well above the critical 12% rate.

II. The results of the sensitivity tests by varying cropping pattern from the base-case are interesting. For TI Shimla and TI Mandi, the ERR shows no change because their cropping patterns remain unchanged from the base case. FIS Mandi shows a slight improvement in ERR from 17% to 17.4%; the variation between project's proposed cropping pattern is small in this case. In all these 3 schemes, however, the estimated ERRs are smaller than those in the base case. FIS Shimla yields 33.8% ERR which is greater than the ERR estimated for the base case (22.7%). In the base case of FIS Shimla 42.35% of the CCA is under cereals and 24.77% is under vegetables, while in the proposed cropping pattern, the area under cereals and vegetables consitutes 32.38 and 34.74% respectively.

The improvement in ERR in the case of LIS Kullu is the most interesting. In the base-case cropping pattern of Kullu, cereals covered 36% and vegetables 9.14% of the CCA; in the proposed cropping pattern the corresponding percentages are 17.7% and 26.9%. The estimated ERR becomes 11.1%. This is the only case where ERR remains below 12% cut-off rate. In the case of LIS Kangra, just 5 percentage point decline in area under cereals (from 72.5% to 67.5%) and a 5 percentage point increase in the area under vegetables (from 15% to 20%) raises the ERR to 18.1%-about 5.7 percentage point above that in the base-case, despite a 33% increase in capital cost. This case serves to demonstrate that some of the lift schemes may be economically viable if there is significant diversification of cropping pattern, with a shift away from cereals and toward vegetables.

Results are similar in the case of Tubewell scheme, Solan. Here too, an 8.8% decline in area under cereals combined with an increase of a like magnitude in area under vegetables, raises the ERR from 8.6% in the base case to 14.6%.

10. Conclusions

There are no problems in regard to the Tank and Flow irrigation schemes. No matter what assumptions are made within reason, about capital and recurrent costs, these schemes are economically viable. And their viability remains unaffected regardless of how outputs are priced.

Some Tubewell schemes may be sensitive to changes in capital costs, as the case of Solan shows. However, the crucial factor affecting their viability in the economic sense is the cropping pattern. It is important to reduce the dominance of grain crops in their cropping pattern.

Lift schemes are sensitive to changes in capital cost, although the critical factor is likely to be the recurrent cost as the case of Kullu indicates. There is evidence to show that recurrent costs tend to increase with increase in the height of the lifts. This relationship may be helpful in determining a basis for accepting/rejecting schemes above/below a stipulated height.

Even with high capital and recurrent cost, some lift schemes may turn out to be economically viable, as the case of Kangra demonstrates, if there is some shift away from low value cereals. Here too, it is important to diversify the cropping pattern. As a matter of fact, some diversification of cropping has already taken place and the pace is likely to accelerate in the near future all over Himachal because of the recent developments indicated earlier in Section 7.

Annex Table 1

ECONOMIC PRICE OF PADDY

Projected 1995 price (US$/Ton) Rice 1/		212		
F.O.B Bombay "		212		
@Rs.14 = US $ 1.0	Rs.	2968	3562 4/	3710 5/
Packing Bags (20 @ Rs.5) Rs.100x0.8		- 80		
Milling Rs. 170x0.8		-136		
		2752	3346	3494
Paddy at Hill (66%)		1816	2208	2306
Transport from Market to Hill Handling & Transport from Farm Rs.120x0.8		- 96		
		1720	2112	2210
Quality Adjustment Factor=0.81 2/				
Economic Price of Paddy At Farm-Gate (Rounded)		1443 3/	1710 3/	1790 3/

1/ Rice (Thai, Milled 5% Broken F.O.B. Bangkok from IBRD Commodity Price Forecast, September 1987.

2/ Quality Adjustment factor calculated under following assumptions:

(a) The content of broken grains in unsorted rice is 25%
(b) The content of broken grains is reduced sorting to 5% to obtain export quality rice; and
(c) Broken grains are sold domestically at above Rs.300/Ton (Economic Price)

3/ Assuming that India is a net exporter of rice

4/ Assuming Foreign Exchange Premium of 20%
Rs.14 = US$ 1.0
Rs.16.8 = US$ 1.0

5/ Assuming Foreign Exchange premium of 25% : Rs.17.5 = US$1.

2083E(1)

Annex Table 2

ECONOMIC PRICE OF WHEAT

Projected 1995 Price	US$/TON	135 1/		
Adjustment for Quality Differential (%)		100		
Projected Price Adjusted for Quality	US$/Ton	135		
F.O.B. Bombay		135		
@ Rs.14 = US $1.0	Rs.	1890	2268 2/	2362 3/
Packing Bags (20 @ Rs.5) Rs.100x0.8		- 80		
Transport & Handling cost in domestic market (Rs/Ton) (SCF)		- 96		
Farmer's Transport & Handling (Rs./Ton)(SCF)		- 50		
Adjusted Farm Gate Prices (Rounded)		1664 4/	2042 4/	2136 4/

1/ IBRD Commodity Price Forecast, September 1987
2/ Assuming Foreign Exchange Premium of 20%
3/ Assuming Foreign Exchange Premium of 25%
4/ Assuming that India is a Net Exporter of Rice

2083E(2)

Annex Table 3

ECONOMIC PRICE OF SUGAR

Projected 1995 World Market Price	(US$/Ton)1/	242	
Adjustment for quality differentials	(%)	95	
Projected price adjusted for quality	(US$/Ton)	230	
International Shipping and Handling		-	
FOB Price	(US$/Ton)	230	
	(Rs./Ton)	3220	4025 3/
Transport & Handling cost in domestic market (Rs./Ton x SCF)		-305	-305
Processing Cost		-620	-620
Processing ratio (%)		10	10
Farmer's transport & handling	(Rs./Ton x SCF)	- 4	- 4
Adjusted farm gate prices (rounder)	(Rs./Ton)	225 2/	306 2/

1/ Raw Sugar, FOB Caribbean Ports - IBRD Commodity
2/ Assuming that India is a net exporter of sugar
3/ Assuming a 25% premium on foreign exchange

2083E(4)

Annex Table 4

FOODGRAIN CONVERSION FACTOR

$$\frac{(Q\ RICE \times PE\ Rice) + (Q\ Wheat \times PE\ Wheat)}{(Q\ RICE \times PF\ Rice) + (Q\ Wheat \times PF\ Wheat)}$$

Where Q = Quantity Produced
PE = Economic Price
PF = Financial Price

$$\frac{(111.5 \times 3534) + (456.6 \times 2136)}{(111.5 \times 3182) + (456.6 \times 2000)}$$

$$\frac{1369338}{1267993} = 1.0799 = 1.08$$

2083E(5)

Annex Table 5

ESTIMATES OF NET RETURN WITH PROJECT AT
DHAKERA, SOLAN AT ECONOMIC PRICES

		(In Rs.000) WITHOUT PROJECT	WITH PROEJCT
A.	Gross Value of output		
	Value of Crop output	309	900
	Value of By Product	36	72
	TOTAL	345	972
B.	Farm Level Costs	151	327
C.	Net Value Added (A-B)	194	645
D.	Net return with Project	451	

Compare, Sinha, Table 2.1.1., Page 56

7241B(3)

Annex Table 6

SUMMARY TABLE FOR DERIVATION OF
ECONOMIC RATE OF RETURN:
TUBEWELL PROJECT AT DHAKERI, SOLAN

(Rs.000)

PERIOD	CAPITAL COST	O&M COST	NET RETURN	NET INCREMENTAL RETURN
0	444			-444
1	1096	149	181	-1064
2		195	272	77
3		246	362	116
4		265	408	143
5		288	451	163
6		288	451	163
7		288	451	163
8-15		288	451	163
16	199	288	451	-33
17-30		288	451	163

7241B(4)

Annex Table 7

ESTIMATES OF NET RETURN WITH PROJECT AT
GUGWABA BHAROLIAN, UNA, (TUBEWELL)
AT ECONOMIC PRICES

(In Rs.000)

		WITHOUT PROJECT	WITH PROJECT
A.	Gross Value of Output Crop Output By Product TOTAL	338	902
B.	Farm Level Costs	127	260
C.	Net Value Added (A-B)	211	642
D.	Net Return with Project	431	

Compare, Sinha, Table 2.2.1., Page 64

7241B(9)

Annex Table 8

SUMMARY TABLE FOR DERIVATION OF ECONOMIC RATE OF RETURN: TUBEWELL PROJECT, UNA

(Rs.000)

PERIOD	CAPITAL COST	O&M COST	NET RETURN	NET INCREMENTAL RETURN
0	394			-394
1	613	120	172	-561
2		156	259	103
3		191	345	154
4		209	388	179
5		227	431	204
6-15		227	431	204
16	140	227	431	64
17-30		227	431	204

7241B(10)

Annex Table 9

SUMMARY OF NET RETURN WITH PROJECT AT
BHAWRA, KANGRA (LIFT SCHEME)
AT ECONOMIC PRICES

(In Rs.000)

		WITHOUT PROJECT	WITH PROJECT
A.	Gross Value of Output		
	Crop Output		
	By Product		
	TOTAL	642	2144
B.	Farm Level Costs	354	641
C.	Net Value Added (A-B)	288	1503
D.	Net Return with Project	1215	

7241B(5)

Annex Table 10

SUMMARY TABLE FOR DERIVATION OF
ECONOMIC RATE OF RETURN:
LIFT IRRIGATION SCHEME, KANGRA

(Rs.000)

PERIOD	CAPITAL COST	O&M COST	NET RETURN	NET INCREMENTAL RETURN
0	639			-639
1	1591			-1591
2	957	288	364	-881
3		404	608	204
4		520	850	330
5		635	1093	458
6		693	1215	522
7-15		693	1215	522
16	604	693	1215	-82
17-30		693	1215	522

7241B(6)

Annex Table 11

ESTIMATES OF NET RETURN
WITH PROJECT: LIS, KULLU

		(In Rs.000) WITHOUT PROJECT	WITH PROJECT
A.	Gross Value of Output		
	Crop Output		
	By Product		
	TOTAL	274	833
B.	Farm Level Costs	189	314
C.	Net Value Added (A-B)	85	519
D.	Net Value of Orchard Products	742	1476
E.	TOTAL Net Value (C+D)	827	1995
F.	Net Return with Project	1168	

7241B(11)

Annex Table 12

SUMMARY TABLE FOR DERIVATION OF
ECONOMIC RATE OF RETURN: LIS KULLU

(Rs.000)

PERIOD	CAPITAL COST	O&M COST	NET RETURN	NET INCREMENTAL RETURN
0	714			-714
1	1780		93	-1687
2	1067	391	234	-1224
3		564	584	20
4		736	817	81
5		908	1051	143
6-15		994	1168	174
16	640	994	1168	-466
17-30		994	1168	174

7241B(12)

Annex Table 13

ESTIMATES OF NET BENEFIT WITH AND WITHOUT
PROJECT AT GURLA SIMLA
(TANK IRRIGATION SCHEME) AT ECONOMIC PRICES

(In Rs.000)

		WITHOUT PROJECT	WITH PROJECT
A.	Gross Value of Output		
	Crop Output		
	By Product		
	TOTAL	80	170
B.	Farm Level Costs	42	62
C.	Net Value Added (A-B)	38	108
D.	Net Return with Project	70	

Compare, Sinha, Table 4.1.1., Page 90

7241B(7)

Annex Table 14

SUMMARY TABLE FOR DERIVATION OF
ECONOMIC RATE OF RETURN:
TANK IRRIGATION, SHIMLA

(Rs.000)

PERIOD	CAPITAL COST	O&M COST	NET RETURN	NET INCREMENTAL RETURN
0	99			-99
1	126	4	28	-102
2		6	48	42
3		7	62	55
4		8	70	62
50-40		8	70	62

7241B(8

Annex Table 15

ESTIMATES OF NET RETURN WITH PROJECT
AT ROPA BUDA, MANDI (TANK IRRIGATION SCHEME)
AT ECONOMIC PRICES

(In Rs.000)

		WITHOUT PROJECT	WITH PROJECT
A.	Gross Value of Output Crop Output By Product TOTAL	36	92
B.	Farm Level Costs	20	36
C.	Net Value Added (A-B)	16	56
F.	Net Returns with Project	40	

Compare, Sinha, Table , Page 96

7241B(17)

Annex Table 16

SUMMARY TABLE FOR DERIVATION OF ECONOMIC RATES OF RETURN: TANK IRRIGATION SCHEME, MANDI

(Rs.000)

PERIOD	CAPITAL COST	O&M COST	NET RETURN	NET INCREMENTAL RETURN
0	33			-33
1	102	2	13	-91
2		3	21	18
3		4	31	27
4		5	40	35
5-40		5	40	35

7241B(18)

Annex Table 17

ESTIMATES OF NET RETURN WITH PROJECT
AT BARI KULWARA, MANDI
(FLOW IRRIGATION SCHEME) AT ECONOMIC PRICES

(In Rs.000)

		WITHOUT PROJECT	WITH PROJECT
A.	Gross Value of Output		
	Crop Output		
	By Product		
	TOTAL	379	887
B.	Farm Level Costs	170	374
C.	Net Value Added (A-B)	209	513
F.	Net Returns with Project	304	

Compare, Sinha, Table 5.1.1., Page 103

7241B(15)

Annex Table 18

SUMMARY TABLE FOR DERIVATION OF ECONOMIC RATE OF RETURN: FLOW IRRIGATION SCHEME, MANDI

(Rs.000)

PERIOD	CAPITAL COST	O&M COST	NET RETURN	NET INCREMENTAL RETURN
0	426			-426
1	548			-548
2		8	122	114
3		12	183	171
4		17	244	227
5		19	274	255
6-50		21	304	283

7241B(16)

Annex Table 19

ESTIMATES OF NET RETURN WITH PROJECT
AT MANDPUR, SHIMLA
(FLOW IRRIGATION SCHEME) AT ECONOMIC PRICES

(In Rs.000)

		WITHOUT PROJECT	WITH PROJECT
A.	Gross Value of Output		
	Crop Output		
	By Product		
	TOTAL	1011	2170
B.	Farm Level Costs	396	625
C.	Net Value Added (A-B)	615	1545
F.	Net Returns with Project	930	

Compare, Sinha, Table 5.2.1., Page 110

7241B(13)

Annex Table 20

SUMMARY TABLE FOR DERIVATION OF ECONOMIC
RATE OF RETURN: FLOW IRRIGATION SCHEME, SHIMLA

(Rs.000)

PERIOD	CAPITAL COST	O&M COST	NET RETURN	NET INCREMENTAL RETURN
0	977			-977
1	1557	22	279	-1557
2	477	37	465	-49
3		51	651	600
4		58	744	686
5		66	837	771
6		75	930	855
7-50		75	930	855

7241B(14)