

# Initial Environmental Examination Document

Project Number: 33209-01  
June 2009

Nepal: Community -Managed Irrigated Agricultural  
Sector Project

Bachharaja Irrigation Subproject, Dhanusha District

Project Proponent: Department of Irrigation  
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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
ADP	- Agricultural Development Plan
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
LEP	Livelihood Enhancement Plan
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 will be 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 can be mitigated 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 Bachharaja 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 subproject is located in the Dhabauli VDC ward no. 4, 5, 6, 7 & 9 of Dhanusha district in Janakpur zone in the Central Development Region. It is located between the latitude and longitude of  $26^{\circ} 43' 02''\text{N}$  to  $26^{\circ} 41' 01''\text{N}$  and  $86^{\circ} 07' 18''\text{E}$  to  $86^{\circ} 06' 46''\text{E}$ . The elevation of the area is about 95.00 m above MSL. The location map of the subproject area is shown Figure 1.

5. **Accessibility.** The subproject area is easily accessible through a gravel motorable road, 20 km southeast from Janakpur Railway station. For about 1.0 km northeast length, the road is seasonal leading to the headworks site from Jadukoha village. Most of the main canal reach and the branch canals can be approached through the existing village road. The nearest market is at Dhabauli.

6. **Existing Situation.** The Bachharaja subproject is an existing FMIS. The farmers have constructed two earthen bunds in Bachharaja Khola within 300 m distance. The main canal from first diversion runs to 2+957 then the discharge in the canal is supplemented from second diversion. The canal after this point has been named as second main canal during the walk through survey. Both the canals are operated by the farmers since a long time. Earlier this irrigation system was getting water freely, which caused uncontrolled inflow of water in the canal system during high discharges in the river with the associated erosion damage to the canal system. The bund also often breached and was outflanked during floods in the river. The second diversion is used mainly during the dry season when the water in the first main canal is limited.

7. **Command Area.** The gross command area of the subproject is 406 ha and the net command area is 367 ha. A layout map of the subproject area is presented in Figure 2.

8. **Walkthrough Survey.** In order to assess the existing situation of the subproject and necessary proposed intervention for improving the water availability, a joint walk through survey along with farmers and the representative of NGO selected for supporting the institutional development of WUA was carried from February 5 to 7, 2009. The existing situation of the canal systems of the subproject and proposed interventions are presented in Annex 1. The main proposed intervention in the system are:

- Construction of permanent diversion structure at the same location as before and intake structure.
- Permanent canal flow control and outlet structures as well as road crossings.

9. **Project Components.** The major infrastructure improvements include the construction of a permanent headworks consisting of concrete weir, intake and river bank protection works, canal reshaping, branch and sub branch canal off-takes (11), VRB (2), Hume Pipe Culvert (3), footbridge (1), culverts (3), outlet (11) and cross drainage structures such as aqueducts etc. The salient features of the subproject are presented in Table 1

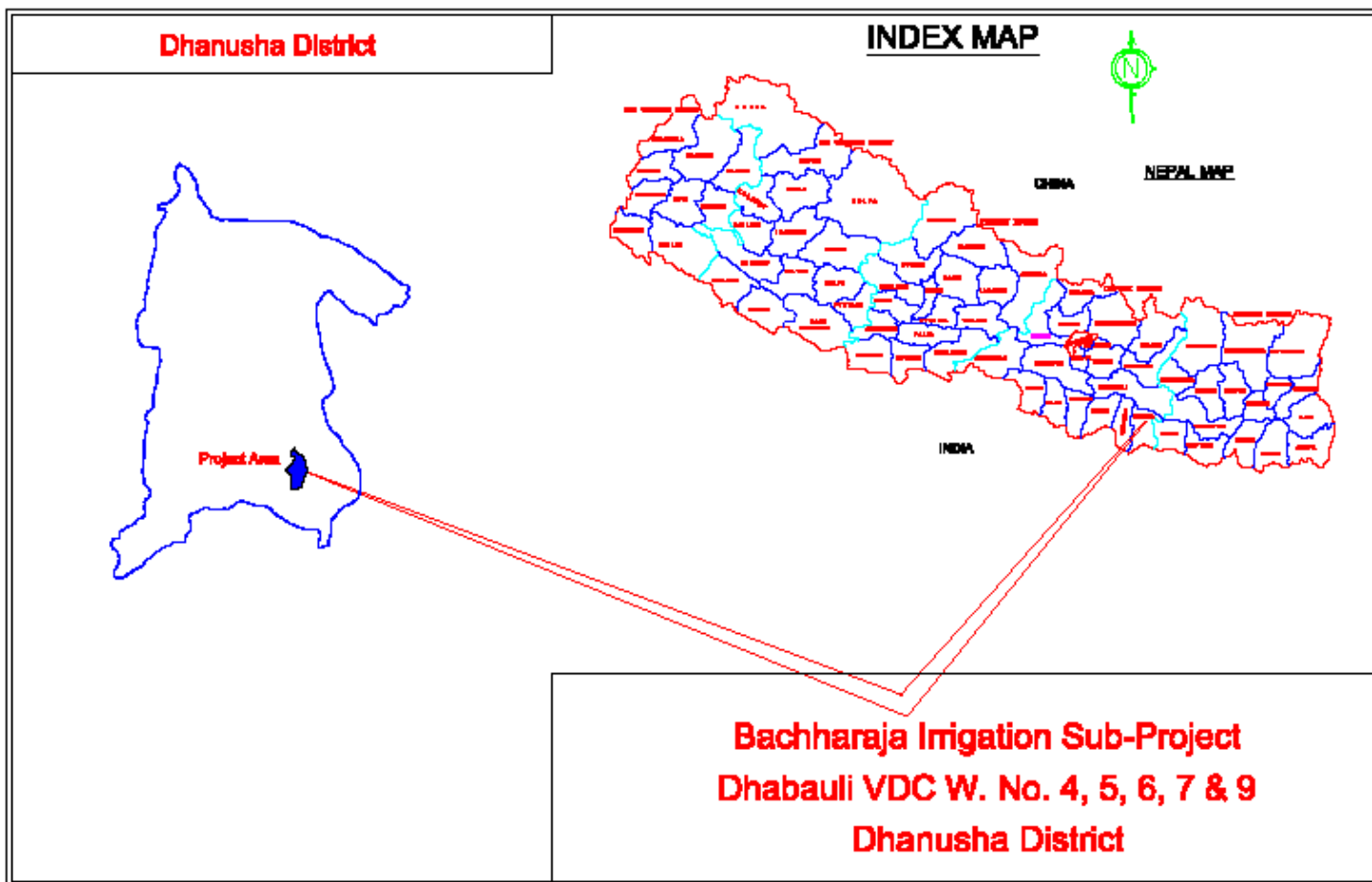


Figure 1 Location Map of the Subproject

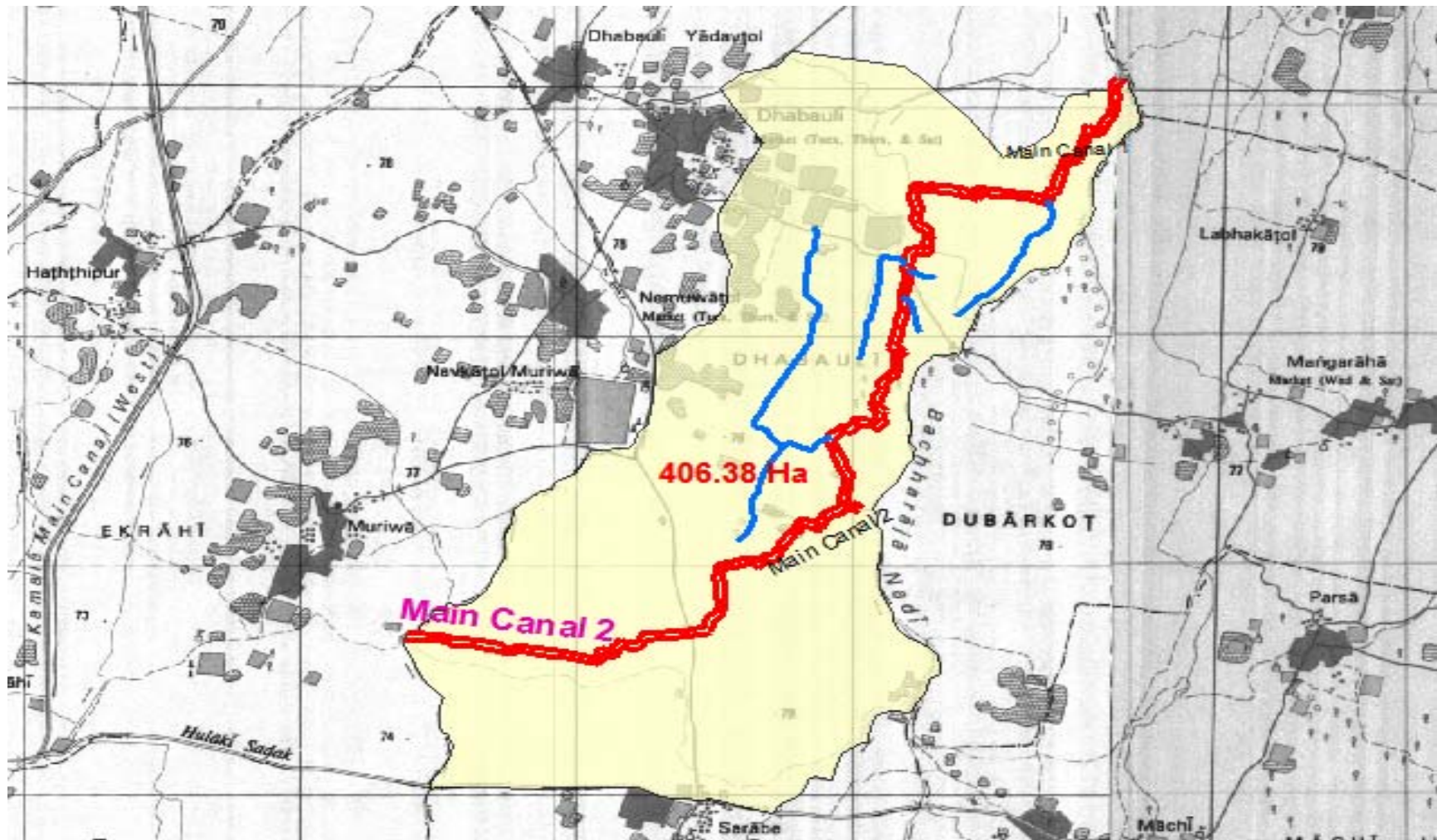


Figure 2: A Layout Map of the Sub project

**Table 1: Salient Features of the Baccharaja Irrigation Subproject**

1. Name of Subproject	Bachharaja Irrigation Subproject
2. Subproject Classification	Rehabilitation
3. Location (VDC and Ward No)	Dhabauli; 5, 6, 7 & 9
4. District	Dhanusha
5. District Headquarter	Janakpur
6. Zone	Janakpur
7. Development Region	Central
8. Number of Households	925
9. General Elevation of the Subproject Area	95 msl
10. Slope and Topography of the Subproject Area	flat or level (0 to 3% slope)
11. Population	4,625
12. Total Canal Length	
a) Main Canal	5.13 km
b) Branch Canal	5.23 km/11 nos.
13. Gross Command Area	406 ha
14. Net Command Area	367 ha
15. Cropping Intensity	117% (present) & 141% (future)
16. Name Of Water Source	Baccharaja River
17. Type Of Water Source	Perennial
18. Catchment Area	2.23 km <sup>2</sup> for 1 <sup>st</sup> H/W (in Hydrological Region-7) 7.70 km <sup>2</sup> for 1 <sup>st</sup> H/W (in Hydrological Region-7)
19. Canal Type	Earthen
20. Canal Discharge	454 liter per second
21. Side Slope	1:1
22. Bed Slope	Shown in the L-Section in detailed design
23. Diversion Structure	2 nos. of concrete weir
24. Proposed Subproject Interventions	
Headworks 2	no.
Outlet	11 nos.
Aqueduct 1	nos.
Village Road Bridge	2 nos.
Foot Bridge	1 no.
Hume Pipe Culvert	3 nos.
Prop. Divider	1 no.
25. Number of people directly involved during construction (estimate)	Skilled: 3,333 mandays Unskilled: 13,809 mandays
26. Construction/Rehabilitation Period (months)	12 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

10. **Topography.** The scheme is located in the Terai plains in an agricultural area with land that slopes gently from north to south at an elevation of just under 100 m above msl. Earlier this area was flood plain of Kamala River. The Bachharaja sub project lies on the right bank of the Bachharaja River. The existing main canal is aligned from north to south along the village road crossing the command area while the branch canals are aligned generally from north to south. The canals are earthen canals in cut with negligible seepage loss and do not need lining.

11. **Climate.** The project area has three distinct seasons, spring, monsoon, and winter. The climate of the subproject area is mainly sub-tropical and humid. There is no meteorological station in the project area itself, however, the nearest meteorological station at Janakpur Airport (Station No: - 01111) is used as reference, which is about 20 km from the subproject area. The recorded data of precipitation, maximum and minimum air temperature and relative humidity from Station No: 01111 whereas wind speed, evaporation and sunshine hour of Station No.: - 01114 at Hardinath is used for the analysis of crop water requirement. However, the river does not dry up completely since its long stretch is fed by perennial springs. Following are some important hydro-meteorological observations:

- Mean annual rainfall – varies from 115.5 mm minimum in November to 624.6 mm maximum in July;
- Mean monthly maximum temperature: varies from 21.4 °C in January to 34.1 °C in May
- Mean monthly minimum temperature: varies from 9.3 °C in January to 26.7 °C in August
- Minimum evaporation: 2.0 mm in January
- Maximum evaporation: 6.9 mm in April and May

12. **Soils.** The subproject area has medium textured soils. Soil texture slightly varies from clayey loam at head reach to sandy loam in the middle reach moving across the command area from north to the south. The fertility status of the soil is found to be poor in major nutrients of Nitrogen, and poor to medium while considering contents of Phosphorous and Potassium and poor in organic matter content (1.44 to 2.18%). The soil reaction is neutral with pH value ranging from 6.4 to 6.9. The soil characteristics (texture, drainage, pH etc) in average are judged good for the existing and proposed crops. To improve the soil fertility organic matter content and nitrogen need to be increased by using compost about 500 to 600 kg per ha and planting crops in rotation with legume crops for fixing the nitrogen in the soil from atmosphere respectively. In addition to this high yielding variety of crops and full doses of fertilizers need to be used as recommended by agri-extension staff in the field and as recommended

13. **Water Resources.** Bachharaja River, the source of irrigation water, is a spring fed perennial source and also gets water from Kajipaini Khola at upstream of this system. The catchments area at the proposed headwork is about 9.93 km<sup>2</sup>.

14. The watershed of the river is mostly covered with agricultural land. Soil texture slightly varies from light to heavy silt moving across the command area from north to the south. Due to highly rechargeable zone lying to the north of the headworks, there are a lot of spring sources, which are adding discharge source of Bachharaja River.

### **Ecological Resources**

15. **Vegetation and Forest.** There is no national forest or community forest within the subproject command area. There are a number of trees of different species of timber, fodder, fuelwood and fruit within the subproject command area and homestead but they are not going to be affected by the subproject activities.

16. **Wildlife.** As reported by the local people, jackals have been occasionally seen within the subproject command area.

17. **Aquatic life.** Fish species like Maugura, Garai, Common carp and Bamha have been reported in the Bachharaja River. These species are mostly local habitat and found all along the river stretch. The fish population behind the earthen dam is reported to be quite high. When the earthen dam is breached, the fish catch is reported to be quite high. It would be as high as 200 kg of different species.

### **Socio-economic Environment**

18. The Bachharaja ISP covers two settlements or villages, namely Dhabauli and Jadukoha. The total number of households with some land holdings in the project area is 925 with an average family size of 8.2 people. The population is estimated at 4625, inclusive of 210 landless households. Ethnically, the settlement has a mixed type of social structure. The settlement of Dhabauli from head to tail has Mandal (Dhanuk) as the ethnic majority followed by Teli, Muslim, Bramhin and other low casts. The sample survey reflected that a majority of households (52%) live in the middle part of the system while 26% hh are located in the upper and 22% hh reside at the tail end.

19. The main occupation of people in the area is farming. The sample household survey revealed that 65% of population depends on agriculture for their livelihood. Apart from agriculture, 3.28% households supplement their income from livestock and 0.33% from business activities. Most of the farmers rear goats, cow and buffaloes for getting meat and milk, which is often also sold in nearby markets to buy the articles of other primary needs. About 0.83% of households meet their needs by working as agriculture labour.

20. The labour force from marginal and middle level families is more involved in urban-based business and foreign employment while those from poor group stay at home are either engaged as agriculture labour or some other business while rich family are totally engaged in farming. 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. At present, 2.2% of sample hh are working as construction labour for their livelihood. Only 20.2% of the sample hh were found fully employed for more than 300 days a year. Landless work as the floating labour force in addition to share cropping in larger

landholders' fields. Labour from Ultra Poor Group supplement their family income also from casual work as mason, carpenter and tailor. However, none of such traditional caste based occupation was reported to provide full employment.

21. The education level of the community is poor. The literacy was found to correlate with the size of land holding of a family, illiteracy being low among large landholders than in small farmers and landless. Most of the people considered literate in the area have not completed even the lower secondary level. The number of female child attending local primary school was found 70%(26.6%) of the number of boys (38 %). School dropout is common, even from the primary school located within the village, to join the labour force for family support.

22. 52.4% of the households own Pucca house (cement mortared) while 46.6% households have access to electricity. 6.61% of hh have installed biogas plant. There is no community drinking water supply system. Tubewells with hand pumps are the only source of drinking water. 88.3% hh reported to have their own tubewells for drinking water. 37.8% population has only access to primary health facilities.

23. 38% of farmers do not produce enough to meet their own food requirements. Only 62% of sample hh reported that they produce enough to meet their family food requirements for the year. Though 62.0% of farmers reported enough food for family, only 33.0% reported for surplus. Of those who reported insufficiency of food, face food scarcity for almost a half of the year. 33.5% hh reported to work as local farm labour within the village to meet their food requirements while 0.2% work outside the village i.e. abroad. Landless people work on wages and some of them take land on rent for farming on contractual basis. The wages to labourers working in the field is provided on the basis of two shifts. Normally they are paid in kind. The average daily wage rate for male labour is 4-5 kg of rice (about US\$ 0.6 to 0.7 equivalent). The wage rate for women is about 20% lower than for men (+- 5 %). Malnutrition is common among children and elders.

#### IV. SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS

##### Environmental Screening

24. **Delineation of geographical boundary of zone of influence (Zoi).** : The project area will be delineated under three categories (i) high impact area: the permanent impact from the project such as permanent land loss and dewatered zone will be considered as high impact area. Such area will include the area where the project 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.

25. The project will be constructing a permanent weir across the Bachh araja, about 1 m above the existing bed level of the river, which will be inundating a certain area at the upstream. There is no major environmental impact observed since the project is already running for a long. The area of inundation and stability of the inundation area would be the major environmental impact under the physical parameters. However, the area inundated will not be significantly more than was inundated before. The screening of 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 Project 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		√	Being an existing system there won't be any additional impediments.
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 farmers have traditional water rights on the water to be diverted for the system. No objection from surrounding VDCs.
1.5	Flooding and Drainage Hazards		√	Drainage water from upper section used in middle and tail sections of the command area. No major erosion problem associated with this practice.
1.6	Displacement of People and Property		√	There will be no land acquisition for this Subproject.
2	<b>Environmental Problems related to Project Design</b>			
2.1	Watershed Erosion	√		The Subproject will construct permanent headworks that will prevent erosion.
2.2	Downstream Water Quality Problems		√	The Subproject is a rehabilitation 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
2.4	Over pumping of Groundwater		√	Groundwater will not be used in this Subproject.

SL	Parameters	Impact		Remarks
		Yes	No	
2.5	Adequacy of Drainage Planning		√	Erosion at the outfall points has been noticed and some protection proposed in consultation with farmers.
2.6	Disruption of Existing Farmer Cooperative Systems		√	There are no existing farmer's cooperatives within the command area.
2.7	Use of Chemicals in Agriculture and Horticulture	√		Use of chemical fertilizers and pesticides is likely to be increased 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		√	Improved efficiency of the canal system will increase the discharge in the canal. 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 main canal has to be worked out.
2.12	Passageways	√		The existing passageways are not sufficient for movement of people and livestock. The Subproject will increase the number of crossings and passageways.
2.13	Scouring Hazards		√	The system has been in operation for many years. Scouring problems have not been reported. Canal beds are stable.
<b>3</b>	<b>Environmental Problems Related to Construction Stage</b>			
3.1	• Excavation	√		Only excavation at structure sites. Being an existing canal no new excavation.
3.2	• Construction material sites (Quarry Sites)		√	The construction work will require 708 m <sup>3</sup> sand, 1,340 m <sup>3</sup> of aggregates and 611 m <sup>3</sup> block stone which can be fulfilled from the local market or local quarry. Operation of quarry site for the subproject 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 13,809 unskilled and 3,333 skilled. Assuming actual construction working season of 12 months, the average labour requirement per day would be 38 unskilled and 9 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 be reside within the work camp itself.
3.5	• Stockpiling of materials	√		The construction material will be stored at the convenient locations for the construction activities.
3.6	• Operation of construction equipment and transport	√		No heavy construction equipments are needed. Only small dewatering pumps, mixers, vibrators, etc will be used which do not contribute major air pollution and noise.

SL	Parameters	Impact		Remarks
		Yes	No	
				Tractors, trucks and bullock carts will be used for material transportation.
3.7	• Occupational health and safety	√		Occupational health and safety of the workers will be dealt with.
3.8	Temporary Closure of Irrigation System	√		Construction activities may disturb the supply of irrigation water for short period. Minimum disturbance will be sought with proper construction scheduling in consultation with WUA.
<b>4</b>	<b>Environmental Problems Resulting from Project Operations</b>			
4.1	Effect on downstream water use		√	The proposed intervention will not be abstracting more water than existing quantity. 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 will improve the irrigation system which will likely recharge the groundwater tables within the command area.
4.4	Mosquito Breeding	√		Water ponding within the command area may lead to increases in incidence of waterborne diseases and mosquito breeding.
4.5	Hazards associated with the use of toxic chemicals	√		Use of pesticides for the pest control could be hazardous to the people and live stock.
4.6	Hazards associated with the use of mineral fertilizer	√		Increased use of fertilizers likely due to improved irrigation system. These may find its ways to ground water and surface water which could be hazardous.
<b>5</b>	<b>Realization of Enhancement Potentials</b>			
5.1	Employment to the local people	√		Construction activities will require construction laborers. 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 (tube wells). Canal waters are not used for domestic purpose and will not be used as such during Subproject implementation.
5.3	Aquaculture in command area		√	Farmers are not practicing aquaculture within the command area. There is potential of fish farming at the headworks site.
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 Project will implement institutional development activities to strengthen capacity of water users associations which could function as a cooperative to support the farmers.

26. In many environmental assessments there are certain effects that 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 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.

27. 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 IMPACTS AND MITIGATION MEASURES

### Environmental Problems related to Subproject Design

28. **Watershed erosion.** The construction of the permanent headworks is going to prevent the erosion in the vicinity of the headworks and cultivated land. This is the positive impact of high magnitude, local extent, and long term duration.

29. **Adequacy of drainage planning.** In general the command area is sloping from north to south and water flow is smooth. But there are some problems at the outfall points where erosion has been noticed. Some protection in the form of outlet structures will be provided in consultation with the farmers. This is the positive impact of high magnitude, local extent and long term duration.

30. **Use of Chemicals in Agriculture and Horticulture.** The subproject area being located very close to the big market like Jaipur, a border town with India, the availability of chemical fertilizers is very convenient. As reported, even the vendors bring them to farmers' doorstep at the comparatively lower price smuggled from India. The use of chemical fertilizers is likely to be increased as the project encourages irrigated agricultural practices. Excess use of chemical fertilizers in the field may percolate into the groundwater or run down into surface water along with the runoff. But it (the excess use) 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.

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

32. **Selection of Pesticides.** Farmers of the subproject area are well aware of the toxicity of the pesticides. As reported, many of them have undertaken integrated pest management (IPM) training program conducted in the district. With this background, it could be assumed that impact associated with the pesticides will be low magnitude, local extent and long term duration.

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

34. **Canal Management.** The proposed project intends to operate one main canal and twelve branch canals together. The main canal will be carrying the water for all the branch canals. The operation and maintenance of the system will be the responsibility of the farmers themselves. Each of the canal system has their own canal management process, which has been practiced for many years. But operation and maintenance of the main canal 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. Any type of contribution for the operation and maintenance of the canal system are being carried out in proportion to the land holding, which holds good for the proposed system also. However this will be worked out by the coordination committee of all canal systems.



35. **Passageways.** There are some passageways in the existing canals which is not adequate for movement of the people. Hence additional passageways, 1 foot bridge, 2 village road bridges and 3 nos of hume pipe culverts have been proposed. This is a positive impact of high magnitude, local in extent and long term duration.

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

36. 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.

37. 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 project of this nature, and is expected to be completed in 18 months.

38. 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.

39. **Excavations.** Excavation will be at the headworks site and at the structures locations. But as the structures are small, quantity of excavation would not cause adverse effects that cause silt run-off, induced erosion, loss of potential cropland, loss of vegetation. After construction, most of the excavated material would be reutilized in backfilling work.

40. *Mitigation measures include: (i) confine excavation 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.*

41. **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.

42. *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 down 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.*

43. **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.

44. *Mitigation measures include: (i) stockpiling of construction material and others 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.*

45. **Operation of construction equipment and transport:** As no heavy construction equipments are needed, the subproject activities will not contribute major air pollution and excessive noise. However high concentration of airborne dust particles due to construction materials may result in deposition and possible damage to vegetation, crops and water resources.

46. *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*

47. **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.

48. Accidental insurance will be covered for all construction workers and staff. An amount of Rs. 47,000.00 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 project will ensure adequate safety measures such as provision of helmets, masks, ear plugs, road signs, warning signals etc.

49. **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 with due consultation with WUA.

50. **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**

51. **Changes in Groundwater Hydrology.** The application of the irrigation water in the field is likely to recharge the groundwater of the subproject area vicinity and the groundwater table will rise in general. But any substantial change in groundwater hydrology is unlikely due to the proposed project because the subproject area is already receiving the irrigation water. The proposed subproject is rehabilitation only. Hence the impact is considered of low magnitude, local in extent and long term in duration.

52. **Mosquito Breeding.** In an irrigation project, the water is flooded in the field especially during the monsoon season, which could be the breeding ground for the mosquito, a carrier of diseases. But the proposed subproject is the rehabilitation of the existing irrigation system, which is already in operation. The proposed subproject is not going to have any additional effect on the environment. Hence the impact is considered of low magnitude, local in extent and long term in duration.

53. **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, they seemed to be aware of the toxicity of the pesticides. Use of pesticides in the project 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.

54. **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 project 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 project 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

55. **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.

56. **Livelihood Programs for Landless Households.** There are 10 ultra poor/landless households in the project area who work as tenants for other households who own the land. The proposed project intends to enhance the economic condition of these households by implementing different livelihood programs.

57. **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 project area. The WUA will have the key role to play in these activities. For the project 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

58. Since the proposed subproject is an existing FMIS, there is no other option for the alternative location for intake location and canal alignment. There were options of the type of intake and lining of the canal. Depending on the topographic condition of the intake site a single orifice intake has been proposed. There was number of options for the canal lining namely: soil cement lining, plastic sheet lining, geotextile lining and cement concrete lining. The farmers preferred to have cement concrete lining with reinforcement of chicken wire mesh.

## VII. INSTITUTIONAL ARRANGEMENTS

59. **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 in 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).

60. 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.

61. **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 PD MED	Management of monitoring and evaluation data
Screening RPSU/SMU		Screen the project results in light of environmental and other criteria
Planning RPSU/SMU/firms		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

62. 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.

63. 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.

64. 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 project location</b>							
<b>2</b>	<b>Environmental Problem related to project design</b>							
	Watershed erosion	Provide permanent headworks	Design Office	Include i n det. design	No cost	Design team	provision of permanent headworks	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 P	rovide passageway structures	Design Office	Include i n det. design	No cost	Design team	provide passage as agreed with the farmers	ISPMC
H	azards associated with the use of toxic chemicals	Avoid using pesticide to the extent possible. Use I PM technique to control pest	Design Office	Include i n Agriculture Development Plan.	No cost	Design team	Include I PM 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, oils, solvents, and lubricants; (ii) unhygienic conditions from laborers.	(i) work camp will be located away from the settlement area. (i) no trees shall be cut and removal of vegetation shall be minimized (iii) used oil and lubricants shall be recovered and reused or removed from site.	Within the sub-project		Part of civil construction cost	Contractor	Location of the work camp	SMU/WUA
		(iv) will make own arrangements for water and sanitation	Work camp		Included in environmental cost (Budget: Rs	Imp: Contractor	disposal and sanitary facilities in the work	SMU/WUA



**Table 4: Environmental Management Plan**

S	Impact	Mitigation Measures	Location	Method	Cost	Responsible agencies for Implementation	Monitoring parameters	Responsible Agency for Monitoring
					50,000.00) cam		p	
		(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 air borne 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	SM	U/WUA
	Occupational health and safety	(i) Buy accident insurance to all workers. (ii) provide safety gears such helmets, boots, ear plug, mouth mask to the worker and labours	Construction site	Provide insurance & safety gears	Included in environmental cost (Budget Rs. 47,000.00)	Imp: Contractor	insurance policy	Mon: SMU/WUA
	Temporary closure of irrigation system	Plan the head work construction during dry season	Head works		No cost	Imp: Contractor	Construction plan	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>
		Make a lternative arr angement t o keep the canal running	Canals		Part o f c ivil construction cost	Imp: Contractor	Enquiry o n canal closure	Mon: SMU/WUA
<b>Environmental Problems Resulting from Project Operations</b>								
H	azards associated with the use of toxic chemicals	Avoid u sing pesticide t o the extent possible. Use l PM technique to control pest	Command area	Pest co ntrol by IPM	No cost	Imp: Farmers	Use of pe sticide in the crops	Mon: DADO
H	azards associated with the use of mineral fertilizer	Use re commended dos e of inorganic fertilizers	Command area	Application o f fertilizers	No cost	Imp: Farmers	Use of chemical fertilizer in the crops	Mon: DADO
<b>Realization of Enhancement Potentials</b>								
	Employment t o t he l ocal people	Provide employment to local people in priority	Within S ub project area	Hire local labour to t he ex tent possible	No cost	Imp: Contractor	Payroll of contractor	Mon: WUA
	Livelihood pr ograms for landless households	Provide Live lihood enhancement Program (LEP) trai ning t o t he targeted people	Within s ub project area	Training l	nclude in LEP cost	Imp: SMU	Training on LEP	Mon: WUA
F	easibility of cooperatives	Provide institutional development training	Within s ub project area	Training l	nclude in Institutional development plan cost.	Imp: SMU	Training o n Institutional development od WUA	Mon: WUA

## IX. PUBLIC CONSULTATION AND DISCLOSURE

65. This IEE report has been in close consultation with WUA members and lead farmers who participated in the walk through survey. The walk through survey was carried out from 5<sup>th</sup> to 7<sup>th</sup> February 2009. The existing situation of the headworks and canal was noted by GPs tracking. A long list of the required intervention was noted. The required intervention was prioritized in consultation with the participating farmer. On 7<sup>th</sup> February, 2009 itself a formal meeting was held with the WUA members and agreed with them on the proposed intervention that could be undertaken by the project. All the highly prioritized interventions were included whereas the medium and low priority interventions were excluded.

66. A list of the WUA members is presented here below:

<b><u>S.No.</u></b>	<b><u>Name</u></b>	<b><u>Position</u></b>
1	Bisheshwor Mandal	President
2	Kishori Mandal	Vice-President
3	Raj Kr. Mandal	Secretary
4	Dilip Kr. Yadav	Treasurer
5	Jagannath Mandal	Member
6	Raj Kr. Mandal	Member
7	Rohit Safi	Member
8	Kusheshwor Mandal	Member
9	Sahida Khatun	Member
10	Sulekha Das	Member
11	Asha Kumari Mandal	Member

67. The participants in the Walkthrough Survey from WUA members were Mr. Raj Kumar Mandal and Ms. Asha Kumari Mandal.

## **X. FINDINGS AND RECOMMENDATIONS**

68. 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.

69. 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

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

71. 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 headworks, 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. Proposed Interventions in the Subproject

### Main Canal 1

Item No	Chainage & WayPoints		Structure	Condition	Severity of the Problems on System Operation	Solution (Priority: H, M, or L)	Sketch
	Fro m	To					
1 0+0	00	Head	Works	Temporary and eroded after every flood	During rainy session it is difficult to build	Construct Permanent HW	
2 0+0	92	Pipe	Culvert	Road crosses the canal	Bank erosion by Road Crossing	Pipe Culvert (H)	
3 0+1	22	Escape		No Escape structure	Flood flow entering the canal and breached due to access Q	Escape (H)	
4 0+2	62	Pipe	Culvert	Road crosses the canal	Bank erosion by crossing Road	Pipe Culvert (H)	
5 0+3	05	HR	Branch R/s	No Diversion structure for command area at the right side	Fulfill demand of Command area	Branch R/S (M)	
6 0+4	42		Pipe Culvert, Outlet L/s	Road crosses the canal and No Structure, uncontrolled outlet	Road Crossing and No controlled outlet causing bank erosions	Pipe Culvert (H) & Outlet (H)	
7 0+6	87	HR	for Partial Distributor Structure, Branch r/s	No Diversion structure for command area at the right side	Fulfill demand of Command area	Partial Distributor & Branch R/S	
8 1+0	38		Inlet Drain, Outlet l/s	Improper inlet and No Structure, uncontrolled outlet	Add Discharge to the Canal and No controlled outlet causing bank erosions	Inlet to main canal (M) & Outlet (H)	
9 1+2	10	I	Inlet, KajiPaini drain	Improper inlet	Add Discharge to the Canal	Inlet to main canal (M)	
10 1+5	11	Cross	regulator with VRB (C hikhahi bandh)	No structures, Road crosses the canal	Difficult divert water, Bank erosion by Road Crossing	VRB (H) with Cross regulator (M)	

Item No	Chainage & WayPoints		Structure	Condition	Severity of the Problems on System Operation	Solution (Priority: H, M, or L)	Sketch
	Fro	m					
11	+645		VRB (existing), repair, Branch R/S	Road crosses the canal, VRB not in proper condition	Road Crossing	Repair VRB (H)	
12	1+68	O	Outlet L/s	No Structure, uncontrolled	No controlled outlet causing bank erosions	Outlet L/S & R/S (H)	
13	1+72	Bra	Branch L/S	Diversion for command area	Fulfill demand of Command area	Branch L/S	
14	1+78	O	Outlet L/s	No Structure, uncontrolled	No controlled outlet causing bank erosions	Outlet (H)	
15	2+043	Inl	Inlet Structure	Improper inlet	Add Discharge to the Canal	Inlet to main canal (M)	
16	2+423	O	Outlet L/s	No Structure, uncontrolled	No controlled outlet causing bank erosions	Outlet (H)	
17	2+627	Inl	Inlet Structure	Improper inlet	Add Discharge to the Canal	Inlet to main canal (M)	
18	2+957		Inlet and End of main canal 1,	Improper inlet	Add Discharge to the Canal	Inlet to main canal (M)	

## Main Canal 2

Item No	Chainage & WayPoints		Structure	Condition	Severity of the Problems on System Operation	Solution (Priority: H, M, or L)	Sketch
	Fro	m					
1 0+0	00	Head	works, Main canal 2	No permanent structure	Check dam damaged in every flood	HW (H)	
2 0+2	11		HR of Branch L/s	No Diversion structure for command area	Difficult to divert water and Fulfill demand of Command area	HR Branch Canal L/S (M)	
3 0+5	36	VRB		Road crosses the canal	Bank damage by Road Crossing	VRB (H)	
4 0+7	44	O	utlet R/s	No Structure, uncontrolled	No controlled outlet causing bank erosions	Outlet (H)	
5 1+0	37	VRB	(Sarabe)	Road crosses the canal	Bank erosion by Road Crossing	VRB (H)	
6 2+1	81		End of main canal 2	No tail structure	Large amount of water waste	EP main canal 2, Outlet	