His Majesty's Government
National Planning Commission Secretariat (NPCS)
Singha Durbar, Kathmandu

FINAL REPORT

on

Effectiveness of Investment in Rajapur Irrigation Project

June 2002

Submitted By:

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Table Of Content

Pages

ACKNOWLEDGEMENT

Rajapur Irrigation Project is precious lifeblood for *Bardiya* district. Six VDCs served by the system have been able to upgrade their socio-economic status at present and are expected to perform better in the irrigation and agricultural sectors in days ahead.

In this study, the consultants provided their best services to complete the job. Team leader **Vallabha Sharma**[Ph. D.] Deserves special mentions for his outstanding contribution.

I would recall with gratitude for the comments provided by to **Mr. Bhoj Raj Ghimire** member-secretary, NPC, **Mr. Shiva Chandra Shrestha** (Joint **Secretary** of **CMED**), Mr. Markandeya Upadhyaya (Senior Officer of CMED) and Mr. Ram Bahadur Ghimire (CMED) was instrumental in bringing this study to this stage. He deserves more than a simple appreciation. Similarly, other senior members of the CMED were equally helpful at every stage of the project work, to whom we express our deep appreciation.

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ACRONYMS

ADB	Asian Development Bank
BCR	Benefit Cost Ratio
DADO	District Agriculture Development Officer
EIRR	Economic Internal Rate of Return
FMIS	Farmer's Managed Irrigation System
IRR	Internal Rate of Return
VDC	Village Development Committee
UG	User group/Water User
WUA	Water User's Association
WB	World Bank

EXECUTIVE SUMMARY

1. *Rajapur Irrigation Project* is technically and economically successful farmer's managed irrigation system located in the Mid-Western Nepal at Bardiya District.

2. Before the project intervention (1991-92) the system had three major problems; viz, land slide and soil erosion, continued siltation, which obstructed the gravitational flow of water in various branch canals, and intangible effect on the local forestry due to mandatory forest denudation to undertake frequent repair works on the system (mostly at *Budi Kulo* premise).

3. On set with construction works on the system the entire project is now free of the stated problems. Agricultural production in and around the area has improved between 1999-000 and the progress to date in the land-based production is optimistic (field information and DADO).

4. About the maintenance scenario of the system; the main and branch canals are found to have been maintained by the UGs with the help of other beneficiaries of the system. There exists a clear job description in the area of system's maintenance. For instance, routine and periodic maintenance works of the system are being executed by staff members and beneficiary farmers; while, emergency maintenance works are being done under the joint effort of DoI and the farmers/ beneficiaries.

5. There has occurred a reduction in the operation and maintenance cost (Chapter-IV). One of the major causes in the reduction of 'O and M' costs is due to sound management applied by the beneficiaries in maintenance works and adequacy of the design (engineering) which provide optimality to net water delivery on demand. However; there exists one problem in water supply to the tail reaches. In three of the six VDCs; water delivery on demand is reported to have been affected due to gravity which declines in the dry season.

6. Contrary to natural problem in water supply, the overall impact of the system on local production economy is positive. Paddy production between 1999-000 has increased from 2.4 mt. To 3.04 mt. Per hectare. Similarly, there has occurred a cumulative change in production of wheat and low land maize. Income of farmers has improved due to incremental benefit of production by exogenous price effect generated due to open border situation has retarded the net gain. Considering this effective policy measures to help farmers is imperative.

7. Command area in six VDCs have increased over 1992 which indicates that farmers are eager to cultivate irrigated land to increase their socio-economic welfare. Employment in agriculture has been static. No evidence is available on this aspect at present. Imputed labour use and a very marginal change in employment is reported (DADO) during visit in large farm size class.
8. Poverty alleviation programs through job opportunity and empowerment of land less and *Kamaiyas* needs greater attention.
9. Women participation has increased due to vegetable production strategy of the agricultural line agency.
10. Environmental degradation and depletion of crown forest has been controlled.
11. Integrated action plan to foster production strategy needs greater attention to help supplement the system in days ahead.
12. On the same count service centre activities need modification (where ever required) to address the 10^{th} plan strategy of poverty alleviation and welfare.
13. The economic rate of return due to the aggregate scenario) 'O and M' cost reduction, command area increase and incremental cropping intensity) has improved from > 18.1% to 19.04%. This may be further increased due to integrated management of the system in up coming days.
14. The system may be reflected elsewhere in Nepal under the identical situation are dedicated approach.

CHAPTER - I
INTRODUCTION

1.1. APPARENT SITUATION

Rajapur Irrigation Project belongs to Bardiya District of Mid-Western Nepal. It is a farmer's managed irrigation system and serves six **VDCs** through perennial irrigation water supply on demand. The Asian Development Bank (**ADB**) provided technical assistance on the system to help upgrade;

- Agricultural production
- Erosion control
- Environmental situation
- Water management and water delivery
- Women participation
- Poverty alleviation through gainful employment
- Beneficiary participation in operation and maintenance of the system
- Irrigation organization network formation
- Cost effective management of the civil works and structural design through appropriate technology and agency support
- Economic viability (**increment**) by realizing incremental output and a price benefits over time and across the space by fostering agricultural and related employment, income and wages for obtaining social equity and generate cost recovery of the project within given life span

Prior to investment intervention, the system had difficulties in regular water supply, due to soil erosion, inundation, lichet formation on the base and poor management of the system as a whole. Onset with construction (**Civil and Weir Works**), material management and physical works (**1992 and onward**); the FMIS systems of the *Rajapur Irrigation Project* gradually regained the required status; where upon, there occurred control in landslide and soil erosion; increase in irrigated land area (**about**

10% over 1992[1]) increment in soil conservation (**5% increase in cultivable land in *Tapra, Manau* and *Khairi Chandanpur*)**[2]. On the other hand, there has occurred a perceptible reduction in forest denudation, due to a control in using wood items in systems repair.

Water demand and percent of water use in irrigation per crop has also increased between 1994-2001 (**19%**)[3]. The increment is highest in improved early paddy (**45%**), followed by wheat (**35%**), and lowland improved maize (**15%**). Water use in vegetables (*Badalpur, Pashupatinagar, Pathbar* under *Manau* and *Patabhar* influence) area has increased[4]. As reported by the line agencies (**DADO, DIO, ALC** and **UGs**), utilization of water in tobacco and oilseed cultivation has also been introduced in past three years (5%)[5].

Water availability as per demand is in unity (**1:1**) in *Budi Kulo* at *Rajapur*. In other systems (*Manau, Patabhar, Khairi*) it is reported to be less in some middle and mostly in tail reaches (**Middle =1:8, Jail=1:0.3-4**)[6]

The main cause behind variable water delivery; especially in middle and tail reaches are flow sequence, being overshadowed by gravity and translog of the water emission. Apart from the physio-technical hindrance, the siltation at the bottom of the flow stream (**APROSC, 1990, 1993**) has also caused the litschets to deregulate the water course; which seems to have affected the flow uniformity[7]. As pointed out elsewhere, the deregulated and variable flow of water has caused trouble to actual water demand of tail reaches and also in (some cases) middle reaches; *Patabhar, Manau, Khairi* and *Gola* **VDCs** face trouble due to variable water delivery over actual demand. The UGs pointed out that 250-300 litres of water is delivered at tail reach which is short by 15-20% of the critical water demand. This situation is

[1] *Reported by **UGs** and District Irrigation Office, Gularia.*
[2] *District Agriculture Development Office (**DADO**), Gularia.*
[3] ***WUA** and District Irrigation Office, Gularia*
[4] *Opcit...*
[5] *Opcit...*
[6] *District Irrigation Office, Gularia*
Socio-economic Study of Rajapur Irrigation System; APROSC, Aprial, 1990, 1993 Page 33.
*- Also see Impact Evaluation Study of Seti Irrigation System; **CEDA**; 1991*
*- Impact Evaluation of the Ground Water project of Kailali District; **CEDA**, 1991.*

prominent during the middle of winter and in pre monsoon period. In rainy season water supply is free of problem due to rain.[1]

Water Trading for irrigation in *Rajapur Irrigation Project* seasonal and complements production according to the calendar of operation. Water trading in agriculture is highest din early and late paddy (**83.5%**), followed by wheat (**15.5%**) and maize (**1%**). The upland early maize is fully rain fed. In middle of winter, when, cash crops such as oilseeds, tobacco and vegetables are grown; the irrigation water use is substituted to cash crops which, as reported, consumers about **15%** of the total water availability. By head, middle and tail reach, water consumption for irrigation is varying and amounts to a high use of it in head and middle reaches.[2]

Land use in the project area (**six VDCs**) has improved in last 3 years (1999-2000/002). In head reach at *Budi Kulo*; land use pattern under crops has improved (**about 5% increment/*Kulopani* head**). In middle and tail reaches the landuse is constant in last three years. Similarly, landuse in other VDCs , viz, *Patabhar*, *Manau*, *Tapra* and *Khairi Chandanpur* have also increased (**about 3% increment**). Land use under vegetable in *Budi*, *Patabhar* and *Tapra* is reported to have also increased (**1.5% increment**)[3].

1.2. MACRO PERSPECTIVE OF THE SYSTEM

The foundation of irrigation perspective within a broad yet comprehensive network (**Macro**) of the *Rajapur Irrigation System* depends on the followings; viz;

- **net water availability at past project level**
- **incremental crop-water relation**
- **cropwise and total increase in demand for water**

[1] *Based on the focus group discussion at **Manau, Patabhar** and **Gola** at the **Kulo Pani** Office.*
[2] *District Agriculture Development Office reported that the commercial use of water has yet to take off i the concerned **VDCs'** of **Rajapur Irrigation Project**. The role of "Service Centres" has to be improved to supplement the net benefit out of water. Similarly, "farm to market", relation by product by road (see App. 1995) is also needed to be integrated with production system to sustain complementarity between cropping, net harvest and marketed surplus. At present, as reported by **DADO**, there exists a gap between marketable and marketed surplus. Similarly, food security system in six **VDCs'** and in the district has to be improved.*
[3] *DADO, Gularia*

- **structures, operation and maintenance**
- **access development and sustainability**
- **increment in irrigated land**
- **channel development and upkeep of channels**
- **production increase, incremental demand of food, costs and food reserve portfolio**
- **participation and cost recovery**
- **poverty alleviation and welfare**
- **institutional development**
- **market and prices and**
- **environmental development**

In what follows, an attempt is made to present them by each *Kulo* subsystem as under:

1.2.1. NET WATER AVAILABILITY

In all six subsystems of six VDCs, the net water availability is reported to have increased by 5 % point on an average. This has benefited the area under irrigation and also land use under various crops. In summer, water availability percent is low in all VDCs due to heat and transevaportion of water from open canal. On winter, the transevaporation of water being low; the water availability is found higher; which is needed to be properly harvested. Besides, the ratio of water availability to net crop water use is also needed to be increased as early as possible to sustain the cost recovery rate.

1.2.2. INCREMENTAL CROP WATER RELATION

Increment in crop to water relation is not evidenced; although there exists increment in the proportion of irrigated land. Generally, the crop water relation is determined by actual water required by crop on the seasonal basis divided by number of hour the water is used. In the present cast such data for six VDCs are not available.

1.2.3. Cropwise and Total Increase in Water Demand

Cropwise and increase in water demand in total is evidenced at *Budi/Rajapur, Tapra, Manu, Gola* and *Khairi*. In other VDC such information was not available. As mentioned in the preceding sections, the demand for water in summer and winter has increased by 22% in a cumulative way. This is calculated on the basis of hourly delivery of water per hectare per crop. Before the commencement of the project, the actual demand for the water was hindered by soil erosion, high amount of siltation and frequent denudation of forest and repairs.

1.2.4. STRUCTURES, OPERATION AND MAINTENANCE

Under the modernization process, the renovated *Rajapur Irrigation Project* comprises the followings:

a) Structures

- intake/interim measures
- river intake closures
- approach canal bank structure
- double intake regulator at *Budi Kulo*
- construction of weirs and offtakes at *Budi Kulo*
- flood embankment at *Budi Kulo*
- construction of connecting canal at *Budi Kulo*
- construction of walk-through and service road (3.6 km) at *Budi Kulo, Manpur, Tapra, Manaupakhar*
- construction of branch canal structures
- village to market road at *Budi, Tapra, Khairi* (4.8 km)

b) Operation and Maintenance

The intake maintenance is conducted twice a year. This is categorized by the project office as periodic maintenance of the system. On the other had, routine maintenance is carried out by the *Kulopani* member staffs under joint cooperation of UGs.

1.2.5. ACCESS DEVELOPMENT AND SUSTAINABILITY

8.6 km. of access roads and 4.8 km. of agricultural roads have been developed within the project influence area. Due to these *Budi, Manau, Tapra* and *Manaupakhar* have been directly benefited. Road and access maintenance is participated/allended by UGs along with DDCs and DOI engineers and staffs. Road and access sustainability is taken care of by VDCs through routine and periodic maintenance.

1.2.6. INCREMENT IN IRRIGATED LAND

There has occurred a 2.2% increase in irrigated land either through land augmentation or net irrigated area increase. Inter cropping in six VDCs has also helped in net irrigated area increase.

1.2.7. IRRIGATION CHANNEL DEVELOPMENT

Private channel development from main and branch canal has taken place in all six VDCs . These channels are built by individual beneficiaries on their own expenses and they monitor as well as perform maintenance works of the channels

1.2.8. PRODUCTION INCREASE AND INCREMENTAL DEMAND

Agricultural production between 1999-2000 in six VDCs increased at 2.1% in paddy, at 1.06% in maize and at 1.02% in wheat. In 2001, paddy cultivation declined by 0.8% due to *Maoist* attack which disrupted the long term strategy of the district. In six sample VDCs, the condition was reported to be same[1].

On the demand side, consumption demand of food grain increased by over **2%** between **1999-2000**; for **2001** it was estimated at **2.1%** and for **2002**, consumption demand is estimated at **2.2%** for six VDCs with elasticity coefficient of **0.22**[2].

[1] *As reported by focus group people*
[2] *DADO and Consultant estimate*

Food prices have reported to have increased at **3.4%** annually between **1999-2001**, while, in early **2002 (Feb/March)**; it registered a growth of **3.8-4%** due to *Maoist* insurgency and associated activities[1]. There is not existing any latest information on food reserver portfolio. As of 1999-2000 it was 9,642 mt[2].

1.2.9. PARTICIPATION AND COST RECOVERY

People participation in system management is reported to have increased in last three years. *Mul Kulopani Chaudhary, Kulopani Chaudhary, Sahayak, Bagdhar, Chaukidar* and *Desawares* are the main office bearers responsible for managing the irrigation system. In each subsystem, there exist the office bearer provisions being paid from the water revenue. Apart from the office bearers, the user groups also provide services in each VDC to the respective system.

The *Mul Kulopani Chaudhari* is the main man to look after the operation and maintenance works. He also looks after the branch canal management. On the other hand, the *Kulopani Chaudhari* is responsible for external resource mobilization.

The *Badghar* is responsible for mobilizing the labour to assist in systems maintenance. The *Chaukidar* acts as the messenger for *Mul Kulopani Chaudhari* and *Kulopani Chaudhari* and informs the respective village people about the upcoming works to be participated by the beneficiaries. Finally, *Desawar* is the maintenance worker and shares work responsibility with UGs. Such structural formations are common in all six VDCs of the irrigation system.

Apart from the irrigation management administration, the system is pretty new at the cost recovery. Between 2000 and 2001, the six VDCs could generate NRS. 4,78,258 as gross revenue. Out of this about 50% was paid as salary and also on the miscellaneous items. Out of other 50% procurement of materials for operation and maintenance, desilting and other activities were covered. In the year 2002, the system has been at a loss due to disturbance caused by terrorists in the *Bardiya* district.

[1] *Chember of Commerce; Nepalgunj*
[2] *DADO, Gularia*

1.2.10. POVERTY ALLEVIATION AND WELFARE

Poverty alleviation through evolving gainful employment in agricultural sector has received a positive response from the farming communities. The large farmers in each VDC have focused to involve the landless *Kamaiyas* and migrants in paddy transplanting, harvesting and storage. The system has in recent time has planned to involve the wage earners in all types of maintenance works.

1.2.11. INSTITUTIONAL DEVELOPMENT

Institutional development about the system comprises institutional linkage and sustainability of the production works; which includes awareness building among farmers about modern agriculture, market led growth in vegetables and other cash crops and development of market based complementarities in realizing production and net gains etc. Farmers of the six VDCs have interaction at the service centers located in *Rajapur* and *Tapra*.

1.2.12. MARKET AND PRICES

Farm gate prices of agricultural products have been found affected by open border adjoining India. Because of this, there exist some problem in switching over to commercial vegetable growth. The service centers and its branches located in different parts of the district have formulated the integrated agriculture pocket programs to address the cultural needs of the local farmers . Area specific programs as amplified in the district annual plan have been in the process of implementation. Such programs are vague in *Khairi* and *Manau* and also at *Patabhar* and *Gola*. *Manau* and *Patabhar* have been identified as the nodal points of growth. Apart from the program formulation and implementation of the program, efforts are underway to increase the sale of the agricultural products through cost effective production and product management

1.2.13. ENVIRONMENTAL DEVELOPMENT

Onset with control in the use of forest products (logo and branches) in repair of the system; about Rs.400000 worth of forest products have been saved (Forest Office). In addition, the move has benefited the riverside environment, flora and fauna.

1.3. ALTERNATIVE STRATEGIES

Rajapur Irrigation Project as a predominant FMIS requires the followings:

- strong complementary between water delivery and production
- fast cost recovery through commercialization of the agricultural crops
- introduction of the high value agriculture in appropriate places
- formation of cooperative of farming community to strengthen the price bargaining power
- establishment of network to facilitate export marketing of agri-product in other parts of Nepal and
- reinforce crop-water relation by erecting sustainable agri-programs

1.4. OBJECTIVE OF THE STUDY

The objectives of the study where:

- examine issues concerning the efficiency, effectiveness and impact of rehabilitation and FMIS to improve future performance;
- assess the appropriateness and relevance of the design, inputs and implementation arrangements as well as sustainability of benefits generated by the project;
- assess the impact of project in relation to ecological/environmental progress, poverty alleviation and gender participation and identify potentialities created for developing the new projects;

- assess the strengths and weaknesses of the project by studying targeted and actual facilities developed;
- assess the actual number of households benefited, participation and involvement of women, poor families and under privileged castes, community participation and the level of participation of beneficiaries in the project activities including their attitude towards such projects and future perspective; and
- recommend future course of action to be adopted by the NPC keeping in view the factors such as sustainability, operation and maintenance cost, long- term and short-term national needs etc.

CHAPTER - II
RESEARCH METHOD AND APPROACH

2.1. RESEARCH DESIGN

Research work to obtain hands on information about *Rajapur Irrigation System* was divided into two parts. First part information was subjected to a brief review of the back ground and setting of the project under this, considerable effort was deployed in contacting local and knowledgeable people by each sub system by VDC. Besides, DADP at *Gulariya* was contacted and through him appropriate institutional heads (**DoI, AIC, local NGO, Community Workers, etc.**) were contacted and the project objectives were discussed.

Second part of study was concerned to fact finding at the grass roots. For that sample of H.H. by sub-region was necessary and it was undertaken. At the outset the entire project area was distributed into homogeneous population universe. The sub division of universe contained ward and also head, middle and tail reach of the system by VDC. Based on it the sample for H.H. survey was identified.

Apart from discussion and H.H. survey, the research team widely discussed the subject matter local women, landless *Kamaiyas*, locl NGOs and with staff members of the canal and branch canals. All out comes and informations have been adequately summarized in the study submitted.

2.2. NATURE AND SOURCES OF DATA

Data and related information on the study ware collected from following sourc3ssources, viz.

CHAPTER - III
PROJECT FINANCING

3.1. PROJECT CONCEPT, OBJECTIVE AND FINANCING

3.1.1. CONCEPT

Rajapur Irrigation Project imbibes dual purpose; viz. to restructure the physical properties, such as, water delivery capacity, water retention and delivery on demand, soil erosion and landslide control, delinking forest property use in system repair and maintenance, augment private participation of men and women and generate production increase by incorporating viable technologies in association of institutions etc. In the second place , the purpose to facilitate the project entails irrigation improvement, setting the right intake structures, improvement in crop intensity through inputs use, market and prices, upgrade production by augmenting irrigated land use buy mitigating soil erosion and run off problems and by all above , generate social welfare and income and create scope for incremental employment and people's participation. The cumulative concept of the *Rajapur Irrigation Porject* has been to alleviate the poverty of marginal and landless families by bringing them to the main stream of development.

Other associated body of reform connected to the project entails, cross sectional issues of gender equity in productive employment, contribution to better health condition of the households and residents of the surrounding regions, facilitation in education and awareness, environment conservation through watershed and management of forestry and promote adequate governance of the irrigation project by seeking public private participation in all types of system's development including operation and maintenance and monitoring the project's performance.

3.1.2. OBJECTIVE

The project concept and the objective of the project has been mutually reinforcing. The overall objective of the irrigation project is to create a system based production structure to

usher benefits to the local people in upgrading their consumption and market economies. Corollary to overall objective of the irrigation system, the broader goals have been to:

a) Meet national and sectoral objectives such as production sustainability through better resource mobilization.

b) Generate agricultural benefits through equity and redistribution and by bringing additional land under irrigation domain.

c) Reduce the operation and maintenance costs through periodic maintenance procedure, and

d) Reduce environmental losses by delinking forest denudation and wasteful use of the woods and trees in maintenance work

3.2. PROJECT FINANCING

The project financing provisions were as follows:

3.1 Table

Summary of Costs Involved in the Project

S. N.	Item	Foreign Exchange Cost [$]	Local Currency Cost	Total
I. Irrigation Improvement				
	A. Civil Works			
1	Intakes	0.14	1.41	**1.55**
2	Budi Kulo Main Canal	3.58	2.67	**6.25**
3	Branch Canals	1.17	0.60	**1.77**
4	Service Roads	1.76	0.67	**2.43**
5	Office and Quarters	0.14	0.03	**0.17**
Subtotal [A]		**6.79**	**5.38**	**12.17**
6	**B. Equipment and Vehicles**	0.22	0.01	**0.23**
7	**C. Suvey/Investigations**	0.03	0.10	**0.13**
8	**D. Recurrent Cost**	0.06	0.29	**0.35**
9	**E. Land Acquisition Cost**		0.23	**0.23**
Subtotal [A]		**7.10**	**6.01**	**13.11**
II. Services For Project				
10	Implementation	0.64	0.24	**0.88**
Total Base Cost [I+II]		**7.74**	**6.25**	**13.99**
11	Physical Contigencies	0.76	0.62	**1.38**
12	Price Escalation	1.51	3.42	**4.93**
13	Service Charge During Construction	0.42	0.00	**0.42**
Total Cost		**10.43**	**10.29**	**20.72**

Source: Project Document, 1992

In what follows, the summary of project financing plan is presented.

Table 3.2: Financing Plan of the Project

$/Million

Source	Foregn Exchange Cost	Local Currency	Total	Percent [%]
Bank	10.43	6.10	16.53	80
Government	-	2.24	2.24	11
Farmers				
Farmers	-	1.86	1.86	9
Total	**10.43**	**10.20**	**20.63**	**100**

Source: Project Document, 1992

3.3. PROJECT COMPONENT

3.3.1. IRRIGATION SYSTEM IMPROVEMENT

The *Rajapur Irrigation Project* is operationalized at *BudiKulo*/command area=8760 ha, *Patabhar Kulo*/Command area=1570 ha, *Gola Kulo*/command area=690 ha, *Tapra Kulo*/command area=2330 and *Khairi Chandanpur*/command area=1210 ha, respectively between 1992-93 through 002. Under the project implementation program, river intake service and regulators have been relaid or installed. Similarly, diversions have been built and breast walls and toes have been constructed to avoid the flood impact. In order to facilitate water supply to head, middle and tail reaches of all subsystems, the input of water at *Budi Kulo* has been completely reestablished under the viable technological approach.

3.3.2. IRRIGATION INTAKE STRUCTURES

Irrigation intake structures have been developed at *Budi Kulo* , three hundred metre down west and south to augment the gravitational flow of water. Fourteen weirs and sixteen gavion trosses have been added at 2.5 metres depth to reinforce the ground base from which 450 litres of water passes per second. Due to the low head and wide dia of the main canal the friction between water flow and the base remains minimal; The gradual diversion of water from south-west and south remains uniform and can

be controlled during flood/ inundation through water regulators which are manually operated by the help of *Deswars* by *Kulopani Chaudhari*.

The intake walls are made of RCC with thick backstoppings .The area is well forested on either side of the river banks allowing firm support to the structures. There exists an intermittant gaps between the RCC structures and the bed slope formed to provide outlets to the rainwater. Such excess water is generally drained into the system as part of water conservation. The intake gates are of jet type to house maximum water volume. The water is contained under the open; therefore, transevaporation of water due to heat cannot be ruled out.

3.3.3. COST ESTIMATES AND FINANCING PLAN

3.3.3.1. COSTS

Project cost estimates have been estimated at $ 20.72 million equivalent which is found to have been used up of the total cost, $ 10.43 million (50%) entails foreign exchange costs. These costs are both direct and also indirect in nature. In addition $10.42 million is apportioned as the service charge of the project. The taxes and duties levied by the government is estimated in local currency at $10.20 million equivalent. Government contribution about land acquisition. Compensation, other expenses are not added in the foreign exchange portfolio.

3.3.3.2. FINANCING PLAN

Asian Development Bank (ADB) provided for the construction and operation of *Rajapur Irrigation* FMIS covering six subsystems into its fold, The Loan of $ 16.62 million has been offered for the job. The loan reimbursement period is stipulated at 40 years time frame with adequate debt servicing annually. The project has a grace period of 10 years with a service charge of 1 percent. The farmers will be contributing throughout the project life span at $11.86 million equivalent at a suitable annual rate. Farmer's contribution covers both cash/kind contributions. On the other hand the government contribution, which stands at $ 2.24 million, has been financed from the local resources.

3.4. SECTORAL PERFORMANCE

3.4.1. AGRICULTURAL PERFORMANCE

3.4.1.1. LAND OWNERSHIP

Small land owners constitute the land ownership system in Bardiya district (66%), followed by medium land owners (**20%**) and large land owners (**14%**). Out of above, the percentage irrigated land distribution is proportionally equal, although, due to size difference , the most beneficiaries are the large and medium land owners. The same characteristics prevails in the six VDCs under question. For instance, the land ownership at *Budi* in small size class (**>1 ha**) is 78%, in middle size class (**<1 ha>2.5 ha**) it is 14% and in large size class (**<2.5** and **above**), it is 8%. A similar trend is prevalent in other VDCs surveyed. Table 3.2 presented below shows the land ownership trend.

3.3 Table: Land Ownership in Sample VDC

Land size Class

S.N	VDC	> 1 Ha. [%]	<1 Ha. >2.5 Ha. [%]	> 2.5 - >Ha. [%]	Total
1	Budi	78	14	8	**100**
2	Patabhar	82	16	2	**100**
3	Gola	80	14	6	**100**
4	Manau	79	13	8	**100**
5	Japra	84	9	7	**100**
6	Khairi Chandanpur	79	14	7	**100**

Source: Field Survey

Out of above, about 94% of land in >2.5 ha is irrigated land; about 90% in middle class in also irrigated land while its percentage in small size class is **87.5%.** In total, the percentage of irrigated land after the project implementation has increased quite considerably. In terms of the project command area, this has increased by **72%** in last 8 years (UGs).

3.4.1.2. CROPPING INTENSITY

Cropping intensity under the irrigated cereal crops has gone up from 119% (1992) to 230% (2002). Cropping intensity is highest at Budi and Tapra (230%) followed by Gola and Manau (224%); at Patabhar and Khairi it is found to be only marginally low (221%).

3.4.1.3. PRODUCTION, EMPLOYMENT AND INCOME:

Production

Agricultural production in the survey area has increased from 2.08 m.ton to 3.04 m ton per has. In improved paddy. The ratio is common in all irrigated land. In weat it has gone up from 1.6 m. ton per has to 1.9 m ton (even 2m ton at Budi). In maize production increase is 2.3 m. ton per ha. from 1.6 m. ton/ha.

Employment

Agricultural employment in the project area is static; and substantial change in it is not evidenced. However, in large landsite class during rainy reason, when paddy is gown that labour employment is reported to be increased. In other classes, family labour form the pattern of imputed labour. This is one area, where the policy have to come around with suitable future plan to increase agricultural employment.

Income

Agriculture income from crops has increased in the tune of 4.2% in last three years; however, between years 2001- 002 has occurred a set back in production sphere due to Maoist attack.

3.4.1.4. SOIL EROSION, SILTATION AND RUNOFF

Soil Erosion

Soil erosion in the project area and also the runoff of top soil has been considerably controlled due to masonite works in many parts of the canal at *Budi, Gola* and *Patabhar* section of the project. Due to the erection of breast walls in the cross-

section and building of cross drainage and culverts have provided strength to the embankments. In *Budi*, the embankments have been reinforced by masonite and forestry development programs. About 3% of cultivated land is saved by the project by controlling soil erosion.

Siltation

Siltation problem on the basin area, which was predominant earlier has greatly eradicated throughout the system. Although very little was experienced during 1999-2000 at the *Khairi* confluence. Due to the eradication of siltation; the river flow at present is more assured than before (**Ugs'**).

3.5. SOCIAL SECTOR PERFORMANCE

3.5.1. CONTRIBUTION OF SYSTEM TO SOCIAL WELFARE

Rajapur Irrigation System has been instrumental towards social welfare on the following aspects, viz.

- creating hope to have better agriculture under irrigated condition.
- improvement in land use and cropping intensity
- land augmentation under major food crops
- creation of scope for institutional participation, such that of **DADO**, service centres and **AIC**- etc.
- created room for commercial crop production
- agricultural road development and connectivity between project area to head quarter (**HQ**) have to a great deal facilitated farm to market product transfer, which is under operation since January, 2002.
- agricultural package program is expected to create intangible benefits to optimum water use on demand and intensive care of the system would prevail, following this the system would be better maintained than before,
- incremental income from agriculture would generate inelastic food demand as a result the propensity to consume would increase (**hopefully more than 0.22%**)

- incremental income would facilitate education, jobs, health care and longevity, besides, the income increase would generate additional employment in agriculture and related field
- as a cumulative perspective, the welfare of the people falling to different brackets would be increased.

3.5.2. PEOPLE'S PARTICIPATION:

People's participation's in the systems have adequate and encouraging. The striking feature of the participation is its work distribution pattern. In each sub system there exists band of office bearers supported by villagers, landless wage earners. Monitoring of system's performance is being done by *Kulopani Choudhari* under the assistance of *Deswars*. Similarly, the operation and maintenance works are being cooperated by all office bearers including villagers,. Membership of the irrigation organization is the table below . The table is self explanatory.

3. Table

S. N	System	Reported Gross Area/Ha.	Reported Irrigated Area/Ha.	Reported No. of H.H.
1	Budi Kulo	8980	8980	2608
2	PatabharKulo	1670	1670	410
3	Gola Kulo	700	1040	320
4	Manau Kulo	780	870	474
5	Tapra Kulo	2160	1730	384
6	Khairi Chandanpur	1210	1210	575
Total		**15500**	**15500**	**4771**

Source: Field Survey

In the next table, subsystem level organization is shown. The duty of the office bearers has been that which is stipulated in the charter of the institution.

3.5. Table: Office Bearers of the Sub-Systems

S. N	Mulkulopani Chaudhari	Kulopani Chaudhari	Sahayak	Badghar	Chaukidar	Desawars
1	Budi Kulo	1	14	15	65	1410
2	PatabharKulo		3	2	15	240
3	Gola Kulo	1	2		10	170
4	Manau Kulo		2	3	18	320
5	Tapra Kulo	1	1	2	16	232
6	Khairi Chandanpur	1	2	3	16	325
Total		**4**	**24**	**25**	**140**	**2697**

Source: Field Survey

The two tables presented clearly indicate that the grass-root organization of the *Rajapur Irrigation System* is strong in delivering services.[1]

3.5.3. WOMEN WELFARE AND PARTICIPATION

Gender Issue

There exists an equity in gender based participation of men and women in irrigation system management. In this regard three things are common, viz.

i) Men and women avidly cooperate in mending private channels up to the farm bed

ii) Men and women cooperate in cleaning the confluence area of the subsystem at regular interval

iii) Crop to water relation in entire project area has been managed by men and women due to the sense of systems' s belonging to their general welfare

Participation

Women participatory role in ushering water to farm bed is highest in all six VDCs. Women particularly use water for vegetable gardening, livestock purposes and in

[1] *During discussion with office bearers following issues came into fore. These are:*

a) *Gravitational flow of water to especially tail reach has to be improved.*
b) *Training to office bearers about- disaster mitigation and post- disaster management needs be provided, and*
c) *DOI support in performance audit of the system needs be mandatory to help upgrade quality and capacity of the UGs.*

maintaining the greenery around. Women however need training in water conservation to optimize water utility.

3.5.4. System's Contribution on Consumption, Health, Education and Welfare

We have at length touched upon the system's contribution by stating that there has occurred production benefit and optimum use of water. To address the specification we also said that the system has three types of benefits, viz

- **intangible economic benefits**
- **tangible economic benefits, and**
- **social benefits**

Intangible benefits cover work opportunity, which may be increased due to an incremental benefit of water. Similarly, increased production results into an increased propensity to consume and also save which may boil down to an increased marketed surplus and hence, increased income. The proportionate increase in income benefits health and education and people enjoy those benefits. In project area, health and education have received a due care in last 2-3 years; although, in last one year there has been some decline in the social services due to Maoist problem in the district.

On the demand and consumption aspects we have presented an overview analysis indicating the food elasticity of the people of the project area. This is presented in section 3.5.5. Tangible benefits are direct production benefits associated by conspicious consumption. It has increased in the project area. The social benefits are interpersonal benefits of the class of households due to other changes. On this aspect the VDCs have achieved a tangible benefits but *Kamaiyas* have to be covered into the mainstream by providing them empowerment.

3.5.5. ESTIMATION OF FOOD DEMAND

FrameWork

Rajapur Irrigation Project area have an increase in food demand due to a) natural growth in population and b) horizontal influx of labour/exogenous population (**DADO**). The rate of cumulated increase in combined population is estimated at 1.3% between 1997-2001 (***Gularia* Municipality 2002**)

The propensity to consume food during the same period is found to be affected by a) gradually increasing commodity prices such that fertilizers, seeds and other inputs, b) inputed labour cost, which increased at **0.8%** in 1997 to **2.1% in 2001/002 (CBS Labour Force Survey update and National Accounts 2002)** in *Bardiya* District has a didactic impact on the household consumption economy. Following the changes in the irrigation status due to refined sustainability of the system; while, there occurred and intangible reinforcement to job opportunity of the local people, increment in health portfolio, education of adults and children and other associated welfare (women health, gender based participation and community awareness); the net consumption increment is found to have been governed by the marketed surplus of food grain (**1.32% of 1997 to 1.36% in 2002 DADO and Service Centre information, 2002**). To address the issue, we wished to underscore food demand in the *Rajapur Irrigation Project* area with following considerations, viz,

- Income elasticity
- Incremental production
- Proportion of per capita income
- Proportion of per capita expenditure, and
- Other surrogates

The information of food demand by six sub systems is followed as under:

$$Dm - \left(1 + e_u \frac{\Delta Yu}{Yu}\right)(cu)(Pu..x) + \left(1 + e_r \frac{\Delta Yt}{Yr}\right)(cr)(\Pr)$$

The demand for food changes (increase or decrease) subject to a change income (r) and marginal productivity encouraged due to irrigation water availability. Water at this place is an intangible benefit corresponding expense (u) and time (t). The production function (land use and productivity is relative constants overtime and across the space of six project sub regions. The pared functional form thus assumes

3.6 Table:

S. N	Subsystem	Weight [Dist.Dev. Indicator]	Avg. Income (Rs)	Income Spent on Food % (Rs)	Avg. Food Budget H.H.	Amount Spent (Rs)	Coefficient of Food Demand Elasticity (%)
1	Budi Kulo	I	32340	15.04	24800	89%	0%
2	PatabharKulo	III	26410	13.2	19001	90%	0.16
3	Gola Kulo	III	27040	14.46	20210	86%	0.17
4	Manau Kulo	V	25418	13.01	20900	89%	0.18
5	Tapra Kulo	IV	24992	12.8	20600	92%	0.19
6	Khairi Chandanpur	VI	23829	12.68	20377	90%	0.19

=1.08/6

=0.18+0.04

=0.22%

The income elasticity of food demand between 1992-1996 was estimated at 0.11 (District Development Indicator, 1992-96). During the period the command area was adjusted at 12000 ha (ADB, 1992). Between 1996-2002, the project command area increased to 15051-15500 ha.

The previous figure (**15051ha**) stands for 1999-2000; while the later (**15500 ha**) stands for **2000/2001/2002**. We have calculated the coefficient on the basis of the latest command area figure. The **3%** increase in area corresponds to an increase in food production at **2.08%** and a relative increase in food demand coefficient at **0.04%.** Added this our original figure of **0.18%**; this becomes **0.18+0.04=0.22%**. We have used this throughout our study wherever required.

Discussions

The change in the food consumption coefficient (0.22%) denotes that :

Change in food consumption in all six sample study points (54)

------- [1] Coefficient elasticity at district income of all size

Total food consumption(538)

------- [2] Coefficient elasticity of income of all sources prevalent

Change in % of income due to a change in command area (12000 ha> 15500 ha)

------- [3] 2500 [adjusted by market price, 2002]

Total % of adjusted income of the observed sample size by Land class by Head, Middle and Tail reach (15500)

------- [4]

$$\frac{54}{538}$$

$$\frac{2500}{5500}$$

$$= 0.22$$

3.5.6. PROJECTED INCREASE IN INCOME; CONSUMPTION AND WELFARE

In what follows, we wish to project H.H. income and expenditure pattern in the project area (six subsystems) in the following way

S. N	Commody Group	[%]	Rs.	Per caput Adjusted Expenditure [Rs]	Income Elasticity Coefficients	Increase in Per Caput con. of Farm Prod	Incremental Demand Due
Budi Kulo							
1	Paddy/Rice	6.00	1800	125	0.90	16.80	42
2	Wheat/Flour	1.70	510	35	0.85	15.80	38
3	Maize	1.70	510	35	0.85	15.80	38
4	Meat/Egg/Milk	1.20	800	42	0.36	6.70	32
5	Vegetables/	2.00	700	206	0.37	6.70	32
6	Vegetable Other Cash Crop	9.90	7970	237	0.37	6.90	34
Patabhar Kulo							
1	Paddy/Rice	6.30	1633	119	0.80	13.02	39
2	Wheat/Flour	1.20	469	23	0.80	14.11	38
3	Maize	1.30	483	23	0.81	14.11	38
4	Meat/Egg/Milk	1.10	697	39	0.29	5.60	30
5	Vegetables/	1.80	609	201	0.28	5.60	28
6	Vegetable Other Cash Crop	2.00	2349	203	0.35	6.01	31
Gola Kulo							
1	Paddy/Rice	6.70	1602	119	0.78	13.02	39
2	Wheat/Flour	1.20	433	21	0.78	13.06	38
3	Maize	1.30	484	21	0.81	14.18	38
4	Meat/Egg/Milk	1.00	697	33	0.28	5.60	31
5	Vegetables/	1.90	609	201	0.28	5.58	28
6	Other crops	2.10	2208	203	0.32	6.00	3
Manau Kulo							
1	Paddy/Rice	6.20	1497	121	0.79	16.00	41
2	Wheat/Flour	1.90	783	23	0.77	15.10	40
3	Maize	1.60	510	22	0.78	14.18	38
4	Meat/Egg/Milk	1.30	776	33	0.27	5.60	33
5	Vegetables/	1.20	702	208	0.27	5.78	29
6	Other crops	2.40	2466	211	0.32	6.00	31
Japra Kulo							
1	Paddy/Rice	6.40	1898	123	0.79	16.00	41
2	Wheat/Flour	1.30	483	23	0.77	15.10	41
3	Maize	1.20	526	23	0.78	14.18	39
4	Meat/Egg/Milk	1.10	770	35	0.27	5.50	36
5	Vegetables/	2.10	702	207	0.29	5.92	31
6	Other crops	2.10	2591	224	0.31	6.30	33
Khairi Chandanpur							
1	Paddy/Rice	5.90	1398	119	0.71	13.02	38
2	Wheat/Flour	1.40	497	20	0.68	14.01	39
3	Maize	1.30	541	20	0.68	14.18	39
4	Meat/Egg/Milk	0.90	592	33	0.27	5.10	33
5	Vegetables/	1.10	700	201	0.28	5.91	31
6	Other crops	2.10	2472	214	0.29	5.98	32

3.5.7. ECONOMIC VIABILITY

Economic Viability of the project contains the following:

- Water Delivery and Social Returns
- Economic Internal Rate of Return
- Soil Erosion and Control at Various Embankment
- Environmental Control and Benefits
- Financial Analysis

3.5.8. PROJECT IMPACT ASSESSMENT:

The project has positive impact on production, income and employment;

3.5.9. ENVIRONMENTAL BENEFIT

It is believed that the environmental benefit would increase by 8-10 % from 2005 onwards.

3.5.10. REDUCTION IN 'O AND M' COST

The 'O and M' Cost would decline by over 10% due to regular and routine maintenance.

3.5.11. BENEFIT TO WUAS AND UGS

Grass-root organizations would learn to participate in operation and maintenance of the system in a productive way. The tangible benefits achieved out of the system are expected to influence the local production economy including H. H's and others.

3.5.12. FARMER'S PARTICIPATION IN SYSTEM'S OPERATION AND MAINTENANCE

It is realized that farmer's participation in managing the system has increased in last two - three years due to its benefits to the people; which is expected to continue in the future as well.

3.5.13. ENGINEERING ASPECTS OF IRRIGATION SYSTEMS

- Procurement of Goods and Services

  It is 100% of the project target.
- Civil works:

Civil works at *Budi* and breast wall constructions at various places of the canal have been completed as stipulated in the schedule.

3.5.14. EQUIPMENT AND CONSTRUCTION MATERIALS

All equipment and reusable materials are found to have been provided back to DOI.

Project Implementation Schedule

The project strictly met the operation target which was revised once.

Operation and Maintenance

It is supervised by DOI in association of UGs and WUAs.

3.5.15. PROJECT MONITORING AND EVALUATION

The engineering type of project evaluation has yet to take place.

CHAPTER - IV
ECONOMIC AND FINANCIAL ANALYSIS

4.1. APPROACH AND ASSUMPTIONS

4.1.1. RATIONALE

i) The economic analysis focuses on two major quantifiable benefits, viz., incremental agricultural outputs and savings in operation and maintenance (O&M) costs, though project benefits are expected to extend to many other areas such as environment and socio-economies of the project area.

ii) The value of economic benefits is derived by comparing value of incremental agricultural production and situation. Incremental agricultural production is computed on the basis of relevant crop budgets and cropping patterns prevalent in the project area.

iii) The economic life of project is taken at 30 years, while its implementation period assumed at six years. The build up period of agricultural output is taken at five years after the project completion.

iv) The financial analysis on the other hand highlights the impact of the project on farm income and welfare.

4.1.2. PRICES

i) All costs and benefits are valued at 2001 constant prices. An exchange rate of NRs.78.0 to the dollar is used.

ii) The economic farmgate price of grains and fertilizers are derived from the World Bank Commodity Price projections of March, 2001. As for locally traded commodities (oilseeds and pulses), wholesale market prices are used. In deriving the farmgate price, adjustment has been made for transportation costs, insurance and processing, etc.

iii) In the light of recent tends in the food balance, all traded crops are assumed to be import substitutes, while fertilizers are valued on an import basis.

iv) A shadow wage rate has been applied for farm labour. With the current market wages of NRs.75 per day, the shadow rate has been computed at NRs. 50.0 ma-day by multiplying by shadow wage rate (SWR) of 0.9 and the standard conversion factor (SCF) of 0.9 respectively. Wage data is obtained from DADO/Gularia.

v) About investment costs, local components have been converted to economic costs with the use of the SCF of 0.9. Farmers' labour contribution is discounted further by SWR of 0.9.

vi) To reflect the impact of improved market access, future economic prices of traded products have been adjusted by an estimated amount of reduced transportation cost (NRs 240/ton). As for the financial prices, adjustments have been made.

4.1.3. CROPPING PATTERNS AND CORP BUDGET

i) Cropping pattern data is obtained from DADO, Gularia.

ii) The introduction of spring crops and increase in winter crops are expected to raise cropping intensity from present 190 per cent to 230 per cent during the upcoming period.

iii) To reflect the natural trend, increase in yields are assumed in future.

iv) Crop yields for "with" project have been estimated on the basis of yield data of recently completed irrigation projects and at experimental stations (Babai, Mohana and others).

v) Subsequent analysis show physical input/output of individual crops and derived economic and financial budgets of the project area.

4.1.4. 'O & M' COSTS

i) Savings in irrigation O&M costs have been computed on the basis of (a) estimated value of required resources, i.e., farmers' labour, bullock cart, wood and brushwood in "without" and "with" project cases; and (b) O&M cost for new works facilities.

ii) In the light of increasing capacity and function for existing facilities construction materials (particularly wood) a 5 per cent annual increase in resource requirements has been assumed.

iii) Because no improvement is required in *Budi Kulo* approach channel and village canals, no O&M cost savings have been considered for these component.

iv) Fixed percentage (1 to 3 per cent) of investment costs have been taken as O&M costs for works and facilities including the service roads presently under operation.

4.2. ECONOMIC VIABILITY

i) Net economic of flows estimated on the basis of preceding analytical framework and assumptions are used appropriately in the study.

ii) The economic value of incremental agricultural output has picked up from the 9th and levels off in the 11th year (beginning of 10th Plan, 2002), in the amount of about $4.7 million per annum. The net benefits is expected to grow gradually due to an increasing savings in the O&M costs.

iii) The economic internal rate of return (EIRR) in the base case is 18.1 per cent. This edges down as parameter values move towards unfavourable directions. The results of sensitivity analysis for key parameters are summarized. The economic viability of the project is affected almost equally in implementation and a 20 per cent change in prices and yields is preordained.

iv) The project will have a positive impact on many other areas including environment. An estimation suggests that the economic value of environmental benefits from the project will be of the order of $100,000-$220,000 a year. It has also been estimated that project will prevent farmland from being captured by rivers in the amount of 20 ha every year, indicating that in the 30th year "foregone" losses (benefits) may reach about $200,000 worth of net product value [$330/ha x 20 (ha) x 30 (years)]. These benefits, when counted, would push up the EIRR by 0.7 per cent to 18.8 per cent in the base case.

4.3. FINANCIAL ANALYSIS

i) The financial internal rate of return for the project is estimated at 9.5 per cent, sub sequentially lower than the corresponding EIRR. This is attributable to the facts that (a) the financial crop prices (local market prices) are much lower than the economic prices which are computed on the basis of international market prices, and (b) the financial costs are higher than the economic costs.

ii) The average farm income (gross margin) of a typical farm family which stands at NRs.14,960 ($350) per year in the "without" project situation, is expected to rise as high as NRs.37,360 ($875) per annum in the 11th year and thereafter. Increase in area and yield of monsoon paddy and introduction of spring paddy contribute most, accounting for two thirds of increase in income of H.H. Net farm income adjusted for noncash income and costs will be around NRs.44,130, an increase of about NRs.23,070 over NRs.21,060.

iii) The project is expected to improve the living standard of landless farmers (*Kamaiyas*). Assuming that a *Kamaiya* family works for a medium-size farm with net cultivated land of 2.4 to 3.02 ha, its annual earnings will go up from about NRs.12,970 ($304) to NRs.20,840 ($488) after being freely employed as a prospective wage earner.

Table 4.1: Derivation of Economic Prices of Major Agricultural Products a/

World FOB Prices (Forecast for 2010) b/	Unit	Rice/Paddy	Wheat	Maize	Pulses	Oilseed
- 1991 constant price	$/mt	170	110	72		
- 1996 constant price c/	$/mt	273	177	116	480	470
- Quality adjustment d/	%	70	70	80	80	90
- Adjusted FOB prices	$/mt	191	124	92	384	423
Transport to border d/ e/	$/mt	40	40	40	20	20
Border CIF price	$/mt	256	224	172	404	443
(rupee equivalent) f/	NRs/mt	10,931	9,565	7,344	17,251	18,916
Processing ratio	%	65	100	100	100	100
Price of commodity	NRs/mt	7,105	9,565	7,344	17,251	18,916
Processing/administrative cost g/	NRs/mt	(175)	0	0	0	0

Wholesale price, Nepalgunj	NRs/mt	6,930	9,565	7,344	17,251	18,916
Transportation to/from farm g/h/	NRs/mt	(190)	(190)	(190)	(190)	(190)
Economic farmgate prices	NRs/mt	6,740	9,375	7,154	17,061	18,726

Similar computation has been made for all years between 1995 and 2005 on the basis of the following IBRD projections (1991) constant prices; $/ton):

	Rice	Wheat	Maize
1995	179	109	67
2000	190	134	80
2005	170	110	72

Grains : IBRD Commodity Price Projection (March 1991);
Others : Border Wholesale Price
Grains : Converted to 2001 constant prices with G-5 MUV Index;
Source: DADO and IBRD
Exchange rate : NRs/$ = 78.0
Assumed Domestic costs are adjusted with SCF = at 0.9.
Estimated transport cost, Nepalgunj to Rajapur, NRs. 200/ton

Table 4.2: Derivation of Economic Prices - Fertilizers a/

	Unit	Urea	TSP b/	MOP c/
A. World FOB Prices (Forecast for 2010) d/			20	
- 1991 constant price	$/mt	112	115	72
- 1996 constant price e/	$/mt	180	185	116
B. Freight to Calcutta f/	$/mt	35	40	25
C. Transport to border f/	$/mt	40	40	40
D. Border CIF price	$/mt	256	265	181
(rupee equivalent) g/	NRs/mt	10,889	11,316	7,729
E. Transport to farm h/	NRs/mt	190	190	190
F. Economic farmgate prices	NRs/mt	11,079	11,506	7,919
G. Nutrient content	%	46	48	60
H. Farmgate prices/nutrient	NRs./mt	24,085	23,971	13,198

a/ Similar computation has been made for all years between 1995 and 2005 on the basis of the following IBRD projections (1991) constant prices; $/ton):

	Urea	TSP	MOP
1991	67	129	114
2000	80	120	114
2005	72	112	115

b/ Triple Superphosphate.

c/ Muriate of Potash (Potassium Chloride).

d/ IBRD Commodity Price Forecasts (March 1991).

e/ Converted to 1991 constant prices with G-5 MUV Index.
G-5 MUV Index (1985=100):1991 = 160.48.

f/ Source: IBRD and DADO.

g/ Exchange rate: NRS/$ = 78.0.

h/ Nepalgunj to Rajapur.

Table 4.3: Economic Farmgate Prices

		Unit	1992	2001
A.	Output			
	1. Paddy	NRs/mt	6,550	6,740 9,375
	2. Wheat	NRs/mt	9,185	7,154
	3. Maize	NRs/mt	6,964	18,726
	4. Oilseeds (Mustard)	NRs/mt	18,536	17,061
	5. Pulses (Lentils)	NRs/mt	16,871	315
	6. By-products	NRs/mt	315	
B.	Input			
	1. Seed			
	Paddy	NRs/kg	b/	b/
	Wheat	NRs/kg	8.1	8.1
	Maize	NRs/kg	11.3	11.3
	Oilseeds (Mustard)	NRs/kg	8.6	8.6
	Pulses (Lentils)	NRs/kg	22.5	22.5
		NRs/kg	20.5	20.5
	2. Fertilizers			
	N	NRs/kg	24.3	24.1
	P	NRs/kg	24.2	24.0
	K	NRs/kg	13.4	13.2
	Manure	NRs/mt	170.0	170.0
	3. Labour c/	NRs/man-day	26.7	26.7
	4. Draft animal	NRs/day	35.0	35.0
	5. Agrochemicals	sNRs	- variable -	

a/ To reflect improved access NRs. 190/ton is added for tradeable goods.

b/ 20 per cent up of relevant grain prices

c/ Shadow price computed as follows:

NRs.75 + (local wage rate) x 0.9 (SWR) x 0.9 (SCF).

Table 4.4: Cropping Patterns

(ha)

Season/Crops a/		1992	2001
A.	Monsoon		
	1. Paddy (IMP)	8,700	12,000
	2. Wheat	3,300	1,000
	3. Maize (IMP)	1,500	1,000
	4. Maize (LOC)	500	-
B.	Winter		
	1. Wheat	3,800	5,500
	2. Oilseeds	4,000	3,500
	3. Pulses	3,450	2,600
C.	Spring		
	1. Paddy (IMP)	-	2,500
	2. Maize (IMP)	-	1,500
	3. Pulses	-	1,000
	Total	25,250	30,600
	Cropping Intensity	190%	230%

a/ IMP - improved varieties; LOC = local varieties.

Table 4.5: Input Output Combination

Crops	INPUT									OUTPUT	
	Fertilizer										
	Seed (kg)	N (kg)	P (kg)	K (kg)	Manure (mt)	Agro-chemical (NRs)	Labour (man-day)	Draft power (bd) b/	Misce-llaneous (NRs)	Crop (mt)	By-product (mt)
Paddy (IMP)											
1992	75.0	10.0	-	-	2.0	-	150.0	40.0	300.0	2.8	2.4
2001	50.0	30.0	10.0	10.0	-	160.0	160.0	45.0	300.0	3.6	2.7
Paddy (LOC)											
1992	90.0	5.0	-	-	2.0	-	150.0	36.0	200.0	2.4	2.2
2001	90.0	10.0	-	-	2.0	-	155.0	40.0	200.0	2.8	2.5
Wheat (IMP)											
1992	120.0	30.0	15.0	-	1.0	-	95.0	30.0	200.0	1.9	1.5
2001	100.0	40.0	15.0	5.0	1.0	-	97.0	35.0	200.0	2.2	1.8
Maize (IMP)											
1992	25.0	-	-	-	2.0	-	95.0	22.0	-	1.2	1.0
2001	22.0	20.0	10.0	10.0	1.0	100.0	100.0	28.0	200.0	1.8	1.4
Maize (LOC)											
Present	25.0	-	-	-	2.0	-	90.0	22.0	-	0.8	0.6
Oilseeds											
1992	20.0	-	-	-	2.0	-	70.0	22.0	-	0.6	-
2001	18.0	20.0	10.0	-	1.0	-	75.0	25.0	150.0	0.8	-
Pulses											
1992	25.0	-	-	-	-	-	45.0	22.0	-	0.4	0.7
2001	22.0	-	-	-	1.5	-	50.0	25.0	50.0	0.6	0.8

a/ IMP = improved varieties; LOC = local varieties.
b/ bd = bullock cart day.

Source: DADO, Gularia.

Table 4.6 : Incremental Economic Output

[%]

Crops a/	1992					2001					INCREMENT		
	Area (ha)	Yield (mt/ha)	Gross Margin per ha (NRs)	Total Production ('000 mt)	Total Gross Margin (million NRs)	Area (ha)	Yield (mt/ha)	Gross Margin per ha (NRs)	Total Production ('000 mt)	Total Gross Margin (million NRs)	Production ('000 mt)	Gross Margin (million NRs)	%
Paddy (IMP) - MNS	8,700	3	13,930	24	121	12,000	4	19,177	43	230	19	109	54
Paddy (LOC) - MNS	3,300	2	11,614	8	38	1,000	3	14,486	3	15	(5.1)	(23.8)	(12)
Paddy (IMP) - SPR	-	-	-	-	-	2,500	4	19,177	9	48	9	48	24
Subtotal	12,000	3		32	160	15,500	4		55	293	23	133	66
Maize (IMP) - MNS	1,500	1	6,133	2	9	1,000	2	9,449	2	9	9	0	-
Maize (LOC) - MNS	500	1	3,380	0	2	-	1	3,380	-	-	(0.4)	(1.7)	(1)
Maize (IMP) - SPR	-	-	-	-	-	1,500	2	9,449	3	14	3	14	7
Subtotal	2,000	1		2	11	2,500	2		5	24	2	13	6
Wheat	3,800	2	12,461	7	47	5,500	2	15,329	12	84	5	37	18
Oilseeds - WINT	4,000	1	8,440	2	34	3,500	1	11,607	3	41	0	7	3
Pulses - WINT	3,450	0	4,885	1	17	2,600	1	7,923	2	21	0	4	2
Pulses - SPR		-	-	-	-	1,000	1	7,923	1	8	1	8	4
Subtotal	3,450	0		1	17	3,600	1		2	29	1	12	6
Total	25,250		10,634	46	269	30,600		15,343	77	470	31	201	100
($000)			249		6,288			359		10,995		4,707	

a/ IMP = improved varieties, LOC = local varieties,
MNS = monsoon, SPR = spring, WINT = winter.

Table 4.7 : Incremental Financial Output

[%]

Crops a/	Present					1992					2001					INCREMENT		
	Area (ha)	Yield (mt/ha)	Gross Margin per ha (NRs)	Total Production ('000 mt)	Total Gross Margin (million NRs)	Area (ha)	Yield (mt/ha)	Gross Margin per ha (NRs)	Total Production ('000 mt)	Total Gross Margin (million NRs)	Area (ha)	Yield (mt/ha)	Gross Margin per ha (NRs)	Total Production ('000 mt)	Total Gross Margin (million NRs)	Production ('000 mt)	Gross Margin (million NRs)	%
Paddy (IMP) - MNS	8,700	3	3,121	23	27	8,700	3	3,745	24	33	12,000	4	7,078	43	85	19	52	55
Paddy (LOC) - MNS	3,300	2	2,228	7	7	3,300	2	2,874	8	10	1,000	3	4,673	3	5	(5.1)	(4.8)	(5)
Paddy (IMP) - SPR	-	-	-	-	-	-	-	-	-	-	2,500	4	7,078	9	18	9	18	19
Subtotal	12,000			30	35	12,000			32	42	15,500			55	107	23	65	69
Maize (IMP) - MNS	1,500	1	59	2	0	1,500	1	516	2	1	1,000	2	2,240	2	2	-	1	1
Maize (LOC) - MNS	500	1	(31)	0	-	500	1	(31)	1	-	-	-	-	-	-	-	-	-
Maize (IMP) - SPR	-	-	-	-	-	-	-	-	-	-	1,500	2	2,240	3	3	3	3	4
Subtotal	2,000			2	0	2,000			2	1	2,500			5	6	3	5	5
Wheat	3,800	2	1,071	7	4	3,800	2	1,533	7	6	5,500	2	3,276	12	18	5	12	13
Oilseeds - WINT	4,000	1	1,634	2	7	4,000	1	2,494	2	10	3,500	1	4,688	3	16	0	6	7
Pulses - WINT	3,450	0	650	1	2	3,450	0	1,405	1	5	2,600	1	3,014	2	8	0	3	3
Pulses - SPR	-	-	-	-	-	-	-	-	-	-	1,000	1	3,014	1	3	1	3	3
Subtotal	3,450			1	2	3,450			1	5	3,600	1		2	11	1	6	6
Total	25,250		1,881	41	48	25,250		2,515	46	64	30,600		5,167	77	158	32	95	100
($000)					1,112					1,487					3,703		2,215	

a/ IMP = improved varieties, LOC = local varieties,
MNS = monsoon, SPR = spring, WINT = winter.

Table 4.8: Annual O&M Requirement for Irrigation

Items gross command area (ha)	Budikulo (8760)	Pata- bharkulo (1570)	Golakulo (690)	Manaukulo (870)	Taprakulo (2330)	Khairi- chakulo (1210)	Total (15430)	Per ha a/	Unit Cost (NRs)	Total Cost (NRs'000)	Total Cost ($'000)
1. LABOUR (man-day											
Intakes	66,000.0	12,250.0	6,000.0	21,000.0	10,000.0	6,750.0	122,000.0	10.2	33.0	1,026.0	94.0
Main/branch canals	81,200.0	3,100.0	1,800.0	9,700.0	8,700.0	5,500.0	110,000.0	9.2	33.0	3,630.0	85.0
Village canals	34,100.0	6,100.0	2,700.0	3,400.0	9,000.0	4,700.0	60,000.0	5.0	33.0	1,980.0	46.0
Subtotal	181,300.0	21,450.0	10,500.0	31,400.0	27,700.0	16,950.0	292,000.0	24.4		9,636.0	225.0
(per ha) a/	26.6	17.6	19.6	50.4	15.3	18.0	24.3				
2. BULLOCK CART (bd) b/											
Intakes	4,500.0	2,650.0	950.0	4,000.0	1,500.0	4,500.0	18,100.0	1.5	40.0	724.0	17.0
Main/branch canals	36,160.0	200.0	180.0	1,095.0	2,810.0	185.0	40,630.0	3.4	40.0	1,625.0	38.0
Village canals	-	-	-	-	-	-	-	-	40.0	-	-
Subtotal	40,660.0	2,850.0	1,130.0	5,095.0	4,310.0	4,685.0	58,730.0	4.9		2,349.0	55.0
(per ha) a/	6.0	2.3	2.1	7.5	2.4	5.0	4.9				
3. BRUSHWOOD (b c.load) c/											
Intakes	900.0	135.0	135.0	1,500.0	180.0	600.0	3,450.0	0.3	30.0	104.0	2.0
Main/branch canals	9,130.0	810.0	460.0	4,575.0	1,385.0	730.0	17,090.0	1.4	30.0	513.0	12.0
Village canals	5,900.0	1,060.0	465.0	585.0	1,570.0	820.0	10,400.0	0.9	30.0	312.0	7.0
Subtotal	15,930.0	2,005.0	1,060.0	6,660.0	3,135.0	2,150.0	30,940.0	2.6		929.0	21.0
(per ha) a/	2.3	1.6	2.0	9.8	1.7	2.3	2.6				
4. WOOD (M3)											
Intakes	500.0	60.0	150.0	75.0	120.0	30.0	935.0	0.1	315.0	295.0	7.0
Main/branch canals	1,220.0	120.0	100.0	3,330.0	240.0	60.0	5,070.0	0.4	315.0	1,597.0	37.0
Village canals	1,320.0	240.0	110.0	130.0	350.0	180.0	2,330.0	0.2	315.0	734.0	17.0
Subtotal	3,040.0	420.0	360.0	3,535.0	710.0	270.0	8,335.0	0.7		2,626.0	61.0
(per ha) a/	0.4	0.3	0.7	5.2	0.4	0.3	0.7				

a/ Net irrigated area (total 15040 hectare) has been used for the calculation of per hectare figures. Conversion rate = 0.78

b/ Bullock cart day.

c/ Opportunity price of farm labour.

d/ To get econmic prices SCF of 0.9 has been applied.

e/ Exchange rate:$1 = NRs.78.0

Table 4.9: Annual Maintenance Cost of Irrigation System ($,000)

$=000/NRs.78.0

	Investment Cost		O&M Cost as % of	O&M Cost	
	Financial	Economic	Investment	Financial	Economic
Intakes	1,702	1,378	2	34.0	27.6
Budikulo Main Canal	6,873	6,208	3	206.2	186.2
Branch Canals	1,949	1,760	1	19.5	17.6
Subtotal	10,524	9,346	0	259.7	231.4
Service Roads	2,672	2,437	2	53.4	48.7

Source: Project Implementation Report, 2000.

Table 4.10: Flow of O&M Cost
($,000)

Year = 1992

Year	Irrigation				
	Labour	Bullock Cart	Brushwood	Wood	Total
1	183	48	20	55	306
2	192	50	21	58	321
3	202	53	22	61	338
4	212	56	23	64	355
5	223	59	24	67	373
6	234	62	25	70	391
7	246	65	26	74	411
8	258	68	27	78	431
9	271	71	28	82	452
10	285	75	29	86	475
11	299	79	30	90	498
12	314	83	32	95	524
13	330	87	34	100	551
14	347	91	36	105	579
15	364	96	38	110	608
16	382	101	40	116	639
17	401	106	42	122	971
18	421	111	44	128	704
19	442	117	46	134	739
20	464	123	48	141	776
21	487	129	50	148	814
22	511	135	53	155	854
23	537	142	56	163	898
24	564	149	59	171	943
25	592	156	62	180	990
26	622	164	65	189	1040
27	653	172	68	198	1091
28	686	181	71	208	1146
29	720	190	75	218	1203
30	756	200	79	229	1264

a/ It is assumed that real term cost will grow by 5 per cent a year.

Table 4.11: Flow of Costs in Irrigation

[$=000]

	Irrigation (existing) a/						Irrigation (new structures)						
Year	Labour	Bullock Cart	Brush-wood	Wood	Sub-total	Intakes	Main Canal b/	Branch Canal	Sub-total	Irigation (total)	Service Roads	Grand Total
1	183	48	20	55	306	0	0	0	0	306	0	306
2	192	50	21	58	321	0	0	0	0	321	0	321
3	161	37	17	47	262	9	37	4	50	312	10	322
4	126	23	14	35	198	18	74	7	99	297	19	316
5	88	6	9	22	125	28	112	11	151	276	29	305
6	92	7	10	23	132	28	149	14	191	323	39	362
7	97	7	10	24	138	28	186	18	232	370	49	419
8	102	7	11	26	146	28	186	18	232	378	49	427
9	107	8	11	27	153	28	186	18	232	385	49	434
10	112	8	12	28	160	28	186	18	232	392	49	441
11	118	8	12	30	168	28	186	18	232	400	49	449
12	124	9	13	31	177	28	186	18	232	409	49	458
13	130	9	13	33	185	28	186	18	232	417	49	466
14	137	10	14	34	195	28	186	18	232	427	49	476
15	143	10	15	36	204	28	186	18	232	436	49	485
16	151	11	16	38	216	28	186	18	232	418	49	497
17	158	11	16	40	225	28	186	18	232	457	49	506
18	166	12	17	42	237	28	186	18	232	469	49	518
19	174	13	18	44	249	28	186	18	232	481	49	530
20	183	13	19	46	261	28	186	18	232	493	49	542
21	192	14	20	48	274	28	186	18	232	500	49	555
22	202	14	21	51	288	28	186	18	232	520	49	569
23	212	15	22	53	302	28	186	18	232	534	49	583
24	222	16	23	56	317	28	186	18	232	549	49	598
25	233	17	24	59	333	28	186	18	232	565	49	614
26	245	18	25	62	350	28	186	18	232	582	49	631
27	257	18	27	65	367	28	186	18	232	599	49	648
28	270	19	28	68	385	28	186	18	232	617	49	666
29	284	20	29	71	404	28	186	18	232	636	49	685
30	298	21	31	75	425	28	186	18	232	657	49	706

a/ It is assumed that real term cost of unimproved structures will grow by 5 per cent annualy in view of increasing difficulty in gathering wood. Because the Project does nto touch village level canals and the approach channel of Budikulo, O&M costs for these will be the same as those of 1992. It is also anticipated that some aprt of branch canals should be taken care of in upcoming years. Upon these assumptions, the O&M cost is calculated with the following formula:

Table 4.12: Incremental O&M Costs
($,000)

1992			2001		Changes in O&M Cost		
Year	Irrigation	Roads	Irrigation	Roads	Irrigation	Roads	Total
1	306	0	306	0	0	0	0
2	321	0	321	0	0	0	0
3	338	0	312	10	(26)	10	(16)
4	355	0	297	19	(58)	19	(39)
5	373	0	276	29	(97)	29	(68)
6	391	0	323	39	(68)	39	(29)
7	411	0	370	49	(41)	49	8
8	431	0	378	49	(53)	49	(4)
9	452	0	385	49	(67)	49	(18)
10	475	0	392	49	(83)	49	(34)
11	498	0	400	49	(98)	49	(49)
12	524	0	409	49	(115)	49	(66)
13	551	0	417	49	(134)	49	(85)
14	579	0	427	49	(152)	49	(103)
15	608	0	436	49	(172)	49	(123)
16	639	0	418	49	(191)	49	(142)
17	671	0	457	49	(214)	49	(165)
18	704	0	469	49	(235)	49	(186)
19	739	0	481	49	(258)	49	(209)
20	776	0	493	49	(283)	49	(234)
21	814	0	500	49	(308)	49	(259)
22	854	0	520	49	(334)	49	(285)
23	898	0	534	49	(364)	49	(315)
24	943	0	549	49	(394)	49	(345)
25	990	0	565	49	(425)	49	(376)
26	1040	0	582	49	(458)	49	(409)
27	1091	0	599	49	(492)	49	(443)
28	1146	0	617	49	(529)	49	(480)
29	1203	0	636	49	(567)	49	(518)
30	1264	0	657	49	(607)	49	(558)

Source: ibid .....

Table 4.13: Investment Schedule (Economic Cost)
($,000)

Year	1	2	3	4	5	6	Total
I. IRRIGATION IMPROVEMENT							
A. Civil Works							
1. Intakes	-	482	407	-	279	210	1,378
2. Budikulo Main Canal	-	168	1,894	2,140	2,006	-	6,208
3. Branch Canal	-	-	352	528	528	352	1,760
4. Service Roads	-	-	274	869	868	426	2,437
5. Other	95	83	-	-	-	-	178
Sub-total	95	733	2,927	3,537	3,681	988	11,961
B. Equipment and Vehicles	156	27	2	45	2	2	234
C. Surveys and Investigations	22	40	27	18	8	11	126
D. Recurrent Cost	60	60	69	69	43	43	344
E. Land Acquisition	-	-	228	-	-	-	228
Sub-total	333	860	3,253	3,669	3,734	1,044	12,893
II. PROJECT COST	209	402	225	55	28	-	919
TOTAL	542	1,262	3,478	3,724	3,762	1,044	13,812

Table 4.14: Net Benefits Cash Flow (Economic)
($'000)

Year	Cost			Agricultural Output	Net Flow
	Construction and Supply	O&M	Total		
1	542	0	542	0	(542)
2	1,262	0	1,262	0	(1,262)
3	3,478	(16)	3,462	0	(3,462)
4	3,724	(39)	3,685	0	(3,685)
5	3,762	(68)	3,694	0	(3,694)
6	1,044	(29)	1,015	0	(1,015)
7	0	8	8	1040	1032
8	0	(4)	(4)	1963	1967
9	0	(18)	(18)	2972	2990
10	0	(34)	(34)	4066	4100
11	0	(49)	(49)	5089	5138
12	0	(66)	(66)	4991	5057
13	0	(85)	(85)	4897	4982
14	0	(103)	(103)	4794	4897
15	0	(123)	(123)	4707	4830
16	0	(142)	(142)	4707	4849
17	0	(165)	(165)	4707	4872
18	0	(186)	(186)	4707	4893
19	0	(209)	(209)	4707	4916
20	0	(234)	(234)	4707	1941
21	0	(259)	(259)	4707	4966
22	0	(285)	(285)	4707	4992
23	0	(315)	(315)	4707	5022
24	0	(345)	(345)	4707	5052
25	0	(376)	(376)	4707	5083
26	0	(409)	(409)	4707	5116
27	0	(443)	(443)	4707	5150
28	0	(480)	(480)	4707	5187
29	0	(518)	(518)	4707	5225
30	0	(558)	(558)	4707	5265

Source: ibid .....

Table 4.15: Economic Internal Rate of Return - Summary

Base Case a/	2001	No Cost Overrun		Cost Overrun of 20%	
18.1%	19.5%	No Delay	2-year Delay	No Delay	2-year Delay
Price down 0%	Yield down 0%	18.1%	15.7%	15.7%	13.8%
	Yield down 20%	16.5%	14.4%	14.3%	12.5%
Price down 20%	Yield down 0%	16.1%	14.1%	13.9%	12.2%
	Yield down 20%	14.6%	12.8%	12.5%	11.0%

a/ It includes the environmental benefits of 18.85%

Table 4.16: Farm Income Situations a/

	1992		2001	
	Area (ha)	Income (NRs)	Area (ha)	Income (NRs)
Paddy (IMP) - Monsoon	2.1	7,680	2.8	20,030
Paddy (LOC) - Monsoon	0.8	2,240	0.2	1,120
Paddy (IMP) - Spring	-	-	0.6	4,180
Maize (IMP) - Monsoon	0.4	180	0.2	540
Maize (LOC) - Monsoon	0.1	-	-	-
Maize (IMP) - Spring	-	-	0.4	780
Wheat	0.9	1,380	1.3	4,260
Oilseeds	0.9	2,340	0.8	3,890
Pulses	0.8	1,140	0.9	2,560
Total	6.0	14,960	7.2	37,360
Adjusted for non-cash income b/		3,120		4,780
Adjusted for non-cash costs c/		9,220		11,550
Net farm income d/		21,060		44,130

a/ Net cultivated area 304 ha.

b/ Income from by-products.

c/ Costs of manure and draft animals.

d/ Includes food consumed within a farm family. but excludes labour costs. Therefore. if this is a farm of owner-occupier who uses no labour force except his own and family labour, the net farm income has to be increased by their labour costs.

Table 4.17: Annual Earnings of Typical Landless Farm Family (Kamaiya) a/ NRs.

	1992	2001
Gross output (crops)	36,630	66,990
Share of Kamaiya (Gross output x 25%)	9,160	16,750
Rental of thatched hut	1,200	1,200
Paddy in kind (675 kg) b/	2,030	2,230
Salt (10 kg)	60	60
Clothing	600	600
Total	49,680	20,840

a/ Net cultivated area: 304 ha.

b/ Financial price: NRs. 3.0/kg for present and NRs.3.8/kg for future.

CHAPTER - V
SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

5.1. CONCLUSIONS

Rajapur Irrigation Project is a successful FMIS and has delivered economic and social benefits to users and associated beneficiaries after its' implementation. There are three aspects where the project could be adjudged as successful. These are:

- Critical benefits
- Sustainability of project norms and standards of the project and
- Project based institutional goals

5.1.1. CRITICAL BENEFITS

Under it the FMIS has been able to war off production uncertainties through increased land use under irrigated crops (**12%**) in six VDCs' under question. Similarly, the project also attracted the poor and land less (*Kamayas*) into the Web of agricultural employment; which may be increased through high value crop production, strengthening of agricultural package program in six project VDCs and adjoining regions in a stepwise manner. The current- rate of return due to irrigation service is over 19%, which is more than the appraisal anticipation of the Asian Development Bank (**1992**).

On the project financing side, there exists a high opportunity cost of the FMIS on water delivery due to consistent increase in demand for water. The demand centers within six VDCs are expected to increase from **60** at present to about 120 in next 2 years (**UGs' and *Kulopani Choudhari***). Increase in demand centers means increase in private channels for incremental irrigation or land augmentation through irrigation. It is reported during discussion (**UGs' and *Kulopani choudhari***) that a one hectare land increase under irrigation would amount to an increase of **NRs 13,220** as net profit per cereal crop (**Barring wheat**) and if intercropping is done (vegetables/ mustard/ tobacco) the market margin may increase to **NRs 15,278**. Under this consideration, therefore, crop substitution in six VDCs has a fair scope in the up coming years.

People in six VDCs are fully aware about the importance of the *Rajapur Irrigation Project*. Increment in cropping intensity from 219% to 290% in a span of three years is a good indication for a high understanding about the worth of the project and activities there of . About project components, the notable feature of the FMIS has been its constituents such as soil erosion, silting, woodlog use in repair and maintenance and unsustainable water flow outside *Budi Kulo*. At present the system has been able to mitigate above problems quite competently. Irrigation intake structure and regulators have been reinstalled by the donor' s support. *Budi Kulo* and its influence area is the central stage for large scope reconstruction and inversion works. The cost estimates and financing plan was undertaken jointly by **ADB** and **HMG**, which is pointed out in the report.

Other Critical benefits include sectoral performance of agriculture, land ownership, cropping intensity, production, employment and income, soil erosion, siltation and runoff. In these areas, the project has noticeably contributed in last three years after project implementation. In the area of land ownership there does not exist any change, but there is an increases in the cropping intensity (**290%**). The production in irrigated agriculture is on the increasing trend; although, this needs to be sustained over the years from institutional support. As mentioned elsewhere, the role of agri- service centre, village and district markets and agri- package programs is paramount. The entire operations need be cohesive within the irrigation demand and water supply concept and functions.

Agriculture production in middle and large farms is stable due to extensive agriculture. The same in small farms have increased (**2.1%**) due to land augmentation. According to the information of the office of DADO, the project is irrigating over 15 thousand hectares of land. Employment in the agriculture sector is only stable as of yesteryears due to the lack of commercial farming. Similarly, the wage income of the sector is static; although, this aspect needs a separate study in future. Soil erosion, siltation and unwanted use of forest resource in O & M of the FMIS have been greatly reduced.

All in all the project has direct benefit in consumption (**elasticity at .22% annually**), health upkeep and social welfare of the people of the six VDCs and those of adjoining regions. It is however difficult to pinpoint the poverty nexus at this juncture in a preciseway; but there has occurred an overall change in the state of acute poverty. A majority of landless are partially to fully employed in agriculture and allied services.

Due to the control in forest denudation aspect; the overall condition of forestry has been stable. The farm to market roads are under upgrading and district roads connecting *Gulariya* municipal area are under active periodic maintenance. In substance the *Rajapur Irrigation Project* has greater economic viability due to all those explained above.

5.1.2. SUSTAINABILITY OF PROJECT NORMS AND STANDARDS OF THE PROJECT

The norms of the *Rajapur Irrigation Project* have been to promote equity and development entitlement to a majority of residents through technical, economic and social gains out of the irrigation service. To this end, the project has ushered reduction in the O & M cost and savings in the revenue (**8.5%**); besides, it has been able to promote a water related culture in six VDCs of the district. Under this consideration the project is fully successful. Apart from the broad outlook on the project, if it is evaluated on the basis of H.H. gains and social welfare, the project has definitively contributed to the economy of the district; although, the externalities created by the border prices and stiff competition on the products, have to some extent affected the income growth and redistribution of income. In order to wardoff certain exogenous impacts it is imperative that economic and production policies and subsequently the action plan be reframed to sustain the utility of the irrigation project. The standards of the FMIS have to be inhabited with respect of its' utility.

5.1.3. PROJECT BASED INSTITUTIONAL GOALS

As variously pointed out, the institutional, goals have to be fabricated in accordance with the centrality of the project. The centrality of the *Rajapur Irrigation Project* imbibes;

- Water delivery on demand
- Increment in use value of water
- Routine, periodic and emergency maintenance of the sub- systems
- Adequate participation of men and women including communities for the up keep and management of the system.

- Production development by increasing land use, cropping pattern, substitution in crop development,
- Application of moderate/ useful technologies and
- Market and prices and transfer modifications to sustain better input and output relation

Under the above set of goals, the line agencies have to target their goals and accordingly the programs need to be set. As understood, the line agencies have still to achieve a great deal in accommodating their functions and programs.

5.2. RECOMMENDATIONS

Rajapur Irrigation Project is technically sound and behaviorally viable project. Economy wise, the project has, both, present and potential benefits in the form of incremental irrigated area, land augmentation under conventional and cash crops and other secondary crops. Despite however the direct benefits; the irrigation project may also have intangible benefits focused to job opportunity in agriculture and agro-based processing business. On the environment front, the project has provided to control the crown forest loss due to control in indiscriminate denudation. The mitigation measures applied to check soil erosion and land slide in various embankments of the system has helped to retain the net cropped land.

The economic viability of the project boils down to:

- economic internal rate of return (EIRR)
- economic rate of return (IRR)
- shadow price, and
- benefit cost ration (BCR)

The EIRR is higher (19.6%>) due to current and expected agricultural benefits. Access benefit due to road upgrading ((7.4 km.) and marginal increase in daily traffic has also contributed to an increase in the EIRR. On same count the combined effect of shadow wage rate and price effect due to competitiveness (border price effect) has made the IRR to decline slightly (17.8%) The benefit to cost ratio has also improved (1.9 to 2.6) due to reduction in the 'O and M' costs and other associated costs. In substance, economic and financial analysis suggest that project has had been a bankable venture.

Contrary to the success story of the project requires;

- Increase in project management efficiency, through integration of agricultural services
- Monitoring of crop water requirement
- Monitoring o the use complementary agricultural programs and
- Project cost recovery analysis by taking cognizance of the project life span.

NPC has to take notice of the same in view of 10^{th} plan poverty alleviation approach.

The project does not have any apparent weakness. The private sector (UGs and beneficiaries) has an appreciable support to the project. Similarly, Women participation to the cause of personal welfare is appreciable. The project may safely be replicated in other area with identical situation.

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Study Team

1.	Team Leader	:	Mr. Vallabha Sharma (Senior Economist)
2.	Irrigation Engineer	:	Mr. M. Shrestha
3.	Statistician	:	Mr. B. Shreshta
4.	Office Manager	:	Mr. N.R. Subedi
5.	Field Surveyors	:	Dilip Panjiyar Sanjaya Choudhari Naresh Prasad Kushwaha

LIST OF PEOPLE CONTACTED

a) District Agriculture Development Office *Gulariya, Bardiya*

- Mr. A. B. Ansari (DADO)
- Mr. Shiv Nath Yadav (Service Centre Coordinator)
- Mr.Tika Ram Dahal (Chief Extension)
- Mr. Hari Shankar Tripathi (Agri-Economist)
- Mr. Diwakar Prasad Paudel (Irrigation Engineer)
- Mr. Shiv Krishna Joshi (Hydrologist)
- Mr. Tulsi Ghimire (Account Officer)

b) Private Sector

- Beneficiary Staffs (10 People)
- Jai Krishna Pandey (Kulopani Chaudhari)
- Ram Bilas Tharu (Mul Chaudhari)
- Tirths Ram Bhandari (Account Staff)
- Tika Maya Oli (Shahayak)
- Giri Raj Timilsina (Deshwar)

c) Focus Group Members

- Tilak Baniya (Local Farmer)
- Hari Chaulagain (Petty Business Person)
- Kiran Pyakurel (Campus Teacher
- Ms. Dil Maya Tharu (Member NGO) (Member NGO) Ms. Durga Ghimire
- Udaya Raj Kaini (President, Truga Group

1.7. Income from Farm and Non-farm Sources

Income from Farm Labour (Rs.)	Income from Non-farm Sources (Rs.)	Total Income/Rs.

1.8. Final Incomes from all Sources:

S. N	Sources	Small Farm (<1 ha.)	Medium Farm (1>2.5 ha.)	Large Farm (>2.5 ha.)	Total Rs.
1.	Crop				
2.	Livestock				
3.	Agri-Labour				
4.	Non-farm Source				

D. Input Information:

1.9. Input Information

S.N.	Item	Price/Kg.	Small Farm/Kg.	Medium Farm/Kg.	Large Farm/Kg.	Total Cost Rs.
1.	Fertilizers					
2.	Manures					
3.	Compost					
4.	Others					

Note: *This information will be for paddy, Wheat, Maize and Oilseeds. the enumerator will calculate the price and quantity and would furnish in the table.*

1.4. *Household Consumption Information*

Food Grain (Rs.)	Livestock-by Product (Rs.)	Others (Rs.)	Total Expenditure (Rs.)

Note: *This information pertains to one year, i.e. 2001-002. Similar information pertaining to before project situation, viz. 1992-93 will be taken from the district agriculture office located at Bardiya/Guleria. Thus, sample information will be cross tabulated to derive the change.*

1.5. Livestock Number and Income from Livestock:

S. N.	Name	Nos.	Milk and Other by Products Lts./Kg./Nos.	Price per Unit (Rs.)	Total Income (Rs.)
1.	Cow				
2.	Milk Buffalo				
3.	Good				
4.	Poultry Birds				

1.6. Income Generated From Agriculture and Livestock:

Net H.H. Income from Sale of Crops (Rs.)	Net H.H. Income from Sale of Livestock (Rs.)	Total Income (Rs.)

1.2. Cropped Area and Cropping Pattern:

Season/Crop	Area (ha.)

1. Summer/Monsoon Season

1.1. Paddy (improved)
Paddy (local)

1.2. Maize (improved)
Maize (local)

Subtotal = (1.1+1.2) Area/ha._____

2. Winter Season
2.1. Wheat
2.2. Oilseeds
2.3. pulses

Subtotal = (2.1+2.2+2.3) Area/ha._____

Total Cropped Area (1.1+1.2 and 2.1+2.2+2.3) = Area/ha._____

Cropping Intensity (100%) = _____/ha

1.3. Crop Production Information:

S. N.	Name of the Crop	Area Under Crop/ha.	Production Per ha./M. ton	Total production/M. ton
1.3.1	Paddy (improved)			
	Paddy (local)			
1.3.2	Maize (improved)			
	Maize (local)			
1.3.3	Wheat			
1.3.4	Oilseeds			
1.3.5	Pulses			

Note: *Vegetable production in Rajapur Irrigation Project area is reported to be confined to household consumption through kitchen garden farming. Hence, aggregate data from Bardiya Agriculture office will be collected and referred.*

HOUSE HOLD SURVEY QUESTIONNAIRE

Rajapur Irrigation Project

A. General Information:

1. Name of the Household _____
2. Name of the Locality _____
3. District _____
4. Ward No _____
5. Head ☐ Middle ☐ Tail ☐ Water User ☐ [Please check]

B. Demographic Information:

S. N.	Male (Nos.)	Age	Female (Nos.)	Age	Total	
					Male	Female
1.						
2.						
3.						

Note: Age wise and sex wise distribution of population by age class will be computed and shall be presented in the text.

C. Activity Information:

1. Agriculture

1.1. Land Ownership Pattern

Land Category	Owned Land (ha)	Rented-In Land (ha)	Rented-Out Land (ha)	Total Land (ha)
Small < 1 ha.				
Medium 1 - 2.5 ha.				
Large > 2.5 ha.				

Note: From the above table, farm size distribution pattern and land ownership pattern will be computed.