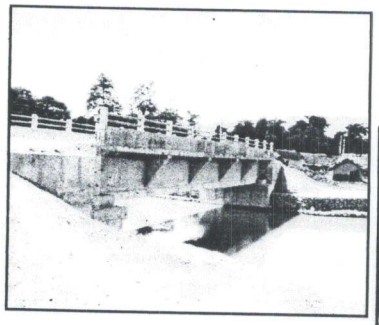
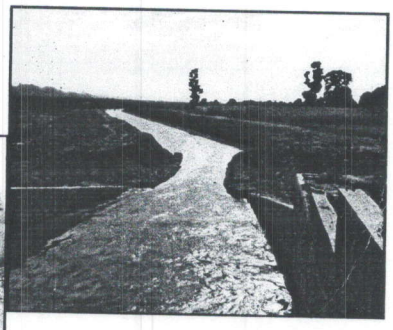
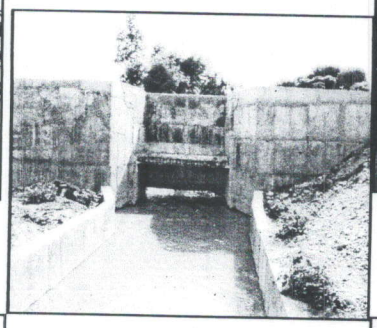
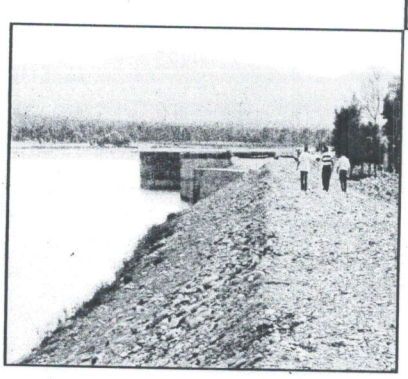
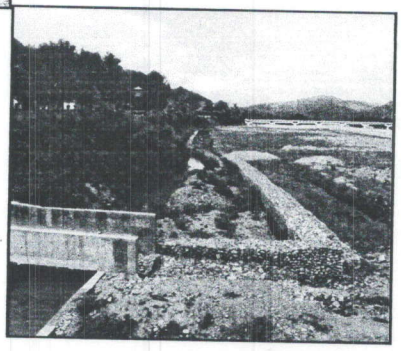
His Majesty's Government of Nepal
Ministry of Water Resources
Department of Irrigation
PRAGANNA KULO IRRIGATION PROJECT
Project Implementation Unit
Jawalakhel, Lalitpur

PROJECT COMPLETION REPORT

VOLUME I - MAIN REPORT

July 2006

SILT Consultants (P) Ltd. *and*
DE Consultancy (P) Ltd.

P.O. Box 2724, Mid Baneshwor, Kathmandu
Tel.: 4470866. 4487598, 4495163
Fax : 977-01- 4473573
Email: silt@mos.com.np
Website: www.silt.com.np

VOLUME I: MAIN REPORT

Praganna Kulo Irrigation Project

(Loan No. HMGN/KFAED/552/PKIP)

Project Completion Report

Project Basic Data

1. Finance	: HMG/N and Kuwait Fund for Arab Economic Development
2. Borrower	: His Majesty's Government of Nepal
3. Executing Agency	: Department of Irrigation
4. Implementing Agency	: Praganna Kulo Irrigation Project
5. Loan No.	: HMGN/KFAED/552/PKIP
6. Loan Amount	: 1,550,000 KD
7. Date of Loan Agreement	: 26 October 1998
8. Date of Loan Expiration	: 15 July 2006
9. Date of Agreement with Multi Disciplinary (P) Ltd, etc.	: 7 April 2000
10. Contract Agreement (PIP 1-4)	: June 2002
11. Approval of Variation Order for Contracts PIP 1-4	: 19 January 2005
12. Completion Date (PIP 1- 4)	: 16 June 2005
13. Agreement with WUA (PIP5)	: 8 January 2002
14. Agreement of Contracts: PIP6	: 16 June 2004
PIP 7 & PIP 8	: 18 June 2004
15. Completion Date: PIP 6	: **14 June 2006 (?)**
PIP 7	: 14 June 2006
PIP 8	: 13 April 2006
16. Agreement with WUA (PIP 9)	: 12 August 2004
17. Agreement of Contract (PIP 13- PIP 19)	: 08 January 2006
18. Completion Date: PIP 13	: 06 July 2006
PIP 14	: 04 July 2006
PIP 15	: 21 June 2006
PIP 16	: 30 June 2006
PIP 17	: 21 June 2006
PIP 18	: 06 July 2006
PIP 19	: 04July 2006

19. Agreement with JV of SILT Consultant (P) Ltd. &
DE Consultancy (P) Ltd : 27 December 2004

20. Project Cost as of July 2006 : NRs. 768,292,780.32
(Initial Estimate Cost of NRs 464.864 million
Revised to NRs. 851,813,000.00)

21. Original List of Goods of KFAED Loan No. 552

SNo.	Items	Allocation of Proceeds (KD)	Percentage of Total Cost of Item	Remarks
1	Civil Works	1,100,000.00	90%	
2	Buildings	20,000.00	60%	
3	Agriculture Extension Services	6,500.00	70%	
4	Administrative Services	10,000.00	40%	
5	Institutional Support	27,000.00	90%	
6	Equipment and Vehicles	80,000.00	100%	
7	Consultancy Services	66,500.00	100%	
8	Contingency	240,000.00		
	Total	1,550,000.00		

22. Revised (7 May 2004) List of Goods of KFAED Loan No. 552

SNo.	Items	Allocation of Proceeds (KD)		Percentage of Total Cost of Item
		As agreed Between Mission and DOI	Latest Proposal	
1	Civil Works and Buildings			
	Old Contracts (PIP 1-PIP 4)	1380.000.00	1,148,700.00	90%
	New Contracts (PIP 6-PIP 8)		231,300.00	32%
2	Administrative Services	6,457.61	6,457.61	40%
3	Institutional Support	10,000.00	10,000.00	100%
4	Equipment and Vehicles	55,000.00	55,000.00	100%
5	Consultancy Services	80,000.00	80,000.00	100%
6	Contingency	18,542.39	18,542.39	
	Total	1,555,000.00	1,555,000.00	

23. Cumulative Project Cost as of 15 July 2006 (NRs) 674,418,726.82

Fiscal Year	Actual Cost (NRs.)
1999/00	2,284,415.60
2000/01	8,952,785.83
2001/02	55,289,375.08
2002/03	254,637,781.35
2003/04	341,114,654.33

	2004/05	529,778,712.46
	2005-06	**674,418,726.82**
	WUA Contribution	93,874,053.50

24. Cumulative Loan Disbursement: As of 15 July 2006

	Fiscal Year	Disbursement (NRs)
	1999/00	
	2000/01	
	2001/02	
	2002/03	
Until	2003/04	219,058,074.77
	2004/05	260,942,773.29
	2005-06	329,467,142.10

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ABBREVIATIONS AND ACRONYMS

AEP	Agriculture Extension Programme
AEP	Agricultural Extension Programme
BM	Barakhuti Main Canal
BMM	Bhanpur-Majhmeria Main Canal
CCA	Culturable Command Rea
CCR	Contract Completion Report
CI	Crop Intensity
CMP	Canal Maintenance Plan
COP	Canal Operation Plan
DOI	Department of Irrigation
Dolai I	HW on Dolai River for Narayanpur Main Canal
Dolai II	HW on Dolai River for Panchgaon Link Canal
EWH	East-West Highway
FFS	Farmers Field School
FMIS	Farmers Manage Irrigation System
HMGN	His Majesty's Government of Nepal
HR/CR	Head Regulator/Cross-Regulator
HW	Headworks
JS	Jurpani Secondary Canal
JT	Junior Technician
JV	Joint Venture
KD	Kuwaiti Dinar
KFAED	Kuwait Fund for Arab Economic Development
KKBS	Kataha-Khurhuriya-Basantpur Secondary Canal
KM	Kalapani Main Canal
LCB	Local Competitive Bidding
MC	Main Canal
MoO	Mode of Operation
msl	Mean Sea Level
NCB	National Competitive Bidding
NM	Narayanpur Main Canal
NRs	Nepalese Rupees
O & M	Operation and Maintenance
PBME	Project Benefit Monitoring and Evaluation
PCR	Project Completion Report
PDS	Pilot Demonstration Site
PKIP/PIP	Praganna Kulo Irrigation Project
PL	Panchgaon Link Canal between Dolai and Singai Concrete HWs
PLP	Project Layout Plan
PM	Panchgaon Main Canal from Singai Concrete HW
POP	Project Operation Plan
RFE	Rapti River Flood Embankment
SC	Secondary Canal
SRI	System of Rice Intensification
SSC	Sub-Secondary Canal
TC	Tertiary Canal
TL	Tikuligadh Link canal Between Dolai Gabion Weir and Singai Gabion Weirs
TM	Tikuligadh Main Canal from Singai Gabion Weir
TOR	Terms of Reference
VDC	Village Development Committee
WC	Watercourse
WMC	Water Users Main Committee
WUA	Water Users Association
WUG	Water Users Group
WUMCC	Water Users Main Coordination Committee
WUO	Water Users' Organization

CHAPTER 1
GENERAL DESCRIPTIONS

1.1 INTRODUCTION

This Project Completion Report (PCR) is prepared in accordance with the contract of the Consultancy services for the construction of the Praganna Kulo Irrigation Project (PKIP) signed on 27 December 2004 between the PKIP and Joint Venture of SILT Consultants (P) Ltd and DE Consultancy (P) Ltd. This report describes the principal features of the project as well as the explanation on the works executed from 7 April 2000 to 15 July 2006, in order to provide useful reference data and information collected in the course of the implementation of the project.

1.2 PROJECT HISTORY

1.2.1 General

Increasing agriculture production to uplift food security and alleviate poverty through the provision of assured irrigation has been the strategy of economic development plan of His Majesty's Government of Nepal (HMGN). The irrigation development has undergone a major policy orientation over the past decades. Demand driven irrigation projects are increasingly being managed by farmers themselves with water user members sharing the cost of construction, maintenance and operation. The irrigation policy 1992 and amended version of 1997 has facilitated the development of farmer managed irrigation system (FMIS), which is recognized as more cost effective, and performance oriented ones than the costly and agency managed irrigation projects.

In conformity with the government strategy, the Department of Irrigation (DOI) conceptualized the rehabilitation and modernization of about 80 years old the farmers managed Praganna Kulo Irrigation systems in Deokhuri valley of Dang district in Western Development Region based on the demands from the farmers of the project area. The DOI got the feasibility study report prepared by a local consultancy firm in 1996 and based on this report started their efforts towards obtaining financial support through any external funding. The DOI eventually obtained a loan assistance of equivalent to One Million Five Hundred Fifty Thousand Kuwaiti Dinars **(1,550,000 KD)** from the Kuwait Fund for Arab Economic Development (KFAED) in accordance with the agreement (Loan No 552) signed on 26 October 1998, its effective period being from 1 January 1999 to 15 July 2006. Thus, the DOI instigated the project named Praganna Kulo Irrigation Project (PKIP) in January 1999 in order to rehabilitate and modernize the farmers managed irrigation systems (FMISs) towards providing assured irrigation in an area of about 5,800 ha.

1.2.2 The FMIS

The canal systems that constitute the Praganna Kulo FMIS for rehabilitation and modernization under the Project fall under the following categories:

Category 1: Barakhutti Main Canal, Bankulo Main Canal, Kalapani Main Canal, and Bhanpur-Majhmeria Main Canal that divert water from the **West Rapti River** along its right bank

Category 2: Narayanpur Canal, Lathwa-Paharwa Canal, and Dodai Canal that draw water directly from **Dolai River**

Category 3: Tikuligadh Canal system and Panchgaon Canal system that draw water from **Dolai cum Singai River.**

Category 4: Sanoghumna Main Canal (SGM) and Thuloghumna Main Canal (TGM) that draw water from **Kaudiya River**, but from different locations.

Category 5: Some Canals like Kolahi Canal and other smaller Channels in the tail end areas of the project, which take off from the local drains that drain irrigation overflows from the upper areas and rainfall runoff. These canals can generally provide supplementary irrigation only in the monsoon season.

Dolai River, Singai River and Kaudiya River are the major natural drains over the project area and form the tributaries of the West Rapti River.

The canal systems under Category 1 have been utilizing water directly from Rapti River by constructing rudimentary side openings along the right bank of the river, temporary diversion bund of the river bed materials and brush-wood, and long approach channel in the river bed from the main watercourse of the river to the respective intakes. The side intakes and part of the main canal often used to get eroded and the channel and temporary bund washed away by the river, resulting in frequent long interruptions of irrigation for rehabilitating these rudimentary infrastructures. The reconstruction of these infrastructures involved a lot of labour and time of farmers at the cost of their farming activities.

The uncontrolled flows of the river more often than not eroded hundreds of hectares of fertile agricultural lands and the canals. For instance, about 2.00 km of Kalapani Main Canal in the head reach and a similar length of Bhanpur–Majhmeria Main Canal system along with about 300 ha of agricultural lands were eroded. Furthermore, the in-rush of uncontrolled flows of the river eroded away the head-reach of the Pipri Secondary canal into Kalapani Main Canal (KMC) and enlarged whole of this in the form of a small Khola, which is called Sano Nadi. Similarly, other canals have also been eroded, deepened and enlarged.

The canal systems under the other categories likewise diverted water from the respective rivers and local drains through rudimentary open side intakes and temporary diversion bunds of the riverbed materials and brushwood, resulting in similar consequences and burden to the farmers.

The distribution of flows from the entire canals was also carried out by constructing temporary diversion of bed material and brushwood, which often resulted into breach of canal banks through overflow and consequent erosion of bed and banks around the diversion works.

The rehabilitation of these infrastructures on the canals and temporary infrastructures and protection of their agricultural lands, villages from floods also required huge capital involvement of the farmers in terms of cash and kind for the rehabilitation of their canals

1.2.3 The Project: Rehabilitation and Modernizations of the FMIS

The PKIP instigated the Project activities through the loan assistance of KFAED, fund from His Majesty's Government of Nepal (HMGN), and contribution of the beneficiaries in cash and kind equivalent to 15% of the total construction cost, in January 1999. However, the detailed design of the project was started only in April 2000 following the employment of the consortium of Multi Disciplinary Consultants (P) Ltd., GEOCE Consultants (P) Ltd., and Development Pioneer Consultancy Services based on agreement signed on 7 April 2000 for providing consultancy services. The tasks of the consultancy services were to assist with: (I) Detailed engineering works, (ii) Advisory services during construction period, (iii) Preparation of operation and maintenance plan, and (iv) Training for farmers.

The Consultants started the planning and design work of the project facilities together with detailed surveys and investigations on topography and soils from April 2000. They identified and planned all the works in close consultation with the WUA; and thus, they agreed to integrate Barakhuti canal and Bankulo canal of Category 1 into one system, supplied through one intake at the Rapti River. Therefore, there are now only three main intakes along the right bank of this river in order to supply water into the three primary canal systems under this category, which are as follows:

1. **Barakhuti Main Canal (BM)**
2. **Kalapani Main Canal (KM)**
3. **Bhanpur-Majhmeria Main Canal (BMM)**

The Consultants accordingly planned and designed the improvement of the FMIS and prepared an initial estimate of project cost to be **NRs 464.864 millions.** According to this design and estimate, the entire project works were divided into five packages (PIP-1 to PIP-5). The works under four packages were awarded to four "A" Class contractors in June 2002. The works under PIP-5 were assigned to the WUA for their contribution in accordance with the agreement signed between them and the Project on 8 January 2002.

However, as chance would have it, the agreement of the consortium of Multi Disciplinary Consultants (P) Ltd., GEOCE Consultants (P) Ltd., and Development Pioneer Consultancy Services was terminated in December 2004, before the completion of the works according to these packages.

Therefore, PKIP, Department of Irrigation (DOI) employed the joint venture (JV) of *SILT consultants (P) Ltd. (the lead firm) and DE Consultancy (P) Ltd.* as the Project Consultants to provide Consultancy Services for the further works of the Project in accordance with an agreement signed between the PKIP/DOI and the JV on 27 December 2004. The Consultants started their service from January 2005.

Over the course of implementation of the rehabilitation works, the situation in the Project was constantly assessed by the Project officials, Consultants and the Water Users Association through frequent visits to different parts of the area. The concerned WUA showed intense resentment over the adequacy of the proposed works. They raised concern on the fact that 17 villages in Sano Ghumna Canal System, 6 villages in Tikuligadh Canal System, 4 villages in Kataha-Basantpur Canal System, and 6 villages in Bhanpur-Majhmeria Canal System would be deprived of irrigation water, if essential structures were not constructed. Considering the concerns of the WUA, the Project, in collaboration with the farmers, identified a long list of 450 structures, extension of Narayanpur canal (12.900 kms) and construction of Jurpani canal (6.000 kms) to cover about 640 ha of agricultural land, and extension of Rapti River Flood embankment for about 4.5 km. However, in view of the constraint of resources, the Project in consultation with the WUA selected only 299 essential structures. Because of such additional scope of the works and also certain price escalation, **the Project cost was revised to NRs 859.63 million.**

The works according to such increased scope were grouped into four new packages (**PIP-6 to PIP-9**). The works under the first three packages, namely PIP 6 – PIP 8 were contracted out to three Class "A" national contractors in June 2004 through Local Competitive Bidding (LCB) procedures, and those under the fourth **(PIP-9),** for earthwork in canal rehabilitation and new construction, were assigned to WUA for their contribution in accordance with the agreement signed on 12 August 2004. The extended dates of completion of the works under package are 13 April 2006 for PIP-8 and 14 June 2006 for PIP-6 and PIP-7.

It was further observed that although the Project constructed 9+856 km long Flood Embankment and 14 number of spurs near Raniyapur village along right bank of Rapti River in order to protect the irrigation systems and hundreds of hectares of agricultural lands of the command area, the river still showed the tendency to shift towards the right bank in other areas. In these areas the river already eroded part of some distributaries, and further hundreds of hectares of agricultural lands and several

villages were in vulnerable conditions. The conditions in the few isolated parts of this zone were critical and needed immediate remedial measures. *Therefore, appropriate additional river training and command area protection works were felt necessary in these zones.*

Apart from this, the topography of the project area is undulating with steep slopes and mounds resulting in several local drainages to drain out rainfall runoff and irrigation overflows via main drains eventually into Rapti River. Also, appropriate tail escapes to control any retrogression at the outfall of the canal are lacking. As a consequence, a lot of command area is being eroded due to gully formation through retrogression along the drainage line and irrigation overflows at the end of canals.

Therefore, appropriate tail escape structures and erosion control measures along the drains were felt necessary to prevent the deterioration of the command area.

As regards the irrigation infrastructures, it was observed that those already constructed and planned to be constructed were not adequate for operating the canals for appropriate water management; several more are required for this. Certain canals lack in some even such structures that are required for their basic safe operation. Although attempts were being made to construct such additional structures that could be managed to the extent possible through the current contracts, but not all of them could be fulfilled within the limitations of the contracts.

Considering the aforementioned needs and the constraints of the Project, the minimum essential works were decided in consultation with the Water Users Main Coordination Committee (WUMCC) and the Main Committees of different areas of the project. The evaluation of the selected works and the budgetary situation of the Project suggested that those works could be completed within the revised estimated cost of the project, which is **N/Rs 859.53 million,** through savings as a result of the biddings for the earlier contracts. For implementation of the works, keeping in view the available short period of the Project (maximum until the end of this FY 2005-06 and scattered works over the project area, the strategies were based on the following considerations:

- Minimizing of the time for the bidding process,
- Expediting the implementation of works simultaneously over the whole Project area by employing small contractors of Class B/C, and
- Creating condition for competition among the contractors to facilitate handling of the works with proper quality.

In order to achieve the strategy within the available time for the Project, the whole works were divided into **7 Packages** (**PIP-13 – PIP-19**) of less than N/Rs 10 millions, in order to minimize especially the bidding process and facilitate handling of construction works, as well as provide opportunities for the local contractors to participate in the construction of the project, which they had been complaining about. The works according to these packages were awarded to seven "B" Class contractors through LCB in accordance with the agreements signed on 8 January 2006.

Thus, the whole works under the project have been accomplished through sixteen contracts. The construction of all the rehabilitation and modernization works of the Project started in June 2002, and was substantially completed in time or in advance of the intended completion date, until 09 July 2006.

1.2.4 Climate

The Project area has a subtropical warm temperate climate, with average minimum temperature of 30^0 in January and maximum temperature of 43.2^0 in May. In June, the monsoon rain starts and the temperature drops to around 30^0. Percentage of Sunshine is around 80% for about 8 months of the year except during monsoon when it is below 50%. Mean annual evapo-transpiration is about 6.00 mm with a maximum of 9.4 mm/day in May and a minimum of 1.9 mm/day in January. The average rainfall is 1647 mm, of which more than 80% occurs during four months from July to September. The rainfall in dry season occurs as occasional showers and in insufficient quantities for good crop yields.

1.2.5 Water Resources

The PKIP is the amalgam of a number of FMISs utilizing water from West Rapti River, Dolai River and Singai River, Kaudiya Khola and even local drains. West Rapti is one of the major river basins of Nepal and originates from Mahabharat range. Dolai River and Singai River are the locally originated tributaries of West Rapti River and run across the project command area and also work as main drains for the command area. Most of the command area is supplied from West Rapti River and the other portions draw water from other Kholas and drains. The discharges in these Kholas are supplemented by the outflows from the canals supplied by West Rapti River and their command areas.

The main source of water in West Rapti River is monsoon runoff and ground water resources. The catchment area of this river at Bhalubang Bridge (East-West Highway) is 3903.73 square kilometers. Bagasoti Station No 350, a discharge recording station, is located about 5.00 km upstream of the Balubang Bridge. Hydrological analysis for low and high flows for infrastructure design has been estimated by using long-term data of Bagasoti Station with the help of frequency analysis. 80% reliable flows at the site of PKIP are presented below in **Table 1**.

Table-1: 80% Reliable Monthly Flows (m3/sec)

Flows	Jan	Feb	Mar	April	May	June	Jul	August	Sept	Oct	Nov	Dec
80% reliable	26.56	21.50	17.31	12.94	10.94	14.44	69.37	180.45	173.29	75.80	42.06	9.76

The flood discharge of West Rapti River has also been estimated at the project area for different return periods for the design of irrigation infrastructure. The estimation of the discharge has been done using the various probability distribution principles. The estimated flood discharges for 10 years, 25 years, 50 years and 100 years are 1768 m^3/sec, 2212 m^3/sec, 2550 m^3/sec. and 2885 m^3/sec respectively (see Assignment Completion Report of Multi Consultants (P) Ltd, GEOCE Consultants (P) Ltd and Development Pioneer Consultancy Services, November 2004). These flood data have been used for the design of Rapti Flood Embankment (RFE) and structures along the right bank of the West Rapti River.

1.2.6 Soils

The project area is a part of Deokhuri valley, representing the ancient flood plain of Rapti River, which includes clay, silty clay and sand. In the northern foothill, yellow, red and brownish clay are predominant whereas in the southern part there is predominant incidence of sand and silt, the dominant soil texture being silty loam. The well-drained command area with soils of greater permeability and average depth of not less than one meter is quite suitable for irrigated diversified arable crops.

1.3 OUTLINE OF THE PROJECT WORKS

1.3.1 Objectives of the Project

The immediate objective of the Project is to rehabilitate and modernize the Praganna Kulo FMIS so as to minimize the problems that the farmers of the Project area have been facing in diverting water from the Rapti River and supplying it to their fields as well as protecting the Project area from river attacks. The ultimate objective consists in improving the income and living standard of the farmers of the Project area by ensuring reliable irrigation with adequate quantity of water on sustainable basis for increased production of crops through improved irrigated agriculture and employing diversified cropping. This aim will contribute towards the Government's goal of enhancing the socio-economic

status of the small farmers, reducing poverty, and generating employment opportunity in the rural areas

In order to achieve such objectives, the Project has implemented the rehabilitation and modernizations of the FMIS mainly to:

- Provide regulated supply from the Rapti River and its tributaries- Dolai River and Singai River, into the respective systems;
- Protect the canals, agricultural lands and the villages from the floods in the Rapti River and its tributaries that flow across the command area;
- Rehabilitate and strengthen the canals in order to provide uninterrupted irrigation;
- Improve village road networks by providing necessary bridges and culverts for the farmers to have round the year transportation facilities for agricultural and other purposes;
- Construct Agricultural facilities;
- Construct operation buildings;
- Construct sanitary facilities for the poor farmers in the project area; and
- Implement Agriculture Extension Services and Farmers' Training

1.3.2 Components of the Project

According to the Loan Agreement (HMG/KFAED/552) signed between the HMGN and KFAED on 16 October 1998, the Project consists of the following components:

(1) Acquisition of land necessary for the implementation of the Project.

(2) Civil Works: include the construction of main intakes on the Rapti River, river training works and the construction of necessary culverts for road networks, water-regulation cross-drainage structures, and rehabilitation of about 150 km of existing irrigation canals.

(3) Buildings: include the construction of two office buildings for the operation of the Headworks, three grain storage facilities and construction and rehabilitation of the Implementation Unit offices, in addition to the construction of about 250 pit latrines for the beneficiaries.

(4) Agriculture Extension Services: The provision of the necessary training and transportation facilities for the extension services personnel.

(5) Administrative Services for the management and supervision of the Project implementation.

(6) Institutional Support: includes training for the department technical personnel, and provision of the necessary equipment.

(7) Equipment: Procurement of necessary equipment and vehicles for Implementation Unit and the research station.

(8) Consultancy Services for the detailed survey, detailed design, preparation of tender documents, advisory services for Implementation Unit during the construction, and preparation of Project Operation and Maintenance Manuals and farmers training for operation and maintenance of the project.

1.3.3 Outline of the Major Works

The construction of all the works under civil works and buildings have been executed through contracts awarded through Local Contract Bidding (LCB) procedures and contribution of WUA. The equipment and vehicles have been procured by the Implementation Unit of the Project through different arrangement in accordance with the financial rules and regulation of the HMGN. As for the Institutional Support activities, since the Government Policy does not allow loan money to be spent on training for the Government officials abroad, this has not been implemented. The Agricultural Extension activities have been implemented through the Consultancy Services.

Civil Woks include the construction of main intakes along the right bank of Rapti River, river training works, construction of necessary culverts for road networks in the project area, irrigation and cross-drainage structures, rehabilitation of existing canals, and construction of new canals. As described in section 1.2.3, all the civil works including buildings and Pit latrines construction have been divided into 16 packages. The works under packages PIP1- PIP 4 and PIP 6- PIP 8 have been awarded to the Class "A" national contractors and that under PIP 13 – PIP 19 have been awarded to Class "B" contractors through LCB procedures. The works under packages PIP 5 and PIP 9 have been assigned to the WUA in accordance with two separate agreements executed between the Project and the WUMCC on 8 January 2002 and 12 August 2004 respectively.

The summary of the major works executed under different packages is given in **Table 2.**

Table-2: Summary of Works Executed under Different Contracts

Contract/Package Nr.	Description of Works	Cost (NRs) Without VAT
HMG/KFAED/552/PIP-1	Construction of Intake # 1 and Intake # 2 at the right bank of the West Rapti River and construction of irrigation infrastructure including Rapti River Flood Embankment from 0.00 km to 1.321 km and Pit Latrines for Poor Farmers over the Project are	71,940,920.44
HMG/KFAED/552/PIP-2	Construction and improvement of irrigation infrastructure including construction of Kalapani Praganna main Canal, Rapti River Flood Embankment from 1.321 km to 2.997 km, and Pit Latrines for Poor Farmers over the Project Area	75,032,955.97
HMG/KFAED/552/PIP-3	Construction and improvement of irrigation infrastructure including Rapti River Flood Embankment from 2.997 km to 5.439km, construction of Intake # 3 at the right bank of the Rapti River, and Pit latrines for Poor Farmers over the Project Area.	86,267,648.81
HMG/KFAED/552/PIP-4	Construction and improvement of irrigation infrastructure including two diversion weirs over Dolai River, two heavy bridges, two operation buildings for Intake # 2 and Intake # 3, and Pit latrines for Poor Farmers over the Project Area.	65,086,291.08
HMG/KFAED/552/PIP-6	Construction of Irrigation Infrastructures in different parts of the Project and 2.20 km of Rapti River Flood Embankment from 5.439 km to 7.639 km.	**63,588,553.00 (?)**
HMG/KFAED/552/PIP-7	Construction of Irrigation Infrastructures in different parts of the Project and about 2.22 km of Rapti River Flood Embankment from 7.639 km to 9.856 km.	54,232,935.58
HMG/KFAED/552/PIP-8	Construction of Irrigation Infrastructures in different parts of the Project .	62,509,378.65
HMG/KFAED/552/PIP-5 & 9	**WUA Contribution part**	93,874,053.50
HMG/KFAED/552/PIP-13	Construction of Irrigation infrastructure over Barahkhutti,Jurpani,Masuriys canal systems and Command area protection work	9,018,033.79
HMG/KFAED/552/PIP-14	Construction of Irrigation infrastructure over Kalapani canal system and command area protection work	8,841,495.94
HMG/KFAED/552/PIP-15	Construction of Irrigation infrastructure over Narayanpur canal system and command area protection work	8,608,350.17
HMG/KFAED/552/PIP-16	Construction of Irrigation infrastructure over Basantapur canal system and command area protection work	8,489,515.12

Contract/Package Nr.	Description of Works	Cost (NRs) Without VAT
HMG/KFAED/552/PIP-17	Construction of Irrigation infrastructure over Jogiya Praganna canal system and command area protection work	8,718,983.65
HMG/KFAED/552/PIP-18	Rapti river embankment work, Pachaha Bagar Canal embankment work, Dulari Kulo embankment work and command area protection work (2327m)	8,597,876.00
HMG/KFAED/552/PIP-19	Construction of irrigation infrastructure over Bhanpur Majmeriya canal system and command area protection work along Rapti River opposite Balrampur Box Culvert over Lamahi-Koilabas Road	8,194,460.20

CHAPTER 2
DESIGN OF THE WORKS

2.1 GENERAL

The farmers' managed Praganna Kulo Irrigation system, herein referred to as FMIS consists of several independent farmers' managed canal systems. These systems divert water directly either from West Rapti River or other tributaries of this. These tributaries such as Dolai River, Singai River, and Kaudiya Khola run across the project command area and also work as main drains in the command area. The basic needs of rehabilitation and improvement of the FMIS consist in:

- Protection of the systems that draw water directly from Rapti River and the command area from the attack of flood in this;
- Prevention of erosion of command area from the irrigation outflows and rainfall runoff;
- Provision of regulator intakes along Rapti River and its tributaries in order to supply water in the respective canal systems;
- Interlinking of Rapti River canal systems and tributary Kholas in order to supplement discharge in these Kholas;
- Construction of flow regulator, division structures, etc along the existing canal systems in order to facilitate regulation and distribution of flows in the canals;
- Improvement of village road networks with provision of adequate number of bridges and culverts in order to facilitate internal transportation activities which will enhance the mobility of agriculture activities including transportation of agricultural production from farm to local markets via East-West Highway;
- Construction of Grain Stores for the storage of agricultural produce;
- Construction of operation buildings; and
- Construction of pit latrine for poor farmers to improve sanitation.

Taking into consideration these needs of rehabilitation and improvement of the FMIS, the planning and design work of the project facilities together with detailed surveys and investigations on topography and soils was carried out from April 2000. The planning and design of the infrastructure includes as given hereunder.

2.2 DESIGN FEATURES OF PROJECT INFRASTRUCTURE

2.2.1 Flood Embankment and Command Area Protection Works

In order to protect the canal systems and the project command area from the attack of flood in Rapti River, 9.856 km long Rapti River Flood Embankment (RFE) with gabion slope protection and revetment with launching apron and 593 number of gabion studs has been provided on the right bank of the river. At other eight (8) vulnerable locations along the same bank of Rapti River, in all 46 number of spurs into eight groups have been provided. At seven (7) of those locations, Thirty–four (34) spurs are sloping spurs specially designed in order to induce silt deposition at critical locations along the riverbanks, rather than deflection of flows. This is considered to strengthen this bank at those locations and minimize adverse effect of spurs on the other bank of the river.

The design of RFE is based on the flood discharged for 50 year and 100 year return periods. The embankment from 0.00 km to 0.572 km, where the Intake # 1 for Barakhutti Main Canal (BM) and Intake #2 for Kalapani Main Canal (KM) are located, and its revetment with launching apron have been designed for 100 year return flood and those from 0.572 km to 9+856 km have been designed for 50 year return flood (Refer Annex A of Assignment Completion Report of Multi Consultants (P) Ltd, GEOCE Consultants (P) Ltd and Development Pioneer Consultancy Services, November 2004).

In order to prevent the erosion of command area as a result of irrigation overflows and rainfall runoff through steep gullies formed in the past due to these flows, series of gabion check bars and/or cascade drops have been planned wherever the soil erosion is noticeable.

2.2.2 Intakes/HWs on the Rapti River and Its Tributaries

For regulated supply from the source in the canal systems, intakes and appropriate HWs have been planned as follows:

(1) Intakes along Rapti River.

Three intakes, namely Intake No. 1 at 0+00 km for Barakhutti Main Canal (BM) Systems (550 ha), Intake No. 2 at 0+531 km for Kalapani Main Canal (KM) System (3698 ha), and Intake No. 3 at 5+304 km for Bhanpur-Majhmeria Main Canal (BMM) System (950 ha), have been provided along RFE.

The intake #1 is designed to supply maximum of 3300 l/sec at water level of 297.39 m in the river, the estimated High Flood Level (HFL) at this point of the river being 299.29 m. The Intake # 2 is intended to supply maximum of 22,000 l/sec in the KM. This intake is designed such that it can supply 44,000 l/sec when water level in the river is 295.57 m and all the four gates are opened; which can supply 22,000 l/s when water level in the river is at 294.52 m and only three gates are opened. The estimated High Flood Level (HFL) at this point of the river is 298.58 m. The Intake # 3 is intended to supply maximum of 4750 l/sec in the BMM. This intake is designed such that it can supply 10,000 l/sec when water level in the river is 280.28 m and 4750 l/s when water level in the river is at 279.26 m, the estimated High Flood Level (HFL) at this point of the river being 282.28 m. (Refer Volume II A of Final Report prepared by Multi Consultants (P) Ltd, GEOCE Consultants (P) Ltd and Development Pioneer Consultancy Services, March 2001).

Considering the design data for the design of the RFE and the Intakes along it and the ground situations of the rivers, it appears that the whole situation of the river and the construction of RFE should be verified to check the adequacy of this in order to cope with the design discharge (50 year return flood of 2550 m^3/sec). According to the design, the riverbed level opposite Intake # 3 is 278.00 m and estimated HFL is 282.28 m, and the invert level of the intake is 277.00 m, whereas the observed riverbed levels across this location are as 279.080 m, 282.410 m and 280.805 m (Review of Performance of Intake # 3, 31, L. K. Jha, March 2005). The positive difference in the riverbed levels by up to over 2.00 m is indeed alarming and attracts immediate attention.

(2) HW along Dolai River and, Singai River

(a) Supply directly from Dolai River (Category 2 of Section 1.2.2). Three canal systems, namely Narayanpur Canal, Lathwa-Paharwa canal (540 ha), and Dodai Canal (60 ha) are planned for supply directly from Dolai River. In order to divert water into Narayanpur Main canal (NM), a concrete HW (**Dolai I**) with intake on the right bank has been designed in the north of East-West Highway (EWH). Lathwa-Paharwa canal has an open side intake on the right bank downstream from this HW. For Tikuligadh Main Canal (TGM) and Dodai Main Canal (DM) intakes on the right bank, a gabion weir has been designed in the south of EWH. A second concrete HW (**Dolai II**) downstream from this crated weir has been designed to supply water into Panchgaon Canal system.

(b) Supply from Dolai cum Singai River (Category 3 of Section 1.2.2). Tikuligadh Link Canal from the gabion weir over Dolai River terminates into Singai River to augment discharge in this. In order to supply into the Tikuligadh Main Canal (TM) over the Singai River, a gabion weir has been designed across this Khola.

Similarly, the Panchgaon Link Canal from Dolai II HW terminates into Singai River over which a concrete HW has been designed to supply into the Panchgaon Main Canal (PM) system on the right bank of this Khola. The Panchgaon canal portion between these Khola is termed Panchgaon Link canal (PL).

Thus, the interlinking of these Kholas and termination of outflows from the main canal systems from the three intakes along RFE make all the canals over the project area interconnected to form one PKIP system.

(3) HW over Kaudiya Khola

At Bankatti village in the south of EWH, a concrete HW has been designed to divert water on its right bank into Sanoghumna Main Canal (SGM). Thuloghumna Main Canal (TGM) diverts water from this very Khola via a ramshackle masonry HW constructed by Care Nepal sometime in the past further downstream near its outfall in Rapti River.

2.2.3 Irrigation Canals and Structures

The Kalapani Main Canal from its intake to 2+545 km, Kataha-Khurhuria-Basantpur Secondary Canal (KKBS) from 0+00 to 0+395 km, 554 m of Basantpur canal in embankment, and 0+00 to 1+830Kmof Bhanpur-Majhmeria Main Canal have been constructed by the project. The Jurpani SC (JS) with a length of 6+000 kms, and the extension of Narayanpur Main Canal (NM) to 12+900 km have been constructed by the farmers as part of their contribution. The others are the existing canals. All the canals over the project have been provided with adequate number of regulating, distribution, conveyance, and protection and service structures. The structures include intakes, HR/CRs, aqueducts, flow dividers, drops, bridges, culverts, unit outlets, lining and retaining walls as protection structures, etc. These structures were designed in accordance with standard engineering principles and practices in order to ensure regular and uninterrupted supply in the canals and proportional division of flows between them.

However, in the construction stage, the project officials often injudiciously changed the hydraulically characteristic dimensions and levels of the structures, especially the width of opening and level of diversion structures, to the detriment of proportionality of flow division and economy of construction by acceding to the vehement demands of the WUAs based on their traditional water shares and methods of diverting the flows into their respective canals from their parent canals. The farmers' traditional practice of water division corresponds to the measurement unit of "Lathi", which was often based on the labour inputs by the farmers of different areas rather than on irrigable area. The results of such appeasement to the farmers are disappointing and the understatement of the Project: Rehabilitation and Modernization of the Praganna Kulo FMIS.

Such situation has been created mainly because of the fact that the farmers presuppose their traditional water distribution practices and methods of diverting their shares from and into channels that have been eroded and enlarged by uncontrolled flows over years. This is presumably because of the fact that the farmers of the project area were not fully oriented about the characteristics and importance and benefits of a structured system before undertaking the planning and design of rehabilitation and modernization of the FMIS. As a consequence, the whole project system has become hydraulically unpredictable and remains a case to be handled by the farmers' traditional method of operation and water distribution using brushwood/earth obstructions, in absence of gates.

2.2.4 Improvement of Village Road Networks

Adequate bridges and culverts and structure for crossing over different drains and Khola have been provisioned on the village road networks in the project area in order to enhance internal mobility for the agricultural purposes and transportation from agricultural farm to EWH and local markets. All these improvements on the Village Road Networks are in reality beyond the capacity of the farmers

2.2.5 Grain Stores

In order to provide storage facility for the farmers of the project area to store surplus agricultural produce, three Grain Stores have been provisioned each at Majhgaon, Pipri and Sonpur villages.

2.2.6 Operation Buildings

In order to provide shelter for the gate operators for the three intakes along RFE, one operation building to serve for both Main Intake # 1 and Intake # 2 has been provided at the location of the latter and the second to serve for Intake # 3 has been provided near this.

2.2.7 Pit Latrines for Poor Farmers

In order to improve the sanitary habits of the poor farmers in the project area, 200 number of pit latrines spread over the whole project area have been provided at the locations selected in close consultation with WUA.

CHAPTER 3
CONSTRUCTION OF CIVIL WORKS

3.1 TENDERING AND CONTRACT AWARD

As described in section 1.2.3 above, the whole civil works under the project have been divided into 16 packages. The works under 14 packages (PIP-1 to PIP-4, PIP-6 to PIP-8, and PIP-13 to PIP-19), have been carried out by the local contractors employed through LCB procedures based on post-qualification evaluation of the tenderers and those under packages PIP-5 and PIP-9 have been carried out by the WUA. The contract procedures incorporate the following:

- Publication of Tender Notice by the Project
- Pre-bid Meeting with the Interested Tenderers
- Receipt and Opening of Tenders on the same Day
- Evaluation of Tenderers' Qualification and their Bids
- Approval of Tender Evaluation by Competent DOI/Project Authority
- Issuance of Notification to Tenderer whose Tender is approved
- Performance Bond by the Contractor
- Contract Negotiation, if required
- Signing of the Contract
- Issuance of Notice to Proceed to the Contractor
- Mandatory Date of Commencement
- Completion Date of the Contract

The construction work was actually commenced towards the end of June 2002 immediately following the execution of contract agreement for the Packages PIP-1 to PIP-4 between 12 June 2002 and 14 June 2002. All the works under these contracts, including construction of RFE for about 5.50 km, three main intakes along this, Kalapani Main Canal with trapezoidal reinforced concrete lining up to 2+275 km and structures along this, two concrete HWs on Dolai River and Singai River each, bridges and culverts on the village road network, irrigation structures on the BM, KM and BMM canal systems including four major HR/CRs on KM Canal, three Grain Stores, two operation buildings, and 200 pit latrines, were completed until 16 June 2005, the intended completion date of the contracts.

The works under the packages PIP-6 through PIP-8 including the other about 4.5 km of RFE were started towards the end of June 2004 following the execution of their agreement on 16 June 2004 and 18 June 2004. The works under contract HMG/KFAED/552/PIP-8 and contract HMG/KFAED/552/PIP-7 were substantially completed according to their scheduled completion until 13 April 2006 and 14 June 2006 respectively, while the contractors of contract HMG/KFAED/552/PIP-6 have failed to complete their works until their finally amended completion date of 14 June 2006.

The other works related especially with command area protection and construction of essential structures along the newly constructed Narayanpur Main Canal extension for 12.90 km and Jurpani Secondary Canal for 6.00 km and some other canals under packages from PIP-13 to PIP-19, were commenced in the second half of January 2006 after the execution of their contract agreement on 8 January 2006 and completed until 06 July 2006.

The Contract Completion Reports (CCRs) including the list of structures constructed by the respective contractors and their Final Payment Claims are given in **Annex- A** and the summary of all the contracts is given in **Table 3.1**.

Table 3.1: Summary of Contract Prices

Package/Contract Nr.	Name of Contractors	Agreement with Variation		Completion	
		Amount (NRs without VAT)	Date	Amount (NRs without VAT)	Date
HMG/KFAED/552/PIP-1	M/s Tamang/Lama Builders/Golden Good JV	74,424,753.23	13-Jun-02	71,940,920.44	16-Jun-05
HMG/KFAED/552/PIP-2	M/s Surya & Sons/D. S. JV	78,527,034.56	14-Jun-02	75,032,955.97	16-Jun-05
HMG/KFAED/552/PIP-3	M/s Super Sherpa/ Prakash/ Lumbini JV	92,643,055.35	13-Jun-02	86,267,648.81	16-Jun-05
HMG/KFAED/552/PIP-4	M/s Ashish Nirman Sewa (P) Ltd	65,621,838.02	12-Jun-02	65,086,291.08	16-Jun-05
HMG/KFAED/552/PIP-6	M/s Swachchanda-Himal hydro-Santoshi JV	66,354,480.36	16-Jun-04	(?)	(?)
HMG/KFAED/552/PIP-7	M/s ASHISH - SURYA - D. S. (JV)	55,684,733.37	18-Jun-04	54232935.58	14-Jun-06
HMG/KFAED/552/PIP-8	M/s The Kanchanjanga-Lama Builders-Nepal Adarsha JV	60,788,561.49	16-Jun-04	62,509,378.65	13-Apr-06
HMG/KFAED/552/PIP-5 & 9	WUA Part		8 Jan 2002 12-Aug-04	93,874,053.50	July 2006
HMG/KFAED/552/PIP-13	M/s Keshav Shah/M. S. Construction JV	8,603,660.64	8-Jan-06	9,018,033.79	06 July 2006
HMG/KFAED/552/PIP-14	M/s Diwa Nirman/Vhola Nirman/Suraj Nirman JV	8,510,808.60	8-Jan-06	8,841,495.94	01 July 2006
HMG/KFAED/552/PIP-15	M/s Dev & Sayar/Aashu/Pushpanjali JV	8,077,287.45	8-Jan-06	8,608,350,17	21-June-06
HMG/KFAED/552/PIP-16	M/s Cm/Vishal & Birat/Sheram JV	8,491,659.40	8-Jan-06	8489515.12	30 June 2006
HMG/KFAED/552/PIP-17	M/s Gajurmukhi/ Juddha & Purna JV	8,365,079.67	8-Jan-06	8,718,983.65	21-June-06
HMG/KFAED/552/PIP-18	M/s Raymajhi, Sherpa T/Ambey Construction JV	8,602,340.25	8-Jan-06	8,597,876.00	06 July 2006
HMG/KFAED/552/PIP-19	M/s Gajurmukhi/ Roshan JV	7,920,996.25	8-Jan-06	8,194,460.20	04 July 2006

All the contractors were granted extension of completion period because of the delay caused by the circumstances beyond their control. The delay was caused mainly due to the continual longer strikes (amounting up to 75 days in one stretch interspersed with frequent shorter ones) and restrictions on vehicle movement and working over these periods that were imposed by the Maoists, hampered the progress of construction work. One interim extension to the contractors of package PIP-1 through PIP-4 up to 15 April 2005 was granted also due to the variation in their scope of work in accordance with the variation order approved on 19 January 2005.

3.2 CONSTRUCTION OF WORKS

The major structures constructed by the Project include three different flow regulator Intakes along the right bank of the Rapti River- Intake #1 for Barakhuti Main Canal (at 0+00 km), Intake #2 for Kalapani Praganna Main Canal (at 0+531 km), and Intake # 3 for Bhanpur-Majhmeria Main Canal (at 5+304 km) respectively. Among the other major structures are six (6) concrete HR/CRs at 2.994 km (Thulo Pani Batuwa), 3.705 km, 6.318 km, 11.063 km, 12.037 km and 14.353 km of Kalapani Main Canal (KM), in order to facilitate diversion of water from this into Maurighat SC, Jogiya SC, Masuriya SC, Pipri SC, Bhanpur II SC, Pipri II SC, Kalapani-Sisaniya SC, Rauniyapur-Sonpur SC, and Pathargadha SC, which are the major SCs, of the project area. The KM terminates into Dolai River.

Furthermore, two concrete HWs have been constructed each on Dolai River and Singai River; a Gabion weir on Dolai River and another on Singai River; and a concrete HW on Kaudiya Khola have been constructed.

In addition to these structures, hundreds of other structures related with canal/irrigation, road crossings over canals, protection of canals, Village Road Networks improvement, etc have been constructed.

For protection from Rapti River floods, 9.856 km long embankment with gabion slope protection and revetment with launching apron and 593 number of gabion studs, and 46 number of spurs including 34 sloping spurs into groups at other isolated locations along the right bank of the river have been constructed.

Also, three (3) Grain Stores, two (2) Operation Buildings and 200 Pit Latrines at different villages over the project area have been constructed

List of structures and other constructed works are given by canal systems in **Annex- B.**

3.2.1 Flood Embankment and Command Area Protection Work

In order to protect the canal systems and the project command area from the attack of flood in Rapti River, 9+856 km long Rapti River Flood Embankment (RFE) with gabion slope protection and revetment with launching apron and 593 number of gabion studs has been provided on the right bank of the river. At other eight (8) isolated vulnerable locations along the same bank of Rapti River, construction of 46 spurs including 34 sloping spurs in order to induce silt deposition along the riverbanks at the critical locations, rather than deflection of flows has been accomplished. This is considered to strengthen this bank at those locations and minimize adverse effects of spurs on the other bank of the river.

3.2.2 Intakes/HWs on the Rapti River and Its Tributaries

Three different flow regulator main intakes, namely Intake #1 for Barakhuti Main Canal (at 0+00 km), Intake #2 for Kalapani Praganna Main Canal (at 0+531 km), and Intake # 3 for Bhanpur-Majhmeria Main Canal (at 5+304 km) have been constructed along the right bank of the Rapti River.

A concrete HW (Dolai I) has been constructed on Dolai River to divert water in Narayanpur Main Canal. In order to augment the flow in Singai River so as to supply adequate water in the Panchgaon Main Canal (PM) two concrete HWs have been constructed each on Dolai River and Singai River that are linked by a canal, now named as Panchgaon Link Canal (PL).

Furthermore, a Gabion weir on Dolai River and another on Singai River have been constructed to divert supply into Tikuligadh Main Canal and Dodai Main Canal. In this case, the two Kholas are linked by Tikuligadh Link Canal and the Tikuligadh Main Canal diverts water from Singai Weir, whereas Dodai Main Canal diverts water directly from Dolai River Gabion Weir. Similarly, a concrete HW has been constructed on Kaudiya Khola to divert water in Sanoghumna Main Canal (SGM). These diversion

structures over the respective tributaries of the Rapti River have made all the canals over the project area interlinked and interdependent, as parts of the same system.

The Schematic Diagram of the project canal systems is given in **Annex- C**.

3.2.3 Irrigation Canal and Structures

Only part of two new canals, namely Kalapani Main Canal from its intake to 2+275 km and 0+00 to 0+395 km of Kataha-Khurhuria-Basantpur Secondary Canal (KKBS) and 554 m of Basantpur canal in embankment has been constructed by the project; the Jurpani SC (JS) with a length of 6+000 kms and extension of Narayanpur Main Canal (NM) from 4+00 to 12+900 kms have been constructed by the farmers under their contribution; and the other canals are the parts of the old FMIS. All the canals over the project have been provided with adequate number of regulating, distribution, conveyance, and protection and service structures. The structures include intakes, HR/CRs, aqueducts, flow dividers, etc. Certain important observations regarding the construction of canals and structures and their operation and impact are briefly described as follows:

- The Narayanpur Main Canal is aligned through a difficult terrain at the foothill, and therefore, has been excavated in deep cutting. Although major structures have been constructed, one escape upstream of the Singai River aqueduct and RCC Rectangular canal in embankment for about 100 m approaching to this aqueduct are felt essential. The farmers excavated the canal to a large extent. However, the canal excavation has not been carried out to proper level and in proper cross-section, for which a lot of work is yet to be done. As a result, the canal is not in a position to be commissioned immediately.

  By virtue of its alignment, this canal cuts across natural drainage lines and hence crosses several drainages. Although some cross drainage and drainage inlet structures have been provided at the obvious locations, some more unforeseen drainage problems cannot be ruled out in future. Transportation of soil eroded by some drains through their inlets and opening in the canal bank and erosion of canal sides because of inrush of drainage flows appear inevitable during the current monsoon season.

- For the Jurpani canal, the farmers have done the excavation of canal, while the project has constructed almost all the necessary structures except tail structures that are necessary.

- As regards the existing canal systems, the project has constructed adequate number of different structures including the flow divider structures. These structures were originally designed as proportional divider. But, in the construction stage, their hydraulically critical dimensions of have been changed by acceding to the vehement demand of the farmers to the detriment of the proportionality of flow division, as stated in Section 2.2.3.

- Furthermore, although the farmers have done quite a large amount of work under their contribution, they have still to do a lot more for strengthening the banks of almost all the major canals in order to enable the safe operation of the canals at desired capacity and to ensure the safety of the structures.

- Apart from the above noticeable problems, the Bhanpur-Majhmeria canal system faces a major problem of excess bed and suspended materials entry through its main Intake # 3. The Project Consultant investigated this problem and submitted a report on 31 March 2005. In addition to this, the shifting of flow towards the other bank causes scarcity of flow to certain extent towards the end of monsoon rice crop season and mainly during the Winter Crop season, for which the farmers demand an alternative supplementary intake on the Kalapani Main Canal suitably near the location of the presently defunct Silt Ejector.

The GIS maps prepared by the Consultant show all the canals over the project area and the locations of the structures along them

3.2.4 Improvement of Village Road Networks

For the road network in the Project area, adequate number of Box Culverts, Slab Culverts and Pipe Culverts has been constructed in order to facilitate all weather movement over the canals and in the Project area.

3.2.5 Construction of Grain Stores, Operation Buildings, and Pit Latrines

In order to provide storage facility for the farmers of the project area to store surplus agricultural produce, three Grain Stores have been constructed each at Majhgaon, Pipri and Sonpur village.

For the operation buildings to provide shelter for the gate operators at the three intakes along RFE, two operation buildings, one at Intake # 2 to serve for both Intake # 1 and Intake # 2 and the second near Intake # 3 to serve for this, have been constructed

In order to improve the sanitary habits of the poor farmers in the project area, 200 number of pit latrines spread over the whole project area have been constructed at the locations selected in close consultation with WUA. These latrines have been constructed through labour contribution from the farmers.

CHAPTER 4
CONSTRUCTION SUPERVISION AND QUALITY CONTROL

4.1 GENERAL

Upon the issuance of the commencement order for the works by the Project, the Contractors started without delay mobilization of their staff and equipment, and the actual construction work. The Contractors made their best efforts to proceed with the works following schedule. However, the progress of works was often hampered due to the continual strikes and ban on vehicle movement and work during those periods, which were imposed by the Maoists.

Upon resumption of works by the Contractors, meetings were held with them to review their schedule and management of works to offset the interruptions, and efforts were made to expedite the progress keeping in view the inevitable interruption by the insurgents.

Quality control of the works was carried out in accordance with Technical Specifications. Generally the quality of concrete was good, but sometimes violated the specifications. Also, the workmanship in some cases was found substandard. For such defects, the Project ordered the Contractors to remove the defects.

Moreover, a new quality control system involving issuance of non-compliance remarks at site by the inspecting project official and consultant was also applied for quality control. The Consultant submitted inspection reports to the Project at not exceeding a week period for necessary actions. As a consequence, the quality of work gradually improved.

4.2 STRATEGIES FOR QUALITY ASSURANCE

In order to expedite the works maintaining their quality, the following arrangements were made:

- The Consultants and the Project officials worked as integrated team.
- For the communication, very harmonious understandings between the Consultants and the Project official were created. Any issue was often discussed and decided on jointly, avoiding the rigmarole of formal procedures. Any written or verbal request by the Consultants for instruction to the contractors regarding the construction progress and/or quality was handled by the Project without delay.
- Regarding the progress and quality of construction works meetings with the contractors were held as and when required.
- The Consultants together with the Project engineers followed the Contractors' construction activities and their progress closely and prepared the construction drawings for new works, and any modifications in the drawings of the works in progress that become necessary as per the field conditions, and provided to the contractors such that no interruption in construction should occur.
- In order to provide incentive so as to urge the contractors towards the progress of construction works, the interim payment claims presented by them were handled without delay in

collaboration with the Project officials. The Consultants, Project engineers, and the authorized representative of the contractors promptly checked the necessary field measurements jointly, in order to release the payment at the earliest. All records of the payments were maintained by the Project engineers and made available to the Consultants in order to facilitate tracking of the construction progress and costs.

- The interruptions to the construction works caused by the continual strikes and ban on working during these periods were sympathetically considered towards granting the deserved extension of the time of contracts.
- In order to supervise the construction works at site, the Project posted work inspector (supervisor) to each site to assist the respective overseers, who had to supervise more than one site simultaneously. The consultant overseers in collaboration with the Project overseers kept visiting the construction sites on daily basis. Similarly, the consultant Construction Supervision and Quality Control Engineers in collaboration with the Project Engineers carried out daily inspection of the construction sites to check that the works were being implemented in accordance with design, drawings, and qualities as specified in the contract.
- WUA had been urged to participate full time in supervising the construction works, which they had enthusiastically agreed to. They deputed full time supervisors at each construction site. The Consultants in collaboration with the project officials provided those supervisors training about the basic items of construction process that they must pay attention to, and they were found working accordingly with all care.
- In order to ensure that the quality of construction materials and cement mortars being used for the construction of structures is in accordance with the specifications stipulated in the contract document, the Consultant set up a Laboratory at Pipri village located centrally over the project area, as required by the Project.
- The Consultants frequently tested the samples of sand, gravels, and concrete from different construction sites. The concrete moulds were prepared at site in the presence of the contractors' representatives and allowed to set under the care of the respective contractors. The test had been carried out for 7-day and 28-day strength. The test results were regularly provided to the Project for review and necessary action. The test results are given in **Annex- D.**
- In addition to these material and concrete tests, field density tests for the earthwork in embankment were also carried out as required throughout the construction period to examine the quality of constructed embankment and provided to the Project. The results of the tests are presented in **Annex- D**.

CHAPTER 5
PROJECT MANAGEMENT AND PERFORMANCE

5.1 PROJECT ORGANISATION AND STAFFING

The executive agency is the DOI of Ministry of Water Resources. The DOI was responsible for executing all proposed works of the Project, and PKIP was the implementing agency with its Project Implementation Unit established at DOI and Field office at Lamahi in Dang District. The present PKIP office is headed by Mr Shiv Kumar Basnet since September 2005, and has three (3) sections, i.e. (i) Engineering Section, (ii) Finance Section, and (iii) Administrative Section. The Engineering Section responsible for design and construction supervision of the project has three (3) engineers and seven (7) overseers, the Finance Section is headed by a Senior Accountant (Gazetted III), and the Administrative Section is headed by a Kharidar (Non-Gazetted II). The PKIP implementation unit organization is shown in **Table- 4**.

5.2 WATER USERS ORGANIZATION

The Project is basically the rehabilitation of the irrigation system that has been constructed and managed by the farmers of the Project area for about a century. Therefore, the farmers have already evolved their own established organization. The Water Users' Organization (WUO) has different tiers where the Water Users' Main Coordination Committee (WUMCC) is at the top and under which there are four Main Committees (MCs) representing Barakhuti Main Canal, Kalapani Praganna portion of Kalapani Main Canal, Jogiya Praganna portion of Kalapani Main Canal, and Bhanpur-Majhmeria Main Canal respectively. The lowest tier of the WUO comprises four Kulo Pani Committees (Village Canal Committees) under each MC. In compliance with Section 4.16 (a) of Loan Agreement, the WUMCC was registered to the concerned authority in May 2000 in accordance with the Water Resources Regulation 2050 of HMG, and it is now a legal entity.

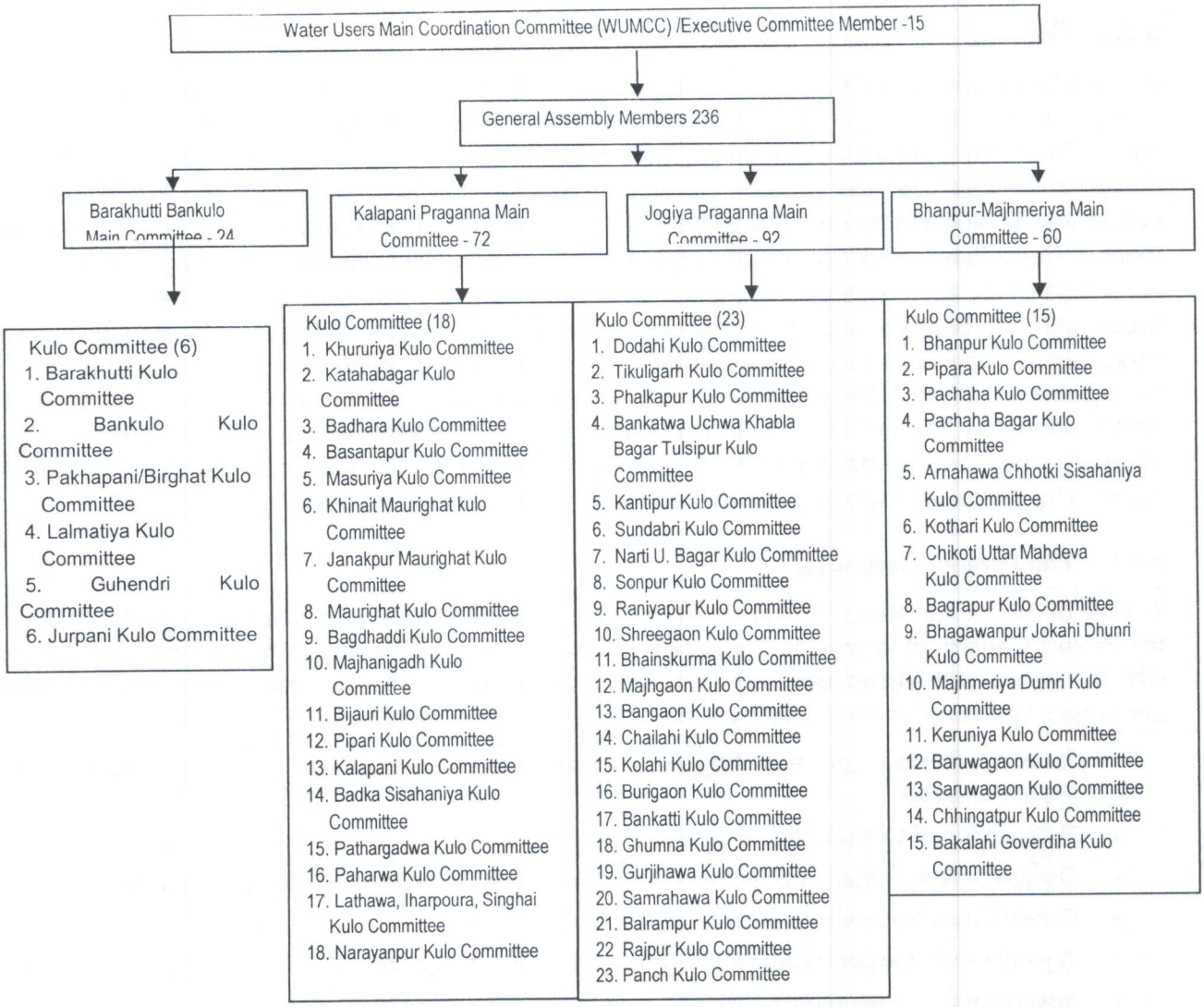
The existing Water Users' Organization in the project area is shown in **Fig. 1.**

Table 4: The PKIP Implementation Unit Organization

S.No.	Name	Title	Grade
1	Mr Shiv Kumar Basnet	Act. Project Manager	Gazetted III
2	Mr Shiv Kumar Basnet	Act. Project Manager	Gazetted III
3	Mr Gir Bahadur KC	Engineer	Gazetted III
4	Mr Ramesh Koirala	Engineer	Gazetted III
5	Mr Tilak Bahadur Khatri	Engineer	Gazetted III
6	Mr Hiranya Prasad Regmi	Senior Accountant	Gazetted III

7	Mr Ram Pukar Sah	Overseer	Non-Gazetted I
8	Mr Om Narayan Shreshtha	Overseer	do
9	Mr Shubha Narayan Yadav	Overseer	do
10	Mr Shiobhakar Paudel	Overseer	do
11	Mr Kashi Prasad Sah	Overseer	do
12	Chandeshwar Prasad Sah	Overseer	do
13	Mr Ram Rath Kharel	Overseer	do
14	Mr Dujendra Basnet	Overseer	do
15	Mr Keshav Raj Paudel	Accountant	do
16	Vacant	Computer Operator	Non-Gazetted Tech
17	Mr Shyam Kumar Shreshtha	Kharidar	Non-Gazetted II
18	Mr Min Bahadur Thapa	Association Organizer	Non-Gazetted II
19	Mr Govid Bdr Budha Magar	Driver	Non-classified
20	Mr Ram Kumar KC	Driver	Non-classified
21	Mr Sukdeva Chaudhary	Peon	
	Mr Khusi Ram Chaudhary	Peon	

Figure 1: WUA Organization under PIP



Name of present main co-ordination committee

5.3 CONSULTANCY SERVICES

5.3.1 General

In accordance with Loan Agreement between the HMGN and KFAED, Consultancy Services were provided for the detailed survey, detailed design, preparation of tender documents, advisory services for the PKIP Implementation Unit during the construction, and preparation of Project Operation and Maintenance Manuals and farmers training for operation and maintenance of the project. The consortium of Multi Disciplinary Consultants (P) Ltd., GEOCE Consultants (P) Ltd., and Development Pioneer Consultancy Services was appointed as the Project Consultant based on agreement signed on 7 April 2000 for providing consultancy services. The tasks of the consultancy services were to assist with: (i) Detailed engineering works, (ii) Advisory services during construction period, (iii) Preparation of operation and maintenance plan, and (iv) Training for farmers. As chance would have it, the agreement of the Consultants was terminated in December 2004, before the completion of the works according to the initial four (4) contracts, i.e. HMGN/KFAED/552/PIP-1 through PIP-4. Thereafter JV of SILT Consultants (P) Ltd. (the lead firm) and DE Consultancy (P) Ltd. commenced the services for the remaining part of the Project from January 2005 and completed in July 2006

5.3.2 The Project Consultant

The JV of SILT Consultants (P) Ltd. and DE Consultancy (P) Ltd. was appointed by the PKIP/DOI as the Project Consultant to provide Consultancy Services for further works of the Project in accordance with the agreement signed between PKIP/DOI and the JV on 27 December 2004. The Consultant performed their services from January 2005 until 10 July 2006 assisting the Project with:

- Design, Review of the Irrigation Infrastructures and River Training Works under implementation;
- Preparation of Construction Drawings;
- Design of New Irrigation Structures/Road Crossings/River Training Works, if required;
- Construction Supervision and Quality Control of Works;
- Agriculture Extension Works and Farmers' Training in Agriculture;
- Institutional Development of Water Users' Associations (WUAs);
- Project Benefit Monitoring and Evaluation (PBME);
- Preparation and Submission of Half Yearly and Yearly Progress Reports;
- Preparation Project Operation and Maintenance Plan (POP);
- Preparation of Project Completion Report;
- Preparation of Project Layout Plan;
- Documentation of Design Drawings, Reports and As-built drawings; and
- Preparation of Audio Visuals of the Project Activities

The services provided by the Consultant are described briefly in the succeeding paragraphs. The total cost of this consultancy services until July 2006 is NRs 5,617,605.55 (Five millions Six Hundred Seventeen Thousand Six Hundred Five and Paisa Fifty-five) only and the details of the inputs of key professional and support staff used are presented in Figure 2.

Fig.2: Inputs of Key Professional and Support Staff- as of July 2006

SNo.	Name	Original Input (mm)	Input Revised	Rate (NRs/mm)	Input Used up to July 2006		Balance	
					mm	Total (NRs)	mm	Total (NRs)
A	**Key Professional Staffs**							
1	L.K. Jha, Team Leader/Irrigation Engineer	7	12.5	95,022.20	12.56	1,193,478.83	(0.06)	(5,701.33)
2	S.P Dhungana/M.L.Yadav, Construction Supervision/Quality Control Engineer	15	19.4	74,921.35	19.26	1,442,985.20	0.14	10,488.99
4	O.P. Gupta/J. Karki, Irrigation Design Engineer	3	6.52	80,011.83	6.52	521,677.13	-	-
5	B. P. Banskota/Surendra Kumar Subedi, Agri-Economist	4	2	80,011.83	2.00	160,023.66	-	-
6	A. N. Yadav, Agriculture Extension Specialist	6	7.5	80,011.83	7.5	600,088.73	-	-
7	S. K. Shrestha, Institutional Specialist	3	0	80,011.83	0	0.00	-	-
8	M. Acharya, CAD Expert cum Civil Engineer	4	3.85	39,940.65	3.85	155,771.50	-	-
	Sub-Total (A)					**4,072,025.05**		**4,787.66**
B	**Support Staffs**							
1	A.K. Mallik / R.S. Singh/L.P.Limbu, Overseers	20	20.15	26,105.00	20.41	532,803.05	(0.26)	(6,787.30)
2	MS K.Thapa, CAD Overseer		4.00	26,105.00	3.50	91,367.50	0.50	13,052.50
3	M. Poudel/ O.N. Seth, Surveyor	20	4.56	26,105.00	4.56	119,038.80	-	-
4	N. Thapaliya/ S. Paudel, Computer Operator	16	19.23	14,357.75	18.99	272,653.67	0.24	3,445.86
5	T.R. Chaudhari/D. J. Chaudhary, JT/JTA	18	15.46	18,012.45	15.46	278,472.48	-	-
6	S. R. Thapa, Enumerator/AO	12	12.48	10,000.00	12.48	124,800.00	-	-
7	AR Chaudhari/S Chaudhari, Peons	16	22.73	5,500.00	22.99	126,445.00	(0.26)	(1,430.00)
	Sub-Total (B)					**1,545,580.50**		**8,281.06**
	Grand Total (A+B)					**5,617,605.55**		**13,068.72**

5.3.2.1 Design of Irrigation Infrastructure and River Training Works

As stated in Section 1.4.3, the whole Project civil works were divided into 18 packages of which the works under PIP-5 and PIP-9 were assigned to the WUA as parts of their agreed contribution and those under other 16 packages were awarded to the contractors through LCB procedures in three lots. The contracts of the first four packages (PIP-1 to PIP-4) were awarded to four national contractors in June 2002; those of other three packages (PIP-6 to PIP-8) were awarded to other three contractors in June 2004; and those of the other seven (7) packages (PIP-13 to PIP-19) were awarded to the other seven contractors in January 2006.

The construction works under the first four contracts were initially implemented based on the typical and working drawings produced by the consortium of Multi Disciplinary Consultants (P) Ltd., GEOCE Consultants (P) Ltd., and Development Pioneer Consultancy Services. However, after September 2003, upon arrival of the present Project Manager, the Project engineers have made a lot of modifications in the design and drawings in order to make the structures cost effective and efficient to cater to the needs of the project. The Project in collaboration with the Project Consultants continued with such efforts even in case of the works related with the other 12 contracts. Nevertheless, in the construction stage, changes were made by the project officials in the hydraulically critical dimensions of the structures by acceding to the vehement demands of the farmers based on their traditional share of water and method of diverting it to their respective canals, which resulted in the detriment to the proportionality of flow division and the economy of construction.

The Consultants carried out the review of the design of the structures that were already constructed and that were under construction, under all the lots of contracts, in close coordination with the Project Engineers. The team of Consultants and the Project Engineers made intensive visits of the construction sites and decided about the modifications that were needed to make the structures more efficient and cost effective. The Consultants then carried out the modified design of the structures both being constructed and to be constructed, based on the data obtained from the Project Engineers together with field surveys. The designs include the modified designs of different components for structures under construction as well as the design of the to-be-constructed new structures. The Consultants in collaboration with the Project Engineers have carried out all the designs so as not to hamper the progress of works. Thus, the Consultants have produced 198 designs along with corresponding working drawings. The list of all the drawings is given in **Annex- E.**

Similarly, the Consultants in close coordination with the Project Engineers carried out necessary survey, design, and preparation of working drawings for the construction of spurs and command area protection works. In order to strengthen the riverbank to protect the command area at different locations along the right bank of the Rapti River series of sloping spurs were designed.

5.3.2.2 Construction Supervision and Quality Control of Works

This activity is described separately in the preceding Chapter 4.

5.3.2.3 Agriculture Extension Services and Farmer Training

The Project Consultant carried out the Agriculture Extension and Farmer Training Programme in the project command area. Brief description of the objectives and structure of the programme and activities executed under this programme are described in the succeeding chapter.

5.3.2.4 Preparation of Project Operation Plan (POP)

In accordance with the TOR, the professional expert of the Consultant has prepared the POP to form a basic document for the Operation, Maintenance, and Management of the project and submitted to the project for review. The POP addresses the following points:

- Levels of Services anticipated;

- Ordering Procedure;
- Communications;
- Data collection and processing requirements;
- Job sharing between the different tiers of WUA and officials of WUGs, including delineation of responsibilities and activities;
- Operating procedures for the Main Intakes and other structures;
- Maintenance requirements for the system;
- Manpower requirements for Operation and Maintenance of the system;
- Financial requirements for Operation and Maintenance of the system including mechanisms for irrigation service fee collection;
- Manuals and catalogues required for structures, equipment and spare parts; and
- Operation and Maintenance Plan and expenditure for this.

As the POP document is to be used by the WUA, the POP prepared by the Consultant is being tested in the field in collaboration with the Project officials and WUA for its validity. Upon the validation of the document, a Nepali version of this will be prepared for the use by the WUA.

5.3.2.5 Preparation of Project Layout Plan (PLP)

The Project Layout Map is prepared to show the source, Location of Headworks/Intake, Primary Canal line, Secondary/Tertiary canal lines, major structures, River Training Works and the command area showing the Irrigation Units, Roads and other details. The layout map is primarily prepared during the design phase of a project for the use in planning and design of the system, which is subsequently updated according to the actual construction. Strangely, such map is not available with the project.

Therefore, the preparation of the PLP was commissioned to this Consultant when the project was in full swing past halfway heading towards the completion. At such stage of the project, it was not so simple to prepare an inclusive layout map, because of constraints of time and resources. Considering these constraints, the PLP survey work was limited in consultation with the project officials to showing to the extent possible the complete canal system of the PKIP along with the canal/irrigation structures, service structures (road crossings), and the river training works on 1:25000 scale topographic map using Total Station instrument to plot the newly constructed infrastructures such as canals, river training works, etc and tape measurement to mark the infrastructures along the canals existing on this map.

However, over the course of the survey work, the project officials changed the mind and asked the Consultant to prepare the layout plan in GIS on a digital version of the topographic map using GPS and tape measurements as required. In compliance with the wishes of the project officials, the Consultant has then prepared the Project Layout Plan in GIS. This map shows all the details of the project and distinguishing features of the project area and provides an efficient tool for the operation and management of the project.

The soft copy of the GIS maps is provided on CD and its hard copies are given in Annex- C.

5.3.2.6 Project Benefit Monitoring and Evaluation (PBME) Survey

The Project Benefit Monitoring and Evaluation (PBME) is basically intended to evaluate the impact of the Project and to assure the investor of the Project of achievement of expected benefit within a stipulated time. It involves assessment of input, output, effect and impact. To this end, a base line survey is carried out to establish agricultural situation before the project and then PBME survey is conducted at specified interval to evaluate the changes as a result of the project. In general, the following are monitored for PBME survey in order to assess the effect of the project:

- Delivery of services to the recipients;
- The use of services by the recipients;
- The direct effect from using the services; and
- Cost recovery

The professional expert of the Consultant has carried out the Baseline and PBME survey within the project area and a report on this has been presented separately.

5.3.2.7 *Institutional Development of Water Users' Organization*

The goal of the institutional development in the PIP is to enhance the capabilities of the WUA through appropriate training and establish a mechanism for sustainable operation and management of the system by the WUA for an equitable, adequate and timely delivery of irrigation water to optimize the production in terms of per unit of land and water. This project is the rehabilitation and modernization of about a century old FMIS having a well established Water Users' Organization (WUO). The WUO has evolved elaborate norms for the operation and management of the system through experiences over years. The WUO along with its norms has been registered in May 2002, as per the prevailing Irrigation Regulations. However, it is felt necessary by both the Project and the WUA to review the existing structure and constitution of the WUA in view of the modernization of the system.

Since the project has so far been engaged in the construction activities related with the rehabilitation and modernization of the FMIS that has been substantially completed until July 2006, the farmers of the project area will start having any feeling about their new system only after the current monsoon season operation of the system. Therefore, both the WUO and the project have considered it appropriate to undertake any institutional development activities only from the coming years.

5.3.2.8 *Preparation of Audio-Visual of the Project Activities*

The audio-visual documentation is proposed to record the progress of all the activities undertaken by the Project. The documentation has been prepared to cover:

- Ongoing construction activities;
- Important Infrastructures;
- System Operation;
- Maintenance works by WUA;
- Management System (WUA);
- River Morphology;
- Agriculture Extension Activities and Agricultural Practices;
- Efforts towards Health and Hygiene;
- Grain Storage Facilities provided by the Project

The audio-visual documentation of the project activities has been submitted to the Project on CD.

CHAPTER 6
AGRICULTURE EXTENSION SERVICES AND FARMERS' TRAINING

6.1 GENERAL

In compliance with the TOR, the Consultants carried out the Agricultural Extension Programme (AEP) in the command area of the Project from January 2005 to January 2006. The consultants formulated the Programme in close consultation with the farmers of the project area to cover to the extent possible within the given constraint of time and resources the extension and training activities related to the main crops, namely rice in the summer season and Tori (oilseeds) in the winter, with focus on the concerns and experiences of the farmers of the Project area. The programme has been constrained in addressing all the concerns of the farmers especially by the limited provision for expert services and to a certain extent paucity of fund. The total cost of implementing the whole programme within the given schedule of the Consultant is NRs 387,105.10 (NRs Three Hundred Eighty Seven Thousand One Hundred Five) only.

The main concern of the farmers is gradually decreasing productivities of different crops in general and of Tori (oil seeds) in particular. The project area has been popularly known for Tori cultivation, as cash crop, in Dang district and even beyond this; whereas, now, the farmers are so frustrated by the degeneration of yields that they are on the verge of abandoning this. Therefore, considering the desperation of the farmers, the Consultants executed the programme with the on-farm needs assessment, problem identification, their diagnosis, programme planning and implementation within the available resources and potential.

The programme was implemented in Rice crop in monsoon and Tori crop in winter. In Rice crop, the advanced technologies: System of Rice Intensification (SRI) and Water management (minimum water use) in Rice Production were demonstrated by establishing Pilot Demonstration Sites (PDS). Similarly, in winter, the alarming problems of Tori degeneration in the area were tackled on-farm through PDSs and Contact Farmers Plots. In both the seasons, an intensive Farmers Field School (FFS) was operated at each of the Pilot Sites. The Programme was completed with highly encouraging performance and achievements in both the seasons.

6.2 THE PROGRAMME

The AEP was developed and executed in line with the on-farm needs and potential of the Project area. In order to identify and diagnose major problems of this sector, the Consultant initially adopted demand-driven bottom up approach such as reconnaissance farm visits and close observation to the project area, intensive meetings/interactions with the resident farmers on a participatory basis. Based on the findings of the study, the Programme was carefully designed to address the concern of the farmers and brought into implementation. The activities were defined and geared towards Rice crop in monsoon and Tori crop in winter. Based on the resources and potential of the area the advance technologies on Rice production such as System of Rice Intensification (SRI) and Water Management (minimum water use) in rice production were demonstrated in full participation with the farmers. Similarly, the technology demonstration on degenerating Tori crop from the area was done and highly

encouraging results were obtained. Two Farmers Field School (FFS) in monsoon season; one at Tikuligarh, in Sonpur-5 and the second at Arnahanpur in Sisahaniya-2 were established. For Tori demonstration in winter, additional two FFSs (one at Barahkhutti and another at Kalapani) were established and operated. Around 80 beneficiary farmers in summer and 74 in winter were trained at the FFS.

In the light of the burgeoning problems of soil fertility degradation, training course on Soil Fertility Management and Operation of Portable Soil Test Kits for instant chemical analysis of major properties of soil were done. Four Potable Kits are provided one to each of the four Water Users' Main Committees so that the soil testing facility may be easily accessible to the farmers over the whole project area. The WUCCC needs to take the lead in this endeavor.

6.2.1 Objective of the Programme

The immediate objective of the programme is to enhance the capability of the farmers in the improved irrigated agriculture as well as to diagnose the fertility problems and suggest the way to improve it in the project area. The ultimate objective of the Programme is to enhance the economic status of the beneficiary farmers of the command area through increased crop productivity, production, cropping intensity (CI) and farm income. Specifically, they are:

- To improve the traditional farming practices in the Project area and support the beneficiary farmers to diversify the existing cropping system adopting improved farming practices;
- To help improve on-farm crop productivity and increase farm income through demonstrating suitable cropping pattern and soil fertility improvement practices.

6.2.2 Objective of Consultancy

Towards meeting the objective of the Program, the objectives of Consultancy were as follows:

- To demonstrate improved crop production practices in a cropping pattern sequence;
- To conduct on-farm problem specific and need-based training activities for the farmers to enhance their technical know-how; and
- To organize leader farmers visit to national and international Agricultural Research Station and Institutions to the extent possible to provide them exposure to improved agricultural technologies.

6.2.3 Activities

The various activities conducted to implement the Programme are summarized as follows:

- Installation and operation of Pilot Demonstration Sites for the paddy cultivation, with emphasis on System of Rice Intensification (SRI) Technologies, in monsoon season;
- Installation and operation of Pilot Demonstration Sites for Tori cultivation in winter season;
- Farmers Field School (FFS) Training;
- Investigation Soil Fertility Status in the Project Area;
- Training on Soil Fertility Management and Operation of Soil Testing Kits;
- Leader farmers' Study Tour and Farm Visits; and
- Agriculture Extension and Training Seminar

Other related activities such as interaction meeting for agricultural produce marketing promotion, inter-pilot sites visits and interactions were also planned.

6.2.4 Appreciation of the Programme

The implementation of the programme has been highly appreciated by the farmers of the project area and beyond this. The farmers from other areas and media persons visited the demonstration sites especially to see the results of SRI technology. The farmers of the project area were so much impressed that they started paddy cultivation using SRI in parallel with the pilot demonstration by the Consultant. Also, the farmers have learnt how to diagnose the fertility problems and to adopt necessary measures to improve the fertility. They have been provided with intensive training in soil testing. Four Soil Testing Centers one for each of the four Water Users' Main Committees (WUMC) has been planned and provided with Soil Testing Kits.

The results of rice cultivation using the advanced SRI Technology have been highly promising with around 10 times less use of seeds and around four times increase in grain yield over the existing farmers' practice in the area. Bibdeshwari and Rampur Masuli varieties of paddy were used for demonstrations. Their yields are nearly double that of Indian hybrid rice Suraj F_1 (5.75 t/ha) grown by the farmer in the vicinity. The Bindeshwari variety was harvested after 109 days and the Rampur Masuli after 143 days of seeding. The grain yields obtained were: Bindeshwari - 9.72 mt/ha and Rampur Masuli - 11.25 mt/ha. The average yield of paddy produced according to the farmers' practice over the project area is 3.51 t/ha.

The yields of paddy produced with a compromise between the SRI technology and farmers practice are also encouraging. In this case, the age of seedlings was kept according to the farmer's traditional practice as 20-30 days old (10-12 days in case of SRI), while the number of seedlings was reduced from the traditional practice of 11-12 to two (2) per hill in contrast to one (1) in case of SRI, keeping the spacing the same as in case of SRI, which is 25-30 cms. The varieties of Rice, Irrigation Cycle and method of application of chemical fertilizers and farmyard manure (FYM) were kept the same as in case of SRI demonstration.

The grain yields in this demonstration, although slightly lower than that of SRI, have also shown equally outstanding and encouraging. The grain yields of the crops are: Bindeshwari - 8.46 mt/ha and Rampur Masuli - 9.54 mt/ha. Thus, it can be concluded that even with the age of seedling according to the prevalent farmers' practice a remarkable yield can be achieved even by reducing the transplantations as near as possible to that adopted for SRI technology, but with similar intermittent application of water.

For Tori, the average yield over the project area being 0.969 t/ha, the average yield achieved in the demonstration plot is 1.446 t/ha.

The detail description of the programme implementation is given in a separate volume as **Annex- F**.

CHAPTER 7
PROJECT FINANCE AND COSTS

7.1 FINANCE

In 1998, the HMGN processed the rehabilitation or the Praganna Kulo Farmers' Managed irrigation system, in the estimated amount of NRs 464.864 million that was finally revised to NRs 851.813 million for about 5800 ha of total command area. The project is named Praganna Kulo Irrigation Project (PKIP). The Project is planned to construct facilities to protect the irrigation systems and their command areas from the attack of floods in the West Rapti River, irrigation/canal infrastructure, facilities to improve the village road networks, and buildings, and to provide agricultural support and necessary equipment and vehicles. The project has been implemented through the fund from HMGN, Loan from Kuwait Fund for Arab Economic Development (KFAED), and 15% contribution of the Water Users' Association. A loan of 1.550 millions Kuwaiti Dinars (KD) has been obtained in accordance with the agreement signed between the HMGN and KFAED on 26 October 1998.

Amounts agreed to by both the parties in the original agreement and their reallocations made on 7 May 2004 are summarized category-wise in the Table 5 and Table 6.

Table 5: Original List of Goods of KFAED Loan No. 552

SNo.	Items	Allocation of Proceeds (KD)	Percentage of Total Cost of Item	Remarks
1	Civil Works	1,100,000.00	90%	
2	Buildings	20,000.00	60%	
3	Agriculture Extension Services	6,500.00	70%	
4	Administrative Services	10,000.00	40%	
5	Institutional Support	27,000.00	90%	
6	Equipment and Vehicles	80,000.00	100%	
7	Consultancy Services	66,500.00	100%	
8	Contingency	240,000.00		
	Total	**1,550,000.00**		

Table 6: Revised (7 May 2004) List of Goods of KFAED Loan No. 552 .

SNo.	Items	Allocation of Proceeds (KD)		Percentage of Total Cost of Item
		As agreed Between Mission and DOI	Latest Proposal	
1	Civil Works and Buildings			
	Old Contracts (4 Packages)	1380.000.00	1,148,700.00	90%
	New Contracts (3 Packages)		231,300.00	32%
2	Administrative Services	6,457.61	6,457.61	40%
3	Institutional Support	10,000.00	10,000.00	100%
4	Equipment and Vehicles	55,000.00	55,000.00	100%
5	Consultancy Services	80,000.00	80,000.00	100%
6	Contingency	18,542.39	18,542.39	
	Total	**1,555,000.00**	**1,555,000.00**	

7.2 PROJECT COSTS

Since the finalization of the Loan Agreement in October 1998, various project activities have been performed, including employment of Consultants and contractors, civil works, building works procurement of equipment and vehicles, and agricultural extension services. As a result, the project cost, as of July 2006, is NRs 768,292,780.32. This includes the contribution of WUA. The details of the estimated project cost and actual expenditures are shown in **Table 7**.

Table 7: Details of Estimated Project Cost and Actual Expenditures

S No	Description	Final Estimated Cost (NRs)*	Actual Expenditures (as of 15 July 2006)
A	**Package PIP 1 to PIP 4**		
A.1	Cont. No. HMG/KFAED/552/PIP-1	71,846,457.25	71,846,457.25
A.2	Cont. No. HMG/KFAED/552/PIP-2	74,777,955.96	74,777,955.96
A.3	Cont. No. HMG/KFAED/552/PIP-3	85,923,326.64	85,923,326.64
A.4	Cont. No. HMG/KFAED/552/PIP-4	64,936,291.08	64,936,291.08
	Sub-total	**297,484,030.93**	**297,484,030.93**
	VAT 10%	31,379,933.45	31,379,933.45
	Contingencies 5%	20,570,433.79	20,570,433.79
	Insurance	1,359,138.24	1,359,138.24
	Total	**350,793,536.41**	**350,794,000.00**
	Say NRs.	**350,794,000.00**	

S No	Description	Final Estimated Cost (NRs)*	Actual Expenditures (as of 15 July 2006)
B	**Package PIP 6 – PIP 8**		
B.1	Cont. No. HMG/KFAED/552/PIP-6	87,850,908.44	63,408,090.00
B.2	Cont. No. HMG/KFAED/552/PIP-7	76,046,347.22	53,994,112.54
B.3	Cont. No. HMG/KFAED/552/PIP-8	71,216,626.45	62,240,068.00
	Sub-Total	**235,113,882.11**	**179,642,270.50**
	Insurance @0.45%	1,058,012.47	688,596.69
	VAT 10%	23,511,388.21	23,353,495.17
	Contingencies 5%	11,755,694.11	**NA**
	Total	**271,438,976.90**	**203,684,362.40**
C	**Package 13-19**	**82,344,000.00**	
C.1	Cont. No. HMG/KFAED/552/ PIP- 13		9,018,033.79
C.2	Cont. No. HMG/KFAED/552/ PIP- 14		8,841,495.94
C.3	Cont. No. HMG/KFAED/552/ PIP- 15		8,608,350.17
C.4	Cont. No. HMG/KFAED/552/ PIP- 16		8,489,515.12
C.5	Cont. No. HMG/KFAED/552/ PIP- 17		8,718,983.65
C.6	Cont. No. HMG/KFAED/552/ PIP- 18		8,597,876.00
C.7	Cont. No. HMG/KFAED/552/ PIP- 19		8,194,460.20
	Total	**82,344,000.00**	**60,468,714.87**
D	WUA Contribution	92,647,000.00	93,874,053.50
E	Land Acquisition	6,200,000.00	6,300,000.00
	Grand Total (B+C+D+E)	452,629,976.90	**364,327,130.80**
	Say NRs.	**452,630,000.00**	
F	Consultancy	22,000,000.00	21,278,568.42
G	Equipment and Vehicles	13,500,000.00	11,107,691.38
H	Furniture	500,000.00	147,000.00
I	Contingency		
J	Administration	12,389,000.00	**20,638,853.57**
	Grad Total (A+B+C+D+E+F+G+H+I+J)	**851,813,000.00**	**747,653,927.00**

* The project cost was revised in the course of implementation of the works under the contracts of the first four packages, namely PIP 1 to PIP 4.

NA Not available

The status of expenditure under HMG and KFAED fund is given in **Table 8**.

Table 8: Status of Expenditures under HMG and KFAED Fund in NRs

FY	HMG	Kuwait	Total	Cumulative	Remarks
1999-00	554,046.20	1,730,369.40	2,284,415.60	2,284,415.60	
2000-01	1,130,388.33	5,537,981.90	6,668,370.23	8,952,785.83	
2001-02	8,271,303.08	38,065,286.17	46,336,589.25	55,289,375.08	
2002-03	46,544,781.57	152,803,624.70	199,348,406.27	254,637,781.35	
2003-04	17,179,776.21	69,297,096.77	86,476,872.98	341,114,654.33	
2004-05	39,221,531.22	72,795,917.21	112,017,448.43	453,132,102.76	
2005-06	110,566,065.36	30,473,949.00	141,040,014.36	594,172,117.12	
Total	223,467,891.97	370,704,225.15	**594,172,117.12**		

7.2.1 WUA Contribution

In accordance with the formulation of the project, the cost of the project has been financed from the Loan from KFAED, fund from the HMGN, and 15% of the cost of the civil construction contributed by the WUA. This cost of contribution by the WUA was estimated to be NRs 92,647,000.00 based on the estimated cost of the civil works construction. The works under this cover: Earthwork in construction of new canals, strengthening of existing canals, approach road to Intake # 1, village roads, service roads, guide bunds, canal reshaping, etc; Earthworks around major and minor structures; 15 cm thick gravelling on village roads; filling of sufficient earth over the pipe culverts along village roads; Earthwork in guide bunds; Improvement of Tertiary canals; sod facing of the Rapti River Flood Embankment (RFE) slope; Provision of land for the construction of RFE and Bhanpur- Majhmeria Link Canal; Labour contribution for the construction of 250 pit latrines for the poor farmers, etc. These works were divided into two packages- PIP 5 and PIP 9- for which necessary agreement between the PKIP and the WUMCC were signed on 8 January 2002 and 12 August 2004 respectively. The details of works assigned to the WUA under these packages and their evaluation until July 2006 are given in **Annex G-1 (a) and G-1 (b)**.

According to this, the works carried out by the WUA until July 2006 is evaluated at NRs 93,874,053.50. According to this, although the farmers have done quite important works, they have still to do a lot more towards strengthening the existing canals in order to enable their operation at the desired capacity with safety.

7.2.2 Acquisition of Land

The project has carried out construction of Kalapani Main Canal from 0+00 km to 2+275 km and Khurhuria Secondary canal from 0+00 km to 0+480 km as new canals. The land occupied by these canals has been acquired from the farmers for which NRs 6,300,000.00 has been paid as compensation to the concerned farmers.

7.2.3 Procurement of Equipment and Vehicles

In accordance with Schedule 2 of Loan Agreement, the Project has procured different equipment and vehicles for its implementation indifferent years. Additionally, according to Para 7 under Technical Aspects of the Minutes of Meeting held on 7 May 2004 between KFAED Review Mission and Department of Irrigation for Praganna Kulo Irrigation Project, the Project has procured one JCB Backhoe for the WUA for the use in the operation and maintenance of the project. The inventory of equipment and vehicles procured in different years is given in Table 8 below.

Table 9: Procurement of Equipment and Vehicles by Year

Year	Equipment	Number	Total Cost (NRs)
2000	Photocopy Machine	1	145,454.00
	Canon Fax Machine	1	16,000.00
	Computer Set	2	219,500.00
	Printer	2	36,000.00
		Sub-Total	416,954.00
2001	Nissan Pick-up	1	1,411,709.97
	YBX Motorbike	6	298,898.00
	Camera	2	21,000.00
		Sub-Total	1,731,607.97
2002	Nissan Wagon Jeep	1	1,801,564.96
	YBX Motorbike	2	158,518.50
	Computer Set	2	129,500.00
	Printer	1	36,000.00
		Sub-Total	2,125,583.46
2003	Photocopy Machine	1	164,450.00
	Computer Set	4	220,000.00
	Printer	3	78,500.00
	Camera	1	2,805.00
		Sub-Total	465,755.00
2004	Computer Set	4	291,500.00
	Printer	2	65,000.00
		Sub-Total	356,500.00
2005	YBX Motorbike	6	493,231.20
	JCB Excavator (Backhoe)	1	5,086,259.00
	Printer	1	39,000.00
	Camera	1	41,800.00
		Sub-Total	5,660,290.20
2006	Garmin GPS MAP 60 CSx	1	64,155.75
	Multimedia Projector	1	99,779.00
	Electric Pump	1	49,269.00
	Lap-Top Computer Set	1	99,892.00
	HP Laserjet Printer	1	17,000.00
	HP Laserjet Printer	1	20,905.00
		Sub-Total	351,000.75
		Grand Total	**11,107,691.38**

7.2.4 Consultancy Services

The project appointed the consortium of Multi Disciplinary Consultants (P) Ltd., GEOCE Consultants (P) Ltd. and Development Pioneer Consultancy Services based on agreement signed on 7 April 2000 for providing consultancy services to assist with: (i) Detailed engineering works, (ii) Advisory services during construction period, (iii) Preparation of operation and maintenance plan, and (iv) Training for farmers. The service of this Consultancy was terminated in December 2004.

Then, PKIP, Department of Irrigation (DOI) employed the joint venture (JV) of *SILT consultants (P) Ltd. (the lead firm) and DE Consultancy (P) Ltd.* as the Project Consultants to provide Consultancy Services for the further works of the Project in accordance with an agreement signed between the PKIP/DOI and the JV on 27 December 2004. The Consultants started their service from January 2005 until July 2006. The services of this Consultancy include design, construction supervision, agriculture extension services, preparation of project layout map, PBME survey, preparation of project operation and maintenance plan, preparation of PCR, preparation of various occasional reports.

The total cost of these two consultants until July 2006 is NRs 21,278,568.42 (NRs Twenty-One Millions Two Hundred Seventy Eight Thousand Five Hundred Sixty Eight and Paisa Forty-Two) only.

7.3 CREDIT DISBURSEMENT

As of July 2006, the project has settled expenditures on contracts, equipment and vehicles including spare parts, Consultancy services, etc. The status of withdrawal application to and reimbursement from KFAED as of 15 July 2006 are presented in Table 9.

Table 10: Status of Withdrawal Application and Reimbursement (as of July 2006)

Date	W/A No	Description	Applied Amount in NRs.	Reimbursement from KFAED in NRs			Total	Category
				Up to FY 2060-61	FY 2061/62	FY 2062/63		
1	Various		43,264,545.47	43,264,545.47				
2	Direct		1,795,277.25	1,795,277.25				
		Sub-Total	**45,059,822.72**	**45,059,822.72**			45,059,822.72	
May 31, 2004	20	PIP-1	36,137,552.41	36,137,552.41				
	21	PIP-2	30,733,586.57	30,733,586.57				
	22	PIP-3	41,860,841.20	41,860,841.20				
	23	PIP-4	29,243,802.20	29,243,802.20				
	27	Multi	2,338,896.12	2,338,896.12				
		Sub-Total	**140,314,678.50**	**140,314,678.50**			140,314,678.50	
July 15, 2004	29	PIP-1	9,443,190.65	9,443,190.65				1 -Civil Works
	30	PIP-2	10,172,225.06	10,172,225.06				--- do ---
	31	PIP-3	8,332,588.92	8,332,588.92				--- do ---
	32	PIP-4	4,023,041.79	4,023,041.79				--- do ---
	33	Multi	1,712,527.13	1,712,527.13				7 - Consultancy
	34	PIP-6,7,8	35,900,000.00		11,488,000.00			1 -Civil Works
	35	Others	514,170.00		514,170.00			6 - Equipment

Date	W/A No	Description	Applied Amount in NRs.	Reimbursement from KFAED in NRs			Total	Category
				Up to FY 2060-61	FY 2061/62	FY 2062/63		
		Sub-Total	**70,097,743.55**	**33,683,573.55**	**12,002,170.00**		45,685,743.55	
Feb 28, 2005	36	PIP-1	3,034,469.76		3,034,469.76			1 -Civil Works
	37	PIP-2	9,611,236.03		9,611,236.03			--- do ---
	38	PIP-4	2,054,445.55		2,054,445.55			--- do ---
	39	PIP-6	3,177,833.31		3,177,833.31			--- do ---
	40	PIP-7	1,435,051.70		1,435,051.70			--- do ---
	41	PIP-8	3,311,001.97		3,311,001.97			--- do ---
	42	Silt	1,679,000.00		1,679,000.00			7 - Consultancy
	Direct		5,579,490.20		5,579,490.20			6 - Equipment
		Sub-Total	**29,882,528.52**		**29,882,528.52**		29,882,528.52	
		Total	285,354,773.29	219,058,074.77	41,884,698.52			
Aug 8, 2005	43	PIP-1	946,339.12			946,339.12		1 -Civil Works
	44	PIP-2	1,468,259.54			1,468,259.54		--- do ---
	45	PIP-3	6,898,114.25			6,898,114.25		--- do ---
	46	PIP-4	5,564,706.59			5,564,706.59		--- do ---
	47	PIP-6	3,543,618.79			3,543,618.79		--- do ---
	48	PIP-7	5,004,189.43			5,004,189.43		--- do ---
	49	PIP-8	2,430,879.65			2,430,879.65		--- do ---
	50	Silt	2,029,494.99			2,029,494.99		7 - Consultancy
	51	PIP-1	2,362,417.90			2,362,417.90		1 -Civil Works
	52	PIP-2	2,432,928.48			2,432,928.48		--- do ---
	53	PIP-3	3,829,344.68			3,829,344.68		--- do ---

Date	W/A No	Description	Applied Amount in NRs.	Reimbursement from KFAED in NRs			Total	Category
				Up to FY 2060-61	FY 2061/62	FY 2062/63		
	54	PIP-4	7,627,115.12			7,627,115.12		--- do ---
	55	PIP-6	2,089,825.34			2,089,825.34		--- do ---
	56	PIP-7	2,927,452.98			2,927,452.98		--- do ---
	57	PIP-8	3,305,554.77			3,305,554.77		--- do ---
	58	Silt	1,163,282.36			1,163,282.36		7 - Consultancy
	59	New Creation	86,896.70			86,896.70		6 - Equipment
		Sub-Total	**53,710,420.69**			**53,710,420.69**		
16-Mar-06								
	60	PIP-1 Ret Mon	1,617,095.45			1,617,095.45		1 -Civil Works
	61	PIP-2	1,688,241.60			1,688,241.60		--- do ---
	62	PIP-3	1,935,000.00			1,935,000.00		--- do ---
	63	PIP-4	1,462,191.54			1,462,191.54		--- do ---
	64	PIP-6	1,911,166.50			1,911,166.50		--- do ---
	65	PIP-8	4,465,791.83			4,465,791.83		--- do ---
	66	SILT	1,734,461.20			1,734,461.20		7 - Consultancy
		Sub-Total	**14,813,948.12**			**14,813,948.12**	68,524,368.81	
19-Jun-06	67	PIP-7	1,531,654.05					1 -Civil Works
	68	PIP-13	655,815.15					--- do ---
	69	PIP-14	1,448,526.14					--- do ---
	70	PIP-15	1,749,866.31					--- do ---
	71	PIP-16	904,537.58					--- do ---
	72	PIP-17	1,915,052.08					--- do ---
	73	PIP-18	1,553,811.80					--- do ---
	74	PIP-19	1,282,966.61					--- do ---
	75	PIP-6	2,030,190.88					--- do ---
	76	PIP-13	1,095,454.39					--- do ---

Date	W/A No	Description	Applied Amount in NRs.	Reimbursement from KFAED in NRs			Total	Category
				Up to FY 2060-61	FY 2061/62	FY 2062/63		
	77	PIP-14	561,673.54					--- do ---
	78	PIP-16	1,308,443.42					--- do ---
	79	PIP-17	442,191.33					--- do ---
	80	PIP-19	558,107.34					--- do ---
	81	Silt	757,354.86					7 - Consultancy
		Sub-Total	**17,795,645.48**					
		Grand Total	**371,674,787.58**	**219,058,074.77**	**41,884,698.52**	**68,524,368.81**	**329,467,142.10**	

SUMMARY

Description / FY	UPTO 2060-61	2061-62	2062-63	Total	Remarks
Requested Money	255,472,244.77	83,592,949.21	32,609,593.60	**371,674,787.58**	
Reimbursed Amount	219,058,074.77	41,884,698.52	68,524,368.8	**329,467,142.10**	

CHAPTER 8
PROBLEM AND ISSUES

8.1 PROBLEM AND ISSUES

Some critical problems and issues observed over the course of implementation of the project are described as follows:

(1) The Narayanpur Main Canal is aligned through a difficult terrain at the foothill, and therefore, has been excavated in deep cutting. Although major structures have been constructed by the project, one escape upstream of the Singai River aqueduct and RCC rectangular canal in embankment for about 100 m approaching to this aqueduct are felt essential. The farmers excavated the canal to a large extent. However, the canal excavation has not been carried out to proper level and in proper cross-section, for which a lot of work is yet to be done. As a result, the canal is not in a position to be commissioned immediately.

By virtue of its alignment, this canal cuts across natural drainage lines and hence crosses several drainages. Although some cross drainage and drainage inlet structures have been provided at the obvious locations, some more unforeseen drainage problems cannot be ruled out in future. Transportation of soil eroded by some drains through their inlets and opening in the canal bank and erosion of canal sides because of inrush of drainage flows appear inevitable. Therefore, the project officials and staff should keenly observe these happenings in order to decide appropriate remedial measures.

(2) For the Jurpani canal, the farmers have done the excavation of canal, while the project has constructed almost all the necessary structures except tail structures that should advisably be constructed after commissioning.

(3) As regards the existing canal systems, the project has constructed adequate number of different structures including the flow division structures. These structures were originally designed as proportional divider. But, in the construction stage, their hydraulically critical dimensions have been changed by acceding to the vehement demand of the farmers to the detriment of the proportionality of flow division, as stated in Section 2.2.3. Therefore, in future, when the farmers realize the problems in flow division, the provision of gates in those structures should be considered for proper operation of canals and water management.

(4) Furthermore, although the farmers have done quite a large amount of work under their contribution, they have still to do a lot more for strengthening the banks of almost all the major canals in order to enable the safe operation of the canals at desired capacity as well aS to ensure the safety of the structures. Therefore, the project needs to keenly motivate them to accomplish this work in the following years as soon as they can.

(5) Apart from the above noticeable problems, the Bhanpur-Majhmeria canal system faces a major problem of excess bed and suspended materials entry through its main Intake # 3. The Project Consultant investigated this problem and submitted a report on remedial measure on 31 March 2005. In addition to this problem, the shifting of flow towards the other bank causes scarcity of flow to certain extent towards the end of monsoon rice crop season and mainly during the Winter Crop season, for which the farmers demand an alternative supplementary intake on the Kalapani Main Canal somewhere near the location of the presently defunct Silt Ejector. After several meetings with the concerned farmers, it has been jointly agreed that the project should

observe the operation of canals during this monsoon and winter crop season, before taking up appropriate remedial measures. It is advisable that the project should keenly monitor the operation of intake to observe the results, so that appropriate remedial measures may be implemented to resolve the problems.

(c) Concerns of People of Dodai Village about Flooding. The people of Dodai Village on the left bank of Singai River have been raising strong voice against the flooding of the area including their village right after the construction of the Headworks (HW) over this river for Panchgaon Main Canal system. They attribute the inundation to the construction of the HW. The outflanking of the HW by the river past the left abutment in the monsoon season following its construction apparently substantiated their opinion. The Project Consultant immediately after starting their services analyzed the design of the HW and submitted a report on 31 March 2005. As a result of the analysis, it was found that the crest of the weir is about 70 cm higher than is required to create necessary pond in order to supply required discharge in the Panchgaon Canal and that the weir could cause inundation in the upstream area because of inadequate waterway of the river. It was based on this finding that the Consultant designed a side spill-weir for 25% of the design flood discharge (60 m^3/s) in order to minimise the afflux, which was constructed last year. The critical design data of the HW weir and spill weir are as follows:

Weir crest Level	260.00 m
Spill-Weir Crest Level	259.30 m
Design HFL	260.80 m
HFL with Afflux	261.10 m
Bed Level of the River and Sluice Level	258.50 m

It is even after the construction of the side Spill-weir that inundation occurs and the local people continue raising voice against it. The Consultant has carried out further investigation into the problem. The observations on the problem are as described in the following paragraphs.

The design data indicate:

⇒ that given sufficient watercourse of the river there will not be significant inundation because of the discharge of this river alone; and

⇒ that there will be inundation when the discharge in this river is augmented by the inflow of Dolai River flood discharge via both Tikuligarh Link Canal and Panchgaon Link Canal that link Dolai River to Singai River in order to supplement the flow in the latter.

Whereas the following physical conditions of the river, apart from interception of drainage in sheet flow by the East West Highway, exacerbate the problem:

⇒ The river upstream from the East West Highway (EWH) and between this and the HW is in sharp meanders; and

⇒ The river waterway immediately upstream and downstream of the EWH crossing is about 10 m while the span of the Highway Bridge constructed presumably according to the original waterway of the river is 62.1 m.

⇒ Tikuligadh Link Canal and Panchgaon Link Canal connecting the Dolai River and Singai River at two locations upstream and downstream respectively of the EWH adds to the flooding over the area

⇒ Because of severe obstruction to the flow (only one of the three spans of the bridge is exposed to the river) of water passing through the Highway Bridge because of encroachment on river waterway, the river flow spills over the banks immediately downstream of the Bridge, before the impact of any other construction could reach this point, while the inundation is aggravated as a consequence of simultaneous flooding by Dolai River.

The review of the overall situations suggests that the inundation in the area around Singai River is the combined effects of the following:

- Afflux due to the Singai HW,
- Severe reduction in the waterway of the river due to encroachment,
- Simultaneous flooding by Dolai River via Tikuligarh Link Canal and Panchgaon Link Canal,
- Interception of drainage in sheet flow by the EWH, and
- The general ground level of the area on the left bank of Singai River and downstream of the Panchgaon Link Canal, where Dodai Village is situated, being lower than upper area by about one (1) m, the river water spilling over the left bank downstream of the EWH Bridge rushes towards Dodai Village.

The people of Dodai Village are emphasizing on chipping off the weir crest to about 259.30m (crest level of the side spill-weir). In this regard, it is obvious that if the weir crest is chipped off to this level, the afflux due to HW weir will be reduced to some extent but to an insignificant relief to the local people, without affecting the supply of required discharge in Panchgaon Canal. Thus, this action alone without proper attention to other influential factors is not going to absolutely prevent the flooding over the left bank of the Singai River Therefore, this problem of flooding should be looked into carefully with a global approach to the drainage system over the whole area between Dolai River and Singai River. Otherwise, an isolated treatment around only Dodai Village may generate adverse situation in the adjoining area instead of resulting in a curative solution to the problem.