

JAPAN INTERNATIONAL
COOPERATION AGENCY

No. 2

DEPARTMENT OF IRRIGATION
MINISTRY OF WATER RESOURCES
HIS MAJESTY'S GOVERNMENT OF NEPAL

THE FEASIBILITY STUDY
ON
TRISHULI IRRIGATION PROJECT

FINAL REPORT
VOLUME I
MAIN REPORT

AUGUST 1997

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CHUO KAIHATSU CORPORATION

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PREFACE

In response to a request by His Majesty's Government of Nepal, the Government of Japan decided to carry out the Feasibility Study on the Trishuli Irrigation Project. The said Study was entrusted to the Japan International Cooperation Agency (JICA)

JICA subsequently dispatched a Study Team headed by Mr. Masamitsu Fujioka, Chuo Kaihatsu Corporation, which conducted survey works during the period December 1996 to March 1997. The Study Team held discussions with officials concerned of His Majesty's Government of Nepal and conducted field surveys in the Study area. After the Team returned to Japan, further home office works were carried out and the present Report was prepared.

It is my sincere hope that this Report will contribute to the promotion of the Project and to the enhancement of the friendly relations between our two countries.

In closing, I wish to express my deepest gratitude to the officials concerned of His Majesty's Government of Nepal for their close cooperation extended to the Team and their valuable contribution to the Study.

August 1997



Kimio Fujita
President
Japan International Cooperation Agency

Mr. Kimio Fujita
President,
Japan International Cooperation Agency
Tokyo, Japan

August 1997

LETTER OF TRANSMITTAL

We have the pleasure of submitting herewith the Final Report on the Feasibility Study on the Trishuli Irrigation Project.

Chuo Kaihatsu Corporation, in line with the contract entered into with the Japan International Cooperation Agency, carried out the subject Study works during the nine month period extending from December 1996 to August 1997. The Study area is located in the hill region roughly 70 kilometers northwest of the capital of Kathmandu, and is an area designated by His Majesty's Government of Nepal for priority development. Study strategy focused on ① a participatory approach, ② pursuit of project sustainability, ③ addressing the issue of alleviation of poverty and ④ technology transfer to counterparts in the course of the Study. The Study was accordingly carried out with the closest collaboration possible between the Study Team members, concerned officials of the Department of Irrigation, representatives from the Study area and beneficiary farmers.

Also, project formulation under the Study reflects the following 3 basic components of irrigation policy by His Majesty's Government of Nepal:

- ① Pursuit of the optimum irrigation project with an appropriate level of investment through a combination of irrigation scheme and related programs;
- ② Supply of irrigation water necessary to increase agricultural production, and realize benefits in the shortest time possible; and
- ③ Reduction of government burden in terms of construction, operation and maintenance costs with regard to the envisioned irrigation scheme through steady expansion of organized user participation in the project.

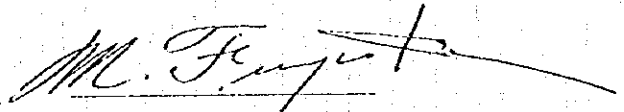
In addition, with full recognition of the importance of instilling targeted beneficiary groups with a heightened social awareness, and sense of ownership and stake in the project as crucial to effective farmer participation under a future project, a Social Preparation Plan was formulated to provide a foundation for beneficiary participation to begin prior to actual Project implementation.

We wish to express our extreme gratitude to the personnel of the Japan International Cooperation Agency, the Department of Irrigation of the Ministry of Water Resources

of His Majesty's Government of Nepal, the Embassy of Japan in Kathmandu and the JICA Nepal Office for the courtesies and cooperation extended to us during our field surveys and studies. We would particularly wish to indicate our deep appreciation to the officials and personnel of His Majesty's Government of Nepal who participated in the work shops during the Study, for their most helpful and insightful comments and recommendations with regard to the envisioned Project.

It is our sincere hope that this Report will serve to promote the realization of this very important Project.

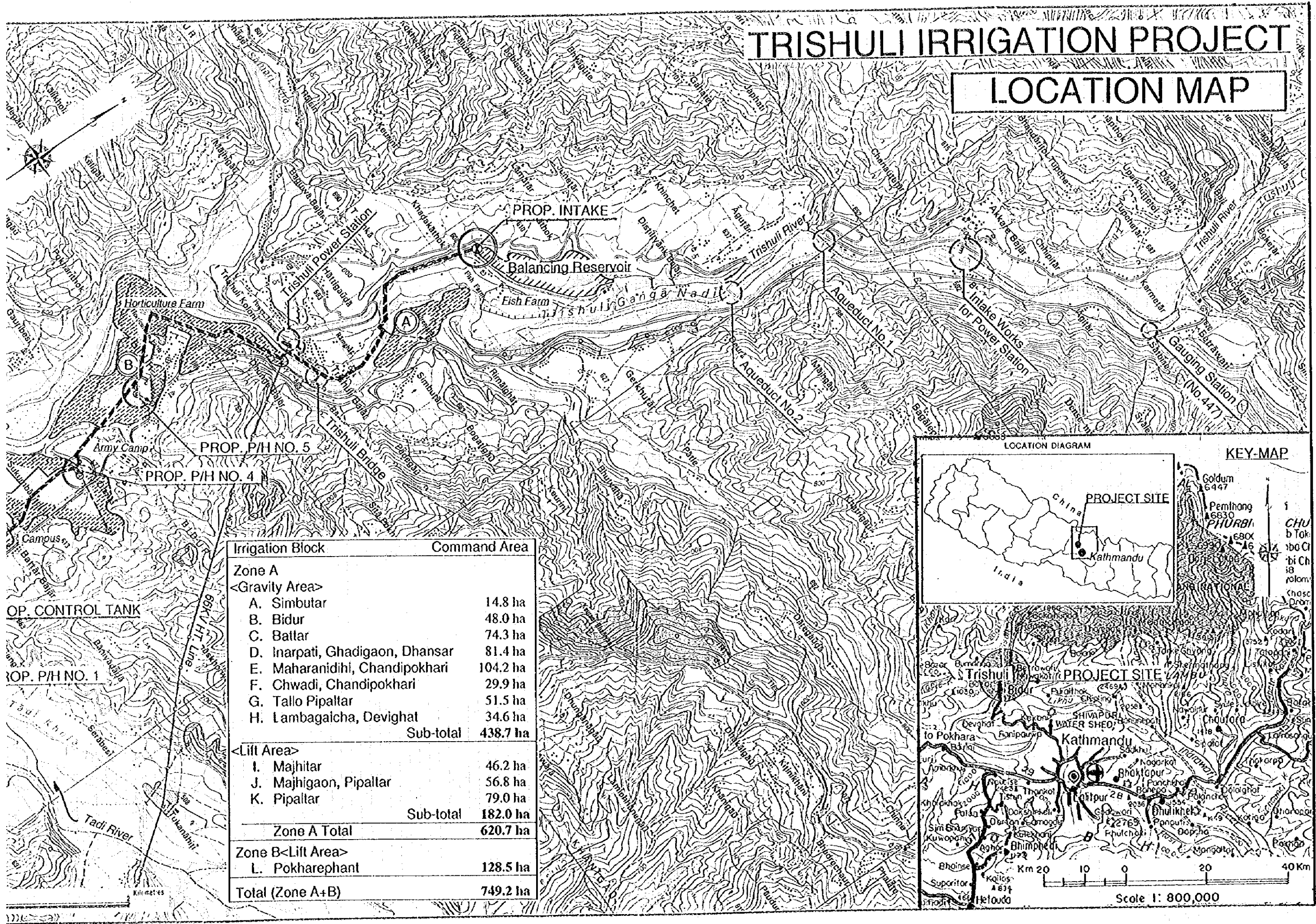
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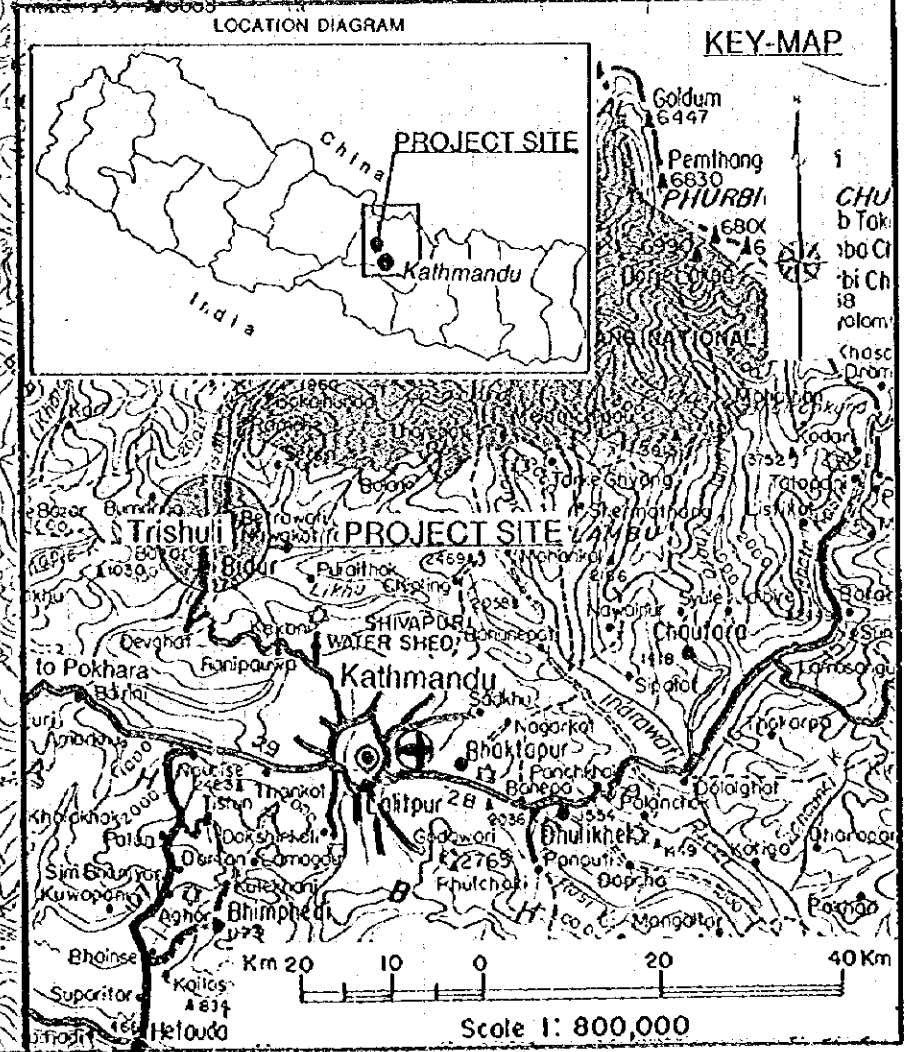
Masamitsu Fujioka
Leader for the Study Team for
the Feasibility Study on the Trishuli
Irrigation Project

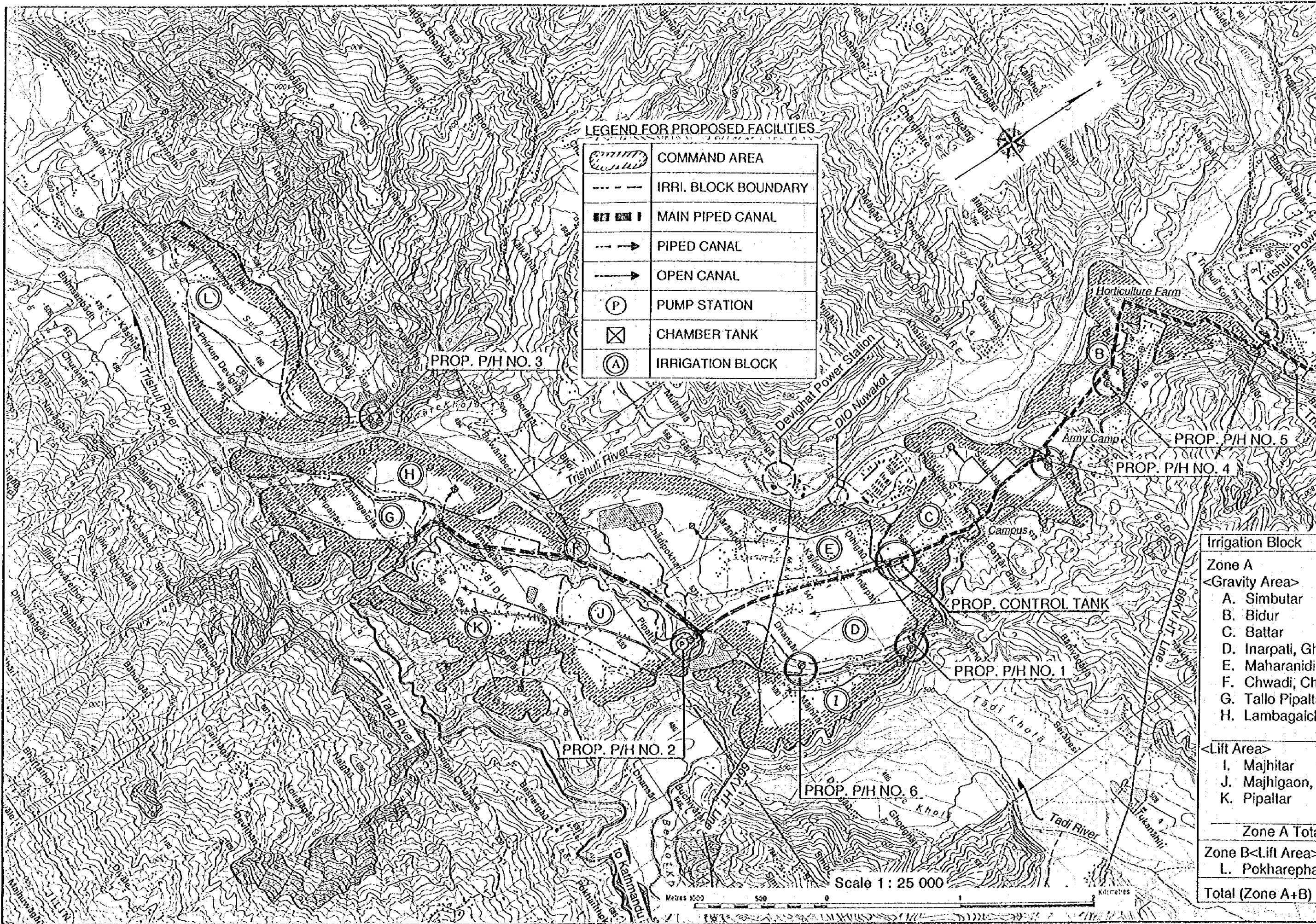
TRISHULI IRRIGATION PROJECT

LOCATION MAP



Irrigation Block	Command Area
Zone A	
<Gravity Area>	
A. Simbutar	14.8 ha
B. Bidur	48.0 ha
C. Battar	74.3 ha
D. Inarpati, Ghadigaon, Dhansar	81.4 ha
E. Maharani dihi, Chandipokhari	104.2 ha
F. Chwadi, Chandipokhari	29.9 ha
G. Tallo Pipaltar	51.5 ha
H. Lambagaicha, Devighat	34.6 ha
	Sub-total 438.7 ha
<Lift Area>	
I. Majhitar	46.2 ha
J. Majhigaon, Pipaltar	56.8 ha
K. Pipaltar	79.0 ha
	Sub-total 182.0 ha
Zone A Total	620.7 ha
Zone B <Lift Area>	
L. Pokharephant	128.5 ha
Total (Zone A+B)	749.2 ha





LEGEND FOR PROPOSED FACILITIES

	COMMAND AREA
	IRRI. BLOCK BOUNDARY
	MAIN PIPED CANAL
	PIPED CANAL
	OPEN CANAL
	PUMP STATION
	CHAMBER TANK
	IRRIGATION BLOCK

Irrigation Block	
Zone A	
<Gravity Area>	
A.	Simbutar
B.	Bidur
C.	Battar
D.	Inarpati, Gh
E.	Maharanidii
F.	Chwadi, Ch
G.	Tallo Pipalt
H.	Lambagaicl
<Lift Area>	
I.	Majhitar
J.	Majhigaon,
K.	Pipaltar
Zone A Total	
Zone B <Lift Area>	
L.	Pokharepha
Total (Zone A+B)	

Scale 1 : 25 000

Metres 1000 500 0 1 Kilometres

Executive Summary

CHAPTER 1 INTRODUCTION

This Report comprises the Final Report for the Feasibility Study on the Trishuli Irrigation Project, and embodies the results of works carried out in accordance with the Scope of Works agreed to between the Department of Irrigation of the Ministry of Water Resources of His Majesty's Government of Nepal, and the Japan International Cooperation Agency on July 15, 1996. The Study was divided into 2 stages:

Stage	Work content	Work period
Stage 1 (field survey)	Data collection, site survey, selection of main canal alignment, participatory rural appraisal, field level acting group meetings, central coordinating group meeting	early December 1996 ~ late March 1997
Stage 2 (home office works)	Development plan formulation and Project evaluation	mid April 1997 ~ mid June 1996

The following related agencies were concerned with the Study execution:

Related agency	Related departments
<Ministry level>	
Ministry of Water Resources	Department of Irrigation (DOI), Nepal Electricity Authority (NEA)
Ministry of Agriculture	Department of Agriculture (DOA), District Agricultural Development Office (DADO)
Ministry of Forestry and Soil Conservation	Department of Forestry (DOF), District Soil Conservation Office (DSCO)
Ministry of Land Administration	District Land Administrative Office (DLAO), District Land Revenue Office
Ministry of Defense	Army Camp (Nepal Royal Army Barrack)
Ministry of Population and Environment	District Soil Conservation Office (DSCO)
Ministry of Home Affairs	District CDO Office
<District level>	
	Nuwakot District Development Committee, Bidur Municipality, Khadga Bhanjyang Village Development Committee (VDC)

CHAPTER 2 PROJECT BACKGROUND

(1) 8th 5-Year Plan (1991/92~1996/97)

Following adoption in 1990 of a national policy to promote a free market economy, the Nepalese government has worked out the 8th 5-year national development plan with the following objectives:

Objective	Target economic indicators
(1) Achievement of sustainable economic growth	GDP growth rate of 5.1% (3.7% for agricultural sector and 6.1% for non-agricultural sector)
(2) Alleviation of poverty	
(3) Regional development and rectification of regional imbalances	

(2) Agricultural Perspective Plan (25 year plan: 1995/96~2014/15)

The above 8th 5-Year Plan is nearing its end, and the Nepalese government has proposed long-term sectoral strategies under its various sector perspective plans.

Agriculture and irrigation targets under the Agricultural Perspective Plan (APP) are as follows:

Sector	Policy objectives	
	8th 5-Year Plan	APP
Agriculture	Priority on agricultural intensification and diversification	Performance of perennial irrigation, promotion of chemical fertilizer use, technological development in research extension, road and energy development
Irrigation development	<ol style="list-style-type: none"> (1) Utilization of irrigation technologies suited to varying geo-physical and climatic conditions and increased food production with careful attention to environmental impact (2) Improvement of operational structure for existing irrigation systems (3) Farmer participation in project promotion 	<ol style="list-style-type: none"> (1) Performance of perennial irrigation (2) Expansion of irrigated area (3) Linkage with marketing activities

(3) Eradication of Poverty, and TIP

- Central issues cited under the 8th 5-Year Plan are eradication of poverty, environmental conservation, expanded employment opportunities, and self-

sufficiency in food production. Under the said 5-year plan, total population nation-wide living under the poverty line is cited at 50%, and accordingly the eradication of poverty is an issue of maximum national priority.

- In the course of the Study, the Study Team identified 83% of the Project area population as subsisting below the poverty line. In order to enable this population to escape poverty, establishment of the irrigation facilities under the Project to achieve the targeted increase in agricultural production is essential. Eradication of poverty is thus the fundamental theme of TIP.
- Achievement of agricultural intensification and diversification under the Project irrigation systems will increase the demand for agricultural labor. This will expand local employment opportunities, will serve as well to stimulate activity among regional industries engaged in agricultural product/input marketing, transport and other related agricultural services.

CHAPTER 3 EXPERIENCE AND LESSONS FROM SIMILAR PROJECTS IN THE HILL

Numerous development projects have been focused to date at the Hill and Mountain areas of Nepal with a basic objective of rectifying skewed levels of socio-economic development in these regions.

Under the Study, such previous similar Projects were carefully reviewed and the lessons learned from the same with regard to the following criteria applied to the planning of the subject Project.

- i. Participatory management in irrigation development (7 projects)
- ii Agricultural diversification (3 projects)

Past Project	Experience and lessons applicable to TIP
i. <Participatory irrigation management> ① Andi Khola Project ② CARE/Nepal and ADB/N ③ HIMI-WECs Action Research Project ④ Dhaulagiri Irrigation Development Project ⑤ Mechi Hill Irrigation Project ⑥, ⑦ Irrigation Line Credit (ILC) and Irrigation Sector Project	<ul style="list-style-type: none"> - Appropriate water distribution to alleviate poverty - Role of group organizers in establishment of WUAs - Farmer participation from the design stage, promotion of farmer participation in physical improvement and management - Appropriate program to alleviate poverty, and selection of catalysts - Beneficiary participation at all stages of project implementation, and engagement of NGOs for program to increase farmer awareness - Introduction of participatory methods (increase of project awareness, participation in implementation and O/M) - Recruiting organizers from among the farmers community, not from DOI
ii. <Agricultural development with agricultural diversification> ① VFC Project Rapti Development (USAID funded) ② IIDP/LIRD Project (Swiss funded) ③ Pakhribas Agricultural Centre (British funded)	<ul style="list-style-type: none"> - Introduction of technical guidance and high value crops to alleviate regional poverty - Production / marketing activities by farmer groups - Switch to cash crops by marginal farmers with small land holdings and subsistence level living standard - Increased food production plan with components to improve regional socio-economic conditions and diversify food consumption - Development of sustainable program by farmer groups in the hill - Intensive cultivation, and crop diversification

CHAPTER 4 BASIC STRATEGY AND APPROACH TO THE STUDY

Basic Study strategy is as follows:

- The basic theme of the Study centered on a participatory investigation approach, with a primary focus on cost-effectiveness and project sustainability. Within the foregoing framework, several alternative plans were to be formulated as a basis for evaluation and selection of an optimum plan for the Project.
- The Study also accorded major emphasis to alleviation of poverty, one of the key goals of the ongoing 8th National Development Plan (1992~1997). With this well in mind, the impoverished stratum of the Project area was identified, and the Study pursued with an aim to maximize the benefits extended to this group under the Project.

4.1 Adoption of Participatory Approach

Irrigation development has played a significant role in improvement of the socio-economic conditions in many countries. However, in recent years, as irrigation development projects have been implemented, there has been general and growing disappointment at the levels of productivity and sustainability in many schemes. One cause, which appears to be widespread, is that the beneficiaries in the irrigated area do not have a sense of ownership in the irrigation project, where they have not participated in the project.

On the basis of the above, a participatory study approach was adopted whereby participation by beneficiaries is to be elicited in all stages of the project cycle, in concert with planners from the concerned central and local agencies.

(1) Participatory Rural Appraisal: PRA

Participatory rural appraisal was carried out based on a household survey questionnaire prepared by the Study Team. The PRA focused on identification of Project area beneficiaries, and through this process the reflection of their aspirations and needs in Project formulation. In this regard, the Study Team hoped to elicit the following on the part of beneficiary farmers:

- A sense of stake-holding in the Project on the part of the farmers themselves
- A sense of shared responsibility with regard to Project success on the part of farmers themselves
- Self-initiated action by the farmers themselves in forming and nurturing the development of WUAs

(2) Field Level Action Group Meeting: FLAG Meeting

1) Method of Organizing FLAG Meetings

The Project area comprises an area extending 12 km east-west within which farmer organization and prior elected farmer representatives are lacking. In this light, gathering of numerous farmer delegates to a FLAG meeting at one location would be difficult; and to address this, meetings were also organized according to the procedure below on a sector / block - wise basis to facilitate maximum farmer participation.

Step	Targeted persons	Site	Date
<u><FLAG Meetings></u>			
1st FLAG meeting	District officers Beneficiary representatives	Nuwakot district DDC meeting hall	Dec. 15, 1996
2nd FLAG meeting	Concerned district reps.	Study Team office	Feb. 28, 1997
<u><Sub-project and irrigation block wise meetings></u>			
1st meeting	Farmers from 5 sub-project sectors	5 locations within site area	Jan. 21~26, 1997
2nd meeting	Farmers from 10 irrigation blocks	10 locations within site area	Feb. 25~28, 1997

2) FLAG Meetings

FLAG meetings were held according to the following procedure.

FLAG meeting	Location and date	Agenda	Targeted personnel
1st meeting	Nuwakot district DDC meeting hall (Dec. 15, 1996)	Briefing on Project strategy and exchange of views on the Project	District officers and 18 farmer representatives
2nd meeting	Study Team office (Feb. 28, 1997)	Briefing on Study findings and exchange of views on problem issues	Concerned officers (2 persons)

Items confirmed via the above meetings are as follows:

- That the Study Team is planning a 9 month irrigation system
- That change of intake site to Option 3 is the sole option to a feasible project
- Procedure to be taken in order for canal to transit army camp
- That concerned officers will move to promote the Project with NEA and other related agencies.

(3) Sub Project and Irrigation Block Wise Farmer's Meetings

Meetings were carried out as follows:

Sub-project and block wise meetings	Location and date	Agenda	Attendees
1st meeting (sub-project wise)	5 locations in site area (Jan. 21~26, 1997)	<ol style="list-style-type: none"> 1) Exchange of information on blocks 2) Confirmation of intake point, Study methodology, irrigation method, O&M by farmers themselves, and farmer cooperation in Study 	Total 363 persons (315 males, 48 females)
2nd meeting (block wise)	10 locations in site area (Feb. 25-28, 1997)	<ol style="list-style-type: none"> 1) Confirmation of 9 month irrigation 2) Briefing and confirmation on design intake point (Alternative-1) 3) Briefing on gravity and lift irrigation 4) Confirmation of O&M by the farmers themselves 5) Farmer share of responsibility under the Project 6) Confirmation of establishment of WUAs 	Total 627 persons (484 males, 143 females)

(4) Central Coordinating Group Meeting: CCG

The CCG meetings were carried out according to the agenda below. In the case of the 2nd CCG meeting, priority was given to discussion on intake site modification and site criteria with DOI and NEA.

CCG meetings	Location and date	Agenda	Attendees
1st meeting (implementation)	DPTC meeting hall (Dec. 25, 1996)	<ol style="list-style-type: none"> 1) Alignment selection and construction works for main canal 2) Confirmation of intake site change 3) Confirmation of difficulty of perennial irrigation; confirmation of dry season irrigation 	Total 36 persons (from 9 concerned agencies of HMG): DOI, MOPE, NEA, DOA, DOF, DOSC, ADI/N, CMS, etc.
2nd meeting (design)	At MOWR	<ol style="list-style-type: none"> 1) Change of intake location 2) Potential for dry season diversion 	DOI and NEA

4.2 Pursuit of Cost Effectiveness and Sustainability of the Project

(1) Cost Effectiveness

The Study Team pursued the Study with the objective of achieving a low cost irrigation system in line with basic Nepal government irrigation policy.

Pursuit of low cost irrigation is according to the following background factors:

- to improve national budgetary balance by reducing public investment of which the irrigation sector occupies a large portion;
- to promote effective recovery from the irrigation project of investment by the international donor agencies; and
- to reduce farmers' payment imposed on certain ratio of capital cost of a project.

(2) Sustainability

The Study was carried out in this regard with focus on the following:

- continued delivery of services and production;
- maintenance of physical infrastructures;
- long-term institutional capacity (WUAs, principal operating agencies)
- support from key stakeholders (national government, local government, community level, etc.).

4.3 Addressing Poverty Alleviation Issues

The Eight National Plan envisages poverty alleviation by reducing the number of people below the poverty line from 49 % to 42 % in the whole country by the end of the Plan period. Methodology for identification of the actual poor, and policy arrangements are prescribed by the Plan to address the poverty issues as per below.

(1) Identification of the Actual Poor

- To identify the backward rural areas and the people living below the absolute poverty line before formulating and implementing a poverty alleviation program
- To establish simple parameters to ascertain the real situation of poverty

(2) Policy Arrangements

- To develop a simple procedure for identification of undeveloped areas and poor families and use it uniformly across all sectoral programs

- To increase the access of the poor to the means of production; and to make arrangements for awarding contracts of technically simple construction works to groups of poor people
- To make legal provisions for elimination of social evils and to create public awareness in this regard
- To take environmental balance into consideration when designing a program, and to make institutional arrangements for extending necessary support to the task of poverty alleviation

(3) TIP Strategy for Poverty Alleviation

The Study Team has adopted the following realistic basic plan in line with the above policy arrangement:

- a) Regarding the identification of the poor groups, setting of an income based parameter to establish the poverty line in the TIP area
- b) Intensification and diversification of agriculture to enable increase in farmer income, and introduction during the project implementation period of a social preparation program
- c) Access to natural resources especially water resources by appropriate irrigation facilities in order to break the vicious circle of poverty and equip the impoverished class with the means of production
- d) Intensive labor employment methods to assure work opportunities during construction; and after construction, labor employment increase due to promotion of agricultural diversification
- e) Special consideration to environmental issues in selection of canal alignment, and continuation of system environmental monitoring after construction completion as well
- f) Creation of functional water users' associations (WUA)

4.4 Technology Transfer to Counterparts

The participatory study approach which comprises the basic Study strategy was fully applied in working with the 5 counterparts, with emphasis on technology transfer with regard to the following:

- Introduction of large scale piped line system in the Hill irrigation system
- Finding methods regarding the different options for the prevailing topography and site conditions (gravity irrigation and pump irrigation)

- **Appropriate incorporation into the Project of the inter-action through FLAG meetings**
- **Identification of hydrological delineations using aerial photos and topographical maps, with block-wise division of hydrological boundaries**
- **Organization of farmers' meetings to create awareness of the Project**
- **Environmental clearance methods for the implementation of this Project**

CHAPTER 5 PRESENT CONDITIONS IN THE PROJECT AREA

5.1 Methodology of Field Investigation

(1) Selection of Survey Spots

In order to identify the diverse conditions existing in the Project area, 15 survey spots were designated on the basis of criteria of elevation, soil and cropping pattern, and present conditions of agriculture, agro-economy, social groups and WUAs studied for each survey spot.

(2) Relationship Between Irrigation Blocks and Survey Points

Twelve irrigation blocks were demarcated in the latter half of the survey based on hydrological boundaries under the irrigation system. In order to overcome any time lag in survey point study, the correspondence between the pre-selected 15 survey points and the 12 irrigation blocks was established as follows:

Survey Spots	Block	Name of villages	Main characteristics
1	A	Simutar, Gerkhutar	Paddy cultivation by traditional irrigation methods; presence of active community groups
2	B	Bidur	Mainly paddy cultivation by rainfed and traditional irrigation methods
3	C	Battar, Apaghari,	Mainly rainfed cultivation of paddy and maize; presence of commercial district
4	D, E	Inarpati, Dihigaun, Kajidihi	Water supplied before for a number of years under the previous Battar project; now mainly rainfed cultivation of maize and millet
5	E	Maharanidihi	Most productive area before under the previous Battar project; now mainly rainfed cultivation of maize
6	D	Machale (Gharigaun)	Paddy and maize cultivation by traditional irrigation methods; no community groups exist
7	I	Beltar, Dhansar	Mainly rainfed cultivation of maize and millet; no community groups exist
8	E, F	Chandipokhari	Cultivation by Maharanidihi residents of mainly paddy and maize by traditional irrigation methods
9	I	Majhitar	Water supplied before for a number of years under the previous Battar project; now mainly rainfed cultivation of maize
10	J, K	Pipaltar	Mainly rainfed cultivation of maize
11	F	Lambagaicha	Mainly rainfed cultivation of maize; no residences in the area and cultivation is by Tallo Pipaltar residents
12	G	Tallo Pipaltar	Mainly rainfed cultivation of maize and millet; existence of soil conservation project
13	II	Devighat	Mainly rainfed cultivation of maize; presence of shrine to Jalapa Devi (Water God) in the area
14	L	Majhigaun	Mainly rainfed cultivation of maize and millet; presence of active community groups
15	L	Pokhariphant (lower terrace)	Mainly paddy and maize; cultivation by traditional irrigation methods; presence of active community groups

5.2 Rural Society

5.2.1 Survey Methodology

Rural society survey was carried out in three stages: (1) land ownership survey, (2) household questionnaire survey and (3) participatory rural appraisal (PRA).

(1) Land Ownership Survey

A plot-wise list of land owners in the Project area was prepared based on old ward numbers, referring to land registration records of the District Land Survey Office. As a result of the fact that multiple land owners exist in a single household, total number of land holders identified at 3,174 far exceeds the household number of 1,445.

(2) Household Questionnaire Survey

On the basis of the land owner list, four categories of land ownership were established, i.e. large (over 1 ha), medium (0.5~1.0 ha), small (0.2~0.5 ha) and marginal (under 0.2 ha). A ward-wise, stratified random sampling was done to select 200 households to be targeted for household questionnaire survey.

(3) Participatory Rural Appraisal

The Project area was divided into the following sectors for PRA through discussion with concerned groups and key informants:

<u>Sector</u>	<u>Ward</u>
i) Khadga Bhanjyang VDC	4,5,7
ii) Bidur Municipality	5,6,7
iii) Bidur Municipality	1,2,3,4
iv) Gerku VDC	3

5.2.2 Land Tenure and Land Holding

Results of land tenure and land holding are summarized as follows:

- (i) Average land holding size is largest in Simbutar and Pakhariphant (0.64~0.82/household), and smallest in Bidur and Battar (0.24~0.29 ha)
- (ii) About 20% of landholders are female
- (iii) Absentee land owners are less than 10% of individual land owners, and are mostly found in Battar, Inarpati and Pipaltar

- (iv) As for the landless, these comprise 10% of total households and are mostly found in Bidur, Battar and Devighat
- (v) The lands under the former command area of Battar irrigation project have been traditionally inhabited and owned by the people of Kumal ethnic group

5.2.3 Demographic and Social Characteristics

Population and social characteristics in the Project area are summarized below:

(1) Demography

Total population in the Project area is 8,742. Of this, infants under 5 years of age and children of school age (6~15 years old) account for 12%, respectively. Economically non-productive population (under 15 years of age and over 50 years of age) averages 52%.

(2) Number of Household Members

With some fluctuation throughout the Project area, number of household members in the Project area is 5~8 persons per household.

(3) Ethnic Composition

Most widely present ethnic groups in the Project area are Brahmin, Chhetri, Newar and Kumal. In addition, there are 5 other ethnic castes as well as occupational caste groups.

5.2.4 Incidence of Poverty

Poverty is not merely a problem of low income, rather, it encompasses a range of problems of high premature mortality, high fertility, low literacy rates, low primary school enrollments, and malnutrition. In light of this situation income was adopted as the main criteria in carrying out poverty analysis. Deprivation of land and employment results in a lack of resources which prevents the impoverished class from escaping their poverty.

(1) Definition of Poverty Line

The Study Team defined the poverty line on the basis of examination of income necessary to purchase the minimal caloric food intake as defined by the National Planning Commission in 1988/89 (Rs. 2,520/person/year in the hill, Rs. 2,364/person/year in the Terai) and the World Bank / UNDP study report (Nepal Poverty and Incomes). As a result, the NPC criterion was converted to current prices, with the number of households divided by the number of household members per household resulting in a poverty line definition of Rs. 3,945/ person/ year.

(2) Identification of Poor Households in the Project Area

On the basis of the Household Census Survey carried out by the District Development Committee, Nuwakot, income and number of household members were surveyed for 1,445 beneficiary households from which 1,291 responses were obtained. On the basis of analysis of these results, 1,072 households (83%) were found to be subsisting below the poverty line.

5.2.5 Status of Women

Status of women in the Project area shows little variation depending on location within the area or ethnicity. Women perform the majority of domestic labor (cooking, laundry, cleaning, water fetching, fuel wood collection) and care of livestock (collecting fodder, feeding, watering, milking, cleaning of animal stalls). In addition to field labor, women spend roughly 13 hours a day engaged in various tasks.

In terms of field labor, men take responsibility for field ploughing and rice threshing, while women engage in rice and millet transplanting, wheat and rape winnowing, and post-harvest rice stalk bundling. Other tasks are done jointly by male and female. The agricultural season from mid-May to mid November is the busiest time for women.

At Pokhariphant and Simputar in the Project area, active women's groups are present and based on this experience it is necessary that women's organizations be planned for the Project area to engage in education, savings and credit and income generating activities.

5.3 Agriculture

5.3.1 Methodology

The 100 farm households interview survey was carried out to identify agricultural management characteristics in each irrigation block.

5.3.2 Households and Land Holdings

The total households in the Project area number 1,445 with an average land holding of 0.52 ha per household. The number of farm households varied by irrigation block from 35 households in Irrigation Block A to 297 households in Irrigation Block C. Similarly, the average land holding also varied from 0.22 ha/household to 1.11 ha/household. According to the classification of different land holding sizes, large, medium, small, marginal, and landless households occupied 11%, 27%, 31%, 20%, and 11% of the total, respectively.

5.3.3 Soil Conditions

Soil conditions in the Project area are shown below.

Block	Topography	Soil (cropped soil layer)	Moisture condition	pH (cropped soil layer)	Organic content	Present land use
A,B,C,D,E, H	middle and lower terrace	Sil, SL	dry-wet	acidic- neutral	medium	upland + paddy
G,I,J,K	upper terrace	Sil, SL	dry	acidic- neutral	medium	upland
L	terrace + alluvial	Sil, Sic	wet	neutral	medium	paddy

note: 1) SL = sandy loam; Sil = silty loam
2) medium = 2.5-5.0% per dry weight

5.3.4 Cultivation Methods

Present cultivation conditions prevailing in the Project area are summarized as follows.

- Ploughing is performed commonly by draft animal, but small farmers have a low possession rate of buffaloes. Rental cost for a pair of bullock with a plough man amounts to Rs.150-200/day.
- Seeding practices are entirely dependent on the timing of rainfall. Early rainfall encourages farmers to plant the most suitable normal maturing varieties of maize, upland paddy, etc., whereas late rainfall forces a change to early maturing varieties.
- Chemical fertilizer consumed by the farmer comprises mainly urea and DAP, and the average consumption for paddy cultivation is 340 kg/ha.

- In order to maintain soil fertility, it is necessary to use organic manure. However, the consumption of organic manure was observed to be very small.
- The use of agro-chemicals is limited to paddy and upland paddy cultivation. Agro-chemicals are not used for local varieties.
- The small and marginal farmers use their own family labor rather than draft animals in farming, and this constitutes an ample source of surplus labor.

5.3.5 Cropping Pattern, Intensity, and Yield

Maize, millet and upland paddy are the major crops grown in the Project area. Other crops include oilseeds. Cultivation of paddy and wheat is also done by use of the limited source of water. The cereal crops occupy 83% of the total cropped area, and the rest is used for cultivation of niger, sesame, and ground nut. The average cropping intensity is 138%, varying from 110% in Irrigation Block A to 151% in Irrigation Block L.

The crop yields were observed to fluctuate due to uncertain rainfall, poor quality of seeds, water shortages, and shortage of organic manure. The average yield of paddy is 2.40/ha, indicating a slightly higher value than the Nuwakot average of 2.31/ha (1995/96).

The annual total crop production was estimated at 1,920 t, of which 95% were cereals with the remaining 5% being oilseeds. The cereal crops, which occupied 83% of the total cropped area, produced 95% of foodgrains.

5.3.6 Crop Budget

The most profitable crop in terms of net return is paddy, followed by upland paddy, millet, maize, and wheat.

5.3.7 Agricultural Extension

Nuwakot District Agricultural Development Office (DADO) is responsible for provision of agricultural extension services to farmers through 6 Agricultural Service Centers and 7 Sub-centers. The Project area is brought under jurisdiction of Devighat Agricultural Service Center, which has one Junior Technician (JT) and one Junior Technical Assistant (JTA).

5.3.8 Agricultural Research

A horticultural farm is located at Trishuli to support vegetable seeds production and sales, and vegetable cultivation. Farmers are aware from their experience during the Old Battar Lift Irrigation Project of the fact that high profitability was brought about by vegetable and potato production.

5.3.9 Animal Husbandry

Nuwakot District Livestock Services Office (DLSO) is the main agency providing livestock services to farmers through 6 Livestock Services Centers and 8 Sub-centers. Devighat Livestock Services Center is responsible for the Project area.

5.3.10 Major Constraints on Agricultural Development

The major constraints on agricultural development are mentioned below.

- (1) In order to overcome food shortage, farmers' priority is given to cereal crop production rather than market-oriented crop production;
- (2) In order to introduce new varieties and technologies, it is essential to provide extension services up to the level of small farmers with due carefulness; and
- (3) There is lack of effort on crop diversification.

5.4 Agricultural Economy

5.4.1 Methodology of Survey

In order to identify the prevailing conditions in the Study area pertaining to the marketing of agricultural products and inputs, the rural credit network and linkages, and farm household economy, the methodology adopted by the Study consisted of a questionnaire study of 202 household samples, interview survey, and case study survey at 15 survey spots.

5.4.2 Marketing System for Agricultural Products and Inputs

(1) Marketing System for Agricultural Products

Agricultural products such as paddy, maize, millet, and wheat were collected and shipped entirely by 21 private traders. While paddy, maize and wheat were shipped to millers or feed industries for poultry in Kathmandu, millet was marketed to Pokhara and Bhairawa for brewing.

(2) Marketing System for Agricultural Inputs

- Chemical fertilizer retailing to farmers is mainly handled by 11 sales outlets from the wholesaling Agriculture Inputs Corporation (AIC) in Bidur.
- Pesticides and fungicides are primarily marketed to farmers through 9 private dealers. Most of agro-chemicals are supplied by private agro-chemical and seed wholesalers in Kathmandu.

- Improved seeds such as cereal crops and vegetables are sold to farmers mainly by the AIC and 9 agro-chemical dealers. However, a number of farmers engage in farmer-to-farmer seed exchange.

(3) Present Marketing Conditions

- Geographic location for marketing of agricultural products has been favourable given the fact that Kathmandu is roughly 70km away (only 3-4 hours by road).
- With extension of the road network and repair works for damaged segments of road surface, agricultural marketing is possible even in rainy months.
- Nuwakot district, due to its advantageous location and access, has become a food supply base for the Kathmandu Valley, which comprises a major consumption center. The radish shipped from Nuwakot district occupies about 50% of the total transaction volume at Kalimati Fruits and Vegetables Wholesale Market in Kathmandu.
- There are 6 collection centers in the Project area at which collection and shipping agents purchase large amounts of cereal crops such as paddy, maize, millet and wheat from farmers of neighboring Village Development Committees (VDCs). These centers are functioning well based on the rural - urban marketing linkage. Individual farmers are the basic operation units for sales to the collectors.
- 3 main market centers scattering over the Project area are responsive to the local demand of rural population for vegetables, oilseeds and pulses; however, such demand is met through imports mainly from neighboring VDCs and Kathmandu.
- At present, marketing information on fruits and vegetables at the Kalimati Wholesale Market is announced via radio broadcast to marketing agents, but there is no information network on cereal crop market conditions in Kathmandu.
- There is no such practice as standardization and grading of agricultural products at the farm level.

5.4.3 Rural Credit

Rural credit institutions can be divided into 3 categories, i.e. institutional credit, non-institutional credit, and semi-institutional credit. The Agricultural Development Bank of Nepal (ADB/N), Nepal Bank Ltd. (NBL), and Nepal Bangladesh Bank Ltd. (NBBL) provide institutional credit to farmers, while non-institutional credit is provided by local money lenders, landlords, traders, large and medium farmers, friends and relatives. Semi-institutional credit is practiced by agricultural cooperative-type credit and savings groups.

The results of household survey reveals that the number of households which have received credit in the past comprise about 52% of the total households. Of the total, 48.5% of households received credit from institutional and semi-institutional sources with the rest being 51.1% provided with non-institutional credit.

5.4.4 Household Economy

Gross crop income per household for the Project area as a whole is Rs. 11,910, which corresponds to Rs.1,970 per capita per annum. On an irrigation block-wise basis, I Block exhibits the highest income at Rs.20,680, while II Block shows the lowest at Rs.5,020, representing roughly a 4 fold variation in income.

The results of analysis of household income by different land holding sizes are as follows.

- Average annual income for large farmers amounting to Rs.52,000 is 3.4 times that of marginal farmers, and the proportion of agricultural income to the total household income accounts for 73%.
- Main source of income for marginal farmers is as wage labor (agricultural labor or other low-paid labor), accounting for 42.8% of total income. Crop income only accounts for 17.3% of the total.
- Engel's coefficient for marginal farmers at 77.9% is the highest for all groups, and indicates that the average land holding of 0.12 ha for this group cannot produce sufficient food to support the average number of household members of 5.3. This situation can be applied to the small farmer group as well.

5.5 Irrigation and Drainage

5.5.1 System Assessment

(1) Previous Battar Lift Irrigation Project

The previous Battar lift irrigation system area occupies 424 ha of the Study area, and is evaluated as follows:

- The scheme is presently non-functional, with 4 locations of pump system inoperable.
- The remaining main canal of the system is deteriorated, being filled in with earth at places and destroyed at locations to make way for construction of resident dwellings.

- The intake level of the main pump station on the Trishuli left bank cannot achieve diversion in the dry season due to river level drop as a result of the Devighat power station constructed immediately upstream.
- Beneficiaries accordingly express doubts about the sustainability of lift irrigation.

(2) Trishuli-Devighat Hydropower Upgrading Project

In order to improve the domestic power situation, the above project was launched in 1992 and completed in 1995. Under the project, an irrigation intake facility was constructed immediately upstream of the NEA headrace aqueduct no. 2. Design discharge for this facility is $Q = 3.0 \text{ m}^3/\text{s}$. To accommodate this, the design discharge for the NEA headrace canal segment from its intake to aqueduct no. 2 is $Q = 48.6 \text{ m}^3/\text{s}$.

Design power station discharge below aqueduct no. 2 is $Q = 45.6 \text{ m}^3/\text{s}$.

Results of field survey by the Study Team are as follows:

- There is no official written agreement between DOI and NEA with regards to the irrigation discharge of $Q = 3.0 \text{ m}^3/\text{s}$, however, this discharge allocation was confirmed by both DOI and NEA at the CCG meeting convened by the Study Team (December 25, 1996).
- Existing intake sill elevation for diversion of irrigation discharge of $Q = 3.0 \text{ m}^3/\text{s}$ is higher than the design water elevation by NEA for the headrace design discharge of $Q = 45.6 \text{ m}^3/\text{s}$, which makes diversion even during the rainy season impossible in many cases.
- Under the upgrading project, it has been promised that about $5.0 \text{ m}^3/\text{s}$ of river maintenance discharge will be released from the NEA intake weir; however, in actuality this amount is not being released. Also, there is no official documentation that clearly stipulates this maintenance discharge.

(3) Formulation of Appropriate Project Cost, and Sustainability of the Project

- Appropriate project cost and sustainability have been reflected in Project planning. In this regard, the following 2 intake points were studied and Option 3 selected as the most feasible in terms of cost and sustainability.

Original: At aqueduct no. 2 as contained in the original request by the Nepalese government

Option 3: At the downstream end of the NEA balancing reservoir (Alternative-1)

(4) NEA Balancing Reservoir

The Study Team surveyed the NEA balancing reservoir which has been selected as the main canal water source.

- The balancing reservoir was not improved under the Trishuli-Devighat Hydropower Upgrading Project. In contrast to the design discharge of $Q = 31.15 \text{ m}^3/\text{s}$ under the said project, reservoir storage capacity remains at $V = 250,000 \text{ m}^3$ equivalent to a peak regulating discharge of $Q = 14.51 \text{ m}^3/\text{s}$.
- Total reservoir volume is $765,000 \text{ m}^3$, comprising a design sediment volume of $510,000 \text{ m}^3$ and a live storage volume of $250,000 \text{ m}^3$.
- At present, reservoir sedimentation is progressing, exceeding the design sediment table and resulting in an estimated 50% reduction in effective storage capacity of $250,000 \text{ m}^3$.
- The dredger which arrived in 1976 (Dutch made) is no longer operable, and in 1995 NEA carried out mechanical dredging of the reservoir.

(5) Sediment Data

Data with regard to sedimentation relevant to the Project was obtained from the following:

- Trishuli-Devighat Upgrading Project feasibility study report
- Sediment Transport Data (DIHM - Hydrology Section)
- Indian Engineering Report

5.5.2 Water Resources

In order to identify Project water resources, the Study Team collected rainfall, discharge and general meteorological records from the relevant gauging stations, and Trishuli power station discharge records.

(1) River Systems

Catchments for the 2 zones comprising the Study area are as follows:

Zone A (irrigated area = 630 ha): 4,644 km^2 (Trishuli river basin)

Zone B (irrigated area = 130 ha): 4.5 km^2 (Trishuli river basin)

(2) Present Water Sources

Zone A: intake from immediately upstream of aqueduct no. 2 (rainy season irrigation only) to downstream

Zone B: direct diversion from Trishuli river (perennial irrigation)

5.5.3 Main Canal Alignment

(1) Topographical Conditions

For the first 4 km segment in the downstream direction from the original intake site (immediately upstream of aqueduct no. 2), topography poses difficulties for open canal works.

(2) Geological Conditions

Together with counterparts, the Study Team carried out geological reconnaissance of the upstream left bank of the Trishuli river, elevated areas, and area of heavy gully erosion. The results of this reconnaissance was used as data in canal alignment selection.

(3) Canal Alignment Selection Method and Outcome of the Same

The Study Team carried out a profile survey of the 8 km existing road parallel to the target area, identified hydraulic gradient and intake site elevation, and on this basis studied the following 3 options for main canal route.

- 1) Open canal (intake site upstream of aqueduct no. 2)
- 2) Pipeline system (intake site upstream of aqueduct no. 2)
- 3) Option 3 (intake at the downstream part of NEA balancing reservoir)

5.5.4 Comparative Study on Main Canal

The Study Team carried out a comparative study of the 3 canal options from the 2 intake sites to the regulating pond in Zone A, and computed the following preliminary construction cost estimates. As a result, it was agreed in discussions with DOI that Option 3 should be adopted for the Project.

System	Main canal length (km)	Estimated construction cost (Rs. million)	Per ha cost (US\$/ha)
1) Open canal	7.01	650	18,000
2) Pipeline	7.31	370	10,300
3) Option 3	5.53	250	6,800

5.5.5 Identification of Command Area

(1) Net Command Area

The command area under the original request by the Nepalese government was a total 1,000 ha; however, on the basis of topographical mapping prepared by the Study Team and field reconnaissance, the benefit area was identified at 757.7 ha as follows:

Name of Area	Proposed by DIO (Gross, ha)	Identified by the Study Team (Net, ha)
Zone A (L/B of Trishuli R.)		
1) Gravity Area	570	447.2
upper block	200	145.6
down block	370	301.6
2) Lift Area	230	182.0
Total 1)+2)	800	629.2
Zone B (R/B of Trishuli R.)	200	128.5
Total: Zone A+B	1,000	757.7

(2) Demarcation of 12 Proposed Irrigation Blocks

On the basis of topographical conditions, the Study Team divided the gravity and lift irrigation zones into a total of 12 irrigation blocks (A~L). Total lift command area was calculated at 348 ha.

5.6 Farmer Organizations and Institutional Aspects

5.6.1 Current Water Users' Associations in TIP Area

There are 6 existing WUAs in the Project area. These are found in the 4 irrigation blocks A, B, E and L as delineated under the Study. Association members total 429.

5.6.2 Past Water User's Associations and their Activities

Two ward-wise WUAs were formed at Maharanidihi (old Bidur village, Ward 6) and Inarpati (old Bidur village, Ward 7) around 1979 when the Battar irrigation project was still functioning. For around a 2 year period, irrigation water was supplied to Majhitar and Pipaltar, however, WUAs were not formed at these locations.

The above 2 WUAs were formed after the Battar project began operation, to resolve conflicts among beneficiaries with regard to water distribution, and were comprised of farmer and government representatives (Chief District Officer, Local Development Officer, representative of Nepal Electricity Authority, Agriculture Development Officer of the District and the In-Charge of Battar Irrigation Sub-Division) with the old ward head acting as head of the WUA. A membership fee of Rs. 100-400/

ha/crop was collected from association members, and this capital was used to hire water management personnel and carry out O&M of canal facilities. In 1988, Bidur village was upgraded to municipality status with the old wards 6 and 7 being amalgamated into a single ward. The WUAs based on the old ward demarcation were disbanded, and a single new WUA was established. However, with the cessation of irrigation water supply under the Battar project, this association became inactive. Lessons from this past experience are (1) WUAs should be formed not on the basis of administrative units (wards) but on the basis of hydrological boundaries, and (2) beneficiary farmers themselves rather than administrative officers (government representatives and ward heads) should form the core of the WUA.

5.6.3 Current Community Groups in TIP Area

There are a total of 45 community groups existing in the Project area (including groups for women, youth, saving and credit, diary farming, forest management, soil conservation, water management, community development, etc.). However the distribution of these is skewed, with numerous active groups in Simbutar and Pokhariphant, and conversely no such groups at all in Machale, Beltar, Dhansar and Lambagaicha.

5.6.4 Degree of Constraints Anticipated for WUA Formation

In light of the varying socio-economic characteristics of the 12 irrigation blocks, survey was carried out for the following items a)-f), and the results summarized in the table below.

- a) The ethnic composition of each block was surveyed, and results tabulated.
- b) Dependency on agricultural income was examined for each block and results tabulated.
- c) Land holding scale was divided into four categories (marginal, small, medium and large) and examined for each block, the results of this tabulated for use in WUA organizing.
- d) Land ownership pattern was likewise surveyed, and results tabulated.
- e) As record keeping is an important component of WUA activity, literacy rate in the Study area was surveyed for each block.
- f) Identification of agricultural income is another factor important in effecting WUA formation, and this was accordingly surveyed and results tabulated.

On the basis of the above, constraints anticipated in WUA formation have been summarized in the table below (✓ indicates the degree of attention required in WUA formation).

	Ethnic composition	Agricultural income	Land use	Absentee land owner	Land ownership system	Location of dwellings	Literacy rate	Income
A					✓			
B	✓	✓	✓		✓			
C		✓	✓		✓			✓
D			✓	✓	✓✓			
E			✓	✓	✓✓			
F				✓	✓	✓		
G				✓	✓✓			✓
H		✓			✓✓		✓	
I	✓				✓			✓
J			✓	✓	✓		✓	
K				✓	✓		✓	
L	✓							

5.7 Environment

5.7.1 Environmental Conditions

Soil erosion, forest conservation, agro-chemicals, irrigation water quality and disease occurrence in the Project area were studied, and environmental issues under the Project area identified as follows:

Soil erosion:	Small landslide zones are seen at the upstream part of the Project area, and soil erosion is in evidence in the design irrigation command area downstream. Principal causes of this are 1) concentrated rainfall in the July~August rainy season, 2) weak geology, 3) farm plots located on steep terrain, and 4) sparse cover due to open livestock grazing.
Forest conservation:	Soil erosion control measures and resource management (fodder, fuel wood) are carried out by the 18 forest users groups in the area, and the status of forest conservation is good. Also, as the design canal alignment will potentially pass through wooded locations, ownership and management structure for these were studied and the need identified for procedures during construction to minimize tree felling and establish maintainable slope collapse works.

5.7.2 Social Infrastructure

- (1) Transportation: In addition to the Trishuli~Kathmandu trunk highway, there exist 8 major roads in the area.
- (2) Drinking water systems: In Bidur municipality, there are two drinking water supply systems. Other potable water supply is from nearby foothill area.
- (3) Medical health facilities: There are 1 public hospital and 2 private clinics in the Study area.
- (4) Schools: In the area, there are 7 public primary schools, 5 public secondary schools, and 3 private boarding schools. In addition, there is a private campus (equivalent to community college) at Battar.

5.7.3 Related Agencies

Principal agencies related to the environment are as follows:

Central government: Ministry of Population and Environment (engaged in environmental policy formulation, liaison with other agencies, environmental impact assessment and evaluation)

District level (Nuwakot):

- 1) DSCO: District Soil Conservation Office (engaged in soil erosion control projects)
- 2) DFO: District Forest Office (engaged in forest conservation projects)
- 3) DOR: Department of Road (engaged in road maintenance projects)
- 4) District Technical Group (engaged in sub-watershed program)

CHAPTER 6 FORMULATION OF IRRIGATION DEVELOPMENT PLAN

6.1 Plan Formulation Strategy

The basic plan formulation strategy for the Project is in line with objectives and management policy as set out in the formulated and enforced Irrigation Policy promulgated by the government in 1992. Particular attention is given to the following items stipulated in the objectives of the said Policy, and these have been specifically included in the various sector plans.

- To optimally develop irrigation services through cost effective investment in the irrigation development and extension programs.
- To ensure greater returns in the short run by meeting the water requirements of farmers' fields with an objective of increasing agriculture production.
- To decrease the government's involvement in the construction, maintenance and operation of irrigation schemes by gradually increasing the participation of organized users.

6.2 Social Preparation Plan

Before the implementation of the irrigation system in TIP, it is necessary to promote social awareness among the beneficiary groups under the Project about the benefit of the system and role to be played by the farmers.

6.2.1 Role of Farmers as Defined by the Irrigation Policy of Nepal

The Irrigation Policy of Nepal 1992 clearly emphasizes increased participation of organized farmer groups in all stages of implementation and O&M. The policy is expected to provide improved agriculture support services to farmers in irrigated areas. DOI is to introduce decentralized management practices and introduction of transparency in budget planning and expenditures, and increased responsibilities to WUAs are to be realized. In line with this policy, a farmer education program is planned and will be reflected in the Project.

6.2.2 Raising Awareness of Beneficiaries on TIP Implementation

Farmer awareness about TIP implementation is to be promoted through meetings between beneficiaries and project staff at the block level. As the literacy rate in the area is high, a combination of pamphlets and video dissemination of information would be used, and the following methodology applied to educated farmers with regard to water management and agricultural development.

- 1) Completion of WUA formation before the start of project construction
- 2) Project orientation directed at the farmers would be in line with the following items
 - TIP will be for 9 month irrigation
 - Crops are to be planned on the basis of 9 month water availability
 - The main canals and some of the main branch canals will be pipeline
 - Some part of the command area is to be served by pumps.
 - The TIP is divided into 12 independent units called irrigation blocks (A-L)
 - WUAs must take the responsibility for O&M of each block including the operation and maintenance cost of lift pumps.
 - The farmers must share a certain percentage of construction cost as a part of their participation in physical infrastructure development
 - Farmers are to be informed about the alternative cropping patterns which will bring them more income.

6.2.3 Training Programs

The following training programs are to be carried out prior to and after completion of WUA formation:

- (1) Preparatory Training Programs for WUA Formation
 - a. District level officers orientation program
 - b. Catalyst training program
- (2) Training Program for WUA Capacity Building
 - a. Orientation program to 1000 beneficiary farmers
 - b. Training to farmer representatives at sub-block level WUAs
 - c. Training program to WUA representatives at the block level

- d. Farmer to farmer training program
- e. Training program on pump operation

6.3 Agricultural Development Plan

6.3.1 Formulation of Agricultural Development Plan

The agricultural development plan was worked out from the following standpoints:

(1) National Plan

The Agricultural Perspective Plan (APP) has seven strategic components: 1) acceleration of agricultural growth, 2) use of agricultural inputs, 3) prioritization of inputs such as irrigation, fertilizers, farming technologies, and farm roads, 4) introduction of prioritized high value crops, 5) prioritized cultivation of vegetables, vegetable seeds, fruits, and potato, 6) enhancement of farm income and employment opportunity, and 7) and improvement of implementation mechanism. The subject plan focuses on items 4)-6) above.

(2) Poverty Alleviation

The agricultural development plan was worked out with special attention to poverty alleviation of marginal and small farmers in conformity with a national plan aiming at reducing the present poverty rate by 10% over 20 years. The increase in crop intensification and diversification with completion of the proposed irrigation system will result in increased crop production and income, enabling these farmers to escape from poverty.

(3) Food Security

Based on the increased food crop production targeted under national policy, the agricultural development plan was worked out to make possible the self-sufficiency in food production in the Project area through introduction of high yielding varieties of crops.

(4) Crop Diversification

As the introduction of high value crops such as vegetables will ensure high profitability to marginal and small farmers, who are living below the poverty line, continuance of vegetable cultivation was planned in the Project area.

(5) Access to Markets

It was verified in the similar projects such as the Rapti zone in the west and Sindhuwa area in the east that farmers motivated themselves to produce more agricultural products if given adequate access to markets. Shipment of surplus agricultural products to Kathmandu and local markets has been planned under the Project by effective utilization of the existing marketing networks.

6.3.2 Strategy for Planning

The agricultural development plan was formulated by taking into due consideration the following experience and lessons in similar projects:

- Adoption of a participatory approach;
- Efficient and practical implementation of agricultural support services;
- Collaboration with line agencies to achieve the target yields of crops;
- Experience (cultivation of cereals and vegetables) of farmers at the time of implementation of the Old Batar Lift Irrigation Project;
- Application of farmer cropping experience and achievement in the Dhikure-Changadha irrigation area;
- Comparative advantage of the Project area and profitability of vegetables and fine quality rice (Pokhareli Masino variety);
- Preference and prioritization of crops introduced into the Project area based on farmers' previous experience; and
- Experience, knowledge and technological know-how of the Project area farmers.

6.3.3 Strategy for Basic Plan

A basic plan was formulated in consideration of irrigation type, farm size, and tenancy situation of Kumal groups. The basic criteria covered (1) selection of foodgrain crops to meet the food requirement of the Project area and its vicinity, (2) selection of high value crops, particularly the most profitable vegetable crops, and (3) anticipated yields based on the performance of farmers in similar irrigation project areas. Moreover, such factors as irrigation, fertilizer application, introduction of high yielding varieties, adoption of new farming technologies based on effective agricultural support services, and accessibility to markets are keys to achieving target yields.

6.3.4 Agricultural Development Plan

(1) Land Use and Cropping Plan

The cropping intensity was estimated at 217% in the case of 9 month irrigation, while at 300% under the perennial irrigation scenario. The cropped area is increased from 1,046 ha to 1,643.9 ha in the case of 9 month irrigation, and to 2, 273.1 ha in the perennial irrigation case.

(2) Improvement of Agricultural Practices, and Target Yield and Production

In order to improve agricultural practices, it is necessary to 1) plant good quality seeds, 2) improve fertilizer application amount, timing and methods, and 3) improve cultivation. These improvements would be nurtured stage-wise based on the locality of the Project area, to ultimately achieve the target yields.

Cultivation with good quality seeds of high yielding variety would require timely and proper ploughing, land preparation, and stable supply of agricultural inputs. With respect to the procurement of seeds, particularly, it is planned that seed multiplication would be achieved locally in the Project area. To accomplish this plan, it will be essential to avail of multiplication technology support from the District Agricultural Development Office (DADO) and the horticulture farm in Trishuli, and obtain foundation seeds from the agricultural farms and stations under the Nepal Agricultural Research Council (NARC). As seed multiplication for paddy, wheat, maize, potato, french beans, etc. is at present undertaken by some farmers at Chandipokhari in irrigation blocks E and L, it is planned to introduce such multiplication technology through its external expansion in close relationship with DADO and the horticulture farm.

A target yield of 5 t/ha was adopted for paddy cultivation in the Project area, taking into consideration criteria of present yields in the area, yields achieved under the former Battar lift irrigation project, yields being achieved in the Dhikure irrigation area, yields as set out in the Department of Agriculture's training manual, soil conditions in the Project area, season-wise available irrigation discharge, present amounts of fertilizer application, and anticipated levels of agricultural support service. The above criteria are applied in the determination of target yields for other crops as well.

(3) Estimated Production Cost and Farm Income

With irrigation performance, the drastic increase in farm income is anticipated. This is mainly due to introduction of highly profitable vegetable crops.

(4) Improvement of Agricultural Support Service System with Special Attention to Marginal and Small Farmers

With a special focus of the Project on poverty alleviation of marginal and small farmers, it is necessary for the Department of Agriculture (DOA) and Agricultural Services Centers (ASCs) to establish a system to support the poor through formulation of an agricultural extension strategy for lifting them above the poverty line. The proposed support services are described below.

- Provision of cultivation loans;
- Technological consideration to vegetable cultivation, which is introduced into the Project area based on its marketability and profitability;
- Transfer of cultivation technology by a farm management expert;
- Training program for farmers and concerned government personnel;
- Collaboration with local agricultural agencies;
- Establishment of water management system; and
- Establishment of agricultural related facilities.

The following special supports are required for marginal and small farmers:

- Introduction of local seed multiplication programs for superior varieties;

- Establishment of technological support system in respect of vegetable cultivation;
- Performance of farmer training, including farmer to farmer training;
- Provision of cultivation technology and agricultural inputs to enable escape from poverty;
- Provision of cultivation loan; and
- Establishment of handling and storage facilities.

6.3.5 Agricultural Marketing Plan

Based on the national policy of increase in food production and the introduction of high value crops, the agricultural marketing plan under the Project is to be formulated according to the following strategy: (i) formulation of an appropriate marketing plan with consideration to the marketability (in local markets and large urban markets in Kathmandu); and (ii) establishment of necessary related market and distribution facilities in order to facilitate smooth collection and shipment of surplus agricultural products, as well as of a stable supply network for essential agricultural inputs. In formulating the said plan, analysis of crop marketability was carried out for each stage from production to shipping and distribution, and the results of this analysis and marketing plan description are given below.

(1) Production Stage of Agricultural Products

- The present self-sufficiency rate in food production in the Project area was estimated at 81.7%, indicating an insufficiency of food production for beneficiary farmers. With implementation of the Project, average self-sufficiency rate would rise from 81.7% to 140.9% in the case of 9 month irrigation and to 173.5% in the case of perennial irrigation, making possible the out-shipment of surplus agricultural products.
- The quantities of surplus agricultural products which could be shipped after achieving self-sufficiency are shown below.

<u>Crops</u>	<u>9 Month Irrigation (mt)</u>	<u>Perennial Irrigation (mt)</u>
Paddy	925	984
Maize	285	422
Wheat	183	568
Cereals (Sub-total)	1,393	1,974
Vegetables	11,442	19,150
Total	12,835	21,124

(2) Shipping and Distribution Stage of Agricultural Products

Results of analysis and plan content are indicated in the table below:

Item	Results of analysis / plan content
1) Shipping structure	Cereals: shipping on an individual base (continuance of present structure) Vegetables: group shipping on an irrigation sub-block basis
2) Shipping quotas of surplus agricultural products appropriate to market demand	Destined for local markets: 817 mt of cereal (9 month - perennial irrigation) 1,609 mt of vegetables (9 month - perennial irrigation) Destined for Katmandu: 576 mt of cereal (9 month irrigation) 1,157 mt of cereal (perennial irrigation) 9,833 mt of vegetables (9 month irrigation) 1,754 mt of vegetables (perennial irrigation)
3) Marketing routes for surplus agricultural products	Paddy: Katmandu millers (using existing marketing routes) Maize, wheat: Kathmandu animal feed produces (using existing marketing routes) Vegetables: Destined for local markets and Kalimati fruit and vegetable market
4) Prices of agricultural products at time of shipping	Paddy: Average annual price (Kathmandu cereal market) Maize: Below the average annual price (Kathmandu cereal market) Wheat: Above the average annual price (Kathmandu cereal market) Cabbage: Below the average annual price (Kalimati fruit and vegetable market) Potato, radish, french bean: Above the average annual price (Kalimati fruit and vegetable market)
5) Procurement of agricultural production inputs	Seed: Local seed production (requiring technical support from DADO and foundation seed supply from NARC) Chemical fertilizer: AIC (using existing marketing network) Agro-chemicals: Via 9 existing outlets (using existing marketing network)
6) Transport method	Truck transport (on going road repair works will eliminate concerns about produce delivery even during the rainy season)
7) Access to marketing information	To be relayed to the farmer groups via the agricultural marketing sub-committees under the jurisdiction of the PMC
8) Standardizing and grading of agricultural products	Training in agricultural marketing to imbue farmers with awareness of the importance of standardizing and grading of agricultural products
9) Post harvest facilities	Cereals for self consumption are to be processed at the existing 26 milling plants. Vegetable collection and shipping centers are to be established at 4 locations (total storage capacity of 500 mt)
10) Establishment of agricultural marketing sub-committees	Agricultural marketing sub-committees are to be established under the jurisdiction of the PMC manage the import of agricultural production inputs and the out-shipment of agricultural products. Members would comprise the Agricultural Development Officer of DADO, the Trishuli branch manager of AIC, and selected members of block-level WUAs.
11) Farmer training in agricultural marketing	In order to realize effective marketing of surplus agricultural products, experts from DOA's marketing information division and the Kalimati Fruits and Vegetables Wholesale Market Board would be invited to carry out farmer training.

6.4 Irrigation and Drainage Plan

6.4.1 Basic Plan

(1) Irrigation Plan

- 1) Water source under the Project is to be the main Trishuli river.
- 2) Intake location is to be modified from the originally planned site (at the intake immediately upstream of aqueduct no. 2) to the downstream NEA balancing reservoir.
- 3) The Project will adopt in 9 month irrigation for the Trishuli LB area (April~December).
- 4) However, Zone B (Pokharephant, A = 129 ha) is planned as a separate irrigation system from Zone A and will adopt perennial irrigation with discharge diverted from the main Trishuli river.

(2) Drainage Plan

- 1) In the design gravity irrigation area, there are existing small natural drainage channels with ample function. These will be incorporated under the Project, and consequently no new drainage canal construction is planned.
- 2) Supply of irrigation discharge to Blocks I, J and K in the pumped irrigation design area, and the farmland along Tadi river in Block G are envisioned to pose the threat of landslide. Accordingly, a terminal drainage facilities plan for these areas will be formulated in coordination with the on-going soil conservation project.

6.4.2 Irrigation Plan

(1) Benefit Area

The Project benefit area is as indicated below.

Location	Design area (ha)
Trishuli LB (Zone A)	620.66
Trishuli RB (Zone B)	128.52
Total	749.18

note: Gerkhutar (A = 8.56 ha) is to be excluded from the general irrigation area due to the availability of spring discharge from the adjoining hill area, which precludes the need for additional irrigation discharge.

(2) Irrigation Plan

Design irrigated area is 749 ha for this scheme. Under the Project, the present cropping intensity of 138 would be improved to 217%.

6.4.3 Water Requirement

Irrigation water requirement was determined according to the following procedure:

- Water requirement calculation adopted the criteria of the publication "Hill Irrigation Engineering", Institute of Engineering, Tribhuvan University, January 1995.
- Water requirement was computed for 5 cases of cropping pattern for Zone A (left bank) and Zone B (right bank).
- On the basis of the above calculations, maximum water requirement was calculated at $Q = 0.63 \text{ m}^3/\text{s}$.
- In the lift irrigation area (left bank: 182 ha) pump operation is assumed at 12 hours/day. As overall system facility capacity is planned at 24 hours/day operation, the differential is to be stored in the zone regulating pond, pump station receiving tanks and farm plot receiving tanks.

6.4.4 Intake Plan

(1) Trishuli Left Bank (Zone A)

1) Intake Water Level

On the basis of consultations with DOI and NEA, the intake location at the downstream of the balancing reservoir (option 3) was selected as the design intake location in terms of cost-effectiveness and sustainability (control of sedimentation).

2) Discharge Capacity of Hydropower Station Canal, and Month-wise Design Intake Discharge

The design discharge of the hydropower station canal is $Q = 45.6 \text{ m}^3/\text{s}$. In light of the fact that the canal has a history of being capable of passing $Q = 50 \text{ m}^3$ of discharge, capacity is not a problem.

Maximum monthly intake discharges for irrigation purposes from the power station balancing reservoir are as follows:

	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Peak intake discharge (m^3/s)	0.32	0.51	0.27	0.06	0.22	0.55	0.63	0.52	0.12

(2) Trishuli Right Bank (Zone B)

This area will derive its irrigation discharge by direct diversion from the Trishuli river right bank. Irrigation system design gives careful consideration to river channel shift and the possibility of sediment intake. The irrigation plan calls for establishment of an intake tank in the river channel to ensure stable diversion and minimized sediment inflow.

6.4.5 Desilting Plan for Balancing Reservoir

- Based on past sedimentation data, sediment inflow into the balancing reservoir with inclusion of discharge for irrigation is $V = 262,000 \text{ m}^3$ year.
- Of this sediment inflow, roughly 20% corresponding to sediment with particle diameter $> 0.075 \text{ m}$ would deposit on the floor of the reservoir at an estimated volume of $V = 52,000 \text{ m}^3/\text{year}$.
- The agency responsible for the reservoir facility, i.e. NEA, in principle should carry out sediment removal in the future.
- Under this Project, leakage prevention works are planned at the existing ejector nearby the proposed intake point to contribute to maintenance of reservoir capacity. In this manner the Project takes into careful consideration any impact to the hydropower station from irrigation discharge diversion.

6.4.6 Facility Plan

A general description of the facility plan under the Project is given below.

Major facility	Salient Features
<u><Zone A></u>	
a. Intake	Intake tank, discharge pipe and turnout works
b. Main canal	Total length L = 5,800 m (ϕ 1000, ϕ 600)
c. Balancing reservoir	Effective volume: 1,200 m ³ ; reverse "T" reinforcement wall works
d. Branch canal	Total length: L = 6.4 km (ϕ 200-430); pump stations at 5 locations (including conveyance pipe), receiving tanks at 10 locations
e. Terminal facilities	Pipe and earthen canal works: 1 set
<u><Zone B></u>	
a. Intake	1 location of pump station works for direct diversion from the Trishuli river
b. Induction canal	ϕ 240 \times 50 m and ϕ 150 \times 100 m
c. Irrigation canal	Total length 3.3 km
d. Terminal facilities	Receiving tank and earthen canal: 1 set

6.5 Farmer Organization Plan

6.5.1 Methodology on Organizing

Organization of farmers is to be according to the following criteria:

- Irrigation supply boundaries (hydrological boundaries) are to be applied as opposed to administrative boundaries.
- Organization members are to be landowner and tenant farmers within a given boundary, with one person (household head) from each household to be member of the organization.
- The 12 irrigation blocks A~L are to be divided into sub-blocks according to branch canals, and these sub-blocks are to be the smallest unit for farmer organization.
- Five representatives from each sub-block will be elected to comprise an Executive Committee.
- Seven irrigation block representatives are to be selected from among the representatives (2 each) of the sub-blocks.
- A Project Management Committee (PMC) will be formed for macro-decision making. The PMC will comprise 12 irrigation block chairmen and 5 district level officials to engage in project operation and management.

6.5.2 Proposed WUA Organization in TIP

- On the basis of WUA formation criteria, (1) sub-block level and (2) PMC member composition was determined and (3) these were incorporated in a WUA design organigram.
- In the case of the LB zone (Irrigation Block L), the irrigation system itself is independent from that of the right bank; however, in light of the need in particular for integrated agricultural marketing strategy under the Project, it is planned that Irrigation Block L, as with other irrigation blocks will designate a delegate to the PMC.

6.5.3 Proposed Functions of WUA Units

The following levels of function have been clarified under Project planning:

- (1) Functions of sub-block WUAs
- (2) Functions of WUAs at the block level
- (3) Functions of PMC

6.5.4 Methodology for WUA Formation

Basic strategy in the formation of WUAs will focus on maximum use of existing community group structure. In Irrigation Block L, a large number of groups are already present (10 groups) in comparison to other blocks (2~3 groups), and women's participation in these is notably active. In particular, groups related to household management (savings and loan) and living environment improvement which are headed by women have received high marks not only from the participant members but from outside parties as well. All the members of these are beneficiaries under TIP, and they well understand the significance and importance of WUAs. Accordingly, WUA formation is planned to begin from Block L, building on steady achievement in female participation, with subsequent formation of WUAs in other blocks by catalysts acting with the cooperation and feedback from the Block L female group leaders.

In this manner, added impetus will be given to female participation in WUAs to be formed throughout the Project area.

WUA formation is proposed according to the following methodology:

- (1) Mobilization of 4 catalysts for WUA organization
- (2) WUA formation utilizing current social groups
- (3) Catalyst training program

6.5.5 Logistic Support Required to WUA

The logistics support required for the WUAs comprises a multi-purpose community building, necessary administrative office equipment, and training program materials.

6.5.6 WUA Registration

On the basis of the Water Resources Act of 1992, planned WUAs are to register with the district Local Development Office.

6.6 Operation and Maintenance Plan

6.6.1 Basic Strategy

The following O&M strategy is planned based on irrigation command area, system operation, etc.

- Joint management by the government and the WUAs is planned during the initial period of irrigation system facility start-up for LB zone given the assessment that O&M by the newly established WUAs on their own would be difficult during the initial period of Project operation.
- The scope of government involvement would then be gradually reduced with eventual full turn over to the WUAs.
- Accordingly, O&M capacity building will focus on the above objective.
- In the case of the RB system, a number of active community groups already exist, and some farmers have experience acting on their own in purchasing and operating pumps for irrigation; accordingly, it is planned that the WUAs will assume full responsibility for system operation from the outset.

6.6.2 Irrigation Systems

The LB and RB have been clearly demarcated and system management for each stipulated.

6.6.3 Joint Management

Respective scope of responsibility for the DOI and the WUAs has been stipulated under Project planning with regards to joint management for the LB area.

Four district DOI officers and 57 WUA members are planned to engage in the management of the main canal, 4 branch canals and 41 distribution canals.

6.6.4 O&M Training Program

The following program is planned:

- (1) Preparation of O&M manual: to be prepared principally by DOI in collaboration with MOA

- (2) Preparation of O&M program: at the district level, block level and sub-block level

6.6.5 Proposed Water Charges

The following water charges are envisioned, to provide WUA with O&M capital:

Lift irrigation area: Rs. 6,500 /ha/year

Gravity irrigation area: Rs. 1,000 /ha/year

6.7 Environment Conservation Plan

6.7.1 Basic Criteria for Planning

Procedure for environmental clearance in Nepal is as follows:

Detailed procedure is not clarified under the Environment Act gazetted on January 30, 1997. Accordingly, it is necessary to await completion of the related regulations.

In implementing a project, the IEE/EIA flow is DOI Environment Section ~ MOWR Planning Section ~ MOPE. However, in the case of IEE, submittal of documentation to MOPE is not necessary.

Under current law, the National Environmental Impact Assessment Guidelines, 1993 are in effect. Under these, the subject Project with command area of 760 ha does not require EIA.

6.7.2 Environmental Evaluations for Proposed Irrigation System Alternative Plan

Evaluation of envisioned environmental impacts was carried out for the 3 main canal alternatives. In light of environmental issues pertaining to tree felling, topographical conditions, soil erosion and sediment inflow, tunnel construction, etc., it was concluded that Option 3 with intake at the NEA balancing reservoir and adoption of pipeline canal would be the recommended option from an environmental standpoint.

6.7.3 Environment Conservation Plan

Environmental measures required for anticipated impacts from the Project comprise mainly counter-measures for soil erosion and landsliding.

6.7.4 Conclusion of IEE Study

The Project content pays careful attention to environmental considerations, i.e.:

- 1) Adoption of pipeline alignment from the intake point which minimizes tree cutting and the possibility of soil erosion;
- 2) Facility design and construction schedule timing which takes into full account the possibility of soil erosion, the largest environmental issue under the Project;
- 3) Farm management plan which gives full attention to the impacts of agro-chemicals and fertilizers on the environment; and
- 4) Clear indication of entities / personnel to be responsible for the relevant countermeasures.

On the basis of the above, it is concluded by the Study Team that no negative impacts from the Project will be indicated by EIA.

6.8 Project Monitoring Plan

The Project monitoring plan is to be carried out on an irrigation block unit basis. Following completion of project construction, district officials will commence irrigation observations and data record collection. Upon elapse of 3 years from the completion of construction, the results of monitoring will be analyzed as a basis for identifying Project effect and impact. Monitoring would be provided in the following areas:

- Irrigation system efficiency
- Agricultural production and marketing
- Environment

6.9 Training Program

The Project training program will be implemented in the following phases based on the social preparation plan and the O&M plan.

- Phase I: For an eight month period leading up to start of construction
- Phase II: 24 months from start to completion of construction works
- Phase III: For a 12 month period from completion of construction works

Phase	Training course	Instructor	No. of Trainees	Duration of course (days)	Remarks
A. Social Preparation Program					
I:	District officials orientation	Senior DOI engineers	30	2	
	Catalyst training	NGO	10	5	
II:	Orientation to farmers	NGO	1000	2	
	Training to WUA representatives at the sub-block level	DOI engineers	100	3	
	Training to WUA representatives at the block level	DOI engineers	60	5	
	Farmer to farmer training	Farmers	200	10	Mainly study of existing projects near TIP
	Training program in pump irrigation	DOI mechanics	30	2	
B. O&M Program					
III:	District officials training	Experts, DOI	10	30	5 day course, 6 times
	WUA representatives at the block level (system operators)	Experts, DOI, district engineers	50	20	5 day course, 4 times
	WUA representatives at the sub-block level (system operators)	DOI, district engineers, WUAs	140	20	5 day course, 4 times

6.10 Technical Assistance

It is concluded that technical assistance will be required under the Project given the targeted agricultural diversification, water management of a large diameter pipeline system, and pump maintenance (which was a factor in the failure of the previous Battar project). Accordingly, it is recommended that 3 experts be assigned: 1 irrigation expert, 1 agricultural expert and 1 pump mechanical expert, to support effective Project performance.

CHAPTER 7 PROJECT PLAN

7.1 Project Components

The subject Project comprises the following 2 irrigation schemes and 3 programs.

(1) Irrigation Schemes

i) Left Bank Irrigation Scheme

- This is a 9 month per year irrigation system comprising 620 ha including the irrigated area under the former Battar lift irrigation project.
- It comprises 11 irrigation blocks A~K, and is a combination of mainly gravity irrigation with one portion of pump lift irrigation. Scheme components include new construction of intake facility, main canal (pipeline), pump stations, etc.

ii) Right Bank Irrigation Scheme

- Water source is the main Trishuli river. Total command area to be serviced by lift irrigation targeted at 129 ha.
- Perennial irrigation is planned.
- The scheme area comprises Block L, one of the 12 irrigation blocks of the overall TIP area.

(2) Program

i) Social Preparation Program

This a preparatory program for project implementation and operation aimed at beneficiary farmers, farmer representatives, representatives of WUAs and district level officials.

ii) Water Management Program

This program will overlap with the latter half of the above human resources development program, and is aimed at water management training of concerned personnel.

iii) Monitoring Program

This program is directed at promoting achievement of project objectives, and is to be carried out at the three stages of project implementation, i.e. start of construction, during construction and after completion of construction.

7.2 Plan and Program Components

Scheme	Design area (ha)	Intake	Main canal	Management facilities	Branch canal facilities	Terminal facilities
i) L/B irrigation plan	620	1	L = 5.8 km	Regulation reservoir: 1 Administrative office: 1 Storages: 3	L = 7.0 km	1 set
ii) R/B irrigation plan	129	1	L = 0.15 km	Receiving tank: 2 Storages: 1	L = 3.3 km	1 set

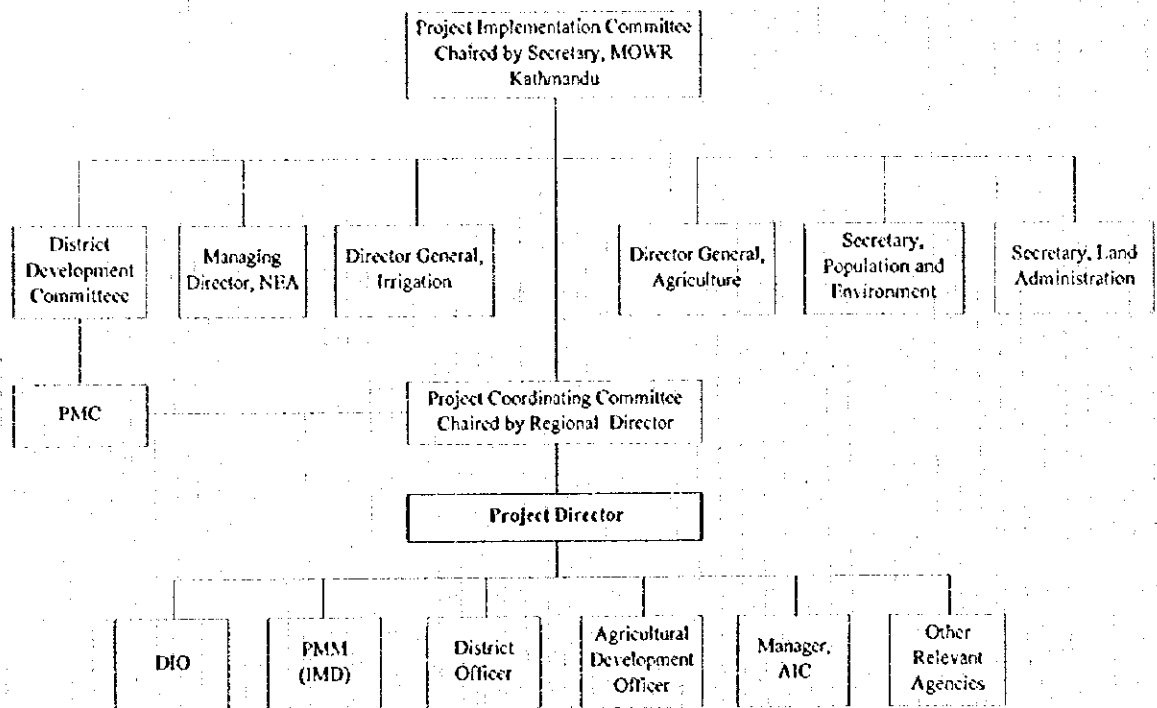
(2) Programs

The 3 programs under the project comprise 4 components, components of which are indicated below.

	Plan	Components
Social preparation, water management and monitoring programs	Training program	Farmer orientation, sub-block farmer representative training, WUA representative training, farmer training, concerned government official training, pump operation training
	Training equipment procurement plan	2 sets each of TV, VCR, screen, OHP, slide projector, video camera; 10 sets of white board
	Equipment procurement for WUA	Motocycle (4 nos.), computer (2 nos.), portable microphone (4 nos.), radio transceiver (2 sets)
	Administrative office	Multipurpose community hall cum office (1 building; 10 × 12 = 120 m ²)

7.3 Project Implementation Structure

The proposed project implementation and O&M structure is indicated in organigram form below.



MOWR: Ministry of Water Resources
 NEA: Nepal Electricity Authority
 PMC: Project Managing Committee
 DIO: District Irrigation Office
 PMM: Project Managers
 IMD: Irrigation Management Division
 AIC: Agriculture Inputs Corporation

7.4 Implementation Plan

Construction period for the Project is 2 years (from October 1998-2000). Each program plan will be carried out based on this construction period.

7.5 Project Cost

Overall project cost, cost portion to be borne by beneficiary farmers and cost portion to be borne by the Nepalese Government are given below.

(Unit: Rs '000)

Cost Item		Local portion	Foreign portion	Total	(Unit: Rs '000)		
					Farmers' burden	Nepalese Govt. burden	
Project Cost		298,215	403,456	701,671	46,037	13,203	
A. Construction Cost		296,495	401,686	698,181	46,037	--	
I. Direct Cost		156,165	295,608	451,773	46,037	--	
I-1	Intake Works	1 set	3,280	6,059	9,339	--	--
I-2	Main Canal Facilities	1 set	76,374	179,940	256,314	--	--
I-3	Proposed Control Tank	1 set	10,316	4,250	14,566	--	--
I-4	Branch Canal Facilities	1 set	14,341	43,454	57,795	--	--
I-5	On-farm Level Facilities	1 set	37,243	11,073	48,316	37,243	--
I-6	Zone B Construction Cost	1 set	11,916	22,985	34,901	6,099	--
I-7	Storage Construction Cost	1 set	2,695	0	2,695	2,695	--
I-8	Equipment	1 set	0	27,847	27,847	--	--
II. Indirect Cost	1 set	95,000	40,000	135,000	--	--	
III. Land Acquisition	1 set	2,259	0	2,259	--	2,259	
IV. Administration	1 set	500	0	500	--	500	
V. Engineering Services	1 set	12,493	23,649	36,142	--	3,683	
VI. Physical Contingency	1 set	3,123	5,912	9,035	--	921	
VII. Price Contingency	1 set	26,955	36,517	63,472	--	5,340	
B. Cost for Program		1,720	4,770	3,490	--	500	
1. Training Program	1 set	500	0	500	--	500	
2. Equipment for Training	1 set	0	1,020	1,020	--	--	
3. Equipment for Water Management	1 set	0	750	750	--	--	
4. Multipurpose Community Hall	1 set	1,220	0	1,220	--	--	

Exchange Rate: US\$1 = Rs.56.7 (March 1997)

CHAPTER 8 PROJECT EVALUATION

(1) Economic and Financial Evaluation

1) Economic Internal Rate of Return

Based on the 25-year flow of project cost, O & M cost, and project benefit derived from increased agricultural production, economic viability of the Project was assessed in terms of Economic Internal Rate of Return (EIRR), Benefit-Cost Ratio (B/C), and Net Present Value (NPV).

The results of analysis reveals that economic viability of this Project was justified as the EIRR has been estimated at 14.8% which was higher than the opportunity cost of capital of 10% estimated by the World Bank. It has become obvious from the results of sensitivity analysis that such economic viability remained unchanged.

2) Farm Income Analysis

With project implementation, average annual net farm income per household will increase 1.6 fold in the case of 9 month irrigation and 2 fold under the perennial irrigation scenario for marginal farmers, while a 4.5 fold increase in the 9 month irrigation and 6.1 fold increase under the perennial condition are assured for large farmers.

3) Cost Recovery

(a) O&M Cost Portion to be Borne by Beneficiaries

Assuming that the beneficiary farmers would assume responsibility for such items as electrical fees, pump operator wages and the O&M for terminal irrigation facilities, etc. out of overall Project O&M cost will be the following percentages of the net income increment under the Project. And on this basis, it is concluded that beneficiary farmers would have ample capability to pay the said O&M cost.

Farm Household Size	Type of Irrigation	9 Month Irrigation (%)	Perennial Irrigation (%)
Marginal	Gravity	1.3	1.1
	Pump	8.7	8.2
Large	Gravity	1.3	1.1
	Pump	8.6	8.1

(b) Project Cost Portion to be Borne by Beneficiaries

Assuming that the beneficiary farmers will bear 7% of total Project cost in line with the Irrigation Policy, 1992, and repayment conditions of 20 year repayment period and interest rate of 5%, annual capital cost payment burden in this regard

by beneficiary farmers would be less than 8% of the net annual income increment under the Project (after subtracting the farmer O&M burden discussed above) as shown in the table below. This represents a low percentage, and indicates that the financial capability to pay for the Project by the beneficiary farmers would be high enough to cover the required capital cost burden.

Farm Household Size	Type of Irrigation	9 Month Irrigation (%)	Perennial Irrigation (%)
Marginal	Gravity	7.1	4.8
	Pump	7.7	5.2
Large	Gravity	7.0	4.8
	Pump	7.6	5.2

4) Poverty Alleviation

Present rate of poverty in the Project area is 83.1%, which will be reduced with implementation of the Project to 30.4% in the case of 9 month irrigation and 16.4% in the case of perennial irrigation enabling the socially disadvantaged group of landless, marginal and small farmers to escape from the grip of poverty.

5) Generation of Employment Opportunities

Project implementation will generate an estimate 852,000 man-days of employment (equivalent to Rs.68.2 million/2years) during the construction period. Moreover, with completion of the Project, it is expected to generate approximately 179,400 man-days of additional employment opportunities amounting to Rs.7.2 million/year in the case of 9 month irrigation, and 301,800 man-days of the same equivalent to Rs.12.1million/year under the perennial irrigation condition.

(2) Technical Evaluation

The Project is deemed to be technically viable in terms of sustainability in light of the careful consideration given during formulation to discharge diversion from stable water source, measures to prevent sediment inflow into canal facilities, adoption of pump lift system, and no negative impacts to the natural and social environments.

(3) Environmental Evaluation

Project planning takes into careful consideration the natural environment of the area, and incorporates tightly managed tree felling, soil conservation measures, and appropriate use of fertilizers and agro-chemicals. It is concluded that subsequent EIA will indicate no negative environmental impacts from Project implementation.

(4) Social Evaluation

Implementation of the Project will have a range of beneficial social impacts including improved literacy, better nutrition, greater participation by women in local community

groups, and most importantly, provision of the means for disadvantaged members of the Project area society to achieve economic independence.

(5) Institutional Evaluation

WUAs will be formed block-wise, and a PMC established to provide overall system management in linkage with related central government agencies. In this manner, systematic water distribution management will be possible down to the field level farmer groups.

CHAPTER 9 CONCLUSION AND RECOMMENDATIONS

i. Farmer Participation

The subject Feasibility Study was carried out from the initial stage with the active participation of the Project area farmers.

ii. Reflection of Farmer Aspirations in Project Planning

Area farmers exhibited an extremely high degree of interest in the Project throughout the course of the Study period. Farmer aspirations and hopes with regard to the Project were carefully identified and are integrally reflected in the Project plan.

iii. Escape from Poverty

Number of beneficiary farm households under the Project is 1,445, or a total beneficiary population of 8,742. On the basis of poverty line criteria (poverty line cut-off of Rs. 3,945 per capita per annum), it was identified that roughly 1,072 households (83% of the 1,291 households responding to the questionnaire survey) in the Project area subsist below the poverty line.

Implementation of the Project is estimated to result in a dramatic reduction of impoverished households to 346 households (26.8%). In addition, in the case of the subject remaining 346 households, it is anticipated that the increase in employment opportunities under the Project will gradually propel these households over the poverty line as well.

Accordingly, it is recommended that the Project be implemented at the earliest, as an alleviation measure for poverty.

iv) Formal Agreement on Intake Site

The timely implementation of the Project is premised on consultation and agreement between DOI and NEA with regards to shift of intake point as recommended by this Study to the proposed location at the balancing reservoir (option 3).

In light of the fact that irrigation system construction based on the originally proposed location (aqueduct no. 2) would be prohibitively costly both in terms of local and international criteria, Option 3 is considered essential to Project realization.

v) Social Preparation

The Project area lacks farmer organization as well as an overall irrigation system. Implementation of the Project requires the earliest possible

organization of farmers, this in light of the fact that consensual agreements are necessary between the government and farmer groups in order to move forward with the Project.

Also, capacity building directed at farmers is essential with regard to modern technology for agricultural diversification, accessing market information, irrigation system management, etc., and to achieve this a social preparation program is proposed under the Project.