

ASIAN DEVELOPMENT BANK

PCR:NEP 22126

PROJECT COMPLETION REPORT
ON THE
RAJAPUR IRRIGATION REHABILITATION PROJECT
(Loan: 1113- NEP[Sf])
IN
NEPAL

October 2003

CURRENCY EQUIVALENTS

Currency Unit	–	Nepalese rupee/s (NRe/NRs)	
		At Appraisal (October 1991)	At Project Completion (May 2001)
NRe1.00	=	\$0.0234	\$0.0133
\$1.00	=	NRs42.70	NRs74.97

The Nepalese rupee is pegged to the Indian rupee (Re) at NRs1.60 to Re1.00, and is fully convertible on all current account transactions. For calculations in this report, the exchange rate used is NRs76 to \$1.00, the rate prevailing at project completion.

ABBREVIATIONS

ADB	–	Asian Development Bank
BCC	–	branch canal committee
CFA	–	central farmers association
CFC	–	central farmers committee
DDC	–	district development committee
DOI	–	Department of Irrigation
EIRR	–	economic internal rate of return
FMIS	–	farmer-managed irrigation system
ha	–	hectare
ICB	–	international competitive bidding
km	–	kilometer
m (m ²)	–	meter (square meter)
O&M	–	operation and maintenance
PCR	–	project completion report
PMC	–	project management committee
POP	–	project operation plan
TA	–	technical assistance
WUA	–	water users association

NOTES

- (i) The fiscal year (FY) of the Government ends on 15 July. FY before a calendar year denotes the year in which the fiscal year ends. For example, FY2003 ends on 15 July 2003.
- (ii) In this report, "\$" refers to US dollars.

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BASIC DATA

A. Loan Identification

1.	Country	Nepal
2.	Loan Number	1113-NEP(SF)
3.	Project Title	Rajapur Irrigation Rehabilitation Project
4.	Borrower	His Majesty's Government of Nepal
5.	Executing Agency	Department of Irrigation (DOI)
6.	Amount of Loan	SDR12,152,000 (equivalent to \$16.62 million at the time of appraisal)
7.	Project Completion Report Number	PCR:NEP 772

B. Loan Data

1.	Appraisal	
	- Date Started	17 April 1991
	- Date Completed	24 April 1991
2.	Loan Negotiations	
	- Date Started	1 October 1991
	- Date Completed	2 October 1991
3.	Date of Board Approval	31 October 1991
4.	Date of Loan Agreement	14 January 1992
5.	Date of Loan Effectiveness	
	- in Loan Agreement	13 April 1992
	- Actual	21 April 1992
	- Number of Extensions	One
6.	Closing Date	
	- In Loan Agreement	30 June 1998
	- Actual closing of account	23 May 2001
	- Number of Extensions	One
7.	Terms of Loan	
	- Interest Rate	1% per annum
	- Maturity (number of years)	40 years
	- Grace Period (number of years)	10 years
8.	Terms of Relending (if any)	None

9. Disbursements

a. Dates

Initial Disbursement	Final Disbursement	Time Interval
25 February 1993	22 March 2001	96 months
Effective Date	Original Closing Date	Time Interval
21 April 1992	30 June 1998	74 months

b. Amount (in SDR)

Category	Original Allocation	Loan Reallocation (at midterm review)	Loan Reallocation (1998)	Last Revised Allocation	Amount Disbursed
Civil Works					
Parts A1 and B1 (FX)	3,885,000	1,899,000	4,492,810	4,796,150	4,796,150
Parts A1, and B1 (LC)	2,729,000	1,964,000	3,984,190	4,253,188	4,253,188
Parts A2, B2, B3, C (FX)	1,848,000	707,000	665,510	558,991	558,991
Parts A2, B2, B3, C (LC)	444,000	451,000	425,490	354,028	354,028
Part A3, B4 (FX)	112,000	3,124,000	147,070	181,623	181,623
Part A3, B4 (LC)	577,000	1,084,000	43,930	54,251	54,251
Part A4 (LC)		81,000	–	20,798	20,798
Equipment and Vehicles (FX)	175,000	153,000	183,000	207,979	207,979
Consulting Services (FX)	524,000	783,000	954,800	965,847	965,847
Consulting Services (LC)	304,000	343,000	409,200	413,934	413,934
Incremental O&M Cost (FX)	51,000	59,000	51,600	18,186	18,186
Incremental O&M Cost (LC)	20,000	236,000	34,400	58,234	58,234
Unallocated (FX)	723,000	593,000	463,125	0	0
Unallocated (LC)	452,000	367,000	11,875	0	0
Service Charge (FX)	308,000	308,000	285,000	268,787	268,787
Total	12,152,000	12,152,000	12,152,000	12,152,000	12,152,000

– = not applicable, FX = foreign exchange cost, LC = local currency cost, O&M = operation and maintenance.

10. Local Costs (Financed)

	Estimate			Actual
	Appraisal	Revised (Midterm)	Revised (1998)	
- Amount (\$'000)	6,190	6,810	5,180	3,056
- Percent of Local Costs	60%	60%	55%	44%
- Percent of Total Cost	30%	30%	25%	15%

C. Project Data

1. Project Cost (\$'000)

Cost	Estimate			Actual
	Appraisal	Revised (Midterm)	Revised (1998)	
Foreign Exchange Cost	10,433	11,443	11,079	13,540
Local Currency Cost	10,285	11,306	9,442	6,889
Total	20,718	22,749	20,521	20,429

2. Financing Plan (\$'000)

Cost	Estimate									Actual		
	Appraisal			Revised (midterm)			Revised (1998)			Foreign	Local	Total
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total			
ADB	10,433	6,191	16,624	11,443	6,810	18,253	11,079	5,180	16,259	13,540	3,056	16,596
Government	0	2,237	2,237	0	2,236	2,236	0	2,132	2,132	0	2,325	2,325
Farmers	0	1,857	1,857	0	2,260	2,260	0	2,130	2,130	0	1,508	1,508
Total	10,433	10,285	20,718	11,443	11,306	22,749	11,079	9,442	20,521	13,540	6,889	20,429

ADB = Asian Development Bank.

3. Cost Breakdown by Project Component (\$'000)

Component	Estimate									Actual		
	Appraisal			Revised (midterm)			Revised (1998)			Foreign	Local	Total
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total			
Irrigation Improvements												
Civil Works												
Intakes		170	2,262	2,432	490	340	830					
Budhi-Kulo Main Canal	4,646	4,453	9,099	4,476	3,062	7,538	2,867	1,388	4,255	4,201	692	4,893
System												
Eastern Systems	0	0	0	1,870	1,023	2,893	3,923	1,447	5,370	4,946	1,505	6,451
Branch Canal	1,549	1,076	2,625	498	1,548	2,046	0	1,745	1,745	0	1,848	1,848
Structures												
Service Roads	2,352	1,189	3,541	1,956	2,585	4,541	2,486	1,657	4,143	2,221	1,754	3,975
Project Offices and	167	38	205	167	38	205	0	192	192	0	120	120
Quarters												
Equipment and Vehicles	252	10	262	252	12	264	245	14	259	291	8	299
Surveys and	36	150	186	35	205	240	0	144	144	0	107	107
Investigations												
Recurrent Cost	78	440	518	97	2,158	2,255	0	2,321	2,321	26	467	493
Land Acquisition	0	344	344	0	25	25	0	30	30	0	37	37
Consulting Services	762	323	1,085	1,140	310	1,450	1,177	504	1,681	1,492	351	1,843
Service Charge	421	0	421	462	0	462	381	0	381	363	0	363
Total	10,433	10,285	20,718	11,443	11,306	22,749	11,079	9,442	20,521	13,540	6,889	20,429

4. Project Schedule

Item	Appraisal Estimate	Actual
Consulting Services		
- Date of Contract with Consultants	Apr 1992	10 Dec 1993
- Date of Completion	Jul 1997	21 Mar 2001
Civil Works		
Project Office and Staff Quarters		
- Date of Award	Jun 1992	28 May 1993
- Completion of Work	Aug 1993	30 Jun 1999
Irrigation System Improvement		
- Date of Award	Jun 1992	1 Dec 1996
- Completion of Work	Jun 1997	31 Aug 1999
Road Construction		
- Date of Award	Jun 1992	21 Feb 1996
- Completion of Work	Jun 1997	30 Apr 2000
Equipment and Vehicles		
- First Procurement	Mar 1993	6 Mar 1992
- Last Procurement	Jun 1993	21 Feb 1999
Other Milestones		
- Reallocation of Loan Proceeds (first reallocation)		8 Dec 1995
- Reallocation of Loan Proceeds & Extension of Loan Closing Date		6 Mar 1998
- Actual Loan Closing Date		23 May 2001

5. Project Performance Report Ratings

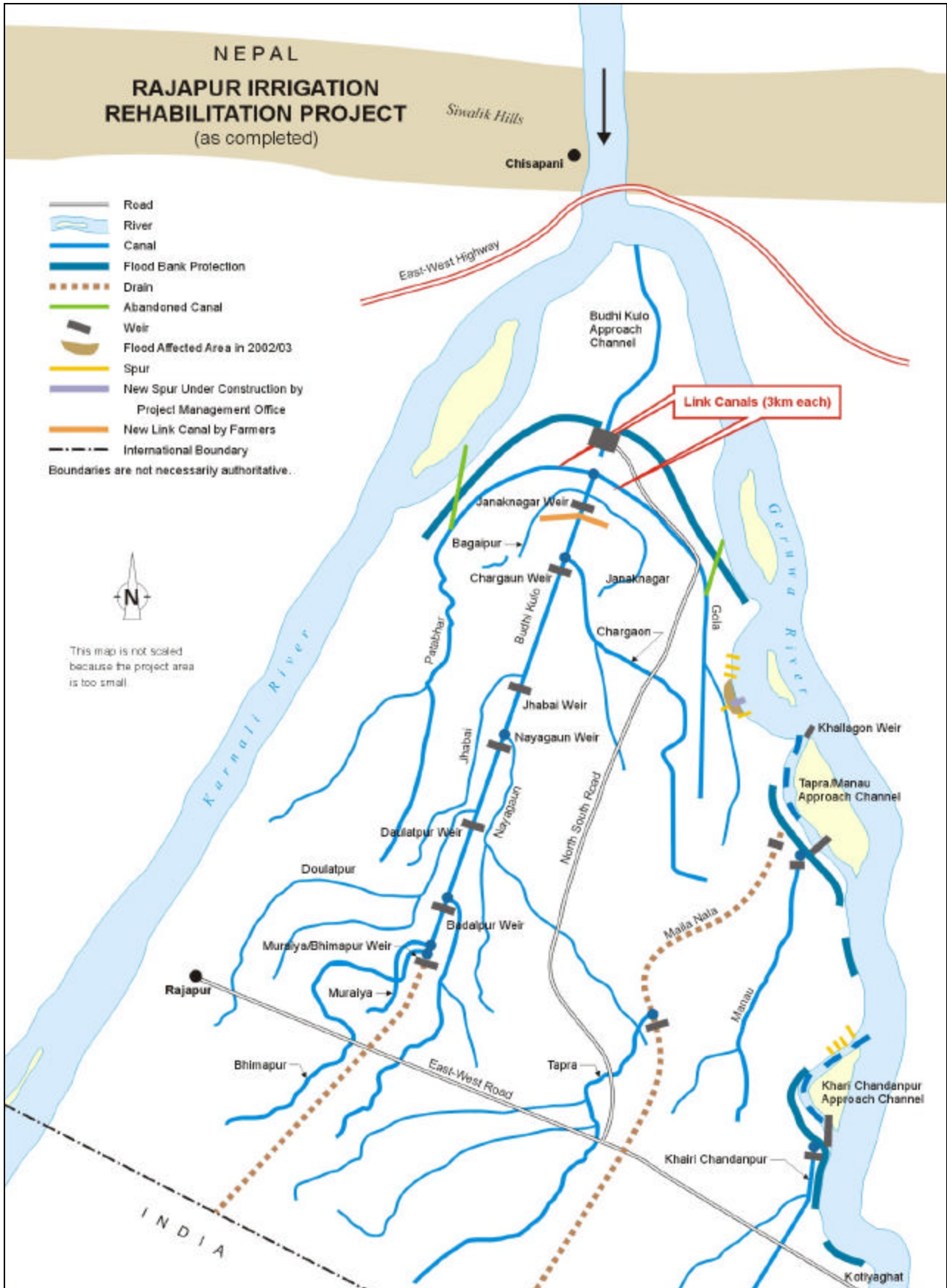
Implementation Period	Ratings	
	Development Objectives	Implementation Progress
From 1 January 1993 to 31 December 1993	Satisfactory	Satisfactory
From 1 January 1994 to 31 December 1994	Satisfactory	Satisfactory
From 1 January 1995 to 31 December 1995	Satisfactory	Satisfactory
From 1 January 1996 to 31 December 1996	Satisfactory	Satisfactory
From 1 January 1997 to 31 December 1997	Satisfactory	Satisfactory
From 1 January 1998 to 31 December 1998	Satisfactory	Satisfactory
From 1 January 1999 to 31 December 1999	Satisfactory	Satisfactory
From 1 January 2000 to 31 December 2000	Satisfactory	Satisfactory

D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members ^a
Loan Reconnaissance	8 – 15 Aug 1990	2	14	a, b
Fact-Finding	27 Jan – 8 Feb 1991	6	78	a, b, c,d,e,f
Appraisal	17 – 24 Apr 1991	5	44	a,b,g,c,h
Inception	3 – 10 Feb 1993	1	7	a
Special Project Administration 1	26 Sep – 2 Oct 1993	1	6	i
Review Mission 1	18 – 24 Nov 1993	2	12	a,j
Review Mission 2	6 – 14 Dec 1994	2	16	a,j
Midterm Review	7 – 21 Nov 1995	4	34	b,j,a,k
Consultation Mission	22 – 25 Dec 1995	1	3	l
Special Project Administration 2	20 – 27 May 1996	1	7	b
Review Mission 3	18 – 27 Nov 1996	2	18	b,j
Review Mission 4	17 – 26 Nov 1997	2	18	m,j
Special Project Administration 3	21 – 27 May 1998	1	6	m
Review Mission 5	2 – 10 Dec 1998	2	16	m,j
Review Mission 6	10 – 12 Mar 1999	2	4	m,b
Review Mission 7	4 – 13 Dec 1999	2	18	a,j
Review Mission 8	10 – 19 Dec 2000	2	18	a,j
Project Completion Review ^b	5 – 26 May 2003	4	70	b,j,n,o

^a a - Project Engineer, b - Project Economist, c - Program Officer, d - River Hydraulic Expert/Staff Consultant, e - Agro-Economist/Staff Consultant, f - Rural Sociologist/Staff Consultant, g - Counsel, h - Community Irrigation Specialist/Staff Consultant, i - Consulting Services Specialist, j - Assistant Project Analyst, k - Senior Project Specialist, l - Project Implementation Officer, m - Financial Analyst, n - Irrigation Management Specialist/Staff Consultant, o - Socioeconomic Specialist/Staff Consultant

^b The project completion report was prepared by Jiangfeng Zhang, Economist.



I. PROJECT DESCRIPTION

A. Introduction

1. The Board of the Asian Development Bank (ADB) approved the Rajapur Irrigation Rehabilitation Project¹ (the Project) on 31 October 1991 with a loan of special drawing rights (SDR) 12.2 million (\$16.6 million equivalent at the time of appraisal). The loan became effective on 21 April 1992, and was closed on 23 May 2001. An advisory technical assistance (TA) of \$650,000 was approved in conjunction with the loan to strengthen the institutional and technical capabilities of water users associations (WUAs). The Executing Agency is the Department of Irrigation (DOI) of the Ministry of Water Resources.

B. Background and Rationale

2. The traditional Rajapur irrigation scheme comprises a group of six farmer-managed irrigation systems (FMISs), with a total area of about 15,800 hectares (ha), in the mid-western Terai of Nepal.² The largest and oldest of these, the Budhi Kulo, served about 8,000 ha and is one of the largest farmer-managed systems in Asia. The other five systems (Patabhar, Gola, Tapra/Maila, Manau, and Khairi Chandanpur) are smaller (up to 2,400 ha) and more recently established. These systems have been built up gradually over years, and have adapted to changing requirements including extension of the irrigated area, intensification of agriculture, and coping with flood damage and changes in the river morphology.

3. The indigenous irrigation system was built entirely by the farmers and had no permanent structures. Taking water from the Karnali River, which is an aggressive and unpredictable gravel-bed river that changes its course each year, the system suffered from severe periodic flood damage. This ADB-assisted rehabilitation project was intended to alleviate this damage, and to improve the efficiency of irrigation. Taking into account experiences obtained in implementing the ADB-assisted Irrigation Sector Project,³ the Project was planned with a strong emphasis on beneficiary participation.

C. Objectives and Scope

4. To bring about sustainable economic development in the project area, the project objectives as determined at appraisal were (i) increasing agricultural production and farm income, (ii) halting the loss of irrigated land caused by river capture and river bank erosion, (iii) reducing environmental degradation through less reliance on forest products for the repair of the irrigation system, and (iv) strengthening the institutional base and technical capabilities of the existing farmers organizations.

5. The project scope was to (i) rehabilitate, improve, and unify six existing FMISs; (ii) upgrade 37.5 kilometers (km) of roads, including a 60-meter (m) long bridge, to improve farmers' access to major market centers, and to enable effective operation and maintenance (O&M) of the new irrigation facilities; and (iii) provide consulting services for project implementation.

6. At appraisal the Project was to comprise four components:

- (i) **Irrigation system improvements and associated works.** Three kinds of civil works were proposed: (a) replacing the temporary intake for the Budhi Kulo

¹ ADB. 1991. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan and a Technical Assistance Grant to the Kingdom of Nepal for the Rajapur Irrigation Rehabilitation Project*. Manila.

² The Terai is an ecological zone located in southern Nepal and northern India, an extension of the Indo-Gangetic plain.

³ ADB. 1988. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan and a Technical Assistance Grant (UNDP-Financed) to the Kingdom of Nepal for the Irrigation Sector Project*. Manila.

- irrigation system by an ungated permanent structure, and connecting the remaining five irrigation systems to the Budhi Kulo main canal with their intakes closed; (b) replacing the brushwood and boulder weirs in the Budhi Kulo by three concrete weirs with sluice gates and ancillary off-take structures; (c) replacing the temporary branch canal structures by concrete, masonry, or gabion structures.
- (ii) **Service roads.** This component was to (a) upgrade and provide 24 km of village roads with culverts and small bridges, (b) provide road crossings over the three proposed weirs in the Budhi Kulo, and (c) upgrade 13.5 km of road from Rajapur to Kothiyagat including a 60 m long bridge over the Budhi Kulo.
 - (iii) **Consulting services for project implementation.** 39 person-months of international and 77 person-months of domestic consulting services were to be provided to assist with the surveys, detailed design, documentation, and construction supervision.
 - (iv) **Project implementation facilities.** The Project was to establish one permanent project office building, construct quarters for project staff and consultants, and provide equipment and vehicles.

D. Technical Assistance

7. TA 1589–NEP: Institutional Support for Project Implementation was associated with the loan to strengthen the institutional and technical capabilities of WUAs for sustainable O&M and to facilitate their active participation in the Project. The TA was to (i) define the function of, and establish a project management committee (PMC); (ii) establish procedures to improve O&M of the irrigation system; and (iii) train farmer organizations and selected farmers in planning, design, construction supervision, and irrigation management including crop-water management. A TA completion report is in Appendix 1.

E. Project Reformulation

8. ADB and the Government signed the loan agreement on 21 April 1992. However, there were no implementation activities for 2 years. The Loan Agreement mandated that no implementation activities under the Project could be started unless the agreement between the DOI and the Central Farmer Association (CFA) had been signed. Issues of land compensation and farmers' contribution arising from the enforcement of a new irrigation policy led to delays in signing the agreement, and consequently all the other implementation activities were delayed.

9. The key feature of the Project is that it required farmers to be effectively involved in the Project from the initial planning stage up to construction and their assumption of O&M after completion. After the signing of the DOI-CFA Agreement on 10 January 1994 and the fielding of the implementation consultants on 15 January 1994, a great deal of work was done on informing farmers about the Project, gaining feedback on their views and requirements, and studying the technical aspects of the Project. Geotechnical and topographical surveys were also undertaken. These activities all led to the conclusion that the project design needed to be reformulated. The two main reasons for the redesign were as follows:

- (i) The implementation schedule specified in the appraisal turned out to be not realistic enough. It did not adequately take into account the lead-time required for institution-building activities, given the size and complexity of the Project and the farmer-participatory approach adopted for the Project. Ample time was required to inform and educate farmers about the Project and, in turn, for them to fully understand the Project.
- (ii) The river behavior in the project area changed significantly since appraisal. This change necessitated additional investigation and surveys, detailed review of the

design of the system, and going back to farmers to inform them about the Project as well as to reconfirm their requirements and preferences for the Project.

10. After intensive consultation with farmers and in accordance with morphological changes in the rivers, the following changes were made in the project design:
- (i) establishing four separate main systems instead of a single integrated system envisaged under the original design;
 - (ii) undertaking river training and flood protection works, instead of closing the river channels and plugging the temporary intakes;
 - (iii) adjusting canal structures including constructing weirs at each branch canal off-take;
 - (iv) constructing additional link roads to intakes and weirs; and
 - (v) building a seasonal pontoon bridge to connect the project area with district headquarters and nearby cities, where previously access had relied on ferries.

The changes were requested by farmers through the PMC and approved by ADB on 13 December 1995 following the midterm review mission. The changes were to make the Project more practical and cost effective. The loan closing date was subsequently extended from 30 June 1998 to 31 December 2000. This extension along with the related reallocation of loan proceeds was approved by ADB in March 1998.

II. EVALUATION OF DESIGN AND IMPLEMENTATION

A. Relevance of Design and Formulation

11. ADB's Country Operational Strategy for Nepal manifests poverty reduction as the major goal. Given the extreme and widespread poverty in the country, ADB identified (i) reducing poverty by generating income and employment for the rural poor, and (ii) enhancing agricultural productivity and production in the Terai and accessible areas in the hills, as two of its sectoral objectives. In pursuit of the objectives, ADB identified a number of key strategic approaches, including (i) rural road and irrigation infrastructure, particularly FMISs, to increase productivity; and (ii) capacity building to increase resource utilization and productivity. Beneficiary participation in the design and implementation was emphasized as an integral part of ADB's strategy. Thus, the Project was highly consistent with ADB's strategy and program for Nepal.

12. The Government accorded poverty reduction its foremost priority as well. At the time of the project appraisal, the Government's Eighth Five-Year Development Plan (1992-1997) was to increase agricultural production through the use of irrigation technology appropriate to the climate and soil conditions with no or little adverse impact on the environment. In the Government's Irrigation Policy of 1992, there were several main features to which the Project was relevant, including (i) carrying out irrigation development in a cost-effective way that is also sustainable from the technical, financial, institutional, and environmental perspective; (ii) reducing Government involvement in the construction and O&M of irrigation schemes by involving beneficiary participation; and (iii) strengthening farmers' WUAs to enable them to continue O&M of improved FMISs. Therefore, the Project was highly relevant and consistent with the country's development objectives, approach, and strategy.

13. The project design was highly relevant in its consideration of farmers' struggle against (i) the harsh and extreme river morphology of the Karnali River, (ii) devastating floods, (iii) prevailing situation of no permanent infrastructure, (iv) progressive erosion of fertile land and forests, (v) lack of forest products for repairing temporary irrigation structures, (vi) virtually no access to markets, (vii) weak productive base, and (viii) severe poverty in the project area. During the midterm review, the project design was reformulated to further take into consideration farmers' requirements on

separate intakes for different systems so that these systems can work independently instead of depending on one system as proposed at appraisal, larger scope of flood protection works, and a seasonal pontoon bridge to replace the ferry across the Geruwa River. The reformulation enhanced farmers' ownership of the Project and increased their incentive to participate in implementing and maintaining the Project.

14. At the time of the project preparation and reformulation, irrigation infrastructure development itself was considered adequate for increasing agricultural production. No efforts have been made to increase the efficiency of water management at the farm level. Though the loan covenants stipulated that farmers should be ensured timely access to the necessary agricultural support services and credit, no provisions were designed and implemented on agricultural development activities under the Project. The absence of integrating these two elements with the Project has hindered farmers' taking full advantage of the improved irrigation facilities to increase crop production.

15. The TA on the institutional support was also highly relevant. Through a series of training and workshops, the TA organized and strengthened farmers along the project line to enable them to participate effectively in project implementation. Training in O&M was provided for farmers so that they can assume O&M responsibilities. Unfortunately only irrigation leaders and village heads have attended these training sessions, and most of them left the project area after project completion due to the insurgency problem that affected Rajapur severely. The ordinary farmers' lack of training on O&M has made them unaware of functions of some constructed irrigation structures and resulted in their misuse (paras. 19 and 37).

B. Project Outputs

16. At project completion, 100% of the civil work targets at the time of reformulation were achieved. Appendix 2 compares the project achievements to the appraisal estimates and the revised targets. Following the reformulation the number of intakes was increased from 1 at appraisal to 4 at completion. In the Budhi Kulo, the number of weirs was increased from 3 at appraisal to 7. The 14 km long earthen bund protection work in the Budhi Kulo anticipated at appraisal was replaced by 18 km long gabion protection works comprising stud revetment works and spurs in all four systems at completion. In addition, a 145.3 m span seasonal pontoon bridge that was not provisioned for at appraisal was also constructed. In terms of the proportions of physical work done, about 35% of the Project was for the irrigation system, 25% for improved access and 40% for flood protection. Two thirds of the irrigation improvements were devoted to the main intakes and weirs, and one third to the small branch canal structures.

1. Irrigation System Improvements

17. The Project constructed the following major irrigation infrastructure:
- (i) an ungated permanent intake structure for the Budhi Kulo that could restrict the discharge into the irrigation system at high flood levels;
 - (ii) seven weirs and eleven branch canal gated off-take structures in the Budhi Kulo system to replace the traditional brushwood and gabion weirs; and
 - (iii) three gated intake structures for Tapra/Maila, Manau, and Khairi Chandanpur systems.

The project completion review mission found all these intakes, gated off-takes, and gabion weirs to be intact and working effectively. Along the branch canals inside the four systems, 300 concrete structures were constructed. Of the 300 structures, 246 are regulating and tertiary off-take structures including cross regulators, head regulators, and pipe off-takes. The remaining 54 are aqueducts, fall structures, escapes, and drain underpasses.

18. Because of the natural instability of the Karnali riverbed, no permanent works were done in the upper half of the approach channel of the Budhi Kulo. Farmers need to restore and relocate it as necessary each year to ensure the river flow into the Budhi Kulo. However, in 2001 and 2002, due to political disturbance, local administration imposed various restrictions and farmers could not mobilize to excavate the approach channel. In the meantime, the Karnali River totally diverted itself to the eastern side with deep scouring of riverbeds. The flow in the Budhi Kulo approach channel was reduced dramatically, and farmers from the Budhi Kulo system suffered severe water scarcity and siltation problems.

19. The siltation problem has existed since the beginning of the indigenous system. In the last 2 years, because of the water scarcity caused by drought, diversion of the river course, and farmers' inability to mobilize to clean up the approach channel due to the insurgency, farmers from the Budhi Kulo system were desperate to get water into their own branch canals; they indented the crests of many cross regulators, head regulators, and off-takes due to lack of awareness of how to operate these structures. About 38% of such branch structures have been damaged to different extents. Unaware of the function and operation, farmers dismantled the gabion silt diverting vanes in the Janaknagar weir that links to four branch canal off-takes. Farmers from Patabhar even cut and dismantled about 10 m wide river protection works at the old Patabhar channel site to attract additional inflow of water. All these actions caused intrusion of more silt into branch canals.

20. In 2003 so far, with improved security in the project area, farmers have excavated the Budhi Kulo approach channel, and there was the required amount of water for all branch canals. As a comparison, the other three systems, which were proposed at appraisal to unite with the Budhi Kulo, faced much less siltation and water scarcity problems. A significant improvement was observed at the Khairi Chandanpur system. Before the Project, this system suffered from low flow in monsoon season and virtually no flow during the dry season. Since project completion, there has been sufficient flow of water in the Khairi Chandanpur, even in the years when the Budhi Kulo was suffering water scarcity.

2. Flood Protection Works

21. Eighteen km of flood protection works at selected locations along the flood-vulnerable banks of Karnali and Geruwa rivers were completed to reduce the risk of overland flows into canals and erosion of the banks by the river, which lead to capture of canals. In addition, upstream and downstream banks of intake and weir structures in the 4 irrigation systems were also protected by river training works. All these flood protection works were found to be intact and working effectively except for the 10 m cut-open at the old Patabhar channel site as mentioned in para. 19, an outflanked spur in Gola, and a partly damaged spur in Parseni. (Both spurs were broken while protecting the local area from floods.) Farmers have been repairing the damaged spurs as observed by the project completion review mission. The cut-open in Patabhar should be plugged and protected immediately since the flood may come anytime during the monsoon season.

3. Roads and Bridges

22. A total of 39.5 km of service roads (27 km of the north-south road and 12.5 km of the east-west road) were built to connect the entire project area with the marketing center of Rajapur and with the district headquarters. Access roads connecting village roads to these two roads were also constructed. Along the road all the water crossings were provided with permanent culverts or bridges. The east-west road is a double lane gravel road that was designed to withstand a much higher traffic volume in the future. Along the east-west road, there are 50 pipe culverts, 22 slab culverts, 8 reinforced concrete box culverts, 1 escape, and 3 bridges ranging from 14 m to 60 m.

Along the north-south road, the Project constructed 105 structures including 86 pipe culverts, 16 slab culverts, 1 box culvert, and 1 bridge.

23. Both roads and ancillary structures are functioning well. The upstream and/or downstream road approaches of major structures on the east-west road were excavated and damaged during the insurgency. Though these cut portions were refilled with earth and gravel, refills have been gradually washed away, leaving the road quite rough at those locations.

24. A seasonal pontoon bridge of 145.3 m span was constructed on the Geruwa River to connect the project area with national road network and outside markets. Operating after the monsoon season, generally from November to the first week of May, the pontoon bridge has been working effectively since its completion.

4. Buildings

25. One project office, 7 staff quarters, and 2 garages were built. Though of high quality as constructed, most of these buildings were destroyed in the insurgency. Security personnel currently inhabit the compound of the project office.

C. Project Costs

26. The estimated project cost at appraisal was \$20.72 million equivalent, inclusive of physical and price contingencies, taxes and duties, and interest and service charges during construction. The loan was for \$16.62 million equivalent; the Government was to provide another \$2.24 million, and the farmers' contribution was to be \$1.86 million. The project reformulation and loan reallocations estimated a total project cost at \$20.52 million equivalent with ADB's share at \$16.26 million, the Government's share at \$2.13 million, and the farmers' contribution at \$2.13 million. The actual project cost (Appendix 3) was \$20.43 million equivalent with an ADB loan \$16.60 million, Government contribution of \$2.32 million, and farmers' contribution \$1.51 million. The foreign exchange cost was at \$13.54 million, or about 66% of the total actual cost. The local currency cost was at \$6.89 million equivalent, or about 34% of the total actual cost.

27. There was no cost overrun. The loan reallocation with the project reformulation and loan savings from exchange rate fluctuations and competitive bidding enabled the construction of additional works including the seasonal pontoon bridge and extra intakes, weirs, and river training works. The overall costs and ADB financing were in line with the appraisal estimate. The design change did not entail any additional financing from ADB.

D. Disbursements

28. A total of \$16.60 million was disbursed through the loan. The loan account was closed on 23 May 2001. Appendix 3 shows project costs by year, and Appendix 4 shows how the ADB loan proceeds were used. The establishment of an imprest account with Nepal Rastra Bank facilitated project implementation.

E. Project Schedule

29. At appraisal the Project was scheduled to begin in early 1992 and be completed at the end of 1997. Construction works were to be carried out over a period of 4 years. The project surveys and designs were initialized in 1994. During the midterm review the implementation schedule was revised to take into account the design modifications and the delays that had already been encountered as mentioned in paras. 8–10. Constructions on the irrigation structures commenced in the second quarter of 1996 and proceeded in accordance with the revised layout smoothly.

Effective participation by beneficiaries and DOI in preparing the revised layout was crucial for ensuring smooth implementation. All the civil works were completed by 30 April 2000. The actual time for civil works took 4 years, remaining the same as the appraisal estimate. Consultants worked until 21 March 2001 in preparing the O&M manual, helping the Government to prepare a project completion report (PCR) and project operation plan (POP). Appendix 5 shows the actual project implementation schedule, compared to the appraisal plan and the revision with project reformulation.

F. Implementation Arrangements

30. The implementation arrangements laid down in the appraisal and revised with project reformulation were followed satisfactorily. The PMC, chaired by the project manager but with a majority of farmer representatives, was set up to share project implementation responsibilities. Farmers were consulted on the magnitude of assistance needed, and they were involved directly in preparing, designing, and implementing the Project.

31. Major civil works were implemented by international contracts. Small structures on the branch canals were built by local contracts, with some contribution by the farmers. Farmers also participated in interim works, incremental O&M during construction, and earthworks for the north-south road and branch canals.

32. At the end of project implementation, the Government prepared a 3-year POP to continue supporting the Project up to 15 July 2004. The Mountain Resources Management Group, a local nongovernment organization that has coordinated with the Project for a while on monitoring, documentation, and farmer support, was also asked to continue its activities. However, due to the insurgency just after project completion, both the project staff and the MRMG withdrew from the project area and were unable to implement all the planned benefit-enhancing activities. This year (2003) with an improved security situation, DOI inspected the project infrastructures and decided to extend the POP for another 2 years until 15 July 2006.

G. Conditions and Covenants

33. All the covenants of the loan agreement were assessed as relevant considering the purpose and implementation requirements of the Project. Most covenants were complied with (Appendix 6). The covenant relating to the key staff composition (schedule 6, para. 17) was partly complied with due to the absence of the agricultural engineer. The covenant that the Department of Roads should send a road engineer to assist in the implementation of the east-west road (schedule 6, para. 18) was not implemented, and the road engineer in the implementation consultant team supervised the works on the roads. The Government still needs to comply with several covenants to ensure that (i) CFA will assume the full O&M responsibilities for the irrigation facilities with necessary training and technical supports and regular inspections from DOI (schedule 6, paras. 27–29 and 31); and (ii) concerned farmers have timely access to the necessary agricultural support services and credit to enable them to take full advantage of the increased potential for crop production as a result of the improved irrigation facilities (schedule 6, para. 34). These covenants relate to activities that the Government could not do after project completion due to the insurgency in the project area. It was agreed that with improved security situation, the Government would comply with the covenants within the extended period of DOI's POP ending on 15 July 2006.

H. Related Technical Assistance

34. The TA consulting service contract was signed on 14 January 1992 and the consultants commenced work in November 1992. A series of interrelated activities were carried out to strengthen the capacity of WUAs and farmers.

35. The TA satisfactorily achieved the objective of helping to establish an institutional base for facilitating farmers' active and effective participation in project implementation. A socioorganizational profile was prepared as a benchmark to develop suitable strategies to strengthen the central farmers committee (CFC) of WUAs and form branch canal committees (BCCs) as unit organizations. WUA organizational structure and rules and regulations were prepared, and in a meeting all the CFC members pledged to abide by the rules and procedures. The institutional framework enlarged CFC membership for greater representation of farmers. Noticeably the CFC became more self-assured after undergoing a series of training and capacity-building programs. Its active role in the PMC made the project more responsive to farmers' needs and aspirations. Changing the alignment of the north-south road, constructing more river protection works, taking leadership to conduct PMC meeting in the absence of the project manager during the insurgency, raising money to hire operators, and persistent efforts and willingness to operate the pontoon bridge are some examples of the increased strength of CFC.

36. Farmers' awareness and understanding of the Project was raised by an extensive information campaign, and their skills were upgraded by undertaking a series of consultations, training, and workshops. Training on gabion weaving helped farmers acquiring new skills, enabled the Project to award the gabion weaving works to BCCs in rotation without seeking gabion weavers outside the area, and allowed BCCs to build their capital for emergency repairs. Training on construction techniques helped improve the quality of earthworks accomplished by farmers. The trained farmers were able to transfer the skills to other farmers.

37. The TA strengthened technical capabilities of farmers to operate and maintain the improved irrigation structures. Farmers were organized at three levels to facilitate O&M (i) CFC encompassing the entire project area, (ii) 4 WUAs operating the 4 independent canal systems, and (iii) BCCs at branch levels. The TA consultants developed and provided 4 O&M training modules based on the O&M manual prepared by implementation consultants (i) systems layout, O&M organizational structure, O&M requirement and roles of WUAs; (ii) O&M of approach channels, weirs, flood protection works, and intakes; (iii) O&M of branch canal structures; and (iv) on-farm water management and crop production. The implementation consultants also conducted field training to disseminate O&M guidelines. However, whatever training was implemented, it was provided to irrigation and village leaders, but most of them have either resigned or left the project area, which was severely affected by the insurgency. The absence of project staff and insufficient O&M training to ordinary farmers were reflected by farmers' misuse of constructed irrigation structures and facilities. The importance of "learning by doing" should also be realized. As farmers are used to the traditional O&M methods, it takes time for them to understand and apply correctly and effectively the O&M training in practice. In summary, a good O&M institutional framework has been established, but its full operation to ensure sustainability, efficiency, and equitability of irrigation water management needs DOI's continuous monitoring, technical support, and interaction with farmers.

I. Consultant Recruitment and Procurement

38. Appendix 7 summarizes consulting services. Consultant recruitment was in accordance with ADB's *Guidelines on the Use of Consultants*. The implementation consultants commenced work on 15 January 1994 and completed the assignments by 21 March 2001, having provided 67

person-months of international and 128 person-months of domestic consulting services. The TA consultants were responsible for institutional development activities from November 1992 to December 2000 with 23 person-months of international and 127 person-months of domestic consulting services.

39. Following ADB's *Guideline for Procurement*, DOI procured goods for various components using direct purchase, direct contribution by beneficiaries, international shopping, and local competitive bidding. The pontoon bridge was procured on a design and construct basis by international competitive bidding (ICB) because of its unusual nature. No significant problem was encountered by following proper modes of procurement, packaging contracts, preparing tender documents, and evaluating bids. Appendix 8 lists the procurement and current usage of project buildings, equipment, and vehicles. These procured goods were sufficient for smooth project implementation. After project completion the operational vehicles and equipment are in use by various branch offices of DOI following standard ADB and government procedures.

J. Performance of Consultants, Contractors, and Suppliers

40. The close supervision and monitoring of civil works by the implementation consultants and the pertinent institutional development activities from the TA consultants were instrumental for successful implementation of the Project. Both consultant teams maintained continuity of key staff throughout the project period and completed their assignments satisfactorily and on schedule. The performance of consultants was satisfactory.

41. There were four contractors by ICB and three by local competitive bidding. Performance of all the ICB contractors was satisfactory. The ICB1 contractor (for the east-west road) and the ICB2 contractor (for the Budhi Kulo intake, flood protection works, and the north-south road) progressed slowly initially. Both contractors were able to gradually speed up and finally delivered high-quality works under a reasonable time extension. The other two contractors ICB3 (for the Budhi Kulo weirs, off-takes and flood alleviation works) and ICB4 (for the pontoon bridge) completed their works on schedule with excellent quality. Domestic contractors worked on the branch canal structures. In general, the quality of the branch structures was good. The performance of domestic contractors was assessed as partly satisfactory, however, considering the preparation of construction drawings, arrangement of construction, interaction with site engineers, and some construction problems observed by the project completion review mission like shallow depth of foundation cutoff. The suppliers of goods performed satisfactorily by providing good quality equipments and materials.

K. Performance of the Borrower and the Executing Agency

42. The Borrower provided the Project with adequate local funds on an annual basis. Some delay in annual program approval and budget release by the Ministry of Finance was noticed, but it did not significantly affect project implementation. DOI appointed a full-time project manager and provided a core of key staff (except for the agricultural engineer as mentioned in para. 33) experienced in farmer participation in irrigation projects. Most key staff were retained by the Project during the design and construction periods. The staff were familiar with ADB procedures. They heeded farmers' genuine requests and were enthusiastic about augmenting farmers' participation in project implementation. The established PMC proved to be an effective body, and ensured good participation of various stakeholders in overall planning, selection of the type and location of works, and management of contracts and voluntary labor.

43. The Borrower complied satisfactorily with accounting, financial reporting, procurement, and progress reporting. The overall performance of the Borrower and the Executing Agency was assessed as satisfactory.

L. Performance of the Asian Development Bank

44. ADB fielded a total of 14 missions, including three special project administrations and a midterm review, with proper timing, composition, and actions. All the missions monitored the project and TA activities closely and had interactive meetings with consultants, stakeholders, and project staff. ADB was flexible in facilitating implementation to overcome emerging problems, including (i) reformulating the project in 1995, (ii) agreeing to use statement of expenditure procedures and imprest funds to expedite implementation, and (iii) reallocating funds to accommodate the construction of a seasonal pontoon bridge and additional flood protection works. The performance of ADB including its Nepal Resident Mission has been efficient and satisfactory.

III. EVALUATION OF PERFORMANCE

A. Relevance

45. Overall, the Project was rated as highly relevant. The project design was highly relevant to the Government and ADB's objectives of rehabilitating FMISs to increase the production potential; strengthening the institutional and technical capabilities of farmers' organizations; and encouraging their participation in planning, design, and implementation of the Project. The Project was also highly relevant to the objectives of halting the encroachment on irrigated land by floods, reducing environmental degradation, and improving local farmers' exposure to outside markets. The Project contributes significantly to rural development and poverty reduction in the project area, which was isolated with little economic activity.

46. The project reformulation further improved the relevance by considering the technical improvements as suggested by farmers. The reformulation enhanced farmers' ownership and participation and was proved to be necessary. Practices after project completion showed that autonomous systems with independent intakes have more flexibility and less pressure of water scarcity. In the present situation, the Budhi Kulo has suffered from inadequate flow, but the other three systems (Tapra, Manau, and Khairi Chandanpur) have no problem of water scarcity. If all the systems were unified with the Budhi Kulo as proposed at appraisal, it would have been a project failure. Similarly, inadequate flood protection work could have faced heavy damage during the big flood in the year 2000.

B. Efficacy in Achievement of Purpose

47. The Project satisfactorily upheld the infrastructure development works in the project area to (i) safeguard the entire project area from high flood waters, (ii) ensure equitable water distribution, (iii) improve access to villages and nearby towns, and (iv) improve agricultural production. All physical achievements exceeded the targets at appraisal, and reached or exceeded the revised targets. The quality of construction was generally good. The facilities improved or provided under the Project have created wide opportunities for rural farmers, traders, laborers, and general people in the project area. The institutional support component achieved the overall objective of strengthening WUAs, though due to problems pointed out in paras. 15 and 19 it remained to fully accomplish the objective of making farmers skilled and more responsible for O&M of improved irrigation facilities. Overall, the Project has been efficacious in achieving its objectives.

48. The project area, though remote and inaccessible in the past, is a major source of paddy for the adjacent districts, particularly areas in the hills. With the developed irrigation facilities and

improved network of canals and roads in the entire project area, farmers will be able to increase agricultural production and attract other development agencies that have largely ignored the area due to inaccessibility. In this line, the Project would contribute to meeting the wider development goal of the Government set out in the Tenth Plan (2003-2007) and ADB's country strategy to reduce poverty in the project area and in the country.

C. Efficiency in Achievement of Outputs and Purpose

49. The intended outputs were delivered at the project completion date. The Project achieved all its physical targets including the widened scope of works at reformulation as described in para. 16. The project reformulation based on more participatory approaches enabled a larger project scope at about the same project costs due to (i) major savings out of cancellation of construction of new earthen canals of 15.5 km, which further reduced the land acquisition cost; (ii) cancellation of 37 irrigation canals and river channels and 5 interim intake structures; (iii) reduction of flood embankment works in the Budhi Kulo from 14 km at appraisal to 6 km at completion; and (iv) the depreciation of the Nepalese rupee against the dollars. Institutional development activities contributed to timely accomplishment and quality control of the project infrastructures. Overall the Project was rated efficient in delivering project outputs.

50. The project completion review mission conducted a field survey to assess project benefits. The findings indicated a positive trend in socioeconomic conditions in the project area. The initial financial performance of the Project is encouraging. (Details of the financial and economic analysis are shown in Appendix 9). It was estimated that a typical farm household with 1 ha of land receives net revenue of about NRs32,600 at constant 2001 prices, which is about NRs14,100 higher than the without-Project scenario. In the project area, the average farm size per family for the small farmers is about 1.07 ha. Thus each small farmer family can receive an annual increase of income of about NRs15,100 from the Project. According to the 2001 socioeconomic study,⁴ the average household income for small farmers is about NRs34,500, and about 75% of the households in the project area are small or marginal farmers. Thus the incremental financial revenue of the Project is a considerable income increase for the poor households.

51. The primary benefit expected from the Project was an increase in the net value of incremental production of rice, wheat, maize, mustard, lentil, potatoes, and other vegetables as a result of improved irrigation through the rehabilitation of FMISs and the strengthening of WUAs. Improved flood control and much better farm-to-market roads and bridges represent further project benefits. Valued against the flows of costs (investment costs and O&M costs), the economic internal rate of return (EIRR) of the Project was estimated at 18.4%.⁵

52. The economic viability of the Project is robust to changes in the assumed benefits from the flood protection and improved market access. If the assumed benefits from both flood protection and market access do not accrue, the EIRR would be 12.9%, but still higher than the cut-off point (12%). Sensitivity analyses found that (i) 20% adverse variance in agricultural production costs or benefits, or (ii) doubling of O&M cost on the project infrastructures, or (iii) a shortening of the life of project facilities to 10 years still produces an EIRR above 12%. The Project was expected to be able to attain a viable rate of return. Overall, the Project was assessed as efficient.

⁴ Department of Irrigation, Ministry of Water Resources, His Majesty's Government of Nepal. February 2001. *Socioeconomic Study on the Rajapur Irrigation Rehabilitation Project*. Kathmandu.

⁵ The appraisal predicted an EIRR of 18.1%. However, the PCR estimate and the appraisal estimate could not be compared directly because of the project reformulation (Appendix 9, para. 20). The project reformulation did not conduct financial and economic analysis, so there was no reformulation EIRR target for comparison.

D. Preliminary Assessment of Sustainability

53. Farmers' participation in implementation and O&M has been a guiding principle from the inception of the Project and in the Government's New Irrigation Policy. In this line, as part of loan covenants, the Project strengthened institutional and technical capabilities of the CFA and BCC through various types of training. In its recent reorganization DOI established an office at Nepalganj, Babai-Rajapur Irrigation Management Division No.7, to support farmers and closely monitor the functioning of the systems developed. To make up for the disruption in supporting the Project after its completion, DOI is preparing to extend the POP to the year 2006.

54. There are several issues the Government needs to pay attention to, arising unexpectedly from the insurgency and the change in the river watercourse, including (i) heavy siltation and water scarcity in the Budhi Kulo approach channel and canals; (ii) lack of water distribution practices in the Budhi Kulo and other canal systems; (iii) inefficient and ineffective functioning of weirs, off-takes and canal structures; and (iv) insufficient agricultural extension services. Farmers lack experience in operating and maintaining the structures. The limited O&M training during the initial year of the operation period was insufficient to train farmers. The lack of farmers' awareness in operating irrigation structures has caused improper practice of water use and more silt deposition in branch canals. The absence of project staff together with the CFC members in the area for about 2 years due to the insurgency contributed partly to the misuse of the irrigation structures and encouraged farmers to even dismantle some of them. With improved security, it is essential for DOI to conduct training programs to enhance the management capacity of WUAs and to increase the awareness of farmers.

55. It is observed that farmers' organizations, WUAs and BCCs, are institutionally strong, especially on mobilizing farm labor and other local resources for system maintenance. After project completion, farmers have mobilized themselves several times to clean up the approach channel and to desilt their canals. The project completion review mission observed the mobilization of over 2,000 farmers from all branch canals to excavate the Budhi Kulo approach channel, and the cleaning up of each branch canal by local farmers. Given farmers' capabilities strengthened and O&M they have implemented on the indigenous systems in the past 100 years, farmers are expected to be able to maintain the improved irrigation systems.

56. For the sustainability of the Project and its continuous benefits, DOI agreed with the project completion review mission to initiate comprehensive O&M training within the extended POP period, and allocate sufficient budget for O&M on the major structures that are beyond the capacity of farmers. Both the Government and the mission felt that the ADB-assisted crop diversification project,⁶ which is going to launch activities and identify production packages in several selected Rajapur villages at the end of 2003, could act as a catalyst in diversifying crops in the project area, and enhance the economic benefits of the Project. Given the substantial institutional development achieved on farmers, if the project area can remain stable and the Government can fulfill its commitment to continue training and supporting farmers, the project infrastructures constructed under the Project and maintained by farmers are likely to be sustainable.

57. To enhance the likelihood of sustainability, the Government needs to encourage WUAs to collect an irrigation service fee. The fund generated can be used for the operational costs of the excavator, diesel, operators, and other miscellaneous equipment, and for annual repair and maintenance of the north-south road, small structures, flood protection works, and emergency works. In the project area, farmers are more inclined to the mobilization of resources and labor. It takes time for farmers to understand the need for generating financial resources. Nevertheless,

⁶ ADB. 2000. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Kingdom of Nepal for the Crop Diversification Project*. Manila.

farmers have already started collecting money to pay for the operator of the excavator and the three guards at the Budhi Kulo intake. Some funds were raised from fines due to noncontribution of labor or in lieu of labor. WUAs thus have some funds as well as expertise in financial management. WUAs also have alternative indirect sources of revenue, in the form of government grants to local government and other local sources such as operation of ferries and the pontoon bridge, or lease of government lands. As one of the institutional achievements under the Project through the TA, all BCCs have opened bank accounts and a number of them have built up substantial amounts of funds. To help farmers move ahead, the Government should make the need assessment and collection mechanism of the irrigation service fee an important part of the POP implementation.

E. Environmental, Sociocultural, and Other Impacts

58. The Project has a positive impact on the environment of the project area and contributes to reducing environmental degradation. Because most structures in the irrigation systems were upgraded to concrete structures, farmers no longer need to use brushwood and timber for O&M as they did historically. This saves sizeable amount of forest products, estimated at about 21,556 cubic meters (m³) annually, and reduces pressure on the adjacent Royal Bardiya National Park. In addition to preventing the river capture and erosion of agriculture land, the river training and flood protection works have resulted in land reclamation and forestry conservation. About 120 ha of land previously eroded have been recaptured and inhabited by landless and former bonded laborers. With the help of the Cooperative Forestry Conservation Organization, a local nongovernment organization, women's group have planted trees around the weir sites.

59. Though the Project did not plan specific activities to support ethnic people and women, it had positive impacts on these two aspects through the participatory approaches. The Project helps to unite different ethnic groups inhabiting the project area into one for achieving a common purpose. Women's participation in constructing, operating, and maintaining the irrigation system and branch canals has not been promising, owing much to the sociocultural practices in the project area. Irrigation in Nepal and particularly in the Terai is generally regarded as a male responsibility. Nevertheless, there have been positive changes such as women's presentations in the informal planning meetings and their stress on the importance of nonirrigation requirements such as water supply, laundry, bathing, and fisheries; participating in the excavation of the Budhi Kulo approach channel by some women; and women's active participation in decision-making of farming activities within their households.

60. In addition, there have been better education and health facilities due to increased accessibility. Farmers are getting bargaining power and receiving higher prices for their crops. Landless people and the formerly bonded laborers are sharing the agriculture land with landowners and getting wages for their labor. The Project was expected to provide on-farm employment of 230,640 person-days because of increased farming activities, benefiting directly the 3,314 formerly bonded laborers in the project area. The full development of the Project was expected to provide the project area annual incremental net crop revenue at about \$2,677,500, out of which about 42% (\$1,123,700) will be distributed to small or marginal farmers, about 25% (\$665,500) will be distributed to medium farmers, and about 33% (\$887,200) will be distributed to large farmers. The Project was expected to increase the livelihood of the poor and former bonded laborers, and contributed to poverty reduction.

IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

A. Overall Assessment

61. The Project reflected many of ADB's priorities: direct poverty reduction, environmental protection, and community participation. The Project inherently corresponded to ADB's Country

Operational Strategy for Poverty Reduction and the Government's goal of increasing agricultural production by supporting irrigation infrastructure particularly FMISs. The Project stipulated this as its key objective and it remained so with reformulation. The Project pragmatically incorporated and accomplished lateral activities like flood protection, control of canal capture by the river, and improvement of accessibility in the area. The institutional base and capacity building made BCCs capable of participating in planning, design, construction, and supervision of the Project. Overall the Project was implemented as conceived, and achieved all its targets. The Project was found to be highly relevant, efficacious, efficient, and likely to be sustainable. The Project was rated as successful. The associated TA was also rated successful.

B. Lessons Learned

62. Irrigation development through farmers' participation is a time-consuming process. Provisions should be made to initiate institutional development activities prior to detailed survey and design. As proved by the project reformulation and the consequent satisfactory implementation of the Project, this stipulation of lead-time for institutional activities helps build a sense of partnership between farmer beneficiaries and the project entity. It raises awareness of farmers and enables them to spell out their primary requirements. As a result farmers' assessed needs and demands would have already been collected and passed over to implementation consultants upon their deployment.

63. The Project successfully demonstrated that farmers' participation could be easily solicited and augmented if the Project and its components are planned and designed as per farmers' needs. To ensure safe and smooth operation of the constructed facilities, farmers' existing structures and their traditional O&M practices must be closely studied while designing irrigation facilities, and the new plan should consider such practices as far as possible. The need becomes even more significant if the system has been operational for a long period of time.

64. Leadership development in irrigation needs to be well addressed in the training modules and care should be taken to essentially include the second generation of emerging leaders who can easily undertake responsibilities in the absence of their leaders. This problem of lack of leadership was witnessed in Rajapur when a number of main leaders of CFC deserted the area because of the insurgency and created a vacuum in the farmers' organization.

65. Training on O&M of newly built structures is equally needed for irrigation leaders and for ordinary farmers. Improving the skills and awareness of ordinary farmers is even more important because they are directly involved in O&M of the canal systems. This need was not realized and only the irrigation leaders were offered training in the Project. This presumably had caused the misuse and mishandling of the constructed facilities by ordinary farmers.

66. The arrangement that the implementation consultants prepared the O&M manual and the TA consultants offered training based on the manual has created problems in coordinating schedules of the two consultant teams. Assigning to the same team of professionals both activities would have increased the efficiency of O&M training.

67. Wherever possible, an irrigation development project should include basic agricultural development activities. In the absence of such activities the impact of the irrigation project might not be clearly visible. The lack of integration of agricultural development activities with the Project had some dormant effect on the real impact of the Project. It is rather unfortunate that despite huge investment in the development of irrigation infrastructure, improved farming systems are still absent in Rajapur.

C. Recommendations

1. Project-Related

68. As this is an FMIS that was envisaged to be managed by farmers with the Government providing necessary technical support, maintenance works should be borne by WUAs (except for those that are caused by excessive natural disasters having high return period) and WUAs should be encouraged and trained to do the needed works without increasing the dependency on the Government. DOI should ensure that farmers are aware that excavating the approach channel each year is primarily their own responsibility.

69. DOI needs to initiate a comprehensive O&M training and launch programs vigorously in the next planned period of POP. Sufficient budget should be allocated for the training and O&M on the major structures that are beyond the capacity of farmers. Heavy siltation of canals, particularly at the head reach of the Budhi Kulo, should be investigated closely and remedial actions should be planned and implemented. Additional river training and protection works should be done in close consultation with farmers.

70. Being one of the major sources of assistance in the irrigation sector and providing policy and institutional support, ADB should closely monitor and provide technical guidance on the Government's follow-on activities to improve the overall sector performance. The new POP should be provided to ADB for comments and advice prior to its finalization.

71. The joint WUA of the Budhi Kulo and the other three intake-based WUAs should be registered and recognized by DOI. The rules and regulations of WUAs should be strictly enforced, and adherence to a water distribution schedule should be ensured.

72. DOI should mediate and help the discussion regarding ownership of the pontoon bridge between the local government and WUAs to reach an amicable solution with a cost and benefit sharing arrangement. It is advisable to turn over O&M of the bridge to the party that undertakes O&M responsibilities of roads.

73. The Crop Diversification Project (footnote 6) can act as a catalyst in diversifying crops in the project area. As the crop project covers Rajapur under its remit, DOI can coordinate with the Department of Agriculture in planning agriculture activities in Rajapur by focusing its attention on the needs of farmers. In that way, the crop diversification project can help enhance the economic benefits of the completed irrigation project in Rajapur.

2. General

74. The capacity building of the executing agency should be duly considered at the project design. As the expensive irrigation structures are handed over to farmers who are less literate, there must be sufficient training in O&M. Efficient water distribution and allocation practices should be designed and implemented. The executing agency needs to establish a linkage between irrigation service provided and collection of irrigation service fee in order to promote sustainability. ADB and other funding agencies should consider introducing farm-level water management with improved cultural practices to those projects that they financed earlier.

TECHNICAL ASSISTANCE COMPLETION REPORT

Division: SAAE

TA No., Country and Name TA 1589-NEP: Institutional Support for Project Implementation		Amount Approved: \$650,000	
		Revised Amount: \$650,000	
Executing Agency: Department of Irrigation	Source of Funding: TASF	Amount Undisbursed \$1114.13	Amount Utilized \$648,885.87
Date of Report		TA Completion Date	
Approval 31 October 1991	Signing 14 January 1992	Fielding of Consultants 8 November 1992	Original: January 1997
			Actual: 31 December 2000
		Account Closing Date	
			Original: December 1997
			Actual: 21 August 2003
Description			
<p>Rajapur farmers faced extreme difficulty in conveying water into their canals due to severe nature of the river. The Rajapur irrigation project (the Project) was implemented to help farmers in rehabilitating their irrigation systems that have worsened beyond their capacity. The Project required organizing and strengthening farmers along the project line to enable farmers to participate effectively in project implementation and to assume operation and maintenance (O&M) responsibilities after project completion.</p>			
Objectives and Scope			
<p>The objectives of the TA were to (i) assist establishing institutional base to facilitate farmers' active and effective participation in project implementation, and (ii) strengthen the institutional base and technical capabilities of farmers to operate and maintain the improved irrigation structures. The scope of the TA consisted of (i) defining the function of, and establishing a project management committee (PMC); (ii) establishing organizational and administrative procedures to improve O&M of the irrigation system; and (iii) training of farmer organizations and selected farmers in planning, design, construction supervision and techniques, and irrigation management.</p>			
Evaluation of Inputs			
<p>A TA team consisting of one international team leader, two institutional development specialists and two community irrigation specialists accomplished the TA satisfactorily. The TA team's immersing in the target community by living in the community itself won the confidence of beneficiary farmers, and expedited information dissemination and farmers' acceptance of the Project. Though there was a replacement of the initial team leader by his colleague in 1997 due to administrative reason, the planned activities and functioning of the team were not affected.</p>			
<p>The Executing Agency, Department of Irrigation (DOI), performed satisfactorily. DOI appointed a full-time project manager and provided a core of key staff experienced in farmer participation in irrigation projects. The project staff heeded farmers' genuine requests and were enthusiastic about augmenting farmers' participation in project implementation. The established PMC proved to be an effective body, and ensured good participation of various stakeholders in overall planning, selection of the type and location of works, and management of contracts and voluntary labor. Nevertheless, sharing of design and scheme of the project development with ordinary farmers was reportedly less satisfactory.</p>			
<p>The consultants, project staff, and farmers worked closely by observing the practice of "working with in addition to working for" target groups. The TA built the proposed organizational framework on traditional farmers organizations after identifying strengths and weaknesses of these organizations. Improvement was made in recognizing each branch canal as a self-governing organization. The consultants and the Executing Agency did lots of works on informing farmers about the Project, and gaining feedback on their views and requirements. After intensive consultation with farmers and in accordance with morphological changes in the rivers, the Executing Agency requested to ADB for a project reformulation that turned out to be necessary and crucial in making the Project feasible, more practical and cost effective.</p>			
<p>ADB closely monitored the TA. Following the inception mission in February 1993, ADB fielded nine review missions including the midterm review, three special project administration missions, and one consultation mission. Almost all the missions had collective interactions with the TA team, and held interactive meetings with members of the central farmers committee (CFC), project staff, and the TA consultants. These meetings helped strengthening farmers' organizations. The performance of ADB was satisfactory.</p>			
Evaluation of Outputs			
<p>The TA successfully developed a framework for strengthening the institutional capacity of Rajapur water users association (WUA) and was able to build the organizational structure of a strong WUA with an influential CFC. The</p>			

institutional framework enlarged CFC membership for greater representation of farmers. Farmers in the project area were organized at three levels (CFC, four WUAs for the four independent canal systems, and BCCs) to facilitate O&M. Noticeably CFC became more self-assured after undergoing a series of training and capacity building programs. Its active role in PMC made the project more responsive to farmers' needs and aspirations. Operational capacity of CFC had been largely enhanced. Changing the alignment of the north-south road, locating WUA's office cum store house at the center of the command area, constructing more river protection works, taking on leadership to conduct PMC meeting in the absence of the project manager during the insurgency period, raising money to hire operators, and farmers' persistent efforts and willingness to operate the pontoon bridge are some of the examples of the increased strength of CFC.

The TA bolstered the functionality of CFC and PMC by outlining operational framework and increasing the CFC membership to accommodate a larger farmers representation. The administrative framework, procedures, rules, and regulations developed under the TA offered opportunities for farmers' effective participation and ensured that their concerns were reflected in the project design. The organizational structure was successfully developed at branch canal level as well. Each branch canal now has a well-defined BCC as a complementary organization to CFC with its own rules and regulations and bank account. Meetings have become regular and keeping records and minutes has become common. New leadership has been emerging and has been able to mobilize resources for canal maintenance even in the absence of the irrigation leaders.

Farmers' awareness and understanding of the Project was raised by extensive information campaign, and their skills were upgraded by undertaking a series of consultations, training, and workshops. Training on gabion weaving helped farmers acquiring new skills, enabled the Project to award the gabion weaving works to BCCs in rotation without seeking gabion weavers outside the area, and allowed BCCs to build their capital for emergency repairs. Training on construction techniques helped improving the quality of earthworks accomplished by farmers. Based on the O&M manual prepared by the project implementation consultants at the end of project implementation, training on O&M were designed and conducted for irrigation leaders. Unfortunately owing to limited inputs of TA consultants, O&M training could not be extended to ordinary farmers. The insufficiency of O&M training was reflected by farmers' misuse of constructed irrigation structures and facilities.

Overall Assessment and Rating

The TA was rated as successful. In its entirety, the TA achieved the outputs satisfactorily. The TA has positively helped soliciting farmers' viewpoints and augmenting farmers' participation right from the design to the completion of the Project. The TA would be more successful if the TA consultants could be fielded for a longer time period after project completion to launch an extensive training on O&M of constructed irrigation facilities and water distribution practices.

Major Lessons Learned

- (i) As proved by the TA, to work successfully in an existing FMIS, a proposed farmers' organizational framework should build on traditional indigenous organizational structures instead of totally replacing them. Assessing and addressing beneficiary needs are critical in soliciting their active participation.
- (ii) Capacity building needs to involve general farmers in addition to lead farmers and irrigation leaders.
- (iii) With the implementation consultants preparing the O&M manual and the TA consultants providing training based on the manual, the TA had problems in coordinating schedules of the two consultant teams. Assigning to the same team of professionals such inter-related activities would have increased efficiency of O&M training.

Recommendations and Follow-Up Actions

As farmers' institution building is a slow process, sufficient time has to be allocated for institutional development activities. The success of the TA in educating beneficiaries to clearly define their requirements and facilitating the Project to become more responsive to farmers' needs has to be capitalized and built on.

The Project and the TA achieved the goal of constructing a sustainable irrigation system with farmers' involvement in each stage of project development. The capacity strengthened and confidence built for farmers has to be maintained by the Executing Agency with close monitoring and follow up activities. DOI needs to initiate a comprehensive O&M training in the next planned period of project operation plan (POP). The POP should allocate sufficient budget for O&M of the system.

Prepared by Jiangfeng Zhang Designation Economist

STATUS OF COMPLETION OF PROJECT COMPONENTS

Component	Unit	Appraised	Revised	Actual	Percentage of Completion	Remarks
A. Main System						
1 Intake Structure in Budhi Kulo	No.	1	4	4	100	A permanent intake on Budhi Kulo and separate permanent intakes for Maila, Manau, and Khairi were recommended and approved at the midterm.
2 Weirs cum Offtakes in Budhi Kulo	No.	3	7	7	100	
3 Connecting Branch Canals						Other connecting canals were cancelled. Cancelled with project reformulation.
- Extension of Existing Canals	km	7.0	1	1	100	
- New Canals	km	15.5	6.3	6.3	100	
- Proportional Regulators	No.	5				
4 Flood Embankment						Additional protection works done with the project reformulation.
- Budhi Kulo	km	14.0	6	6	100	
5 Additional Flood Protection Works						Additional protection works done with the project reformulation.
- Budhi Kulo	km		10.5	10.5	100	
- Tapra	km		0.9	0.9	100	
- Manau	km		2.6	2.6	100	
- Khairi Chandanpur	km		4.1	4.2	102	
6 Raising Bank Level of Approach Canal	km	1.0	1.0	1.0	100	
7 Interim Intake Structures	No.	5				Cancelled with project reformulation.
8 Plugs						The others were cancelled with project reformulation. River channels plugging came under additional flood protection.
- Irrigation Canals	No.	22	}	3		
- River Channels	No.	15				
B. Branch Canals						
Number of Structures in the Canal System						
1 Budhi Kulo	No.	103	213	225	106	Additional structures.
Patabhar Kulo ¹	No.	25	28	29	104	
Gola Kulo ¹	No.	20	21	21	100	
Janaknagar	No.		10	10	100	
Bagahipur	No.		9	11	122	
Chargaun	No.		31	31	100	
Jhabahi	No.		12	12	100	
Nayagaun	No.		28	30	107	
Daulatpur	No.		23	24	104	
Badalpur	No.		26	31	119	
Muraiya	No.		7	7	100	
Bhimapur	No.		18	19	106	
2 Manau Kulo	No.	20	20	21	105	
3 Tapra Kulo	No.	30	30	31	103	
4 Khairi Kulo	No.	24	23	23	100	
Total (1, 2, 3 and 4)		177	286	300	105	
C. Roads and Bridge						
1 East-West Feeder Road	km	13.5	12.5	12.5	101	
2 North-South Service Road	km	24.0	27	27	101	
3 Seasonal (Pontoon) Bridge	No.		1	1	100	
D. Buildings						
1 Project Office (Rajapur)	m ²	200		400	200	
2 Mobile Staff Quarters	m ²	600	}	755	94	
3 Mobile Consultant Quarters	m ²	200				
4 Godown (shed)	m ²	300	}	400	100	
5 Godown (garage)	m ²	100				

km= kilometers, m²= square meter, no. = number.

¹ Both Kulo were unified with the Budhi Kulo System.

PROJECT COSTS

Table A3.1: Appraisal Estimates
(\$'000)

Item	Asian Development Bank			Government	Farmers	Total Cost
	Foreign	Local	Total	Local	Local	
Irrigation Improvements						
Civil Works						
Intakes	170	877	1,047	148	1,237	2,432
Budhi Kulo Main Canal System	4,646	3,657	8,303	796	-	9,099
Eastern Systems (Maila, Manau, Khairi)	-	-	-	-	-	-
Branch Canal Structures	1,549	571	2,120	189	316	2,625
Service Roads	2,352	569	2,921	316	304	3,541
Project Office and Quarters	167	25	192	13	-	205
Equipment and Vehicles	252	-	252	10	-	262
Surveys and Investigations	36	139	175	11	-	186
Recurrent Cost	78	30	108	410	-	518
Land Acquisition	-	-	-	344	-	344
Consulting Services	762	323	1,085	-	-	1,085
Service Charge	421	-	421	-	-	421
Total	10,433	6,191	16,624	2,237	1,857	20,718

- = not applicable.

Table A3.2: Revised Allocation at Midterm Review
(\$'000)

Item	Asian Development Bank			Government	Farmers	Total Cost
	Foreign	Local	Total	Local	Local	
Irrigation Improvements						
Civil Works						
Intakes	490	300	790	-	40	830
Budhi Kulo Main Canal System	4,476	2,909	7,385	55	98	7,538
Eastern Systems (Maila, Manau, Khairi)	1,870	854	2,724	63	106	2,893
Branch Canal Structures	498	364	862	985	199	2,046
Service Roads and Pontoon Bridge	1,956	1,454	3,410	844	287	4,541
Project Office and Quarters	167	25	192	13	-	205
Equipment and Vehicles	252	-	252	12	-	264
Surveys and Investigations	35	205	240	-	-	240
Recurrent Cost	97	389	486	239	1,530	2,255
Land Acquisition	-	-	-	25	-	25
Consulting Services	1,140	310	1,450	-	-	1,450
Service Charge	462	-	462	-	-	462
Total	11,443	6,810	18,253	2,236	2,260	22,749

- = not applicable.

Table A3.3: 1998 Loan Reallocation
(\$'000)

Item	Asian Development Bank			Government	Farmers	Total Cost
	Foreign	Local	Total	Local	Local	
Irrigation Improvements						
Civil Works						
Intakes	-	-	-	-	-	-
Budhi Kulo Main Canal System	2,867	1,199	4,066	189	-	4,255
Eastern Systems (Maila, Manau, Khairi)	3,923	1,447	5,370	-	-	5,370
Branch Canal Structures	-	680	680	1,065	-	1,745
Service Roads and Pontoon Bridge	2,486	1,011	3,497	434	212	4,143
Project Office and Quarters	-	73	73	119	-	192
Equipment and Vehicles	245	-	245	14	-	259
Surveys and Investigations	-	144	144	-	-	144
Recurrent Cost	-	122	122	281	1,918	2,321
Land Acquisition	-	-	-	30	-	30
Consulting Services	1,177	504	1,681	-	-	1,681
Service Charge	381	-	381	-	-	381
Total	11,079	5,180	16,259	2,132	2,130	20,521

- = not applicable.

Table A3.4: Actual Costs at Completion
(\$'000)

Item	Asian Development Bank			Government	Farmers	Total Cost
	Foreign	Local	Total	Local	Local	
Irrigation Improvements						
Civil Works						
Intakes						
Budhi Kulo Main Canal System	4,201	559	4,760	133	-	4,893
Eastern Systems (Maila, Manau, Khairi)	4,946	503	5,449	86	916	6,451
Branch Canal Structures	-	401	401	1,447	-	1,848
Service Roads and Pontoon Bridge	2,221	966	3,187	196	592	3,975
Project Office and Quarters	-	90	90	30	-	120
Equipment and Vehicles	291	-	291	8	-	299
Surveys and Investigations	-	107	107	-	-	107
Recurrent Cost	26	79	105	388	-	493
Land Acquisition	-	-	-	37	-	37
Consulting Services	1,492	351	1,843	-	-	1,843
Service Charge	363	-	363	-	-	363
Total	13,540	3,056	16,596	2,325	1,508	20,429

- = not applicable.

Table A3.5: Project Costs by Year
(\$)

Item	FY1992	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY2000	FY2001	Total
Civil Works											
Irrigation, Roads, Project Office and Quarters											
Government	1,067	1,701	15,262	21,392	42,844	60,073	351,904	377,868	673,210	322,861	1,868,182
Farmers		178,722	224,922	210,763	225,469	244,294	205,035	205,035	14,600		1,508,841
ADB			9,926	93,091	354,185	2,321,592	2,310,721	4,138,522	3,555,217	1,104,781	13,888,035
Equipment and Vehicles											
Government	5,134		56		31	34		870	2,675		8,800
Farmers											
ADB	49,915	116,027	19,074	3,286	27,621	3,450	6,502	14,349	50,599	401	291,224
Consulting Services											
Government											
Farmers											
ADB			247,001	406,523	517,516	161,066	207,394	176,442	153,290	80,425	1,949,657
Incremental O&M Costs											
Government	7,008	6,376	18,231	25,755	38,943	44,593	61,793	64,628	65,927	77,596	410,850
Farmers											
ADB				6,503	13,068	10,559	12,421	34,620	16,910	10,792	104,873
Land Acquisition											
Government	8,673							6,858	5,146	17,183	37,860
Farmers											
ADB											
Service Charge											
Government											
Farmers											
ADB			6,007	12,083	17,314	34,001	57,092	101,334	135,135		362,967
Total	71,797	302,826	540,479	779,396	1,236,991	2,879,662	3,212,862	5,120,526	4,672,709	1,614,039	20,431,289
Government	21,882	8,077	33,549	47,147	81,818	104,700	413,697	450,224	746,958	417,640	2,325,692
Farmers		178,722	224,922	210,763	225,469	244,294	205,035	205,035	14,600		1,508,841
ADB	49,915	116,027	282,008	521,486	929,704	2,530,668	2,594,130	4,465,267	3,911,151	1,196,399	16,596,756

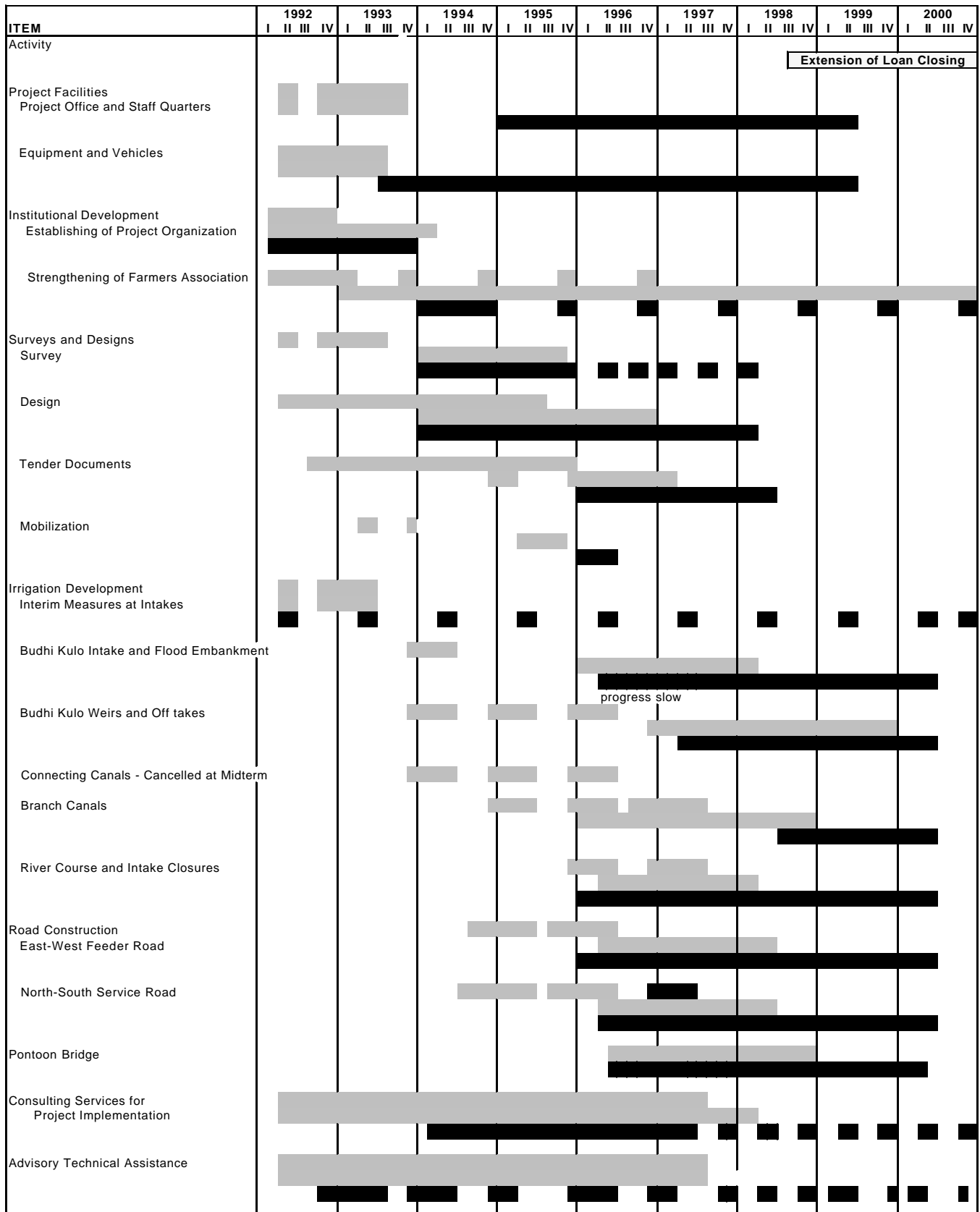
ADB = Asian Development Bank, O&M = operation and maintenance.

USE OF ASIAN DEVELOPMENT BANK LOAN

(\$)

Category Name	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	Total
Civil Works - Parts A.1 and B.1					129,976	2,209,073	2,109,124	3,814,570	3,017,601	985,305	12,265,649
Civil Works - Parts A.2, B.2 and C			6,160	75,453	98,791	4,332	174,757	309,610	476,675	119,176	1,264,954
Civil Works - Part A.3, B.4			3,766	17,638	125,418	108,187	8,845	3,905	60,376	-	328,135
Equipment and Vehicles	49,915	116,027	19,074	3,286	27,621	3,450	6,502	14,349	50,599	401	291,224
Consulting Services			247,001	406,523	517,516	161,066	207,394	176,442	153,290	80,425	1,949,657
Incremental Operation and Maintenance Cost				6,503	13,068	10,559	12,421	34,620	16,910	10,792	104,873
Civil Works - Part A.4							17,995	10,437	565		28,997
Service Charge During Construction			6,007	12,083	17,314	34,001	57,092	101,334	135,135		362,967
Unallocated											
Total Disbursement	49,915	116,027	282,008	521,486	929,704	2,530,668	2,594,130	4,465,267	3,911,151	1,196,099	16,596,456

PROJECT IMPLEMENTATION SCHEDULE



Legend: At Appraisal ■ At Midterm Review ■ Actual ■

STATUS OF COMPLIANCE WITH LOAN COVENANTS

Covenant	Reference in Loan Agreement	Status of Compliance
A. Implementation Arrangements		
The Department of Irrigation (DOI) under the Ministry of Water Resources will be the Executing Agency and as such will be responsible for the overall supervision, control, and execution of the Project.	Schedule 6, para 1	Complied with.
DOI will establish and furnish a project office to be located in Rajapur in the project area. One permanent office building and a number of mobile units shall be provided.	Schedule 6, para 2	Complied with. However, all the buildings and mobile units were destroyed in the insurgency. The compound of the project office is currently used by security personnel.
An alternative satellite design office shall be set up as appropriate to be used when accessibility to the project area is restricted due to floods in the Geruwa and Karnali rivers.	Schedule 6, para 3	Complied with.
DOI will appoint a suitably qualified and competent project manager satisfactory to the Asian Development Bank (ADB).	Schedule 6, para 5	Complied with.
DOI shall designate the regional director of the Mid-Western Irrigation Directorate of DOI as the project director. This person shall be responsible for liaison and coordination between the Project and the DOI head office in Kathmandu. The regional director shall have decision-making authority on most technical and financial matters on behalf of DOI. During the construction season, this person shall visit the Project at least once a month to monitor and discuss with the project manager the progress of the Project.	Schedule 6, para 6	Complied with.
DOI shall establish a project management committee (PMC) through which it shall share the responsibility for project implementation with representatives of concerned farmers in the project area. PMC should be established within three (3) months of the effective date. Meetings of the PMC shall be convened at least twice a month.	Schedule 6, para 7, and para 15	Generally complied with. The PMC was established in January 1993. Meetings were held regularly. During the midterm review it was discussed and approved by ADB that PMC meeting would be convened once a month.
DOI through its designated representatives shall inform the PMC on, inter alia, all survey, design, procurement, and construction activities. The farmers, through their representatives in the Central Farmers Committee (CFC), shall inform the PMC on any issue that may affect the implementation of the Project.	Schedule 6, Para 14.	Complied with.
DOI will provide a core of key staff familiar with the aspects of farmer participation in the construction of irrigation projects.	Schedule 6, para 17	Complied with.

Covenant	Reference in Loan Agreement	Status of Compliance
The key staff shall include at least one deputy project manager, three irrigation engineers, and one agricultural engineer.	Schedule 6, para 17	Partly complied with. The agricultural engineer position is not occupied (as of August 2003).
To assist in the implementation of the East-West Feeder Road, the Department of Roads will send a road engineer from the Bardiya District to the Project.	Schedule 6, para 18	Not complied with. Department of Roads did not send a road engineer. The road engineer in the implementation consultant team supervised the work.
B. Farmers Participation		
DOI will assist the existing farmer managed irrigation systems (FMISs) in the project area to establish or constitute themselves into the new Central Farmers Association (CFA). To obtain a legal status, the CFA shall be established and registered under the Association Registration Act, 2034 prior to the effective date.	Schedule 6, para 19	Complied with. The CFA was established and registered on 28 April 1991.
The CFC, which is presently the joint governing committee of the existing FMISs in the project area, shall be co-opted to continue within the constitutional framework of the CFA as the executive committee responsible for the management of the CFA.	Schedule 6, para 21	Complied with.
The CFC shall include the heads of the six existing FMISs.	Schedule 6, para 22	Complied with.
The existing branch canal committees, which constitutes the managing bodies of the existing FMISs, shall, inter alia, serve as subcommittees of the PMC for project implementation at the branch canal level.	Schedule 6, para 23	Complied with.
The Borrower shall ensure that farmers benefiting from the irrigation component of the Project shall contribute to the construction cost in accordance with the cost-sharing arrangements applied for the rehabilitation of small and medium-scale FMIS. The farmer's contribution shall be about 9.5% of the construction cost of the irrigation system improvement works, to be provided in kind, cash, or a combination thereof.	Schedule 6, para 25	Complied with. Farmers contributed 10% of the construction cost.
Prior to the commencement of project preparatory activities, the Borrower shall ensure that a written agreement has been entered into between DOI and CFA.	Schedule 6, para 26	Complied with delay. The DOI-CFA Agreement was signed on 10 January 1994. Issues of land compensation and farmers' contribution arising from the enforcement of a new irrigation policy led to delays in signing the agreement.

Covenant	Reference in Loan Agreement	Status of Compliance
C. Operation and Maintenance		
Upon completion and turnover of the project works, DOI shall ensure that the CFA will assume the full operation and maintenance (O&M) responsibility for the irrigation facilities.	Schedule 6, para 27	To be complied with. Affected by the insurgency, the CFA has not been able to assume the full O&M. DOI is developing extended project operation plan (POP) to provide training and technical support.
Upon completion of the East-West Feeder Road, the Borrower shall ensure that the Department of Roads, through its District Office, will assume the full O&M responsibility for said road.	Schedule 6, para 28	To be complied with. Due to change in government policy the responsibility of district road offices have been transferred to district development committee (DDC). In view of the capacities of DDC still under development, the road is to be managed by CFC under supervision of DOI until formal transfer to DDC can take place.
After completion of the Project, DOI shall continue to advise CFA through its staff in the Bardiya District. The district irrigation engineer shall carry out quarterly inspections of the irrigation facilities, together with representatives of the CFA. DOI shall provide technical assistance if deemed to be necessary.	Schedule 6, para 29	To be complied with. Due to the insurgency, DOI staff could not go to the project area in the last 2 years. DOI staff visited the area in 2003 as soon as the security situation improved. DOI is developing extended POP to provide training and technical support.
DOI shall, with the assistance of the consultants, prepare detailed O&M manuals for all major irrigation facilities. The preparation of the manuals shall take into account the users, which will be the farmers in the project area.	Schedule 6, para 30	Complied with.
D. Other Matters		
1. Project Report Monitoring and Evaluation Toward the end of project implementation, DOI shall upgrade the socioeconomic benchmark study prepared as part of the project feasibility study.	Schedule 6, para 31	Complied with.
To monitor the economic and technical performance of the project facilities after the completion of the Project, DOI shall ensure that the CFC will keep records of irrigation and agricultural operations and system performance.	Schedule 6, para 31	To be complied with. Due to insurgency, the Project was not yet turned over to CFC, and most CFC members left the project area. The transfer would be done by 2006 at the end of DOI's extended POP.

Covenant	Reference in Loan Agreement	Status of Compliance
The DOI shall carry out annual inspections of the irrigation system's performance.	Schedule 6, para 31	Partly complied with. Due to the insurgency, DOI staff could not go to the project area in the last 2 years. DOI staff inspected the irrigation system in 2003 as soon as the security situation improved.
<p>2. Land Acquisition</p> <p>The Borrower shall take, or cause to be taken, all such action as shall be necessary to make available on a timely basis all land and rights in respect of land required for carrying out the Project.</p>	Schedule 6, para 32	Complied with.
<p>3. Environmental Impact</p> <p>To safeguard against any possible adverse effects on the environment, DOI shall, in the implementation of the Project, observe the ADB's <i>Environmental Guidelines for Irrigation Projects, Land Clearance, and Watershed Development</i>.</p>	Schedule 6, para 33	Complied with.
<p>4. Agricultural Support Services</p> <p>The Borrower shall ensure that concerned farmers in the project area shall have timely access to the necessary agricultural support services and credit to enable them to take full advantage of the increased potential for crop production as a result of the facilities to be improved under the Project.</p>	Schedule 6, para 34	To be complied with. DOI needs to coordinate with Department of Agriculture in planning agriculture activities in Rajapur to enhance the economic benefits of the Project. In this regard the ADB-assisted Crop Diversification Project can play a role in helping diversifying the crops in the area.
The Borrower shall (i) maintain separate accounts for the Project; (ii) have such accounts and related financial statements audited annually; (iii) furnish to the ADB unaudited accounts and financial statements, as soon as available but in any event not later than nine (9) months after the end of each related fiscal year; and (iv) submit to ADB the audited accounts and financial statements and the report of the auditors relating thereto, all in the English language not later than twelve (12) months after the end of each related fiscal year.	Article IV, Section 4.06(b)	Complied with. Audit reports were submitted to ADB regularly and the financial audits were all clear and unqualified according to the deputy auditor general.
DOI shall submit to ADB trimester progress report within two (2) months after the end of the trimester (March, July, November) containing a summary of the progress made under the Project during the trimester.	Article IV, Section 4.07(b)	Complied with.
DOI shall submit to ADB a project completion report after the physical completion of the Project.	Article IV, Section 4.07(e)	Complied with. Report was received on 16 August 2001.

CONSULTING SERVICES

Item		Appraised	Per Contract	Revised	Actual	
A. Consulting Services for Project Implementation						
International						
1	Irrigation Design and Planning Engineer	pm	23	22	35.97	36.49
2	River Hydraulic Design Engineer	pm	4	3	10.60	10.60
3	River Hydraulic Design Engineer	pm			0.73	0.73
4	River Engineer	pm		2	0.66	0.66
5	Irrigation Structure Engineer	pm			5.69	5.69
6	Contracts/Bridge Engineer	pm			1.30	1.30
7	Construction Management Specialist	pm	10	10	11.83	11.83
8	Unallocated	pm	2		0.53	0.00
	Total	pm	39	37	67.31	67.30
Domestic						
1	Irrigation System Design Engineer	pm	33	33	27.57	27.57
2	Irrigation Structure Design Engineer	pm	27	27	16.85	16.85
3	Irrigation Structure Design Engineer II	pm		0	23.78	23.78
4	River Engineer	pm			15.43	15.43
5	Road Engineer	pm	6	6	6.44	6.04
6	Hydraulic Engineer/Hydrologist	pm		1.5	1.13	1.13
7	Structural Engineer	pm		3	4.49	4.49
8	Construction Engineer	pm			30.46	30.49
9	Operation and Maintenance Engineer	pm			1.85	1.83
10	Unallocated	pm	11		0.00	0.00
	Total	pm	77		128.00	127.61
B. Consulting Services for TA 1589						
1	Foreign Expert/Team Leader	pm	12	12	17.43	17.60
2	Foreign Expert/Alternate Team Leader	pm			5.57	5.40
3	Institutional Development Specialist/Administration	pm	20	20	24.50	24.50
4	Institutional Development Specialist/Administration				49.17	6.72
5	Rural Sociologist/Community Irrigation	pm	40	40	46.47	50.80
6	Rural Sociologist/Community Irrigation	pm	40	40	3.73	44.97
	Total	pm	112	112	146.87	149.99

O&M = operation and maintenance, pm = person-months, TA = technical assistance.

LIST OF VEHICLES AND EQUIPMENT

Component	Unit	Appraisal	Revised	Actual	Procurement	Percentage	Remarks
1 Project Office (Rajapur)	m ²	200		400	LCB	200	1 building - damaged during insurgency
2 Mobile Staff Quarters	m ²	600	}	755	IS + LCB	94	5 mobile houses (under IS) and 2 fixed houses (under LCB) - 2 mobile & 1 fixed house damaged
Mobile Consultant Quarters	m ²	200					
3 Godown (shed)	m ²	300	}	400	LCB	100	2 godowns (in Rajapur and Nayagaon) both damaged during insurgency.
Godown (garage)	m ²	100					
4 Four-wheel Drive Jeeps	Nos.	4		7	IS	175	2 in project use, 2 broken & others in DOI
5 Motorcycles	Nos.	10		14	IS	140	3 in project use, others in DOI
6 Tractors	Nos.	2		0		0	
7 Bicycles	Nos.	50		29	Locally purchased	58	11 to user farmers, others in store damaged
8 Generator	Nos.	2		2	IS	100	1 in use, 1 broken
9 Theodolite	Nos.	1		2	IS	200	2 in use
10 Auto-level	Nos.	5		9	IS	180	1 in use, 8 in DOI for other projects
11 Electronic Distance Meter	Nos.	1		1	IS	100	broken
12 Blueprinting Machine	Nos.	2		2	IS	100	in use
13 Photocopy Machine	Nos.	2		2	IS	100	1 in use, 1 broken
14 Air Conditioners	Nos.	4		4	IS	100	2 in use, 2 in other DOI project
15 Drafting Equipment	lot	1		1	IS	100	in use
16 Survey Equipment (miscellaneous)	lot	1		1	IS	100	in use
17 Office Furniture	lot	1		1	Locally purchased	100	in use
18 Office Equipment	lot	1		1	IS	100	in use
19 Spare Parts for Bulldozer/ Machines/ Vehicles	lot		1	1	IS	100	some used and some in stock
20 Inflatable Boats	Nos.		2	2	Direct Purchase	100	1 in use, other transferred to DOI

DOI = Department of Irrigation, IS - international shopping (direct purchase with letter of credit provision for payment), LCB - local competitive bidding, m² = square meter, Nos. = numbers.

FINANCIAL AND ECONOMIC ANALYSIS

A. Introduction

1. The Project has had a direct impact on the economy of the Rajapur region of Nepal by increasing agricultural production and farm income. In total 7,532 farm families (or about 68,617 people) live in the project area.⁷ Because of the Project, the project completion review mission expected each family to receive an average annual increment of NRs26,800 in net revenue. Additional farm output is accompanied by increased farm employment in the region. The Project protects about 20,103 people and their properties from floods along the Karnali River. The constructed concrete irrigation structures reduce farmers' usage of forest products from the nearby Royal Bardiya National Park for system operation and maintenance (O&M), providing an element of environmental protection.

B. Methodology

2. The financial and economic analysis was done in accordance with ADB's *Guidelines for the Economic Analysis of Projects*.

1. Economic Life of the Project

3. The economic life of the Project was assumed to be 25 years. That is, the Project was expected to last until 2026. Though the main structures of the Project were built with high safety factors, the discounted present value of benefits after 25 years becomes insignificant. Sensitivity analyses of the risk of a shorter economic life expectancy have been conducted.

2. Prices

4. All prices, benefits, and costs were adjusted to 2001 constant values using (i) a gross domestic product deflator for all local currency costs and benefits, and (ii) the G-5 manufacturer's unit value index for all foreign exchange. The local values were expressed in dollars at an exchange rate of \$1.00=NRs76, the Government's average exchange rate for 2001. A discount rate of 12% was used to calculate the net present value and also as a cut-off point for the economic internal rate of return (EIRR).

5. Economic prices for major tradable commodities, including both outputs (rice, wheat, maize) and inputs (urea, diammonium phosphate, and potash), are derived from the November 2002 World Bank Commodity Price Projections,⁸ considering quality adjustment and international freight for the border pricing, and local transport and handling costs to the project area (Tables A9.1a and A9.1b). Economic prices for nontraded goods and other costs were based on local financial prices and adjusted by the standard conversion factor (SCF) of 0.9. The economic price for labor was computed as local wage rate x 0.9 (shadow wage rate) x 0.9 (SCF). The financial prices for various farm inputs and outputs and the local wage rate were collected during the project completion review mission field survey. Transfer payments such as taxes were excluded from economic valuations. Table A9.2 summarizes the financial and economic prices used for the analysis.

⁷ Department of Irrigation, Ministry of Water Resources, His Majesty's Government of Nepal. February 2001. *Socio-Economic Study on the Rajapur Irrigation Rehabilitation Project*. Kathmandu.

⁸ World Bank. 2003. *Global Economic Prospects and the Developing Countries* (Table A2.14). Washington, D.C.

3. With and Without Project

6. A comparison of with- and without-project scenarios was used to evaluate the quantifiable project benefits. Illustrative farm models were constructed for both the with-project scenario, and the without-project scenario under the assumption that the Project had not been implemented. The same input and output prices were used in the with- and without-project scenarios.

C. Project Costs

7. Investment costs in the analysis included (i) civil works for the irrigation systems, flood embankment, roads, pontoon bridge, and project buildings; (ii) project vehicles and equipment and their operating costs; (iii) consulting services; and (iv) administrative expenses. Expenses on land acquisition were excluded from the analysis. Variable farm inputs for farm production included labor, seed, fertilizer, and machinery like tractors and pumpsets. Labor was not taken into account for the financial analysis as a majority of farmers use their own labor inputs.

8. Annual regular O&M of the irrigation systems has been estimated at \$5 per hectare (ha). It rises to \$6/ha after 10 years, and \$7/ha after 20 years. In the 10th and 20th years of an system's life an additional \$50/ha was assumed to cover more substantial replacement costs. For the risk that these amounts are inadequate for proper maintenance, sensitivity analyses have been conducted on the cost of O&M.

D. Project Benefits

1. Improved Agriculture Production

9. Incremental net crop revenue comprised the main economic benefit included in the analysis. Table A9.3 reports the cropping pattern with and without the Project. With-project the total irrigated area is 13,389 ha with a cropping intensity 187%, and without-project, 12,500 ha with cropping intensity 186%. Because no new canals were introduced in the Project and it was not possible to raise canal water levels significantly, the increase in irrigated area was limited to small isolated areas (where it has been possible to raise water levels) or places toward the tail where water supply was previously so unreliable that there was no effective irrigation.

10. Farm models of inputs and outputs were developed for major crops in the with- and without-project scenarios, using data based on field visits, the project completion review mission, field survey, the socioeconomic study conducted in 2001, and releases from the Department of Agriculture.⁹ It is observed that, though the cropping pattern changed only by 1%, there were modest increases in input usage and crop yield. A survey of 105 farm households in the project area done by the project completion review mission indicates that the average yield of pre-monsoon wheat and monsoon paddy after project completion is 2.1 tons/ha and 3.3 tons/ha respectively, compared to 1.9 tons/ha and 2.8 tons/ha without Project. A similar trend was noticed in other crops. The increased yield is primarily associated with improved irrigation through the rehabilitation of the farmer managed irrigation systems and the strengthening of water users associations (WUAs). The Project's contributions to improved flood control and better farm-to-market roads and bridges have also motivated farmers to adopt new technologies and practices. Potatoes and a variety of other vegetables were introduced into the

⁹ District Agriculture Development Office. *Agriculture Development Program and Achievement 2001/02*. Guleria, Bardia, Nepal.

project area. Contrary to what was envisaged at the appraisal, farmers did not grow any spring paddy because of difficult post-harvest conditions during the monsoon season.

2. Flood Protection

11. Another large portion of the project benefit is in preventing flood damage to crops and villages, with significant damage prevented in about 1 in 10 years. The Project with revetment protection works and stud spurs has already shown its success in flood protection: the Budhi Kulo intake and the other three intakes were so effective in blocking the floods in the 2000 monsoon that those who would have been affected were unaware of the dangers that they would have faced had the project infrastructures not been completed by then. The floods were 30 kilometers north of Rajapur town. Without the Project, the floods would have breached the Budhi Kulo and cut through to the Karnali River, causing a prolonged damage to about 30% of the project area (including Rajapur town).¹⁰ The floods would cause loss of irrigation for one or more years, permanent loss of some land, and impaired irrigation for the remainder. Such damage has occurred in the past, and could be expected to occur more frequently in the future without the Project due to loss of forest cover and increase in cultivation close to riverbanks.

12. All the flood-vulnerable villages that were provided with river protections endured the flood safely. According to a survey of farmers during the project completion review mission, permanent loss of land if without-project would be about 1,448 ha, which accommodates about 362 ha of cropping area, 435 households, and 4,010 heads of livestock. The assessed benefit from the flood protection works during the 2000 flood was about NRs6.7 million (Table A9.4). Floods with similar magnitude have a return period of 1 in 10 years, thus with a probability 0.1 the same benefit is assumed to occur each year in the future with the Project. Sensitivity analyses have been conducted based on lower flood protection benefits.

3. Improved Market Accessibility

13. Improved market access is a further benefit. The Project enhanced the accessibility for farmers to the local market center at Rajapur and the main market in Nepalganj, and facilitated movement of farmers and goods around the project area. It has significantly reduced travel time, and trimmed down the transportation costs of farm produce while maintaining the quality of crops intact, which otherwise used to get wet and deteriorate during canal crossings.

14. Based on the daily traffic records, about 84,189 people crossed the pontoon bridge in the last season (from December 2001 to May 2002). Without the pontoon bridge, to commute between Rajapur and Nepalganj, people have to travel through India or other sides of the Rajapur Island by spending one more day on the road and extra NRs100 on travel-related expenses. The expected annual economic benefit is about NRs13.0 million¹¹ (Table A9.5). The benefits from the pontoon bridge and roads would be much higher than these estimates if the social benefits coming with the improved market access could be quantified.

¹⁰ Department of Irrigation, Ministry of Water Resources, His Majesty's Government of Nepal. December 2000. *Borrower's Project Completion Report for the Rajapur Irrigation Project*. Kathmandu.

¹¹ The savings in travel time was not included in calculating the financial benefit, but included in calculating the economic benefit.

4. Other Benefits

15. Apart from the directly quantifiable benefits, some other major benefits were also identified during the project completion review mission. First of all, the Project successfully strengthened the institutional capacity of WUAs. Beneficiary participation in the Project through the project management committee is a significant step in terms of democratization at a local level. The Project significantly reduced the use of forest products for system and canal maintenance, reducing pressure on the adjacent Royal Bardiya National Park and contributing to environmental protection. Employment during construction has had a positive impact, both in terms of cash earned and skills learned. In addition to preventing the river capture and erosion of agriculture land, the river training and flood protection works have resulted in land reclamation and forestry conservation. About 120 ha of land previously eroded have been recaptured and inhabited by landless and formerly bonded laborers.

E. Impact on Farm Output and Household Income

16. From the standpoint of beneficiary farmers, a model of a typical 1 ha farm growing the major crops in the area was developed to demonstrate with- and without-project production. This farm has a cropping pattern and intensity representing the project area. Financial costs at constant 2001 values were derived for each major crop (Tables A9.6a and A9.6b). The net crop revenue was then derived from subtracting the production cost from the gross production revenue (Tables A9.7a and A9.7b). It was found that with the Project a household would earn an average incremental net income of NRs8,491.6/ha from rice and its byproducts (Table A9.8). The highest level of incremental income per ha comes from potato at NRs9,500/ha. However, the high production cost makes only about 2% of the arable land allocated for potatoes.

17. Incremental net financial farm revenue from the typical 1 ha farm will be NRs14,129 per year (Table A9.9). The full project area, which is 14,500 ha, will have incremental farm income of NRs204.9 million per year. With an average farmland holding at about 1.07 ha, each small farmer family will receive an annual increase of income about NRs15,119. As found in the 2001 socioeconomic study, the average household income for small farmers is about NRs34,509, and about 75% of the households in the project area are farmers owning land less than 2.7 ha. Thus the incremental financial revenue of the Project is a considerable income increase for the poor households. The annual incremental net crop revenue per household to medium farmers and large farmers were expected to be NRs48,040 and NRs81,385 respectively (Table A9.10).

18. The incremental outputs were expected to be approximately 15,283 tons of paddy, 7,369 tons of wheat, and 1,844 tons of potatoes. The outputs on maize, mustard, and lentil were expected to drop by 258 tons, 767 tons, and 27 tons respectively. On average, there is an increase of roughly 3.1 tons of food per household per year (Table A9.11).

F. Economic Analysis

19. Given that the relative prices of major commodities will change over time, four versions of the farm models in economic terms have been produced, using 2001 prices and projected future prices in 2005, 2010, and 2015. Economic benefits for years 1997-2004 were valued at year 2001 prices; 2005-2009 at year 2005 prices; 2010-2014 at year 2010 prices; and 2015 and beyond at 2015 prices—all in 2001 constant dollars.

20. As farmers just started to adopt modern technologies after the rehabilitation of the irrigation structures was completed, it will take some time to obtain the full advantage from irrigation. For this reason, the incremental benefits of agricultural produces were assumed to phase in over 3 years. Considering the flow of benefits (incremental crop revenues, expected benefits from flood protection, and benefits from improved market access) against the flows of costs (investment costs and O&M costs), the EIRR was estimated at 18.4% (Table A10.11). The economic net present value (ENPV), with a 12% discount rate, was \$4.6 million. The appraisal predicted an EIRR of 18.1%. Though these two EIRRs are of similar magnitude, they cannot be compared directly because of the project reformulation. Flood protection benefit was listed as one small environmental benefit at appraisal, but as described earlier this is a substantially greater benefit for the revised project layout, as emphasized during the project reformulation and realized after project completion. The project reformulation did not conduct economic analysis, so there is no reformulation EIRR target for comparison.

G. Sensitivity Analysis

21. Table A9.13 summarizes sensitivity tests. The EIRR and ENPV were reestimated to test the Project's sensitivity to any changes in its projected parameters and assumptions. The first test is on the impact of assumed benefits from flood protection and improved market access. If there were no benefits from improved market access, the EIRR would be 17.8%. If there were no benefits from flood protection, the EIRR would be 13.5%. If there were no benefits from both flood protection and market access, the EIRR would be 12.9%. Thus the economic viability of the Project is robust to changes in the assumed benefits from the flood protection and improved market access.

22. Three other areas of risk will probably affect these results. Sensitivity analyses were carried out for (i) unfavorable changes in the level of agricultural benefits (possibly due to a drop in output prices), (ii) O&M cost increases, and (iii) a shortening of the life of project facilities.

23. The first risk is that of the level of incremental crop revenue. Sensitivity analyses indicate that a drop of 20% in incremental crop revenues will result in a project EIRR of 15.9% (compared to the base case of 18.4%). The switching value (beyond which the Project has an EIRR below 12%) is at a 47% decrease in agriculture production benefits. The economic viability of the Project, then, is not very sensitive to production shortfalls.

24. A second area of risk has to do with the adequacy of O&M. Sensitivity was tested against increased O&M expenditures. The results indicate that the EIRR would drop only to 18.0% if O&M expenditures were to double. It would take an O&M expenditure of 15 times the estimated figure (i.e., up to \$75 per ha per year plus \$750 per ha in more major expenses in the 10th and 20th years of project life) to cause the EIRR to drop below 12%. The Project's viability, therefore, is not very much at risk from increased O&M costs.

25. Project economic life is the third major risk area. Sustainability tests indicate that a 15-year life would produce an EIRR of 17.0%; a 10-year life, 13.7%; and a 5-year life, 5.4%. A 9-year minimum economic life would produce an EIRR of 12%. Assuming that WUAs perform normal levels of O&M, the Project should be able to attain a viable rate of return.

Table A9.1a: Deviation of Economic Prices for Major Tradeable Grains

Crop/Item	Unit	Actual								Projected				
		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2005	2010	2015
A. Rice														
World Market Price FOB ^a														
Constant 1990 Dollars ^b	\$/t	242.8	269.2	297.3	280.0	291.9	240.5	208.0	180.1	199.1	211.4	226.9	233.9	223.6
Constant 2001 Dollars ^b	\$/t	233.0	258.3	285.3	268.7	280.1	230.8	199.6	172.8	191.0	202.8	217.7	224.4	214.5
Less Quality Adjustment	30%	69.9	77.5	85.6	80.6	84.0	69.2	59.9	51.8	57.3	60.9	65.3	67.3	64.4
Quality Adjusted FOB	\$/t	163.1	180.8	199.7	188.1	196.1	161.5	139.7	121.0	133.7	142.0	152.4	157.1	150.2
International Freight	\$/t	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Calcutta CIF Price	\$/t	203.1	220.8	239.7	228.1	236.1	201.5	179.7	161.0	173.7	182.0	192.4	197.1	190.2
Transport and Handling to														
Nepal Border (Nepalganj)	\$/t	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Nepalganj CIF Price	\$/t	263.1	280.8	299.7	288.1	296.1	261.5	239.7	221.0	233.7	242.0	252.4	257.1	250.2
CIF price in NRs ^c	NRs/t	19,993.8	21,341.4	22,775.8	21,892.7	22,500.2	19,876.4	18,217.4	16,793.3	17,763.1	18,391.0	19,182.2	19,539.5	19,013.8
Freight to and from mill	NRs/t	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)
Processing Rate	NRs/t	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Processing Cost	NRs/t	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)	(250.0)
Freight to Farmgate, Rajapur	NRs/t	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0
Economic Farmgate Price	NRs/t	12,933.5	13,809.4	14,741.8	14,167.8	14,562.6	12,857.2	11,778.8	10,853.1	11,483.5	11,891.6	12,405.9	12,638.2	12,296.4
B. Wheat														
World Market Price FOB ^d														
Constant 1990 Dollars	\$/t	135.9	148.5	182.1	147.2	121.1	108.5	117.2	132.2	157.1	181.2	144.8	143.9	139.2
Constant 2001 Dollars	\$/t	130.4	142.5	174.7	141.2	116.2	104.1	112.5	126.8	150.7	173.9	138.9	138.1	133.6
Less Quality Adjustment	20%	26.1	28.5	34.9	28.2	23.2	20.8	22.5	25.4	30.1	34.8	27.8	27.6	26.7
Quality Adjusted FOB	\$/t	104.3	114.0	139.8	113.0	93.0	83.3	90.0	101.5	120.6	139.1	111.1	110.5	106.8
International Freight	\$/t	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0
Calcutta CIF Price	\$/t	174.3	184.0	209.8	183.0	163.0	153.3	160.0	171.5	190.6	209.1	181.1	180.5	176.8
Transport and Handling to														
Nepal Border (Nepalganj)	\$/t	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Nepalganj CIF Price	\$/t	234.3	244.0	269.8	243.0	223.0	213.3	220.0	231.5	250.6	269.1	241.1	240.5	236.8
CIF price in NRs	NRs/t	17,808.1	18,543.1	20,503.3	18,467.3	16,944.7	16,209.6	16,717.2	17,592.2	19,044.8	20,450.8	18,327.3	18,274.8	18,000.6
Freight to Farmgate, Rajapur	NRs/t	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0
Economic Farmgate Price	NRs/t	18,158.1	18,893.1	20,853.3	18,817.3	17,294.7	16,559.6	17,067.2	17,942.2	19,394.8	20,800.8	18,677.3	18,624.8	18,350.6
C. Maize														
World Market Price FOB ^d														
Constant 1990 Dollars	\$/t	97.6	103.6	145.5	108.0	97.9	87.3	91.0	93.4	103.7	125.8	111.0	107.9	109.7
Constant 2001 Dollars	\$/t	93.6	99.4	139.6	103.6	93.9	83.8	87.3	89.6	99.5	120.7	106.5	103.5	105.3
Less Quality Adjustment	10%	9.4	9.9	14.0	10.4	9.4	8.4	8.7	9.0	10.0	12.1	10.7	10.4	10.5
Quality Adjusted FOB	\$/t	84.3	89.5	125.6	93.3	84.5	75.4	78.6	80.7	89.6	108.6	95.9	93.2	94.7
International Freight	\$/t	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Calcutta CIF Price	\$/t	150.3	155.5	191.6	159.3	150.5	141.4	144.6	146.7	155.6	174.6	161.9	159.2	160.7
Transport and Handling to														
Nepal Border (Nepalganj)	\$/t	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Nepalganj CIF Price	\$/t	210.3	215.5	251.6	219.3	210.5	201.4	204.6	206.7	215.6	234.6	221.9	219.2	220.7
CIF price in Nrs	NRs/t	15,981.5	16,375.2	19,125.1	16,664.0	16,001.2	15,305.5	15,548.3	15,705.8	16,381.8	17,832.2	16,860.9	16,657.5	16,775.6
Freight to Farmgate, Rajapur	NRs/t	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0
Economic Farmgate Price	NRs/t	16,331.5	16,725.2	19,475.1	17,014.0	16,351.2	15,655.5	15,898.3	16,055.8	16,731.8	18,182.2	17,210.9	17,007.5	17,125.6

CIF = cost, insurance and freight, FOB = free on board, t = tons.

^a Thai white, milled, 5% broken, FOB, Bangkok

^b Constant 1990 prices are derived from World Bank Commodity Price Projections (for 2000 to 2015: 12 November 2002; for 1999: 30 January 2001; for 1997-98: 25 April 1999; for 1994-96: August 1998). The inflation index (2001/1990), measured by manufacturing unit value index, is 0.9595 as estimated in the 12 November 2002 publication. This use of multiple issues of the World Bank commodity prices was in order to get the most finalized versions of actual prices (especially for year not ending a decade- only two of which appear in any given publication) and the latest version of projected prices.

^c The average 2001 NRs/\$ rate was NRs76.0 per United States dollar.

^d Canadian, No.1 western Red Spring, St. Lawrence, export.

Table A9.1b: Derivation of Economic Prices of Fertilizers

Crop/Item	Unit	Year											
		Actual					Projected						
		1995	1996	1997	1998	1999	2000	2001	2002	2003	2005	2010	2015
A. Urea													
World Market Price FOB ^a													
Constant 1990 Dollars ^b	\$/t	177.4	180.3	118.0	98.9	75.3	103.9	99.3	96.4	109.4	122.3	118.1	114.6
Constant 2001 Dollars ^b	\$/t	170.2	173.0	113.2	94.9	72.3	99.7	95.3	92.5	105.0	117.3	113.3	110.0
International Freight	\$/t	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Calcutta CIF Price	\$/t	230.2	233.0	173.2	154.9	132.3	159.7	155.3	152.5	165.0	177.3	173.3	170.0
Transport and Handling to													
Nepal Border (Nepalganj)	\$/t	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Nepalganj CIF Price	\$/t	290.2	293.0	233.2	214.9	192.3	219.7	215.3	212.5	225.0	237.3	233.3	230.0
CIF Price in NRs ^c	NRs/t	22,056.4	22,267.8	17,724.8	16,332.0	14,611.0	16,696.6	16,361.2	16,149.7	17,097.7	18,038.4	17,732.1	17,476.9
Transport and Handling to													
Wholesaler, Nepalganj	NRs/t	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Wholesalers' Margin	20%	4,471.3	4,513.6	3,605.0	3,326.4	2,982.2	3,399.3	3,332.2	3,289.9	3,479.5	3,667.7	3,606.4	3,555.4
Transport and Handling to													
Farmgate, Rajapur	NRs/t	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0
Retailors' Margin	10%	2,717.8	2,743.1	2,198.0	2,030.8	1,824.3	2,074.6	2,034.3	2,009.0	2,122.7	2,235.6	2,198.9	2,168.2
Economic Farmgate Price	NRs/t	29,895.4	30,174.5	24,177.7	22,339.2	20,067.6	22,820.5	22,377.7	22,098.6	23,349.9	24,591.6	24,187.4	23,850.5
B. Diammonium Phosphate													
World Market Price FOB ^d													
Constant 1990 Dollars	\$/t	181.7	187.0	184.5	195.2	172.1	158.5	154.0	163.8	169.1	164.1	157.4	151.9
Constant 2001 Dollars	\$/t	174.3	179.4	177.0	187.3	165.1	152.1	147.8	157.2	162.3	157.5	151.0	145.7
International Freight	\$/t	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Calcutta CIF Price	\$/t	240.3	245.4	243.0	253.3	231.1	218.1	213.8	223.2	228.3	223.5	217.0	211.7
Transport and Handling to													
Nepal Border (Nepalganj)	\$/t	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Nepalganj CIF Price	\$/t	300.3	305.4	303.0	313.3	291.1	278.1	273.8	283.2	288.3	283.5	277.0	271.7
CIF Price in NRs	NRs/t	22,825.9	23,212.4	23,030.1	23,810.4	22,125.9	21,134.1	20,806.0	21,520.6	21,907.1	21,542.5	21,053.9	20,652.9
Transport and Handling to													
Wholesaler, Nepalganj	NRs/t	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Wholesalers' Margin	20%	4,625.2	4,702.5	4,666.0	4,822.1	4,485.2	4,286.8	4,221.2	4,364.1	4,441.4	4,368.5	4,270.8	4,190.6
Transport and Handling to													
Farmgate, Rajapur	NRs/t	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0
Retailors' Margin	10%	2,810.1	2,856.5	2,834.6	2,928.2	2,726.1	2,607.1	2,567.7	2,653.5	2,699.9	2,656.1	2,597.5	2,549.3
Economic Farmgate Price	NRs/t	30,911.2	31,421.4	31,180.7	32,210.7	29,987.2	28,678.1	28,244.9	29,188.2	29,698.4	29,217.1	28,572.2	28,042.8
C. Muriate of Potash													
World Market Price FOB ^e													
Constant 1990 Dollars	\$/t	98.8	102.6	107.5	112.2	117.8	125.9	123.1	117.2	120.8	119.7	114.2	109.7
Constant 2001 Dollars	\$/t	94.8	98.4	103.1	107.7	113.0	120.8	118.1	112.5	115.9	114.9	109.6	105.3
International Freight	\$/t	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Calcutta CIF Price	\$/t	160.8	164.4	169.1	173.7	179.0	186.8	184.1	178.5	181.9	180.9	175.6	171.3
Transport and Handling to													
Nepal Border (Nepalganj)	\$/t	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Nepalganj CIF Price	\$/t	220.8	224.4	229.1	233.7	239.0	246.8	244.1	238.5	241.9	240.9	235.6	231.3
CIF Price in NRs ^c	NRs/t	16,780.7	17,057.8	17,415.1	17,757.8	18,166.2	18,756.9	18,552.7	18,122.5	18,385.0	18,304.8	17,903.7	17,575.5
Transport and Handling to													
Wholesaler, Nepalganj	NRs/t	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0
Wholesalers' Margin	20%	3,416.1	3,471.6	3,543.0	3,611.6	3,693.2	3,811.4	3,770.5	3,684.5	3,737.0	3,721.0	3,640.7	3,575.1
Transport and Handling to													
Farmgate, Rajapur	NRs/t	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0	350.0
Retailors' Margin	10%	2,084.7	2,117.9	2,160.8	2,201.9	2,250.9	2,321.8	2,297.3	2,245.7	2,277.2	2,267.6	2,219.4	2,180.1
Economic Farmgate Price	NRs/t	22,931.5	23,297.3	23,769.0	24,221.4	24,760.4	25,540.1	25,270.6	24,702.6	25,049.2	24,943.3	24,413.9	23,980.7

CIF = cost, insurance and freight, FOB = free on board, t = tons.

^a Bagged, spot, FOB, West Europe.

^b Derived from World Bank Commodity Price Projections (see f.n. b/ for rice).

^c The average 2001 NRs/\$ rate was NRs76.0 per United States dollars.

^d Bulk, spote, FOB, US Gulf.

^e Standard grade, spot, FOB, Vancouver.

Table A9.2: Summary of Financial and Economic Prices
(constant 2001 NRs)

Item	Unit	Financial Price 2001 ^a	Economic Price (constant 2001) ^b												
			Actual								Projected				
			1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2005	2010	2015
A. Outputs															
Rice	NRs/kg	8.5	12.9	13.8	14.7	14.2	14.6	12.9	11.8	10.9	11.5	11.9	12.4	12.6	12.3
Rice Byproducts	NRs/kg	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Maize	NRs/kg	9.0	16.3	16.7	19.5	17.0	16.4	15.7	15.9	16.1	16.7	18.2	17.2	17.0	17.1
Maize Byproducts	NRs/kg	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Wheat	NRs/kg	9.0	18.2	18.9	20.9	18.8	17.3	16.6	17.1	17.9	19.4	20.8	18.7	18.6	18.4
Wheat Byproducts	NRs/kg	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Lentil / Pulses	NRs/kg	32.0	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8	28.8
Mustard / Oilseed	NRs/kg	27.0	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3
Potato	NRs/kg	13.0	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
B. Inputs															
Seed															
Rice	NRs/kg	15.0	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
Maize	NRs/kg	14.0	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6
Wheat	NRs/kg	12.0	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Lentil / Pulses	NRs/kg	40.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0
Mustard / Oilseed	NRs/kg	30.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0
Potato	NRs/kg	12.0	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8	10.8
Fertilizers															
Urea	NRs/kg	14.5	25.7	29.9	30.2	24.2	22.3	20.1	22.8	22.4	22.1	23.3	24.6	24.2	23.9
DAP	NRs/kg	18.6	28.5	30.9	31.4	31.2	32.2	30.0	28.7	28.2	29.2	29.7	29.2	28.6	28.0
Potash	NRs/kg	14.0	22.7	22.9	23.3	23.8	24.2	24.8	25.5	25.3	24.7	25.0	24.9	24.4	24.0
Farmyard Manure	NRs/t	500.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0	450.0
Miscellaneous	NRs/set	100.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0
C. Labor															
Farm labor ^c	NRs/person-day	80.0	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8	64.8
Draft animal ^d	NRs/pair-day	150.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0	135.0
D. Machine															
Tractor	NRs/hour	450.0	405.0	405.0	405.0	405.0	405.0	405.0	405.0	405.0	405.0	405.0	405.0	405.0	405.0
Pumpset	NRs/hour	60.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0

DAP = diammonium phosphate, kg = kilogram.

^a Financial prices, adjusted to 2001 levels, were derived from project completion review mission field survey and data from the Agriculture Development Program and Achievement 2001/02, District Agriculture Development Office, Guleria, Bardia.

^b Economic prices for major traded commodities were derived from the World Bank Commodity Price Projections. Economic prices for nontraded goods, labor and nontraded goods, labor and other costs were based on local financial prices and adjusted by the standard conversion factor of 0.9.

^c Economic price for labor computed as follows: local wage rate x 0.9 (shadow wage rate) x 0.9 (standard conversion factor).

^d Including operator.

Table A9.3: Cropping Patterns With and Without the Project
(hectare)

Item	Total Project Area			Amount per 1 ha Farm		
	Without Project	With Project	Increment	Without Project	With Project	Increment
A. Irrigated Area	12,500.0	13,389.0	889.0	0.89	0.96	0.06
Rice	12,500.0	12,928.0	428.0	0.89	0.92	0.03
Wheat	4,000.0	6,848.0	2,848.0	0.29	0.49	0.20
Maize	2,000.0	1,198.0	(802.0)	0.14	0.09	-0.06
Mustard / Oilseed	4,000.0	1,866.0	(2,134.0)	0.29	0.13	-0.15
Lentil / Pulses	3,500.0	1,890.0	(1,610.0)	0.25	0.14	-0.12
Potato	-	272.0	272.0	0.00	0.02	0.02
Total	26,000.0	25,002.0	(998.0)	1.86	1.79	-0.07
B. Rainfed Area	1,500.0	1,111.0	(389.0)	0.11	0.08	-0.03
Rice	-	1,073.0	1,073.0	0.00	0.08	0.08
Wheat	-	568.0	568.0	0.00	0.04	0.04
Maize	-	99.0	99.0	0.00	0.01	0.01
Mustard / Oilseed	-	155.0	155.0	0.00	0.01	0.01
Lentil / Pulses	-	157.0	157.0	0.00	0.01	0.01
Potato	-	23.0	23.0	0.00	0.00	0.00
Total	-	2,075.0	2,075.0	0.00	0.15	0.15
C. Total Area	14,000.0	14,500.0	500.0	1.00	1.04	0.04
Rice	12,500.0	14,001.0	1,501.0	0.89	1.00	0.11
Wheat	4,000.0	7,416.0	3,416.0	0.29	0.53	0.24
Maize	2,000.0	1,297.0	(703.0)	0.14	0.09	-0.05
Mustard / Oilseed	4,000.0	2,021.0	(1,979.0)	0.29	0.14	-0.14
Lentil / Pulses	3,500.0	2,047.0	(1,453.0)	0.25	0.15	-0.10
Potato	-	295.0	295.0	0.00	0.02	0.02
Total	26,000.0	27,077.0	1,077.0	1.86	1.93	0.08
Cropping Intensity (%)	186%	187%	1%	186%	187%	1%

Source: Based on published and unpublished project monitoring data and project completion review mission field survey.

Table A9.4: Assessment of Benefits from Flood Protection Works**A. Land, Crops, Household and Cattles Saved from Flood of 2000^a**

System	With the Project			
	Land saved (ha)	Cropping Area Saved ^c (ha)	Household Saved (Nos.)	Livestock Saved (Nos.)
Patabhar	400	100	80	640
Bagaipur	346	87	190	1,800
Madhavpur	100	25	25	250
Janaknagar	320	80	75	700
Gola	282	71	65	620
Total	1,448	362	435	4,010

^a The frequency of the floods similar to the 2000 flood is of 1 in 10 years.

^b Saved cropping area is assumed 25% of the saved land area.

Source: Based on farmers' statement during the system level group meetings with the project completion review mission.

B. Financial Value in Constant 2001 Dollars

Item	Incremental Benefit from			
	Land Saved	Cropping Area Saved	Household Saved	Livestock Saved
Average rate, NRs.	337,500.00	32,581.04	6,500.00	2,300.00
Total Amount in NRs.	488,700,000.00	11,794,337.41	2,827,500.00	9,223,000.00
Total Amount in US\$ (equivalent)	6,430,263.16	155,188.65	37,203.95	121,355.26

C. Economic Value in Constant 2001 Dollars

Item	Incremental Benefit from			
	Land Saved	Cropping Area Saved	Household Saved	Livestock Saved
Average rate, NRs.	303,750.00	36,977.45	5,850.00	2,070.00
Total Amount in NRs.	439,830,000.00	13,385,836.24	2,544,750.00	8,300,700.00
Total Amount in US\$ (equivalent)	5,787,236.84	176,129.42	33,483.55	109,219.74

Table A9.5: Benefits accruing from Roads and Pontoon Bridge

Item	Unit	Quantity	Financial Value	Economic Value
People Travelling	(person-trips)	84,189		
Time Saving Per Trip	(days/person-trip)	1		
Cost Saving Per Trip	(NRs/person-trip)	100		
Savings in Travel Time			-	5,455,447.2
Savings in Travel Cost			8,418,900.0	7,577,010.0
Total	NRs		8,418,900.0	13,032,457.2
	\$		110,775.0	171,479.7

Note: Due to increased accessibility, to commute between Rajapur and Nepalganj, people can save one day on the road, and save NRs100.00 in travel related expenditures by avoiding travel through India or other sides of the project area.

Source: Based on farmers' statement during the system level group meetings with the project completion review mission

Table A9.6a: Farm Model of Inputs per Hectare: Financial Costs Without Project
(Physical Inputs and Production Costs)

Items	Financial Costs (constant 2001 NRs)																		
	Rice			Wheat			Maize			Mustard / Oilseed			Lentil / Pulses			Potato			
	Quantity	Price	Total	Quantity	Price	Total	Quantity	Price	Total	Quantity	Price	Total	Quantity	Price	Total	Quantity	Price	Total	
Irrigated Areas																			
Seeds	(kg)	75.0	15.0	1,125.0	150.0	12.0	1,800.0	32.0	14.0	448.0	25.0	30.0	750.0	27.0	40.0	1,080.0	800.0	12.0	9,600.0
Urea	(kg)	15.0	14.5	217.5	30.0	14.5	435.0	-	14.5	-	16.0	14.5	232.0	-	14.5	-	125.0	14.5	1,812.5
DAP	(kg)	10.0	18.6	186.0	27.0	18.6	502.2	-	18.6	-	16.0	18.6	297.6	-	18.6	-	15.0	18.6	279.0
Phosphate	(kg)	-	14.0	-	-	14.0	-	-	14.0	-	-	14.0	-	-	14.0	-	5.0	14.0	70.0
Manure	(t)	2.0	500.0	1,000.0	1.0	500.0	500.0	4.0	500.0	2,000.0	2.0	500.0	1,000.0	-	500.0	-	3.0	500.0	1,500.0
Miscellaneous	(NRs)	3.0	100.0	300.0	2.0	100.0	200.0	-	100.0	-	-	100.0	-	-	100.0	-	-	100.0	-
Labor	(person-day)	120.0	-	-	90.0	-	-	95.0	-	-	75.0	-	-	45.0	-	-	250.0	-	-
Bullocks	(day)	20.0	150.0	3,000.0	20.0	150.0	3,000.0	24.0	150.0	3,600.0	10.0	150.0	1,500.0	10.0	150.0	1,500.0	20.0	150.0	3,000.0
Tractor	(hour)	5.0	450.0	2,250.0	3.2	450.0	1,440.0	-	450.0	-	5.5	450.0	2,475.0	3.0	450.0	1,350.0	-	450.0	-
Total Cost				8,078.5			7,877.2			6,048.0			6,254.6			3,930.0			16,261.5
Rainfed Areas																			
Seeds	(kg)	75.0	15.0	1,125.0	120.0	12.0	1,440.0	32.0	14.0	448.0	20.0	30.0	600.0	20.0	40.0	800.0	600.0	12.0	7,200.0
Urea	(kg)	15.0	14.5	217.5	8.0	14.5	116.0	-	14.5	-	5.4	14.5	78.3	-	14.5	-	80.0	14.5	1,160.0
DAP	(kg)	10.0	18.6	186.0	5.0	18.6	93.0	-	18.6	-	6.0	18.6	111.6	-	18.6	-	10.0	18.6	186.0
Phosphate	(kg)	-	14.0	-	-	14.0	-	-	14.0	-	-	14.0	-	-	14.0	-	-	14.0	-
Manure	(t)	1.0	500.0	500.0	-	500.0	-	4.0	500.0	2,000.0	-	500.0	-	-	500.0	-	1.0	500.0	500.0
Miscellaneous	(NRs)	3.0	100.0	300.0	2.0	100.0	200.0	-	100.0	-	-	100.0	-	-	100.0	-	-	100.0	-
Labor	(person-day)	100.0	-	-	40.0	-	-	75.0	-	-	60.0	-	-	40.0	-	-	180.0	-	-
Bullocks	(day)	10.0	150.0	1,500.0	24.0	150.0	3,600.0	12.0	150.0	1,800.0	5.0	150.0	750.0	8.0	150.0	1,200.0	20.0	150.0	3,000.0
Tractor	(hour)	2.0	450.0	900.0	3.2	450.0	1,440.0	-	450.0	-	4.2	450.0	1,890.0	-	450.0	-	-	450.0	-
Total Cost				4,728.5			6,889.0			4,248.0			3,429.9			2,000.0			12,046.0

DAP = diammonium phosphate, kg = kilogram, t = tons.

Sources: Quantities include the project completion review mission field survey, field visits, the socioeconomic study conducted in 2001, and data from the Agriculture Development Program and Achievement 2001/02, District Agriculture Development Office, Guleria, Bardia.

Table A9.6b: Farm Model of Inputs per Hectare: Financial Costs With Project
(Physical Inputs and Production Costs)

Item	Financial Costs (constant 2001 NRs)																		
	Rice			Wheat			Maize			Mustard / Oilseed			Lentil / Pulses			Potato			
	Quantity	Price	Total	Quantity	Price	Total	Quantity	Price	Total	Quantity	Price	Total	Quantity	Price	Total	Quantity	Price	Total	
Irrigated Areas																			
Seeds	(kg)	50.0	15.0	750.0	120.0	12.0	1,440.0	26.0	14.0	364.0	21.0	30.0	630.0	27.0	40.0	1,080.0	800.0	12.0	9,600.0
Urea	(kg)	30.0	14.5	435.0	40.0	14.5	580.0	20.0	14.5	290.0	24.0	14.5	348.0	-	14.5	-	150.0	14.5	2,175.0
DAP	(kg)	20.0	18.6	372.0	35.0	18.6	651.0	10.0	18.6	186.0	24.0	18.6	446.4	-	18.6	-	20.0	18.6	372.0
Phosphate	(kg)	2.0	14.0	28.0	3.6	14.0	50.4	10.0	14.0	140.0	1.0	14.0	14.0	-	14.0	-	5.0	14.0	70.0
Manure	(t)	-	500.0	-	1.0	500.0	500.0	2.8	500.0	1,400.0	1.0	500.0	500.0	0.5	500.0	250.0	3.0	500.0	1,500.0
Miscellaneous	(NRs)	3.0	100.0	300.0	2.0	100.0	200.0	2.0	100.0	200.0	1.5	100.0	150.0	0.5	100.0	50.0	2.5	100.0	250.0
Labor	(person-day)	120.0	-	-	90.0	-	-	100.0	-	-	75.0	-	-	45.0	-	-	250.0	-	-
Bullocks	(day)	20.0	150.0	3,000.0	20.0	150.0	3,000.0	34.0	150.0	5,100.0	16.0	150.0	2,400.0	10.0	150.0	1,500.0	10.0	150.0	1,500.0
Tractor	(hour)	5.0	450.0	2,250.0	3.0	450.0	1,350.0	1.0	450.0	450.0	5.5	450.0	2,475.0	3.0	450.0	1,350.0	-	450.0	-
Total Cost				7,135.0			7,771.4			8,130.0			6,963.4			4,230.0			15,467.0
Rainfed Areas																			
Seeds	(kg)	50.0	15.0	750.0	100.0	12.0	1,200.0	26.0	14.0	364.0	16.0	30.0	480.0	20.0	40.0	800.0	600.0	12.0	7,200.0
Urea	(kg)	25.0	14.5	362.5	8.0	14.5	116.0	-	14.5	-	8.0	14.5	116.0	-	14.5	-	80.0	14.5	1,160.0
DAP	(kg)	10.0	18.6	186.0	7.0	18.6	130.2	-	18.6	-	10.0	18.6	186.0	-	18.6	-	10.0	18.6	186.0
Phosphate	(kg)	-	14.0	-	-	14.0	-	-	14.0	-	-	14.0	-	-	14.0	-	-	14.0	-
Manure	(t)	-	500.0	-	-	500.0	-	1.4	500.0	700.0	-	500.0	-	-	500.0	-	1.0	500.0	500.0
Miscellaneous	(NRs)	3.0	100.0	300.0	2.0	100.0	200.0	2.0	100.0	200.0	1.5	100.0	150.0	0.5	100.0	50.0	2.5	100.0	250.0
Labor	(person-day)	100.0	-	-	40.0	-	-	80.0	-	-	60.0	-	-	40.0	-	-	180.0	-	-
Bullocks	(day)	10.0	150.0	1,500.0	24.0	150.0	3,600.0	16.0	150.0	2,400.0	8.0	150.0	1,200.0	8.0	150.0	1,200.0	20.0	150.0	3,000.0
Tractor	(hour)	2.0	450.0	900.0	3.0	450.0	1,350.0	1.0	450.0	450.0	4.2	450.0	1,890.0	-	450.0	-	-	450.0	-
Total Cost				3,998.5			6,596.2			4,114.0			4,022.0			2,050.0			12,296.0

DAP = diammonium phosphate, kg = kilogram, t = tons.

Sources: Project completion review mission field survey, field visits, the socioeconomic study conducted in 2001, and data from the Agriculture Development Program and Achievement 2001/02, District Agriculture Development Office, Guleria Bardia.

Table A9.7a: Net Crop Revenue Without Project

Crop	Yield	Price	Irrigated			Rainfed				
			Gross Revenue	Prod. Cost	Net Revenue	Yield	Price	Gross Revenue	Prod. Cost	Net Revenue
Financial Net Crop Revenue per ha (constant 2001 NRs)										
Rice	2.5	8.5	21,165.0	8,078.5	13,086.5	2.5	8.5	21,165.0	4,728.5	16,436.5
Rice Byproducts	2.0	0.4	796.8		796.8	2.0	0.4	796.8		796.8
Wheat	1.7	9.0	15,300.0	7,877.2	7,422.8	1.7	9.0	14,850.0	6,889.0	7,961.0
Wheat Byproducts	1.5	0.5	765.0		765.0	1.5	0.5	742.5		742.5
Maize	0.9	9.0	7,650.0	6,048.0	1,602.0	0.9	9.0	7,650.0	4,248.0	3,402.0
Mustard / Oilseed	0.5	27.0	13,500.0	6,254.6	7,245.4	0.5	27.0	13,500.0	3,429.9	10,070.1
Lentil / Pulses	0.3	32.0	9,600.0	3,930.0	5,670.0	0.3	32.0	9,600.0	2,000.0	7,600.0
Potato	5.5	13.0	71,500.0	16,261.5	55,238.5	5.5	13.0	71,500.0	12,046.0	59,454.0
Economic Net Crop Revenue per ha (2001 prices in constant 2001 NRs)										
Rice	2.5	10.9	27,024.3	15,301.6	11,722.7	2.5	10.9	27,024.3	10,990.6	16,033.7
Rice Byproducts	2.0	0.4	717.1		717.1	2.0	0.4	717.1		717.1
Wheat	1.7	17.9	30,501.8	13,511.9	16,989.8	1.7	17.9	29,604.7	8,924.2	20,680.4
Wheat Byproducts	1.5	0.5	688.5		688.5	1.5	0.5	668.3		668.3
Maize	0.9	16.1	13,647.4	11,599.2	2,048.2	0.9	16.1	13,647.4	8,683.2	4,964.2
Mustard / Oilseed	0.5	24.3	12,150.0	10,822.5	1,327.5	0.5	24.3	12,150.0	7,094.3	5,055.7
Lentil / Pulses	0.3	28.8	8,640.0	6,453.0	2,187.0	0.3	28.8	8,640.0	4,392.0	4,248.0
Potato	5.5	11.7	64,350.0	32,237.2	32,112.8	5.5	11.7	64,350.0	23,366.7	40,983.3
Economic Net Crop Revenue per ha (2005 prices in constant 2001 NRs)										
Rice	2.5	12.4	30,890.8	8,078.5	22,812.3	2.5	12.4	30,890.8	4,728.5	26,162.3
Rice byproducts	2.0	0.4	717.1		717.1	2.0	0.4	717.1		717.1
Wheat	1.7	18.7	31,751.4	7,697.2	24,054.2	1.7	18.7	30,817.5	6,745.0	24,072.5
Wheat byproducts	1.5	0.5	688.5		688.5	1.5	0.5	668.3		668.3
Maize	0.9	17.2	14,629.3	6,003.2	8,626.1	0.9	17.2	14,629.3	4,203.2	10,426.1
Mustard / Oilseed	0.5	24.3	12,150.0	6,179.6	5,970.4	0.5	24.3	12,150.0	3,369.9	8,780.1
Lentil / Pulses	0.3	28.8	8,640.0	3,822.0	4,818.0	0.3	28.8	8,640.0	1,920.0	6,720.0
Potato	5.5	11.7	64,350.0	15,301.5	49,048.5	5.5	11.7	64,350.0	11,326.0	53,024.0
Economic Net Crop Revenue per ha (2010 prices in constant 2001 NRs)										
Rice	2.5	12.6	31,469.1	15,332.0	16,137.1	2.5	12.6	31,469.1	11,021.0	20,448.1
Rice Byproducts	2.0	0.4	717.1		717.1	2.0	0.4	717.1		717.1
Wheat	1.7	18.6	31,662.1	13,575.1	18,087.1	1.7	18.6	30,730.9	8,940.4	21,790.5
Wheat Byproducts	1.5	0.5	688.5		688.5	1.5	0.5	668.3		668.3
Maize	0.9	17.0	14,456.3	11,599.2	2,857.1	0.9	17.0	14,456.3	8,683.2	5,773.1
Mustard / Oilseed	0.5	24.3	12,150.0	10,856.7	1,293.3	0.5	24.3	12,150.0	7,106.0	5,044.0
Lentil / Pulses	0.3	28.8	8,640.0	6,453.0	2,187.0	0.3	28.8	8,640.0	4,392.0	4,248.0
Potato	5.5	11.7	64,350.0	32,464.1	31,885.9	5.5	11.7	64,350.0	23,514.7	40,835.3
Economic Net Crop Revenue per ha (2015 prices in constant 2001 NRs)										
Rice	2.5	12.3	30,618.1	15,321.7	15,296.4	2.5	12.3	30,618.1	11,010.7	19,607.4
Rice Byproducts	2.0	0.4	717.1		717.1	2.0	0.4	717.1		717.1
Wheat	1.7	18.4	31,196.0	13,550.7	17,645.3	1.7	18.4	30,278.5	8,935.0	21,343.5
Wheat Byproducts	1.5	0.5	688.5		688.5	1.5	0.5	668.3		668.3
Maize	0.9	17.1	14,556.8	11,599.2	2,957.6	0.9	17.1	14,556.8	8,683.2	5,873.6
Mustard / Oilseed	0.5	24.3	12,150.0	10,842.8	1,307.2	0.5	24.3	12,150.0	7,101.0	5,049.0
Lentil / Pulses	0.3	28.8	8,640.0	6,453.0	2,187.0	0.3	28.8	8,640.0	4,392.0	4,248.0
Potato	5.5	11.7	64,350.0	32,411.9	31,938.1	5.5	11.7	64,350.0	23,482.5	40,867.5

Source: Derived from previous tables.

Table A9.7b: Net Crop Revenue With Project

(In Constant 2001 NRs)

Crop	Irrigated					Rainfed (Not Irrigated)				
	Yield	Price	Gross Revenue	Product Cost	Net Revenue	Yield	Price	Gross Revenue	Prod. Cost	Net Revenue
Financial Net Crop Revenue per ha										
Rice	3.3	8.5	28,135.0	7,135.0	21,000.0	3.4	8.5	28,645.0	3,998.5	24,646.5
Rice Byproducts	2.6	0.4	1,059.2		1,059.2	2.7	0.4	1,078.4		1,078.4
Wheat	1.9	9.0	16,830.0	7,771.4	9,058.6	2.4	9.0	21,600.0	6,596.2	15,003.8
Wheat Byproducts	1.7	0.5	841.5		841.5	2.2	0.5	1,080.0		1,080.0
Maize	1.1	9.0	9,900.0	8,130.0	1,770.0	1.3	9.0	11,340.0	4,114.0	7,226.0
Mustard / Oilseed	0.6	27.0	16,470.0	6,963.4	9,506.6	0.6	27.0	16,470.0	4,022.0	12,448.0
Lentil / Pulses	0.5	32.0	16,000.0	4,230.0	11,770.0	0.5	32.0	16,000.0	2,050.0	13,950.0
Potato	6.3	13.0	81,250.0	15,467.0	65,783.0	6.3	13.0	81,250.0	12,296.0	68,954.0
Economic Net Crop Revenue per ha (2001 Prices)										
Rice	3.3	10.9	35,923.9	14,732.8	21,191.1	3.4	10.9	36,575.0	10,426.9	26,148.2
Rice Byproducts	2.6	0.4	953.3		953.3	2.7	0.4	970.6		970.6
Wheat	1.9	17.9	33,552.0	13,647.7	19,904.3	2.4	17.9	43,061.4	8,683.7	34,377.6
Wheat Byproducts	1.7	0.5	757.4		757.4	2.2	0.5	972.0		972.0
Maize	1.1	16.1	17,661.4	14,225.3	3,436.1	1.3	16.1	20,230.3	8,886.6	11,343.7
Mustard / Oilseed	0.6	24.3	14,823.0	11,639.7	3,183.3	0.6	24.3	14,823.0	7,697.5	7,125.5
Lentil / Pulses	0.5	28.8	14,400.0	6,723.0	7,677.0	0.5	28.8	14,400.0	4,437.0	9,963.0
Potato	6.3	11.7	73,125.0	31,812.9	41,312.1	6.3	11.7	73,125.0	23,591.7	49,533.3
Economic Net Crop Revenue per ha (2005 Prices)										
Rice	3.3	12.4	41,063.6	14,818.0	26,245.7	3.4	12.4	41,808.0	10,492.0	31,316.0
Rice Byproducts	2.6	0.4	953.3		953.3	2.7	0.4	970.6		970.6
Wheat	1.9	18.7	34,926.5	13,769.1	21,157.5	2.4	18.7	44,825.5	8,708.3	36,117.2
Wheat Byproducts	1.7	0.5	757.4		757.4	2.2	0.5	972.0		972.0
Maize	1.1	17.2	18,932.0	14,276.0	4,656.0	1.3	17.2	21,685.7	8,886.6	12,799.1
Mustard / Oilseed	0.6	24.3	14,823.0	11,715.9	3,107.1	0.6	24.3	14,823.0	7,724.9	7,098.1
Lentil / Pulses	0.5	28.8	14,400.0	6,723.0	7,677.0	0.5	28.8	14,400.0	4,437.0	9,963.0
Potato	6.3	11.7	73,125.0	32,162.8	40,962.2	6.3	11.7	73,125.0	23,778.5	49,346.5
Economic Net Crop Revenue per ha (2010 Prices)										
Rice	3.3	12.6	41,832.4	14,791.9	27,040.5	3.4	12.6	42,590.7	10,475.4	32,115.3
Rice Byproducts	2.6	0.4	953.3		953.3	2.7	0.4	970.6		970.6
Wheat	1.9	18.6	34,828.3	13,728.4	21,099.9	2.4	18.6	44,699.5	8,700.5	35,999.0
Wheat Byproducts	1.7	0.5	757.4		757.4	2.2	0.5	972.0		972.0
Maize	1.1	17.0	18,708.2	14,256.2	4,452.0	1.3	17.0	21,429.4	8,886.6	12,542.8
Mustard / Oilseed	0.6	24.3	14,823.0	11,690.1	3,132.9	0.6	24.3	14,823.0	7,715.2	7,107.8
Lentil / Pulses	0.5	28.8	14,400.0	6,723.0	7,677.0	0.5	28.8	14,400.0	4,437.0	9,963.0
Potato	6.3	11.7	73,125.0	32,086.6	41,038.4	6.3	11.7	73,125.0	23,739.7	49,385.3
Economic Net Crop Revenue per ha (2015 Prices)										
Rice	3.3	12.3	40,701.2	14,770.3	25,930.9	3.4	12.3	41,439.0	10,461.7	30,977.3
Rice Byproducts	2.6	0.4	953.3		953.3	2.7	0.4	970.6		970.6
Wheat	1.9	18.4	34,315.6	13,694.8	20,620.8	2.4	18.4	44,041.4	8,694.1	35,347.3
Wheat Byproducts	1.7	0.5	757.4		757.4	2.2	0.5	972.0		972.0
Maize	1.1	17.1	18,838.1	14,239.8	4,598.3	1.3	17.1	21,578.2	8,886.6	12,691.6
Mustard / Oilseed	0.6	24.3	14,823.0	11,668.9	3,154.1	0.6	24.3	14,823.0	7,707.2	7,115.8
Lentil / Pulses	0.5	28.8	14,400.0	6,723.0	7,677.0	0.5	28.8	14,400.0	4,437.0	9,963.0
Potato	6.3	11.7	73,125.0	32,023.3	41,101.7	6.3	11.7	73,125.0	23,707.5	49,417.5

Source: Derived from previous tables.

Table A9.8: Net Incremental Crop Revenue, Without Project vs. With Project
Constant 2001 NRs

Crop	Irrigated			Rainfed (Not Irrigated)		
	Without Project	With Project	Increment	Without Project	With Project	Increment
Financial Net Incremental Crop Revenue per ha						
Rice	13,086.5	21,000.0	7,913.5	16,436.5	24,646.5	8,210.0
Rice Byproducts	796.8	1,059.2	262.4	796.8	1,078.4	281.6
Wheat	7,422.8	9,058.6	1,635.8	7,961.0	15,003.8	7,042.8
Wheat Byproducts	765.0	841.5	76.5	742.5	1,080.0	337.5
Maize	1,602.0	1,770.0	168.0	3,402.0	7,226.0	3,824.0
Mustard / Oilseed	7,245.4	9,506.6	2,261.2	10,070.1	12,448.0	2,377.9
Lentil / Pulses	5,670.0	11,770.0	6,100.0	7,600.0	13,950.0	6,350.0
Potato	55,238.5	65,783.0	10,544.5	59,454.0	68,954.0	9,500.0
Economic Net Crop Revenue per ha (2001 Prices)						
Rice	11,722.7	21,191.1	9,468.4	16,033.7	26,148.2	10,114.5
Rice Byproducts	717.1	953.3	236.2	717.1	970.6	253.4
Wheat	16,989.8	19,904.3	2,914.5	20,680.4	34,377.6	13,697.2
Wheat Byproducts	688.5	757.4	68.9	668.3	972.0	303.8
Maize	2,048.2	3,436.1	1,387.8	4,964.2	11,343.7	6,379.5
Mustard / Oilseed	1,327.5	3,183.3	1,855.7	5,055.7	7,125.5	2,069.8
Lentil / Pulses	2,187.0	7,677.0	5,490.0	4,248.0	9,963.0	5,715.0
Potato	32,112.8	41,312.1	9,199.3	40,983.3	49,533.3	8,550.0
Economic Net Crop Revenue per ha (2005 Prices)						
Rice	22,812.3	26,245.7	3,433.4	26,162.3	31,316.0	5,153.8
Rice Byproducts	717.1	953.3	236.2	717.1	970.6	253.4
Wheat	24,054.2	21,157.5	(2,896.7)	24,072.5	36,117.2	12,044.7
Wheat Byproducts	688.5	757.4	68.9	668.3	972.0	303.8
Maize	8,626.1	4,656.0	(3,970.1)	10,426.1	12,799.1	2,373.1
Mustard / Oilseed	5,970.4	3,107.1	(2,863.3)	8,780.1	7,098.1	(1,682.0)
Lentil / Pulses	4,818.0	7,677.0	2,859.0	6,720.0	9,963.0	3,243.0
Potato	49,048.5	40,962.2	(8,086.3)	53,024.0	49,346.5	(3,677.5)
Economic Net Crop Revenue per ha (2010 Prices)						
Rice	16,137.1	27,040.5	10,903.5	20,448.1	32,115.3	11,667.2
Rice Byproducts	717.1	953.3	236.2	717.1	970.6	253.4
Wheat	18,087.1	21,099.9	3,012.9	21,790.5	35,999.0	14,208.4
Wheat Byproducts	688.5	757.4	68.9	668.3	972.0	303.8
Maize	2,857.1	4,452.0	1,594.9	5,773.1	12,542.8	6,769.7
Mustard / Oilseed	1,293.3	3,132.9	1,839.5	5,044.0	7,107.8	2,063.8
Lentil / Pulses	2,187.0	7,677.0	5,490.0	4,248.0	9,963.0	5,715.0
Potato	31,885.9	41,038.4	9,152.5	40,835.3	49,385.3	8,550.0
Economic Net Crop Revenue per ha (2015 Prices)						
Rice	15,296.4	25,930.9	10,634.4	19,607.4	30,977.3	11,369.9
Rice Byproducts	717.1	953.3	236.2	717.1	970.6	253.4
Wheat	17,645.3	20,620.8	2,975.4	21,343.5	35,347.3	14,003.9
Wheat Byproducts	688.5	757.4	68.9	668.3	972.0	303.8
Maize	2,957.6	4,598.3	1,640.8	5,873.6	12,691.6	6,818.1
Mustard / Oilseed	1,307.2	3,154.1	1,846.9	5,049.0	7,115.8	2,066.8
Lentil / Pulses	2,187.0	7,677.0	5,490.0	4,248.0	9,963.0	5,715.0
Potato	31,938.1	41,101.7	9,163.5	40,867.5	49,417.5	8,550.0

Source: Derived from previous tables.

Table A9.9: Financial Revenue on a Typical One Hectare Farm

(Constant 2001 NRs)

Item	Total Project Area			Amount per 1 ha Farm							
	Without Project	With Project	Increment	Without Project			With Project			Increment	
				ha	Net Rev. per ha	Net Revenue	ha	Net Rev. per ha	Net Revenue	ha	Net Revenue
A. Irrigated Area	12,500.0	13,389.0	889.0	0.89			0.96			0.06	
Rice	12,500.0	12,928.0	428.0	0.89	13,883.3	12,395.8	0.92	22,059.2	20,370.1	0.03	7,974.3
Wheat	4,000.0	6,848.0	2,848.0	0.29	8,187.8	2,339.4	0.49	9,900.1	4,842.6	0.20	2,503.2
Maize	2,000.0	1,198.0	(802.0)	0.14	1,602.0	228.9	0.09	1,770.0	151.5	(0.06)	(77.4)
Mustard	4,000.0	1,866.0	(2,134.0)	0.29	7,245.4	2,070.1	0.13	9,506.6	1,267.1	(0.15)	(803.0)
Lentil	3,500.0	1,890.0	(1,610.0)	0.25	5,670.0	1,417.5	0.14	11,770.0	1,589.0	(0.12)	171.5
Potato	-	272.0	272.0	-	55,238.5	-	0.02	65,783.0	1,278.1	0.02	1,278.1
Total	26,000.0	25,002.0	(998.0)	1.86		18,451.6	1.79		29,498.2	(0.07)	11,046.6
	-	-	-								
B. Rainfed Area	1,500.0	1,111.0	(389.0)	0.11			0.08			(0.03)	
Rice	-	1,073.0	1,073.0	-	17,233.3	-	0.08	25,724.9	1,971.6	0.08	1,971.6
Wheat	-	568.0	568.0	-	8,703.5	-	0.04	16,083.8	652.5	0.04	652.5
Maize	-	99.0	99.0	-	3,402.0	-	0.01	7,226.0	51.1	0.01	51.1
Mustard	-	155.0	155.0	-	10,070.1	-	0.01	12,448.0	137.8	0.01	137.8
Lentil	-	157.0	157.0	-	7,600.0	-	0.01	13,950.0	156.4	0.01	156.4
Potato	-	23.0	23.0	-	59,454.0	-	0.00	68,954.0	113.3	0.00	113.3
Total	-	2,075.0	2,075.0	-		-	0.15		3,082.8	0.15	3,082.8
	-	-	-								
C. Total Area	14,000.0	14,500.0	500.0	1.00			1.04			0.04	
Rice	12,500.0	14,001.0	1,501.0	0.89		12,395.8	1.00		22,341.7	0.11	9,945.9
Wheat	4,000.0	7,416.0	3,416.0	0.29		2,339.4	0.53		5,495.1	0.24	3,155.7
Maize	2,000.0	1,297.0	(703.0)	0.14		228.9	0.09		202.6	(0.05)	(26.3)
Mustard	4,000.0	2,021.0	(1,979.0)	0.29		2,070.1	0.14		1,404.9	(0.14)	(665.2)
Lentil	3,500.0	2,047.0	(1,453.0)	0.25		1,417.5	0.15		1,745.4	(0.10)	327.9
Potato	-	295.0	295.0	-		-	0.02		1,391.4	0.02	1,391.4
Total	26,000.0	27,077.0	1,077.0	1.86		18,451.6	1.93		32,581.0	0.08	14,129.4
	-	-	-								
Cropping Intensity (%)	186%	187%	1%	186%			187%			1%	

ha = hectare.

Source: Derived from previous tables.

Table A9.10: Distribution of Project Benefits on Incremental Net Crop Revenue

Total farm households in the project area: 7,532

Total former bonded laborer households in the project area: 3,314

Size of Farmholding	Percent of Farm Households	Number of Farm Households	Average Land Holding (ha per household)	Incremental Net Revenue on a Typical 1 ha Farm (NRs per ha)	Incremental Net Revenue			
					Per Household (NRs)	All Households		
						(NRs)	(\$)	(%)
Small	75%	5,649	1.07	14,129.4	15,118.5	85,404,146.0	1,123,738.8	42%
Medium	14%	1,054	3.4	14,129.4	48,039.9	50,657,163.2	666,541.6	25%
Large	11%	829	5.76	14,129.4	81,385.3	67,429,366.8	887,228.5	33%
Total						203,490,676.0	2,677,508.9	100%

ha = hectare.

Source: Derived from previous tables.

Table A9.11: Physical Output for a Typical One Ha Farm and the Project

Item	Without Project				With Project				Increment	
	Ha	Yield per ha tons	Typical 1 ha Farm Output tons	Total tons Project Area Output	Ha	Yield per ha tons	Typical 1 ha Farm Output tons	Total tons Project Area Output	Typical Farm Output tons	Total tons Project Area Output
A. Irrigated Area	0.89				0.96					
Rice (Monsoon)	0.89	2.5	2.22	31,125.0	0.92	3.3	3.06	42,791.7	0.8	11,666.7
Wheat	0.29	1.7	0.49	6,800.0	0.49	1.9	0.91	12,805.8	0.4	6,005.8
Maize	0.14	0.9	0.12	1,700.0	0.09	1.1	0.09	1,317.8	(0.0)	(382.2)
Mustard	0.29	0.5	0.14	2,000.0	0.13	0.6	0.08	1,138.3	(0.1)	(861.7)
Lentil	0.25	0.3	0.08	1,050.0	0.14	0.5	0.07	945.0	(0.0)	(105.0)
Potato	-	5.5	-	-	0.02	6.3	0.12	1,700.0	0.1	1,700.0
Total A	1.86				1.79					18,023.5
B. Rainfed Area	0.11				0.08					
Rice (Monsoon)	-	2.5	-	-	0.08	3.4	0.26	3,616.0	0.3	3,616.0
Wheat	-	1.7	-	-	0.04	2.4	0.10	1,363.2	0.1	1,363.2
Maize	-	0.9	-	-	0.01	1.3	0.01	124.7	0.0	124.7
Mustard	-	0.5	-	-	0.01	0.6	0.01	94.6	0.0	94.6
Lentil	-	0.3	-	-	0.01	0.5	0.01	78.5	0.0	78.5
Potato	-	5.5	-	-	0.00	6.3	0.01	143.8	0.0	143.8
Total B	-				0.15					5,420.8
C. Total Area	1.00				1.04					
Rice (Monsoon)	0.89		2.22	31,125.0	1.00		3.31	46,407.69	1.1	15,282.7
Wheat	0.29		0.49	6,800.0	0.53		1.01	14,168.96	0.5	7,369.0
Maize	0.14		0.12	1,700.0	0.09		0.10	1,442.54	(0.0)	(257.5)
Mustard	0.29		0.14	2,000.0	0.14		0.09	1,232.81	(0.1)	(767.2)
Lentil	0.25		0.08	1,050.0	0.15		0.07	1,023.50	(0.0)	(26.5)
Potato	-		-	-	0.02		0.13	1,843.75	0.1	1,843.8
Total C	1.86				1.93					23,444.3
Cropping Intensity (%)	186%				187%					

ha = hectare.

Source: Derived from previous tables.

Table A9.12: Economic Cash Flow
(In constant 2001 \$)

Year	Economic Investment Cost	Total Regular O&M	Replacement Costs	O&M of Civil Works ^a	Total Costs	Total Incremental Net Crop Revenue	Expected Benefits ^c from Flood Protection	Benefits from Improved Market Access	Incremental Economic Benefits ^b	Incremental Economic Cash Flow:
1992	67,895.1				67,895.1					(67,895.12)
1993	319,328.0				319,328.0					(319,328.03)
1994	558,756.4				558,756.4					(558,756.43)
1995	789,953.8				789,953.8					(789,953.84)
1996	1,229,164.2				1,229,164.2					(1,229,164.22)
1997	2,805,334.9				2,805,334.9					(2,805,334.88)
1998	3,068,563.4	10,787.0		10,787.0	3,079,350.4	309,115.9			309,115.9	(2,770,234.50)
1999	4,788,234.2	22,586.2		22,586.2	4,810,820.4	801,794.5			801,794.5	(4,009,025.85)
2000	4,284,822.8	40,997.9		40,997.9	4,325,820.7	1,653,021.6	6,106,069.56		7,759,091.2	3,433,270.48
2001	1,437,170.4	57,473.8		57,473.8	1,494,644.2	2,558,025.0	-	171,479.7	2,729,504.7	1,234,860.46
2002		63,000.0		63,000.0	63,000.0	3,216,258.5	-	171,479.7	3,387,738.2	3,324,738.16
2003		63,000.0		63,000.0	63,000.0	3,531,507.7	-	171,479.7	3,702,987.4	3,639,987.35
2004		63,000.0		63,000.0	63,000.0	3,610,687.5	610,607.0	171,479.7	4,392,774.2	4,329,774.20
2005		63,000.0		63,000.0	63,000.0	1,952,885.7	610,607.0	171,479.7	2,734,972.4	2,671,972.38
2006		63,000.0		63,000.0	63,000.0	1,952,885.7	610,607.0	171,479.7	2,734,972.4	2,671,972.38
2007		63,000.0	107,870.3	170,870.3	170,870.3	1,952,885.7	610,607.0	171,479.7	2,734,972.4	2,564,102.05
2008		65,157.4	117,991.9	183,149.4	183,149.4	1,952,885.7	610,607.0	171,479.7	2,734,972.4	2,551,823.02
2009		67,517.2	184,116.5	251,633.7	251,633.7	1,952,885.7	610,607.0	171,479.7	2,734,972.4	2,483,338.65
2010		71,199.6	164,759.4	235,959.0	235,959.0	4,021,792.9	610,607.0	171,479.7	4,803,879.5	4,567,920.55
2011		74,494.8	55,261.9	129,756.6	129,756.6	4,021,792.9	610,607.0	171,479.7	4,803,879.5	4,674,122.88
2012		75,600.0		75,600.0	75,600.0	4,021,792.9	610,607.0	171,479.7	4,803,879.5	4,728,279.51
2013		75,600.0		75,600.0	75,600.0	4,021,792.9	610,607.0	171,479.7	4,803,879.5	4,728,279.51
2014		75,600.0		75,600.0	75,600.0	4,021,792.9	610,607.0	171,479.7	4,803,879.5	4,728,279.51
2015		75,600.0		75,600.0	75,600.0	3,930,335.4	610,607.0	171,479.7	4,712,422.1	4,636,822.06
2016		75,600.0		75,600.0	75,600.0	3,930,335.4	610,607.0	171,479.7	4,712,422.1	4,636,822.06
2017		75,600.0	107,870.3	183,470.3	183,470.3	3,930,335.4	610,607.0	171,479.7	4,712,422.1	4,528,951.74
2018		77,757.4	117,991.9	195,749.4	195,749.4	3,930,335.4	610,607.0	171,479.7	4,712,422.1	4,516,672.71
2019		80,117.2	184,116.5	264,233.7	264,233.7	3,930,335.4	610,607.0	171,479.7	4,712,422.1	4,448,188.34
2020		83,799.6	164,759.4	248,559.0	248,559.0	3,930,335.4	610,607.0	171,479.7	4,712,422.1	4,463,863.11
2021		87,094.8	55,261.9	142,356.6	142,356.6	3,930,335.4	610,607.0	171,479.7	4,712,422.1	4,570,065.43
2022		88,200.0		88,200.0	88,200.0	3,930,335.4	610,607.0	171,479.7	4,712,422.1	4,624,222.06
2023		73,098.2		73,098.2	73,098.2	3,257,372.6	610,607.0	171,479.7	4,039,459.3	3,966,361.11
2024		56,579.3		56,579.3	56,579.3	2,521,264.8	610,607.0	171,479.7	3,303,351.4	3,246,772.15
2025		30,803.0		30,803.0	30,803.0	1,372,630.6	610,607.0	171,479.7	2,154,717.3	2,123,914.30
2026		7,736.7		7,736.7	7,736.7	344,758.2	610,607.0	171,479.7	1,126,844.9	1,119,108.20
EIRR^c										18.4%
ENPV at 12%										\$4,572,317.00

EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operation and maintenance.

^a Civil Works O&M calculated at \$5 per hectare annually (rising to \$6 after 10 years and \$7 after 20 years) plus 50 per hectare for more substantial replacement costs in the 10th and 20th years for structures.

^b Economic benefits for years 1997-2004 are at year 2001 prices; 2005-2009 at year 2005 prices; 2010-2014 at year 2010 prices; and 2015 and beyond at 2015 prices -- all in 2001 constant dollars. Benefits are phased in over 3 years.

^c The probability that the flood may happen in any given year in the future is 0.1.

Table A9.13: Economic Sensitivity Analysis

Scenario	ENPV at 12% (million \$)	EIRR	Switching Value (Risk Level at which EIRR is just 12%)	
PCR Base Case	4.6	18.4%		
Risk Factors				
Without including benefits from improved market access	4.1	17.8%		
Without including benefits from flood protection	1.2	13.5%		
Without including both benefits above	0.7	12.9%		
Incremental crop revenues generally decrease 20%	2.6	15.9%	Benefits decrease	47%
O&M costs double	4.2	18.0%	Factor times	15
Life of project shortened from base case of 25 years				
15 years		17.0%	Minimum years of life	9
10 years		13.7%		
Previous EIRR Calculations				
1991 RRP of Originally Designed Project		18.1%		
1995 Reformulated Project	No economic & financial analysis was done.			

EIRR = economic internal rate of return, ENPV=economic net present value, O&M = operation and maintenance, PCR = project completion report, RRP = report and recommendation of the President.