

# Initial Environmental Examination Document

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June 2009

## Nepal: Community-Managed Irrigated Agricultural Sector Project

### Ghatte Khola Irrigation Subproject, Bhojpur District

Project Proponent: Department of Irrigation  
Prepared by Eastern Irrigation Development Division No. 2 (Bhojpur)

This Initial Environmental Examination is a document of the borrower. The views expressed herein do not necessarily represent those of ADB's Board of Directors, Management, or staff, and may be preliminary in nature.

## ABBREVIATIONS

ADB	- Asian Development Bank
CMIASP	- Community-Managed Irrigated Agricultural Sector Project
CPMO	- Center Project Management Office
DADO	- District Agriculture Development Office
DB	- Design Branch
DDC	- District Development Committee
DOI	- Department of Irrigation
EB	- Environment Branch
EMP	- Environmental Monitoring Plan
FMIS	- Farmer-managed irrigation systems
ha	- Hectare
IDD	- Irrigation Development Division
IDSD	- Irrigation Development Sub-division
IEE	- Initial Environmental Examination
IPM	- Integrated Pest Management
ISPM	- Institutional Strengthening and Project Management
km	- Kilo Meter
lps	- Liter Per Second
MEQCB	- Monitoring, Evaluation, and Quality Control Branch
MoEST	- Ministry of Environment, Science and Technology
NGO	- Non Governmental Organization
O&M	- Operation and Maintenance
PDMED	- Planning, Design, Monitoring and Evaluation Division
RCC	- Reinforce Concrete Cement
Rs.	- Rupees
SISP	- Second Irrigation Sector Project
SWD	- Surface Water Division
VDC	- Village Development Committee
VRB	- Village Road Bridge
WECS	- Water Energy Commission Secretariat
WUA	- Water User's Association
Zol	- Zone of Influence

## WEIGHTS AND MEASURES

ha	- hectare
km	- kilometer
l	- liter
m	- meter
mo	- month
s	- second
t	- ton
yr	- year

## CURRENCY EQUIVALENTS

(as of 31 March 2009)

Currency Unit - Nepalese Rupee (NR)

NR 1.00	=	\$0.01226
\$1.00	=	NRs 81.54

## NOTE

In this report, "\$" refers to US Dollars.

## **GLOSSARY**

Terai	The southernmost strip of land in Nepal, bordered to the north by Himalayan foothills and to the south by the Ganges River. The area was originally covered with tropical vegetation, but has been almost completely converted to agricultural production. The Terai is now the breadbasket of Nepal and is covered with farms.
Command Area	It is the agriculture or cultivable area which receives assured irrigation through canals, waters, courses, and field channels up to farmers field.

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## I. INTRODUCTION

1. The Community-Managed Irrigated Agricultural Sector Project is designed to improve the agricultural productivity and sustainability of farmer-managed irrigation systems (FMISs) while strengthening the policies, investment plans, and institutions for irrigated agriculture, following the lessons learned during the Loan 1437-NEP: Second Irrigation Sector Project (SISP). The Project is located in the Eastern and Central regions of Nepal and comprises two parts: (i) participatory irrigated agriculture development for FMIS; and (ii) institutional strengthening and project management (ISPM). Under the first part, 210 FMIS will be rehabilitated, resulting in improvements in irrigated agriculture over 34,000 hectares (ha) benefiting about 270,000 people. The second component comprises the development and implementation of improved institutional mechanisms for FMIS development, further improved policies and regulations, strengthening of the key stakeholders agencies and their linkages.

2. An initial environmental examination (IEE) was undertaken for the core subprojects based on data collected during the Detailed Design Period. The overall objective of the IEE is to analyze the adverse environmental impacts arising from site selection, design, construction, and operation of the Project if such effect occurs and its mitigation to acceptable levels through implementation of a set of clearly defined and costed mitigation measures which have been included in the Project cost estimates. For each additional subproject, an IEE, and an environmental impact assessment (EIA) if warranted, will be carried out in accordance with the Bank's guidelines and relevant government's environmental requirements during the preparation of subproject feasibility studies.

3. This Initial Environmental Examination (IEE) Report for the Ghatte Khola Irrigation Subproject has been prepared to meet the Asian Development Bank's (ADB) requirements for environmental assessment process and documentation prior to Subproject approval, following the procedures in ADB's Environmental Assessment Guidelines (2003), and the Project's Environmental Assessment and Review Procedures and Arrangements.

## II. DESCRIPTION OF THE SUBPROJECT

4. **Project Location.** The proposed Ghatte Khola Irrigation Subproject is located in the central part of Bhojpur District in Koshi Zone of Eastern Development Region. The Ghatte Khola Irrigation subproject covers four wards i.e. 2, 3, 6 and 8 of Siddheswor VDC. The headworks lies in Siddheshwor VDC of Bhojpur district.

5. The Subproject area lies between the Longitude  $87^{\circ} 00' 00''$  (Head) to  $87^{\circ} 02' 30''$  (Tail) E and Latitude  $27^{\circ} 12' 33''$  (Head) to  $27^{\circ} 15' 00''$  (Tail) N. The elevation of the Subproject area is about 1500 m above msl. The subproject location is shown in Figure 1.

6. **Accessibility.** The subproject area can be reached on foot. The subproject is easily accessible from District Headquarter, Bhojpur. It takes about four hours from Bhojpur. The nearest market is Leguwaghat situated at a distance of 60 km from the subproject area.

7. **Existing Situation.** The history of the Sub project construction is very old and farmers say this scheme has been in place since 1956 AD. Farmers since then are operating and managing this scheme by themselves. The farmers have extended the irrigation canal on their own efforts. A layout map of the subproject area is presented in Figure 2.

8. The present diversion at the Ghatte intake site consists of a temporary diversion structure built of local materials to divert water during the dry season. The intake usually breaches during the monsoon season and has to be frequently repaired. Uncontrolled inflow of floodwater has also caused erosion and damaged the canal banks in the head reaches of the main canal.

9. Main canal runs from north to south and irrigate the area on the right bank of Ghatte Khola. This canal has an irregular shape and there are no permanent control or cross drainage structures in the system. Conveyance efficiency is low in the canal system due to high seepage losses.

10. There is a need for reshaping of the existing 0.77 km long canal section and construction of 3.23 km long new canal. Control structures are needed to maintain uniform water levels ensuring an equitable water distribution throughout the system as well as to avoid the canal's bank and bed erosion due to rapidly varied flow. Along with these masonry lining of the canal and landslide protection works are required to minimize the seepage loss and protect the canal from breaching respectively.

11. **Command Area.** The present total irrigated area is 10 ha. Extension in irrigable area is about 105 ha of Siddheswor; this would bring the total irrigated area to 115 ha. Two main crops cultivated are paddy and wheat. Paddy covers 100% of the command area. Early paddy, maize, mustard etc are also grown in 20 to 30% of the total command area.

12. **Project Components.** The major infrastructure improvements include the rehabilitation of headworks and river bank protection works, canal reshaping, new canal sections, linings, and

cross drainage structures such as aqueducts, superpassage etc. The detail of subproject interventions is presented in Annex 1. The salient features of the subproject is presented in Table 1.

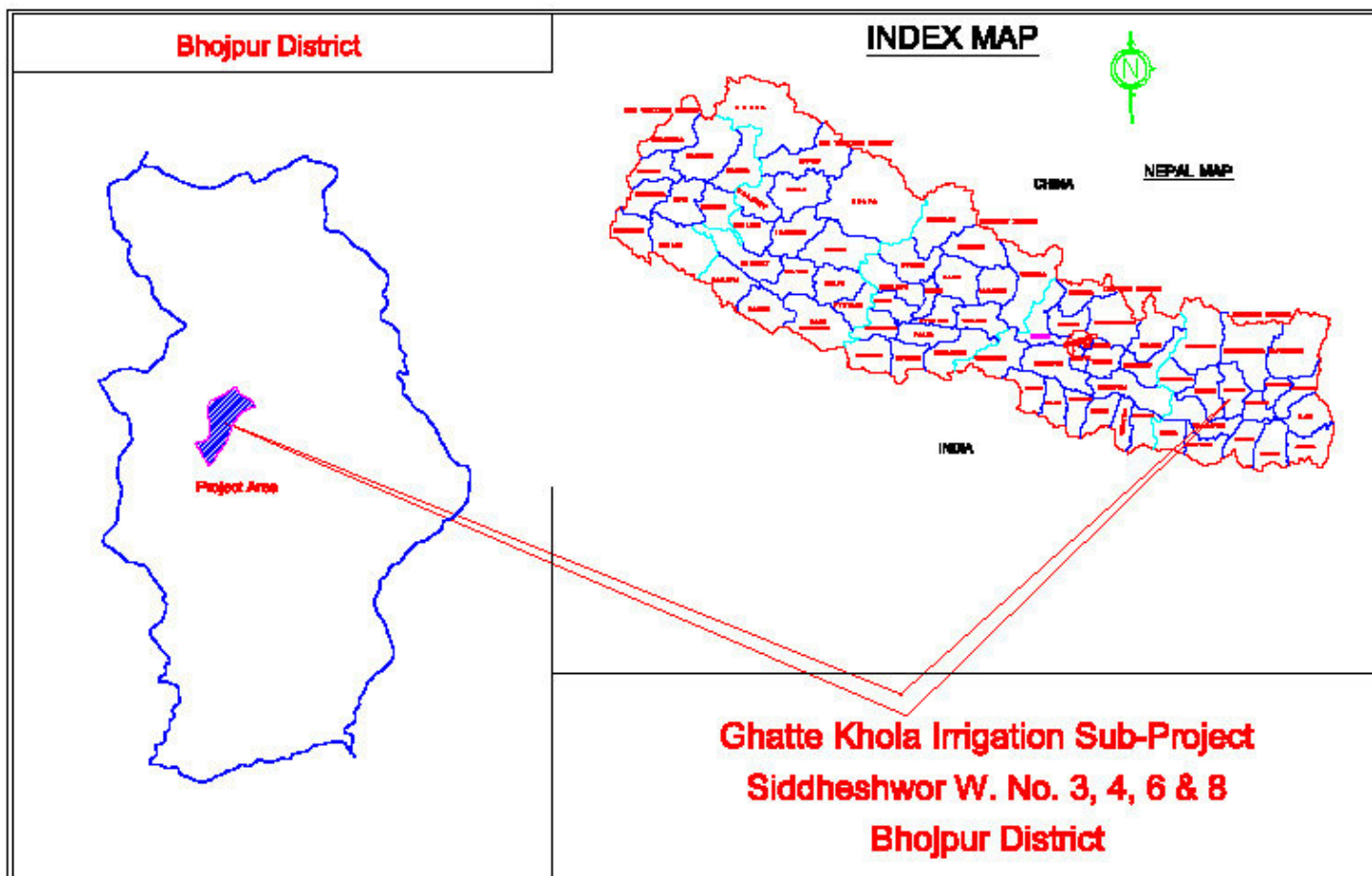
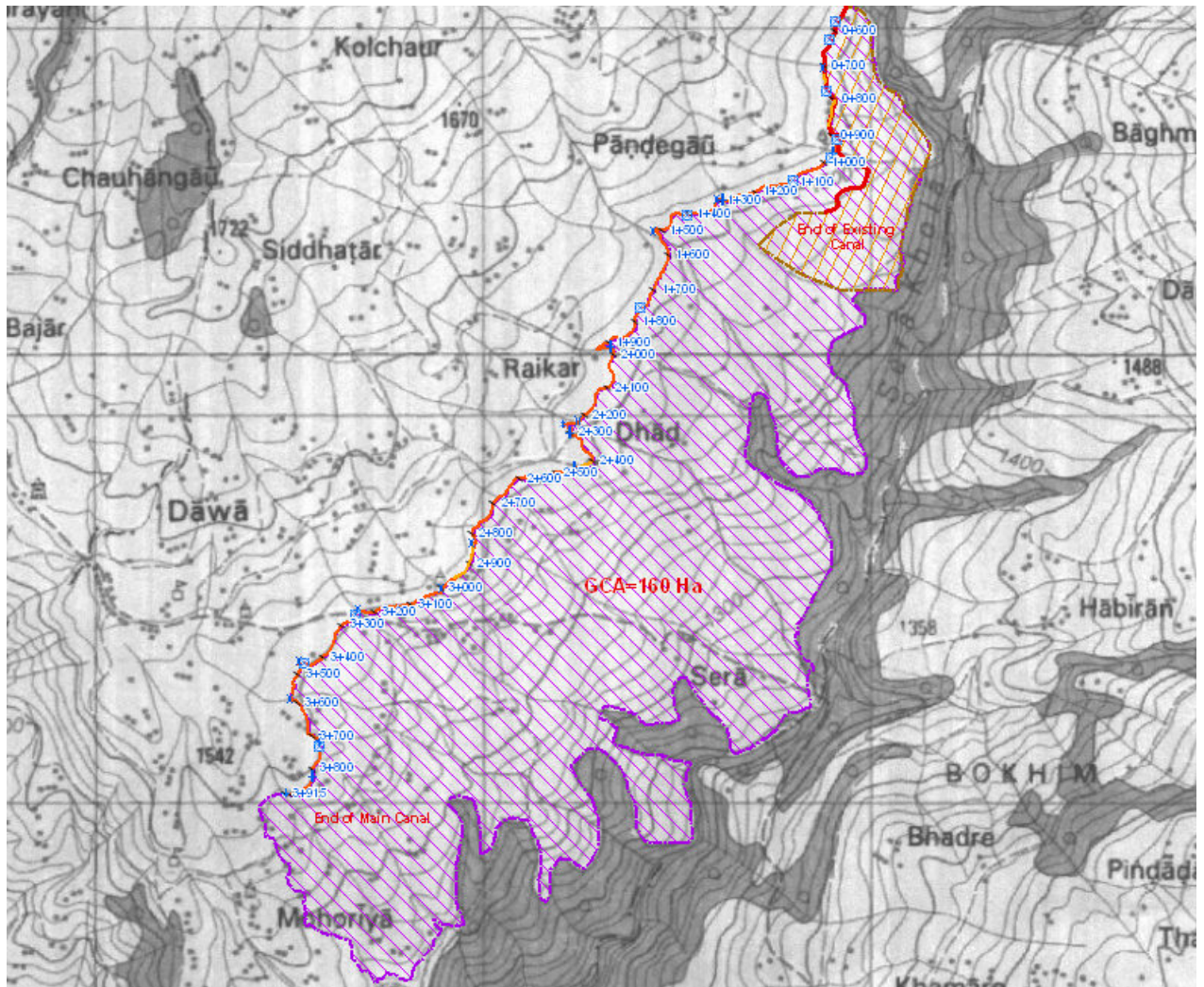


Figure 1: Location Map of the Subproject



**Figure 2: A Layout Map of the Sub project**



**Table 1: Salient Features of the Ghatte Khola Irrigation Subproject**

1. Name of Subproject	Ghatte Khola Irrigation Subproject
2. Subproject Classification	Rehabilitation/Extension
3. Location (VDC and Ward No)	Siddheshwor, Ward No: 3, 4, 6 and 8
4. District	Bhojpur
5. District Headquarter	Bhojpur
6. Zone	Koshi
7. Development Region	Eastern
8. Number of Households	193
9. General Elevation of the Subproject Area	1600 msl
10. Slope and Topography of the Subproject Area	Rolling to moderately steep (18 to 30% slope)
11. Population	798
12. Total Canal Length	
a) Main Canal	4.00 km
b) Branch Canal	None
13. Gross Command Area	157 ha
14. Net Command Area	115 ha (Existing 10 ha & Extension 105 ha)
15. Cropping Intensity	122% (present) & 184% (future)
16. Name Of Water Source	Ghatte Khola and others
17. Type Of Water Source	Perennial
18. Catchment Area	4.01 km <sup>2</sup> (in Hydrological Region-I)
19. Canal Type	Earthen & RCC Lined canal
20. Canal Discharge	230 liter per second
21. Side Slope	1:0.5 (Earthen Canal), 1:0 (Lined Canal)
22. Bed Slope	Shown in the L-Section in Detailed Design
23. Diversion Structure	Side Intake
24. Proposed Subproject Interventions	
Side Intake	1
Super Passage	12 nos.
District Road Bridge	1
Foot Bridge	6
Outlet	16 nos.
One Side RCC Lining	120 m
Both Side RCC Lining	235 m
Covered Canal	95 m
Piped Canal	4 nos. – 184 m
25. Number of people directly involved during construction (estimate)	Skilled: 1,209 man days Unskilled: 8,362 man days
26. Construction/Rehabilitation Period (months)	16 months

Notes: VDC = Village Development Committee ; msl = meters above sea level; km = kilometers; ha = hectares; km<sup>2</sup>= square kilometers; RCC = reinforced concrete cement; VRB = Village Road Bridge

### III. DESCRIPTION OF THE ENVIRONMENT

#### Physical Environment

13. **Topography.** The scheme is located in the Hill plains in an agricultural area with land that slopes gently from north to south at an elevation just above 1600 m above msl. The Ghatte Khola subproject command area lies on right bank of the Ghatte Khola.

14. **Climate.** The climate is tropical during the summer and subtropical during the winters, so as can be expected in the Eastern area of Nepal. The seasons can be divided into three distinct parts. The spring season is warm and dry, summers are warm, wet and humid and winters are cool and normally dry. In the same way, the months of November to February are cool and dry, March to June is hot and dry, July to August is warm and humid and September to October is pleasant. The warm temperate climate allows for cultivating three crops a year. As there exist no long term discharge records for this source river, the flood discharge is sought to be estimated based on the rainfall and catchment characteristics. The average annual rainfall recorded at Station Bhojpur (Station Index 1324) is 1303 mm and is presented below. More than 80% of the rainfall is concentrated during the four months of the year, June through September.

15. Following are some important hydro-meteorological observations:

- Mean annual rainfall – varies from 8.0 mm minimum in December to 311.0 mm maximum in July;
- Minimum evaporation: 2.9 mm in January
- Maximum evaporation: 6.6 mm in April

16. **Soils.** The soil pH of head reach is close to neutral side (soil pH 7.09) but soil pH of middle (soil pH 4.96) and tail reaches (soil pH 5.02) are acidic. The soil of head reach is slightly heavier texture (Silt Loam) but middle and tail canal reach have light soil (Loam). The Nitrogen content of soil of each canal reaches is medium level. Phosphorus content of soil in the subproject area is too low; it shows that soils of subproject area are deficit in Phosphorus. Potassium content of soil of command area is of medium level. Therefore, farmers of the command area should judiciously use the plant nutrient mainly phosphoric fertilizer. Organic matters content of soils of subproject area is also of medium level. It is recommended that farmers have to use full dose of the recommended dose of Phosphorous and half dose of Nitrogen and Potash nutrient for good crop production. Soil and texture of soil of the subproject area are suitable for crop production. Paddy, maize, wheat, oil crops, pulses and vegetables can be very successfully grown in the command area.

17. **Water Resources.** Ghatte Khola is a Perennial River. The catchment area is relatively small at only 3.5 km<sup>2</sup>. It originates from Barse dada (2659 m msl) and flows due north-south. It drains to Sera Khola, which finally drains to big river, Pikhwa. Most of this catchment area is located inside the dense forest and the good forest cover in this area provides the catchment with a high water retaining capacity, which limits the occurrence of flash flood, provides the river with a relatively stable flow regime and provides for the presence of considerable perennial spring flows. This gives the river considerably higher base flow than is normally expected from

streams with this small a catchment area in the Hill range. According to the feasibility study conducted in January 2008, the lowest mean monthly flow is 77 lps in the month of April while the maximum mean monthly flow is expected to be 1921 lps in the month of August.

## **Ecological Resources**

18. **Vegetation and Forest.** There is no national forest or community forest within the subproject command area. However, there are a number of trees of different species such as sal, uttis, katus, chilaune etc and oranges within the subproject command area but they are not going to be affected by the subproject activities.

19. **Wildlife.** As reported by the local people, there are no wildlife habitat as such in the subproject area and its vicinity. Some jackals and monkeys have been seen occasionally within the subproject command area.

20. **Aquatic life.** No major fish species have been reported in the Ghatte River. But some local species are found all along the river stretch. People in the command are not involved in any fishing activities.

## **Socio-economic Environment**

21. The total number of households in the subproject area is 193 and the population is around 798. Ethnically the settlement has a mixed type of social structure.

22. Brahmin and Chhetri are the two major settlements located at the head and tail reach of the system, respectively. There are a larger number of medium land holders, and therefore medium farmers. The ultra poor are scattered evenly in entire settlements. Most of Dalit (occupational caste groups) are ultra poor and vice versa.

23. The main occupation of people in the area is farming. The sample household survey revealed that 87% of households depend on agriculture for their livelihood. Apart from agriculture, 5.42% households supplement their income from business and 7.83% by service. Most of the farmers rear ducks, goats and buffaloes for getting meat and milk, which is often also sold in nearby markets to buy the articles of other primary needs. About 18% of households meet their needs by working as agriculture labour.

24. The labour force from Rich and Middle Level families is more involved in urban based business and foreign employment while those from the poor group are highly mobile from farm to nearby urban industry. The main source of agricultural labour for the command area is the Ultra poor group. There is sufficient labour force to meet the unskilled labour required for infrastructure construction. 80.5% of sample hh were found fully employed for more than 300 days a year, while 13.2% are unemployed.

25. The wage rate of human labour is recorded as NRs. 100/man-day (same wage for man and woman for similar work) and for draft animal (including man) is NRs. 250/man-day.

26. A majority (92%) of farmers produce enough food for themselves. Large farmers meet their entire food requirement from their produce, while marginal and landless meet only 33.33% of their food requirements.

27. The participation of both men and women in the social affairs has been increasing. Women had participated in casting votes in the previous election whereas men were involved in candidacy and voting also.

28. The education level of the community is poor. The literacy rate was found to correlate with the size of land holding of a family, illiteracy being higher among small farmers and marginal/landless than large land holders. Most of the people, considered literate in the area, have not completed even the lower secondary level.

#### IV. SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS

29. **Delineation of geographical boundary of zone of influence (Zoi).** : The subproject area will be delineated under three category (i) high impact area: the permanent impact from the subproject such as permanent land loss and dewatered zone will be considered as high impact area. Such area will include the area where the subproject infrastructures will be located such as headworks, canal alignment and canal structures (ii) Moderate impact area: This will cover the area where land loss will be temporary during the construction period only. They will include camp sites, quarry sites; borrow areas, labour camp sites etc. (iii) low impact area: This will cover the adjoining areas within 200 to 500m (depending upon the settlement pattern) from the boundary of the sub project area of the VDC that are likely to be affected.

30. The subproject will be constructing a permanent side intake at the right bank of the river Ghatte Khola, which will not be inundating any area at the upstream. The screening of the potential impacts is presented in Table 2.

**Table 2: Screening of Potential Impacts**

SL	Parameters	Impact		Remarks
		Yes	No	
1	<b>Environmental Problems due to Subproject Location</b>			
1.1	Encroachment into Areas of Conservation Significance		√	There are no conservation areas (wetlands and protected forests) within the Subproject command area
1.2	Impediments to Movements of Wildlife, Livestock and People	√		Extension of canal would impede the movement of wildlife, livestock and people to some extent. Canal crossing structures would be provided at several locations.
1.3	Encroachment on Historical and Cultural Sites		√	There are no historical, cultural, and religious sites within the Subproject command area
1.4	Water Resource Conflicts		√	The Subproject irrigation system being in operation for more than fifty years, system for water use has been established and no records are available showing any evidence of misunderstanding or conflicts among users.
1.5	Flooding and Drainage Hazards	√		The canals which also carry the surface runoff would require escape structure and cross drainage structure.
1.6	Displacement of People and Property	√		The extension of canal would require 0.97 ha of cultivated land. WUA will acquire the required land.
2	<b>Environmental Problems related to Subproject Design</b>			
2.1	Watershed Erosion	√		The Subproject will provide riverbank protection works u/s and d/s of river near intake area. At diversion, PCC core wall will be provided.
2.2	Downstream Water Quality Problems		√	The Subproject is a rehabilitation/extension project therefore no other water sources (e.g. groundwater) will be utilized. Therefore quality of water supply will not change
2.3	Suitability of Natural Water for Irrigation		√	The water sources have been used prior to rehabilitation works. There will be no changes in water use during the Subproject implementation

SL	Parameters	Impact		Remarks
		Yes	No	
2.4	Over pumping of Groundwater		√	Groundwater will not be used in this Subproject.
2.5	Adequacy of Drainage Planning	√		Some problem at the outfall points. Protection will be provided in consultation with the farmers.
2.6	Disruption of Existing Farmer Cooperative Systems		√	There are no existing farmers' cooperatives within the command area.
2.7	Use of Chemicals in Agriculture and Horticulture	√		Use of chemical fertilizers and pesticides is currently negligible which may increase due to the improved irrigated agriculture practice
2.8	Selection of Pesticides	√		Selection and use of pesticides may be a problem
2.9	Land Use Conflicts		√	The land use within the command area has been established prior to the implementation of the Subproject. No records are available showing misunderstanding or conflicts among different land uses.
2.10	Inadequacies in Water Distribution		√	Although there is extension area in the subproject, there is sufficient water at the source. Necessary improvement work in the system and improved efficiency of the canal system will increase the discharge in the canal and would meet water requirement of whole command area. Inadequacy in water distribution will not occur.
2.11	Canal Management	√		The operation and maintenance (O&M) of the existing irrigation system has been in place prior to implementation of the Subproject. The (O&M) of the canal with extension has to be worked out.
2.12	Passageways	√		The existing passageways are not sufficient for movement of people and livestock. The Subproject will construct necessary number of crossings and passageways.
2.13	Scouring Hazards		√	The system has been in operation for many years. Scouring problems has not been reported. Canal beds are stable.
<b>3</b>	<b>Environmental Problems Related to Construction Stage</b>			
3.1	• Excavation	√		Excavation at structure sites and canal extension area.
3.2	• Construction material sites (Quarry Sites)		√	The construction work will require 206 m <sup>3</sup> sand 204 m <sup>3</sup> of aggregates which can be fulfilled from the local market or local quarry. Operation of quarry site for the sub project may not be feasible.
3.3	• Work camp location and operation	√		The contractor will have to establish work camp for the construction activities
3.4	• Labour camp		√	Total labour requirement will be about 8,362 unskilled and 1,209 skilled. Assuming actual construction working season of 13 months, the average labour requirement per day would be 21 unskilled and 3 skilled. The most of the unskilled and some of skilled manpower will be fulfilled from the local area. Hence labour camp will not be operated. Some of the outside labour will reside within the work camp it self.
3.5	• Stockpiling of materials	√		The construction material will be stored at the convenient locations for the construction

SL	Parameters	Impact		Remarks
		Yes	No	
				activities.
3.6	<ul style="list-style-type: none"> <li>Operation of construction equipment and transport</li> </ul>	√		No heavy construction equipments are needed and only small dewatering pumps, mixers, vibrators etc will be used which do not contribute major air pollution. Tractors and trucks would be used for material transportation.
3.7	<ul style="list-style-type: none"> <li>Occupational health and safety</li> </ul>	√		Occupational health and safety of the workers will be addressed.
3.8	Temporary Closure of Irrigation System	√		Construction activities are likely to disturb the supply of irrigation water.
<b>4</b>	<b>Environmental Problems Resulting from Subproject Operations</b>			
4.1	Effect on downstream water use		√	There is still plenty of water for the downstream users after proposed intervention. Hence effect on downstream users has not been foreseen.
4.2	Adverse soil modifications		√	The proposed subproject is the rehabilitation of the existing irrigation system, adverse soil modification will not occur due to the proposed subproject implementation.
4.3	Changes in groundwater hydrology		√	The subproject command area being in hilly terrain groundwater recharge will be minimal.
4.4	Mosquito Breeding		√	The command area being in hilly area mosquito breeding is not a concern.
4.5	Hazards associated with the use of toxic chemicals	√		Use of pesticides for the pest control is currently very low. Its use may increase which could be hazardous to the people and livestock
4.6	Hazards associated with the use of mineral fertilizer	√		Currently the use of fertilizers is very low. Its use may increase due to improved irrigation system, These may find its ways to surface water which could hazardous
<b>5</b>	<b>Realization of Enhancement Potentials</b>			
5.1	Employment to the local people	√		Construction activities will require construction labors. Local people will get opportunity in employment. In addition farmers have to share the construction cost which will be mostly usually in terms of labor force.
5.2	Community water supply in command area		√	The command area has existing water supply schemes (tap water) constructed and operated by farmers. Canal waters are not used for domestic purpose and will not be used as such after Subproject implementation.
5.3	Aquaculture in command area		√	Farmers are not practicing aquaculture within the command area. It is unlikely that this will change during Subproject implementation.
5.4	Livelihood programs for landless households	√		Construction activities will require both skill and unskilled laborers. The Subproject will also provide livelihood trainings to enhance economic conditions of landless households.
5.5	Feasibility of cooperatives	√		The Subproject will implement institutional development activities to strengthen capacity of water users associations which could function as a cooperative to support the farmers.

31. In many environmental assessments there are certain effects that, although they will occur during either the construction or operation stage, should be considered as impacts primarily of the location or design of the project, as they would not occur if an alternative location or design was chosen. The two activities in which the Subproject interacts physically with the environment are during construction and operation, so these are the two activities which most significant environmental impacts can occur. The Subproject will not cause any significant adverse environmental impacts because: (i) most of the individual elements of the Subproject are relatively small and involve straightforward construction and operation, so impacts will be mainly localized and not greatly significant; (ii) most of the predicted impacts are associated with the construction process, and are produced because that process is invasive, involving trenching and other excavation; and (iii) mitigation measures are devised for any negative environmental impacts.

32. These potential environmental impacts may be direct or indirect, and reversible or irreversible. The magnitude of the impacts may be high, medium or low and such impacts may be of site-specific, local, regional or of national nature. Furthermore, some impacts may be short-term, particularly related with the upgrading stage, medium-term and long-term duration.



## V. POTENTIAL ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

### Environmental Problem Related to Subproject Location

33. **Flooding and Drainage Hazard:** The area is already partially irrigated. The water flow in the canal is unregulated. The excess water in the canal is overtopped from many places. There are erosion problems at a number of places where the water from the agriculture land flows out into the natural drains. The proposed intervention will be regulating the flow in the canal with the provision of escape structures. The proposed subproject will be guiding the critical drainage outfalls by providing the outfall structures. These interventions will be positive impact of high magnitude, local extent and long term duration.

34. *The escape structures will be provided at the appropriate locations so that the excess water in the canal can be discharged safely into the natural drains and a number of drainage outfall structures will be constructed in consultation with the farmers.*

35. **Displacement of People and Property:** There will be no displacement of people by the subproject. But the extension of canal would require about 0.97 ha of cultivated land. WUA will acquire the land from the landowners. This impact is considered medium in magnitude, local extent and long term duration.

### Environmental Problem Related to Subproject Design

36. **Watershed Erosion.** For the stabilization of the river course up and down stream of the intake some riverbank protection works will be required. The protection works will involve the reshaping of the riverbanks, raising the level of the right side embankment. At the diversion a PCC core wall is provided with gabion protection downstream. Gabion mattresses with a geotextile filter will be placed on the reshaped riverbanks and the raised flood embankments. Downstream protection works will be especially required for protection of the head reach of the main canal. This is the positive impact of high magnitude, local extent and long term duration.

37. **Adequacy of Drainage Planning:** In general the command area is sloping from north to south and water flow is smooth. But there will be some problems at the outfall points. Some protection will be provided in consultation with the farmers. This is the positive impact of high magnitude, local extent and long term duration.

38. **Use of Chemicals in Agriculture and Horticulture:** The subproject area being located near to the main market like Bhojpur, the availability of chemical fertilizers is not so inconvenient. However, the use of chemical fertilizers is minimal which may increase as the subproject encourages irrigated agricultural practices. Excess use of chemical fertilizers in the field may run down into surface water along with the runoff. But the excess use of fertilizers would be very rare in practice. Considering the rareness of the occurrence, this impact has been considered of low magnitude, local extent and long term duration.

39. *The agricultural development plan has recommended the optimum dose of required chemical fertilizers for each of the proposed crops.*

40. **Selection of Pesticides:** Majority of farmers of the subproject area are not aware of the toxicity of the pesticides. As reported, many of them have not undertaken some kind of integrated pest management (IPM) training in their district. The impact associated with the pesticides will be low magnitude, local in extent and long term in duration.

41. *Include IPM training under agriculture development program. The cost of this training will be covered from ADP.*

42. **Canal Management:** The proposed subproject intends to operate one main canal. The operation and maintenance of the system will be the responsibility of the farmers themselves. The canal system has its own canal management process, which has been practiced for many years. The operation and maintenance of the main canal with extension will have to be worked out, which should not be a problem as they have been practicing such works for many years. Hence this impact has been considered of low magnitude, local extent and long term duration.

43. *Water management plan will be developed for the operation of the system.*

44. **Passageway:** There are some passageways in the existing canals which is not adequate for movement of the people. Hence additional passageways, 1 District Road Bridge and 6 foot bridges have been proposed. This is a positive impact of high magnitude, local in extent and long term duration.

#### **Environmental Problems Related to Construction Stage:**

45. The Subproject will use labour-based, environment-friendly, and participatory approach, the important features of which are:

- Use of local people as labour, hand tools and small equipment, rather than heavy machinery for construction.
- Balancing cut and fill and reuse of excavated materials as construction materials, and thus not generating excess spoils as far as possible.
- Use of bio-engineering techniques: integrated use of vegetation, simple civil engineering structures, and proper water management systems for slope protection.

46. Significant adverse negative environmental impacts are not expected during the construction stage mainly because: (i) rehabilitation works can be constructed without causing major disruption to irrigation users; (ii) most construction will be conducted by small teams of farmers working on short lengths at a time so most impacts will be localized and short in duration; and (iii) the overall construction program will be relatively short for a subproject of this nature, and is expected to be completed in 16 months.

47. During the construction phase most of the potential negative environmental impacts are associated with the activities of the construction contractor(s). By including environmental

management clauses in the individual contract documents, the potential for adverse impacts can be significantly reduced.

48. **Excavations.** Major excavation will be at the structures sites which may cause increase in silt run-off, induced erosion, loss of potential cropland, loss of vegetation, and landscape degradation.

49. Mitigation measures include: (i) confine operations to the dry season; (ii) use of silt traps; and (iii) spoils shall be disposed of in locations that will not promote instability and result in destruction of property, vegetation, irrigation and drinking water supply. Disposal near wetlands, protected areas, and other areas that will inconvenience or deprive local residents of their livelihood shall not be allowed. Acidic and saline spoils shall not be spread into agricultural land.

50. **Work Camp Location and Operation.** Potential environmental impacts include (i) temporary air and noise pollution from machine operation; (ii) water pollution from storage and use of fuel, oils, solvents, and lubricants; (iii) unhygienic conditions from laborers.

51. *Mitigation measures include: (i) The Contractor shall consult with WUA and or VDC before locating project offices, sheds, and construction plants; (ii) camps shall not be located near settlements or near drinking water supply intakes; (iii) no trees shall be cut and removal of vegetation shall be minimized; (iv) water and pit latrines facilities shall be provided for laborers; (v) used oil and lubricants shall be recovered and reused or removed from site by the Contractor; (vi) at conclusion of the Subproject, all wreckage, rubbish, or temporary works that are no longer required shall be removed or given to local residents; (vii) all temporary structures, including office buildings, shelters, and latrines shall be removed; (viii) sites shall be restored to near natural or stable conditions; (ix) exposed areas shall be planted with suitable vegetation; and (x) the Subproject proponent shall report in writing that the camp has been vacated and restored to pre-project conditions before acceptance of the works.*

52. **Stockpiling of Materials (Storage of topsoil, fill material, gravel, aggregates, and other construction materials).** Potential environmental impacts include (i) siltation and pollution of surface water resulting from uncontrolled runoff from storage piles; and (ii) disturbance to private property.

53. *Mitigation measures include: (i) stockpiling shall not be permitted during the rainy season unless covered by a suitable material; (ii) stripped material shall not be stored where natural drainage will be disrupted; (iii) protection of materials from erosion prior to rainy season; and (iv) storage on private property will be allowed only if written permission is obtained from the owner or authorized lessee.*

54. **Operation of construction equipment and transport:** Potential environmental impacts include emission of air pollutants, high concentration of airborne dust resulting in deposition and possible damage to vegetation, crops, and water resources; and excessive noise resulting annoyance and potential hazard to human populations even lead in disruption in livestock and wildlife breeding.

55. Mitigation measures include: (i) stockpiled sand and soil shall be slightly wetted before loading particularly in windy conditions; (ii) vehicles transporting sand and soil shall be covered with a tarpaulin; and (iii) limit and control working practices through contract provisions such as: (a) avoid noise-generating activities at night; (b) consult with local community to inform them of the nature, duration, and likely effects of the construction work; (c) schedule work during dry season

56. **Occupational health and safety:** In the construction sites, there will be movement of local peoples. Despite precautions, possibility of accidents could not be ruled out completely as many types of equipment will be under operation. Hence, construction activities may pose safety concern to local peoples as well as workers. Although the health and safety will be major concern during the construction stage, magnitude of the impacts has been evaluated as low since provision of health and safety measures are mandatory in any of the construction contracts and due to small scale of construction. The extent will be site specific and duration will be of short term.

57. Accidental insurance will be covered for all construction workers and staff. An amount of Rs. 24,000.00 has been allocated for the buying the accident insurance policy of the workers. This cost shall be covered from the environmental management cost. In order to minimize the unwanted accidents and possible effects of dust and gaseous emission to construction workers, the subproject will ensure adequate safety measures such as provision of helmets, masks, ear plugs, road signs, warning signals etc.

58. **Temporary closure of irrigation system.** The construction activity in the canal system is likely to disturb the supply of the irrigation water. Hence the provision of temporary closure of irrigation system will have to be made in consultation with WUA.

59. **Mitigation Measures:** *The construction activities will be planned in consultation with the WUA members. The headworks construction will be carried out during the dry season and the alternative measures will be made to keep the canal in running conditions if the construction activities will be carried out during the canal operation time. Flexible hosing and/or diversion canals will be used to supply water to affected users. Cost of alternative arrangement for supplying the water will be part of the civil construction cost.*

## **Environmental Problems Resulting from Subproject Operations**

60. **Hazards associated with the Use of Toxic Chemicals.** Pesticides are the toxic chemicals that would be used in the agricultural crops whenever crops are infested by the insects. From the focused group discussion with the farmers, majority of them are not aware of the toxicity of the pesticides. Use of pesticides in the subproject area is minimum. Farmers need some IPM (integrated pest management) training so as to train the farmers in pest management without the use of pesticides. With this background, it could be assumed that impact associated with the pesticides (toxic chemicals) will be of low magnitude, local in extent and long term in duration.

61. **Hazards associated with the Use of Mineral Fertilizer.** The farmers have been using chemical fertilizers in the crops. But the quantity of usage is less than the recommended dose for the crops. The subproject intends to carry out training in the crops cultivation to increase the crops yield. Hence the use of chemical fertilizers is going to be increased with the subproject implementation. But given the proper training programs, the application dose will be optimum for the crops and it would not create any hazard as such. Hence the impact is considered of low magnitude, local in extent and long term in duration.

### **Realization of Enhancement Potentials**

62. **Employment Opportunity to the Local People.** The construction of the subproject would require both skilled and unskilled labour. Semi skilled and unskilled labours are available in the subproject area as well as its vicinity. The subproject would provide employment opportunity to the local people. In addition, the farmers will have to make their contribution, which could be in kind and cash. The farmers preferred to make contribution by providing labour.

63. **Livelihood Programs for Landless Households.** There are ultra poor/landless households in the subproject area who work as tenants for other households who own the land. The proposed subproject intends to enhance the economic condition of these households by implementing different livelihood programs.

64. **Feasibility of Cooperatives.** The existing irrigation system is being operated and maintained by the water users association. They have defined rules and regulations, which are followed by all the members. The rules and regulations are socially binding. The proposed CMIASP intends to implement a number of institutional development activities in strengthening capacities of the WUAs in agricultural production, and poverty alleviation of the subproject area. The WUA will have the key role to play in these activities. For the subproject implementation, a coordination committee is planned to be formed. The WUA could also function as the cooperatives to support the farmers in terms of making timely availability of agricultural inputs, marketing of the agricultural production, facilitating the micro credits.

## **VI. ANALYSIS OF ALTERNATIVES**

65. Since the proposed subproject is an existing FMIS, there is no other option for the headworks site. There were options of the type of headworks and lining of the canal. A concrete side intake has been proposed in consultation with the WUA members and canal lining has been proposed at required places. The existing diversion structure for the intake is a boulder intake without the provision of intake gates and sluice gates. For the stabilization of the river course up and down stream of the intake some river bank protection works will be required. The protection works will involve the reshaping of the river banks, raising the level of the right side embankment. Gabion mattresses with a geotextile filter will be placed on the reshaped river banks and the raised flood embankments. Downstream protection works will be especially required for protection of the head reach of the main canal. Extension of canal has been proposed as requested by the farmers.

## VII. INSTITUTIONAL ARRANGEMENTS

66. **Institutional requirements.** Nepal has an established legal and policy framework for environmental safeguarding in relation to projects. Environmental protection is overseen by the Ministry of Environment, Science and Technology (MoEST). It holds overall responsibility for environmental policy. The principal legislation for environmental safeguarding is the 1997 Environmental Protection Act (EPA) and its rules 1997, amended in 1999 and amendment 2008. Implementation of the EPA is the responsibility of the MoEST and the sectoral ministries. For those projects having insignificant environmental impacts, the responsibility of undertaking and approving IEEs and implementing the subsequent environmental monitoring plan (EMP) are delegated to the concerned sectoral ministries. The DOI is under the MOWR. Both DOI and MOWR have environmental sections that liaise with each other. The Environmental Section within DOI was established in 1988 and is located within the Surface Water Irrigation Division (SWID).

67. The revised Schedule 1 of Section 2 of the EPR stipulates the environmental assessment requirements for irrigation schemes. It stipulates that an initial environmental examination (IEEs) is required for the rehabilitation of irrigation schemes which has new headworks or change in the main canal alignment. Since the proposed sub project is a simple rehabilitation of the existing FMIS, a formal IEE in accordance with EPR amendment 2008 will not be required.

68. **Institutional arrangements and responsibilities.** At the DOI headquarters level, a central project management office (CPMO) has been set up with class-I engineer as full time project director, and will be responsible for overall environmental management, under technical support and guidance from Environmental Section in SWID. At the regional level, regional project support unit (RPSU) has been established with director of the Regional Irrigation Directorate as project manager of each region and will be responsible for day-to-day implementation of the Project. RPSU will have an assigned staff to manage environmental activities with the assistance of the consultants. At the field level, subproject management unit (SMU) has been established in each division headed by the chief of the irrigation development division/ subdivision (IDD/IDSD), which will undertake field operations including environmental planning and monitoring under supervision by RPSU. Specific institutional responsibilities during the subproject implementation cycle are stipulated as below.

**Table 3: Institutional Responsibilities for Environmental Management**

Subproject Stage	Responsible Organization	Responsibilities
Overall	ISPM Consultants	Support capacity development of environmental planning, monitoring, and management
	EB in SWID	Guidance for environmental planning, monitoring, and mitigation
	MEQCB in PDMED	Management of monitoring and evaluation data
Screening	RPSU/SMU	Screen the project results in light of environmental and other criteria
Planning	RPSU/SMU/firms <sup>1</sup>	Prepare IEE (included in SIP), minimize avoidable losses, incorporate mitigation measures, and prepare EMP
	CPMO-EB in SWD	Endorse IEE and SIP
	Subproject Appraisal Subcommittee	Approve IEE and SIP
	Ministry of Water Resources	Approve IEE (which fall under schedule 1,

		section 2 of EPR 1997, amendment, 2008)
WUA formation	RPSU/SMU/NGOs/COs	Strengthen WUA including monitoring capacities
Detailed Design	RPSU/SMU/firms	Assist in preparing RP, incorporate EMP into engineering design and specifications
Construction	Contractor	Implement required environmental measures
	RPSU/SMU/firms	Supervise contractor implementation of environmental measures
Agriculture and social support	RPSU/SMU/firms/NGOs	Implement specific environmental mitigation measures incorporated in the agriculture and social development plan.
Operational	DOI	provide budget to undertake annual monitoring and audit
	RPSU/SMU/NGOs (during Project)	Carry-out annual performance audit of completed schemes. Support additional mitigation measures as necessary.
	RID/IDD/IDSD/DDC/DADO (after Project)	Same as above
	WUAs	Monitor agriculture practice and impacts and report them to SMU.

Notes: DB=Design Branch; EB=Environmental Branch; MEQCB=Monitoring, Evaluation, and Quality Control Branch; PDMED=Planning, Design, Monitoring and Evaluation Division; SWD=Surface Water Division

## **VIII. ENVIRONMENTAL MANAGEMENT PLAN**

69. The Environmental Management Plan (EMP) is prepared to guide implementation of mitigation measures and monitoring requirements. It includes institution and their roles, environmental management activities, environmental management organizational structure and budget for mitigation measures.

70. Essentially, it will be put into operation through data collection at subproject level by SMU with the engagement of private firms as necessary and/or WUA, monitored and supervised by RPSU through regular management review and field confirmation, and processing and analysis by Monitoring and Evaluation Branch of DOI in coordination with DOA. Environmental data will be shared with Environment Division. Monitoring costs have been incorporated into the design of the PPME system for the project. The findings of the monitoring activities will be incorporated in the regular PPME reports prepared by CPMO with the assistance of the consultants engaged under institutional strengthening and project management, and submitted to ADB.

71. Framework for implementing environmental management plan is shown by Table 4.



**Table 4: Environmental Management Plan**

<b>S</b>	<b>Impact</b>	<b>Mitigation Measures</b>	<b>Location</b>	<b>Method</b>	<b>Cost</b>	<b>Responsible agencies for Implementation</b>	<b>Monitoring parameters</b>	<b>Responsible Agency for Monitoring</b>
<b>1</b>	<b>Environmental Problem due subproject location</b>							
	Flooding and drainage hazards	escape structures and drainage outfalls	Design Office	Include in det. design	No cost	Design team	provision of escape structures and Drainage outfall in the design	ISPMC
<b>2</b>	<b>Environmental Problem related to subproject design</b>							
	Watershed erosion	Provide river training work, PCC core wall	Design Office	Include in det. design	No cost	Design team	provision of river training work, PCC core wall	ISPMC
	Canal management	Prepare sub project specific water management plan and O & M Plan.	Design Office	included in det. design	No cost	Design team	Prepare site specific water management plan	ISPMC
	Passageway	Provide passageway structures	Design Office	Include in det. design	No cost	Design team	provide passage as agreed with the farmers	ISPMC
	Hazards associated with the use of toxic chemicals	Avoid using pesticide to the extent possible. Use IPM technique to control pest	Design Office	Include in Agriculture Development Plan.	No cost	Design team	Include IPM training package in Agriculture Development Plan (ADP)	ISPMC
<b>3</b>	<b>Environmental Problem related to construction stage</b>							
	Excavation	(i)confine operations in the dry season; (ii) use of silt traps; (iii) spoils shall be disposed of at the designated locations	Within the sub-project	designate the spoil disposal area	Part of civil construction cost	Imp: Contractor Mon: SMU/WUA	spoil disposal sites	SMU/WUA
	Quarry sites							
	<b>Work Camp Location and Operation:</b> (i) temporary air and noise pollution from machine operation; (ii) water pollution from storage and use of fuel,	(i) work camp will be located away from the settlement area. (ii) no trees shall be cut and removal of vegetation shall be minimized (iii) used oil and lubricants shall be recovered and reused or removed	Within the sub-project		Part of civil construction cost	Contractor	Location of the work camp	SMU/WUA

**Table 4: Environmental Management Plan**

<b>S</b>	<b>Impact</b>	<b>Mitigation Measures</b>	<b>Location</b>	<b>Method</b>	<b>Cost</b>	<b>Responsible agencies for Implementation</b>	<b>Monitoring parameters</b>	<b>Responsible Agency for Monitoring</b>
	oils, solvents, and lubricants; (iii) unhygienic conditions from laborers.	from site.						
		(iv) will make own arrangements for water and sanitation	Work camp		Included in environmental cost (Budget: Rs 50,000.00)	Imp: Contractor	disposal and sanitary facilities in the work camp	SMU/WUA
		(v) Site will be placed back in the original site condition and shall report in writing that site has been restored to pre-project conditions before acceptance of the works.	Within the sub-project		Included in environmental cost (Budget : Rs, 50,000.00)	Imp: Contractor	Condition of the work camp site before the issue of completion certificate	SMU
	<b>Stockpiling of Materials :</b> (i) siltation and pollution of surface water resulting from uncontrolled runoff from storage piles; and (ii) disturbance to private property.	(i) stockpiling will not be permitted during the rainy season unless covered by a suitable material; (ii) stripped material will not be stored where natural drainage will be disrupted; (iii) protection of materials from erosion prior to rainy season; and (iv) storage on private property will be allowed only with the written permission from the owner.	Construction sites	ensure good construction practice	Part of civil construction cost	Imp: Contractor	Inspection of the construction material stocking site.	SMU/WUA
	<b>Operation of construction equipment and transport :</b> emission of air pollutants, high concentration of airborne dust resulting and excessive noise resulting annoyance and potential hazard to human populations	(i) Stockpiled sand and soil shall be slightly wetted before loading particularly in windy conditions; (ii) vehicles transporting sand and soil shall be covered with a tarpaulin; and (iii) limit and control working practices through contract provisions.	Construction site	ensure good construction practice	Part of civil construction cost	Imp: Contractor		SMU/WUA
	Occupational health and safety	(i) Buy accident insurance to all workers. (ii) provide safety gears	Construction site	Provide insurance &	Included in environmental	Imp: Contractor	insurance policy	Mon: SMU/WUA

**Table 4: Environmental Management Plan**

<b>S</b>	<b>Impact</b>	<b>Mitigation Measures</b>	<b>Location</b>	<b>Method</b>	<b>Cost</b>	<b>Responsible agencies for Implementation</b>	<b>Monitoring parameters</b>	<b>Responsible Agency for Monitoring</b>
		such helmets, boots, ear plug, mouth mask to the worker and labours		safety gears	cost (Budget Rs. 24,000.00)			
	Temporary closure of irrigation system	Plan the head work construction during dry season	Head works		No cost	Imp: Contractor	Construction plan	Mon: SMU/WUA
		Make alternative arrangement to keep the canal running	Canals		Part of civil construction cost	Imp: Contractor	Enquiry on canal closure	Mon: SMU/WUA
<b>Environmental Problems Resulting from Subproject Operations</b>								
	Hazards associated with the use of toxic chemicals	Avoid using pesticide to the extent possible. Use IPM technique to control pest	Command area	Pest control by IPM	No cost	Imp: Farmers	Use of pesticide in the crops	Mon: DADO
	Hazards associated with the use of mineral fertilizer	Use recommended dose of inorganic fertilizers	Command area	Application of fertilizers	No cost	Imp: Farmers	Use of chemical fertilizer in the crops	Mon: DADO
<b>Realization of Enhancement Potentials</b>								
	Employment to the local people	Provide employment to local people in priority	Within Sub project area	Hire local labour to the extent possible	No cost	Imp: Contractor	Payroll of contractor	Mon: WUA
	Livelihood programs for landless households	Provide Livelihood enhancement Program (LEP) training to the targeted people	Within sub project area	Training	Include in LEP cost	Imp: SMU	Training on LEP	Mon: WUA
	Feasibility of cooperatives	Provide institutional development training	Within sub project area	Training	Include in Institutional development plan cost.	Imp: SMU	Training on Institutional development training	Mon: WUA

## **IX. PUBLIC CONSULTATION AND DISCLOSURE**

72. This IEE report has been prepared in close consultation with WUA members and lead farmers who participated in the walk through survey. The impact and proposed mitigation measures were discussed and agreed with farmers during the SIP endorsement by WUA general body meeting.

73. The walk through survey was carried out from 2<sup>nd</sup> to 3<sup>rd</sup> January 2009 and the WUA endorsement meeting was conducted on 3<sup>rd</sup> January 2009. The list of WUA member is presented below:

1. Mr. Gyan Bahadur Basnet, Chairman
2. Mr. Durga Bahadur Raut, Vice-Chairman
3. Mr. Bishnu Bahadur Raut, Secretary
4. Mr. Prem Bahadur Bhandari, Treasurer
5. Mr. Hari Bahadur Khadka, Member
6. Ms. Tara Pandey, Member
7. Ms. Purna Kumari Nepali, Member
8. Mr. Bal Bahadur Basnet, Member

## **X. FINDINGS AND RECOMMENDATIONS**

74. The principal findings are that the Subproject provides for inherently environmentally friendly irrigation interventions and contributes to significantly improved living conditions through (i) community emphasis on subproject design and implementation, (ii) extensive technical support in eliciting sustainable practices in irrigated agriculture and (iii) addressing institutional needs for sustained and equitable O&M.

75. The identified adverse environmental impacts will be addressed through proper planning, design, implementation, and O&M while incorporating identified mitigation measures. The screening process carried out in the IEE has not identified any significant negative environmental impacts likely to be caused by the Project. Environmental issues were considered throughout development of the Project and necessary changes were made to the designs to reduce or avoid impacts. Potential negative impacts associated with construction activities can be mitigated by the application of standard health, safety, and environmental clauses in contract documents, close supervision, and close attention to transparency in tendering, and to quality control and supervision on site. Mitigation measures for other impacts are provided in detail in the IEE.

## **XI. CONCLUSION**

76. The project is not expected to give rise to any significant negative environmental impacts, and therefore does not require an ADB Environmental Impact Assessment.

77. The proposed subproject is rehabilitation of existing irrigation system, which is already in operation. Hence, the environmental impact during the operation phase will not be very much different than the existing situation. Rather the existing system lacks basic structures like intake, cross drains, the proposed intervention will be providing basic civil engineering structures for the operation of the canal. From the proposed intervention some adverse impacts of low magnitude have been identified during the construction stage but they are of short-term duration and could be easily mitigated. The proposed intervention will provide round year irrigation to the entire command area. Taking into consideration the adverse impact of low magnitude and extensive positive impacts, this subproject is recommended for implementation on the environmental perspectives. Mitigation of minor adverse environmental impacts can be carried out as an integral part of the Subproject, during both the detailed design and implementation stages. Appropriate measures will be included in the tender documents for the civil works.

### Annex 1: Details of Proposed Intervention in the Subproject

Item No.	Chainage and waypoints		Structure	Condition	Severity of the Problems on System Operation	Solution (Priority:H, M or L)
	From	To				
1	0+000		Intake with temporary Diversion at Ghatte Khola	No Structure	Excess water enter into the main canal	Single Orifice side intake with feeder canal and protection(H)
2	0+006	0+030	HDP Pipe (24m)	Seepage/ Landslide Zone	Seepage of water from the canal system and Landslide	Piped canal with protection work (H)
3	0+060	0+120	HDP Pipe (60m)	Steep slope; Seepage/ Landslide Zone	Seepage of water from the canal system and Landslide	Piped canal with protection work (H)
4	0+125		Outlet	No Structure,Uncontrolled flow	No controlled outlet causing bank erosions	Outlet(H)
5	0+200		Phedi Kholsi Superpassage (7m)	Drain Crossing	Canal Damage by drain water	Superpassage(H)
6	0+218		Outlet	No Structure,Uncontrolled flow	No controlled outlet causing bank erosions	Outlet(H)
7	0+250	0+270	Lining both side (20m)	Seepage Zone	Seepage of water from the canal system	Lined Canal (H)
8	0+300	0+320	Lining both side (20m)	Seepage Zone	Seepage of water from the canal system	Lined Canal with protection (H)
9	0+320		Aakhan Khola Superpassage cum Inlet (24m)	Drain Crossing, drain discharge appreciable	Canal Damage by drain water	Superpassage cum Inlet and spillway for intake of drain water during lean flow period and spilling of excess water during floods(H)
10	0+350	0+390	One Side Lining (40m)	Small and Irregular Shape canal along Fractured Hard Rock ,Box cutting not possible	Canal Discharge is low	One side Lined Canal with RRM retaining wall in certain portion (H)
11	0+400	0+430	One Side Lining (30m)	Small and Irregular Shape canal along Fractured Hard Rock ,Box cutting not possible	Canal Discharge is low	One side Lined Canal with RRM retaining wall in certain portion (H)
12	0+450		Outlet	No Structure,Uncontrolled flow	No controlled outlet causing bank erosions	Outlet(H)
13	0+460	0+510	One Side Lining (50m)	Small and Irregular Shape canal along Fractured Hard Rock ,Box cutting not possible	Canal Discharge is low	One side Lined Canal with RRM retaining wall in certain portion (H)
14	0+545		FB	Track Crossing	Damage by Crossing	Footbridge (M)
15	0+550		Outlet	No Structure,Uncontrolled flow	No controlled outlet causing bank erosions	Outlet(H)
16	0+700		Kaule Kholsi Superpassage (6m)	Drain Crossing	Canal Damage by drain water	Superpassage(H)

17	0+7 05	0+75 0	Lining both side (45m)	Seepage Zone	Seepage of water from the canal system	Lined Canal (H)
18	0+7 75	0+83 5	HDP Pipe (60m)	Houses above canal alignment	Risk to the houses	Piped canal (H)
19	1+017		Outlet	No Structure	No controlled outlet will cause bank erosions	Outlet(H)
20	1+127		Outlet	No Structure	No controlled outlet will cause bank erosions	Outlet(H)
21	1+260		<b>Dhapini Kholsi Superpassage cum Inlet (15m)</b>	Drain Crossing, drain discharge appreciable	Canal Damage by drain water	Superpassage cum Inlet and spillway for intake of drain water during lean flow period and spilling of excess water during floods(H)
22	1+280		Outlet	No Structure	No controlled outlet will cause bank erosions	Outlet(H)
23	1+515		FB	Track Crossing	Damage by Crossing	Footbridge (M)
24	1+5 25	1+55 0	Lining both side (25m)	Seepage Zone	Seepage of water from the canal system	Lined Canal (H)
25	1+550		<b>Bhauaure Kholsi Superpassage cum Inlet (8m)</b>	Drain Crossing, drain discharge appreciable	Canal Damage by drain water	Superpassage cum Inlet and spillway for intake of drain water during lean flow period and spilling of excess water during floods(H)
26	1+850		Outlet	No Structure	No controlled outlet will cause bank erosions	Outlet(H)
27	1+9 85	2+00 0	Lining both side (15m)	Seepage Zone	Seepage of water from the canal system	Lined Canal (H)
28	2+000		<b>Neware Kholsi Superpassage cum Inlet (6m)</b>	Drain Crossing, drain discharge appreciable	Canal Damage by drain water	Superpassage cum Inlet and spillway for intake of drain water during lean flow period and spilling of excess water during floods(H)
29	2+0 06	2+03 1	Lining both side (25m)	Seepage Zone	Seepage of water from the canal system	Lined Canal (H)
30	2+100		Outlet	No Structure	No controlled outlet will cause bank erosions	Outlet(H)
31	2+250		VRB	Road Crossing	Damage by Crossing	VRB (H)
32	2+300		<b>Danke Kholsi Superpassage (5m)</b>	Drain Crossing	Canal Damage by drain water	Superpassage(H)
33	2+340		Outlet	No Structure	No controlled outlet will cause bank erosions	Outlet(H)
34	2+350		FB	Track Crossing	Damage by Crossing	Footbridge (M)
35	2+445		FB	Track Crossing	Damage by Crossing	Footbridge (M)
36	2+4 50	2+48 5	Covered Canal (35m)	Seepage Zone; Loose Fractured rocks; possible slide above the canal	Seepage of water from the canal system; Shallow Landslide and debris deposition	Covered Canal (H)
37	2+500		Outlet	No Structure	No controlled outlet will cause bank erosions	Outlet(H)
38	2+6 70	2+69 5	Lining both side (25m)	Seepage Zone	Seepage of water from the canal system	Lined Canal (H)



39	2+670	<b>Khahare Kholsi Superpassage (2m)</b>		Drain Crossing	Canal Damage by drain water	Superpassage(H)
40	2+700	Outlet		No Structure	No controlled outlet will cause bank erosions	Outlet(H)
41	2+880	<b>Gairigaun Kholsi Superpassage (4m)</b>		Drain Crossing	Canal Damage by drain water	Superpassage(H)
42	2+900	2+930	Lining both side (30m)	Seepage Zone	Seepage of water from the canal system	Lined Canal (H)
43	2+930	2+970	HDP Pipe (40m)	Houses below canal alignment	Risk to the houses as slide is possible after canal operatin due to Seepage of water from the canal system	Piped canal (H)
44	2+970	3+000	Lining both side (30m)	Seepage Zone	Seepage of water from the canal system	Lined Canal (H)
45	3+045	<b>Gahate Kholsi Superpassage (5m)</b>		Drain Crossing	Canal Damage by drain water	Superpassage(H)
46	3+050	3+100	Covered Canal (50m)	Houses above canal alignment; Seepage area	Risk to the houses as slide is possible after canal operatin due to Seepage of water from the canal system	Covered Canal (M)
47	3+300	3+310	Covered Canal (10m)	Seepage Zone; Loose fractured rocks; Shallow minor slide	Seepage of water from the canal system; Shallow Landslide and debris deposition	Covered Canal (H)
48	3+400	Outlet		No Structure	No controlled outlet will cause bank erosions	Outlet(H)
49	3+500	Outlet		No Structure	No controlled outlet will cause bank erosions	Outlet(H)
50	3+510	<b>Birta Kholsi Superpassage cum Inlet (2m)</b>		Drain Crossing, drain discharge appreciable	Canal Damage by drain water	Superpassage cum Inlet and spillway for intake of drain water during lean flow period and spilling of excess water during floods(H)
51	3+610	Outlet		No Structure	No controlled outlet will cause bank erosions	Outlet(H)
52	3+650	<b>Lapse Kholsi Superpassage (6m)</b>		Drain Crossing	Canal Damage by drain water	Superpassage(H)
53	3+794	FB		Track Crossing	Damage by Crossing	Footbridge (M)
54	3+800	Outlet		No Structure	No controlled outlet will cause bank erosions	Outlet(H)
55	3+900	FB		Track Crossing	Damage by Crossing	Footbridge (M)
56	4+000	<b>End of main Canal at Bote Kaji Kholsi</b>				Tail Protection with Gabion Crates(H)