VOLUME 2: ENVIRONMENT ASSESSMENT

DEPARTMENT OF IRRIGATION
RANI JAMARA KULARIYA IRRIGATION PROJECT
DECEMBER 27, 2017

PREFACE

This document is the second of eight volumes, which together describes the Environmental Assessment (EA), Biodiversity Impact Assessment (BIA), Integrated Pest Management (IPM) and Social Assessment studies including Vulnerable Community Development Plan (VCDP) and Resettlement Plan Framework (RPF) conducted in relation to the Modernization Rani Jamara Kulariya Irrigation Scheme (MoRJKIS) in Tikapur Kailali Districts Far West in the Province Seven of Nepal. These studies were conducted by project proponent (Department of Irrigation, Rani Jamara Kulariya Irrigation Project) between April to November 2017 and finalized on December 26, 2017. The Report has been prepared in compliance with the GoN Law and World Bank Safeguard Policies.

The report of these studies comprises eight volumes, which are arranged as follows:

Volume 1: Executive Summary (combining the finds of EA, BIA, IPM, SA, VCDP & RPF)

Volume 2: Environment Assessment (EA)-**this document**;

Volume 3: Biodiversity Impact Assessment (BIA);

Volume 4: Integrated Pest Management Plan (IPM);

Volume 5: Social Impact Assessment (SIA);

Volume 6: Vulnerable Community Development Plan (VCDP);

Volume 7: Resettlement Planning Framework (RPF);

Volume 8: Stakeholder Consultation Proceeding conducted at Tikapur on December 14, 2017.

The relevant inputs received from the stakeholders during consultation has already been incorporated in respective reports. It is enclosed for reference only.

LIST OF ACRONYMS AND ABBREVIATIONS

Agricultural Component Implementation Unit	ACIU
Bank Procedures	BP
Bikram Sambat	BS
Command Area	CA
Command Area Development	CAD
Command Area Protextion	CAP
Community Based Organization	CBO
Central Bureau of Statistics	CBS
Community Forest Users Group	CFUG
Convention on International Trade in Endangered Species	CITES
Department of Hydrology and Meteorology	DHM
Department of Agriculture	DOA
Department of Irrigation	DOI
Disaster risk reduction	DRR
District Water Resources Committee	DWRC
Environmental Assessment	EA
Environment, Health and Safety	EHS
Environmental Impact Assessment	EIA
Environmental Management Action Plan	EMAP
Environment Management and Monitoring Committee	LEMC
Environmental and Social Management Plan	ESMP
Environment Protection Act	EPA
Environment Protection Rules	EPR
Environmental Specialist	ES
Farmers Field School	FFS
Farmers Management Irrigation System	FMIS
Fiscal Year	FY
Geographic Information System	GIS
Government of Nepal	GoN
High value crops	HVCs
International Development Association	IDA
Initial Environmental Examination	IEE
Intergovernmental Panel on Climate Change	IPCC
Key Informant Information	KII

Karnali River Basin	KRB
Liquefied Petroleum Gas	LPG
Ministry of Education	MOI
Nepali Rupees	NPR
Non-timber Forest Product	NTFP
Occupational Health and Safety	OHS
Operational Policies	OP
Project Implementing Office	PIO
Project Operation Plan	POP
Rani, Jamara and Kulariya Irrigation Project	RJKIP
Rani Jamara Kulariya Irrigation Scheme	RJKIS
Rapid Rural Appraisal	RRA
South Asian Association for Regional Cooperation Secretariat	SAARC
United Nation Framework Convention on Climate Change	UNFCCC
United States Dollar	USD
Village Development Committee	VDC
World Bank	WB
Water User Association	WUA
Water User Groups	WUG

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1. Introduction

1.1 Project Description

The irrigation systems of Rani, Jamara and Kulariya located in Kailali District of Far Western Region of Nepal is more than a century old Farmer Managed Irrigation System (FMIS) of Nepal. The location map of the project is presented in Appendix A. Rani and Kulariya irrigation systems were developed by the farmers between 1896 and 1915. The Jamara system was developed from 1903 onwards. These three irrigation systems were independent, traditionally operated and managed by the indigenous Tharu community. Later on, towards the end of 1986, management of all these three systems was unified in Rani, Jamara, and Kulariya Irrigation System (RJKIS). These irrigation systems have combined command area of about 11,000 ha at present. The source of water for these irrigation systems is the Karnali River. The intakes were used to be seasonal inundation types located on the right bank of Karnali River with no other permanent control structures except canal network. The temporary diversion structures that were constructed were used to get washed away by the annual floods resulting in inundation of the adjoining command area. The river has changed its course from west to east during the last two decades causing problems for water diversion into the canal. Therefore, the farmers of the command area have demanded for the development of an irrigation system.

Department of Irrigation set up Rani, Jamara, Kulariya Irrigation Project (RJKIP) Office at Tikapur, in Kailali District in FY 2009/2010 to implement the Project activities. The project started procurement activities for the construction of Intake, main canal and feeder canal along with associated structures on the fund allocated to the project by the GON. In the meantime, GON requested the World Bank to provide financial support for the remaining works of modernization of RJKIS. The World Bank agreed to provide financial assistance for the Phase-2 for the modernization of RJKIS.

1.2 Proposed Modernization of Rani Jamara Kulariya Irrigation Scheme, Phase 2 Project

The major activities in the Phase-2 includes Command Area Development (CAD) work, Command Area Protection (CAP) work, Rural Agriculture Road Improvement work and Agriculture Extension works.

The modernization shall also focuses addressing the lower-order irrigation system (such as- sub-branches, tertiary canals and water courses) so that irrigation water can reach farmer fields with the optimal flows. It further provide continuation to the WUA/WUG support program along with the implementation of a comprehensive agricultural improvement program. Therefore, the activities to be carried out during the implementation of Phase 2 are:

1. Construction Phase

a) Review, Evaluation and Surveying of existing RJKIP system by the Technical Team;

b) Construction Contractor Mobilization and establishment of ancillary components (such as- labor camps, laboratory, quarters, plants and equipment etc.) at site;

c) Site Clearance to begin the construction works;

d) Canal earthwork (excavation, filling in embankment, hauling etc.);

e) Canal structure construction (along with earthwork);

f) Users' capacity building, agricultural and institutional development works.

2. Operation and Maintenance Phase

a) Emergency repair works;

b) Regular maintenance works;

c) Canal operation as per schedule;

d) On farm water management works;

e) Farmer's capacity building and institutional development works

1.3 Environmental Assessment of the Proposed Project

In view of its importance, the Government of Nepal decided to modernize the Rani Jamara Kulariya Irrigation Scheme, and approached the World Bank (WB) for funding. As per the Bank's requirements, Department of Irrigation initiated the safeguards assessments of MoRJKIS Phase 2.

The proposed project is the modernization of an existing facilities, therefore the potential environmental impacts of the proposed project are expected to be minimal and site specific, compared to the development of entirely new project involving major civil works. However, the RJKIP is taking this opportunity to integrate the environmental aspects of development works in such a way that the anticipated benefits shall be obtained and augmented without causing serious implication during the execution of the Project.

1.4 Proponent

The proponent of the proposed modernization project is Rani, Jamara, and Kulariya Irrigation Project (RJKIP). It is an undertaking of Department of Irrigation (DoI) under Ministry of Irrigation (MoI), Government of Nepal (GON).

1.5 Rationality of Conducting the EA

The Environmental Impact Assessment Guideline of 1993, the Environment Protection Act (EPA) of 1997 and the Environment Protection Rules (EPR) of 19971 are key to the environmental assessment system in Nepal. The EIA process in development proposals and enactment is legally binding to the prescribed projects that integrate IEE and EIA. The projects, requiring EIA or IEE, are included in Schedules 1 and 2 of the EPR, 1997.

In the case of the present study rehabilitation and "modernization" of existing irrigation systems, the EPA and EPR of the Government of Nepal do not have threshold for IEE or EIA in case of rehabilitation schemes. IEE needs to be carried out in case of changes occurred in the main canal alignment. However, the World Bank requires only Environmental Assessment (EA) of projects for its financing to ascertain and ensure that project is environmentally acceptable as per the Bank's OP4.01 and the present study is guided by the ToR for Environmental Assessment for fulfilling the WB safeguard requirements.

1.6 Methodology for the EA Study

Following steps were followed for this EA study.

- This EA is prepared in accordance with relevant laws and policies of the Government of Nepal (GoN) and the safeguard policies of the World Bank2.

[1] EPA and EPR have been enforced since 24 and 26 June 1997 respectively in Nepal.

[2]For example OP 4.01 Environmental Assessment, OP 4.04 Natural Habitat, OP 4.09 Pest Management, OP 4.36 Forestry, OP 4.11 Physical Cultural Resources etc. as well as World Bank Group's Environmental Health and Safety Guidelines.

- Review of pertinent literatures, collection of baseline data on environmental condition of the project influence/ impact area was carried out. Moreover, site investigations were carried out by the Environmental Expert to collect primary data to validate the available relevant secondary data to establish a comprehensive environmental baseline (including physical, biological, and socio-cultural environments) for the Project Area of Influence. For the data gaps identified, field level walk through survey were conducted in and around the command area to depict the micro-level features. Similarly, discussions were held with the local communities on the various environmental aspects such as drainage issues, geology, soil, land stability features, cropping patterns, canal operation and maintenance mechanism, trend of climatologically variables, impact of inundation etc.
- Environmental impacts, both direct and indirect, in terms of magnitude, extent and duration that are expected to occur during construction and operation in the project's area of influence were identified. In addition, alternative analyses from the environmental point of view including "No Project Alternative" (or with and without project comparison) were carried out and critical environmental problems that require further studies and/or monitoring are identified and recommended.
- Mitigation measures for the adverse impacts (measures to avoid, reduce, mitigate, manage and/or compensate the adverse impacts) and enhancement measures for the beneficial impacts (potential opportunities and design measures to maximize complementary economic, financial, environmental and social benefits of the Project) are established and recommended.
- Based on identified impacts and mitigation measures, an Environmental Management and Monitoring Plan, including site-specific Environmental Management Action Plan(s) (EMAPs) for contractor bid documents is prepared.
- Institutional arrangements and capacity for the implementation of Environmental Management and Monitoring Plan by RJKIP is assessed changes. Moreover, the arrangements as well as capacity strengthening measures are recommended.
- Information dissemination and consultation strategy for the implementation of the environmental mitigations and enhancement measures during project implementation is developed. During site investigation the project affected people, parties and other stakeholders are consulted to ensure that the relevant stakeholders and Project Affected People are informed about the Project and its possible environmental impacts. Their opinions and feedback have been internalized into the assessment and relevant planning and design studies.

1.7 Project Impact Area Delineation

The project spans into Tikapur Municipality, Janaki Rural Municipality and Lamki Chuha Municipality. The project site is connected to the East-West Highway at Lamki Bazaar. The Area of Influence (AoI) for a project is the combination of project footprint or some set distance from the project area. The impact areas have been delineated for the legacy of the original Rani, Jamara, Kulariya Irrigation Project (RJKIP) and emerging environmental issues of the proposed MoRJKIS Phase 2 as following:

1.7.1 Direct Impact Areas (DIA)

The direct impact areas are those geographical areas where the impacts of the project are due to the direct intervention on the land and other natural resources. Normally, DIA extends within 150 m radius of the direct intervention areas and the DIA for the MoRJKIS Phase 2 are bounded by Karnali River in the east, Kandra River in the west, East-West Highway in the north and Mohana River in the south.

1.7.2 Indirect Impact Areas (IIA)

The IIA of MoRJKIS Phase 2 relates to the induced effects of the direct intervention at specified locations due to activities of the project. The area that is beyond 150 m radius of direct intervention of the irrigation structures within the Tikapur Municipality, Janaki Rural Municipality and Lamki Chuha Municipality along with parts of East-West Highway is taken as Indirect Impact Area (IIA).

2. Environmental Baseline Assessment

This section describes the existing environmental status of the project area based on the literature review and site specific information gathered during the field level studies. The objective of the environmental baseline description in this section is to provide basis for the identification and prediction of the environmental impacts of the project. The present write up is built-on the review of the inception report, field information, Biodiversity Assessment Report, Integrated Pest Management Report and Social Assessment Report.

2.1 Physical Environment

The District of Kailali currently occupying around 3, 28,552 hectare area in total, out of which 2,05,939 hectare is forest whereas 24,418 hectare is river bed and barren land. The remaining 98,195 hectare is cultivated and agricultural land. The elevation in district ranges from 109 amsl of Terai flood plain to 1950 amsl of Churia range. The Kailali district spreads 74 Km and 51 Km East to West and North to South respectively. It lies N 28°22'-29°5" E 80°30'-81°18" of far west Nepal.

2.1.1 Physiography and Topography

The RJKIP lies in the Terai plain that starts from the intake at West bank of Karnali River near Chisapani. It is a historical irrigation system of Kailali district that dates back to more than century managed by the farmers (Tharu community) led Water User Association (WUA). The project area (Figure 2-1) is in flat-Terai landscape enclosed by the Karnali River in the East, Pathariya River in the West and Mohana River in the South. Tropical forest lies in northern part. Elevation of command area varies between 100 m and 200m with an average falling gradient of 1 in 700 towards south. The key features of the project area are unique because of its physical environment and the characteristics of watershed[3].

The project area receives average annual rainfall of 1,693 mm. Rainfall is concentrated mainly on four months from June to September. Rainfall is usually one month late as compared to the Eastern region. Enclosed between the rivers and forest the project area has good ground water potential with water table variation between 3 to 5 m.

Surface run off from northern forest area flows through the local drainage system to the South. These drains in the form of rivulet carry base flow as well as flash flood down to the Pathariya, Mohana and Karnali River. The secondary canals Rani, Jamara, Kulariya not only function as irrigation canals but also convey water drained into from some part of the command area. The tail end part of majority of canals including branch canals function as drainage canals. The Dhobeni and Dhoduwa drains are inlet in the Kulariya branch and their discharge is passed through this branch to the Pathariya River.

[3]There are altogether 15 sub-watersheds (Charali, Godkhola, Ghuraha, Kandra, Godawari, Kar, Karnali-Jamara, Khutiya, Khaerala, Kateni, Kortadi and Japri, Macheli, Tallo Landri- Kandra, and Thuligadh).

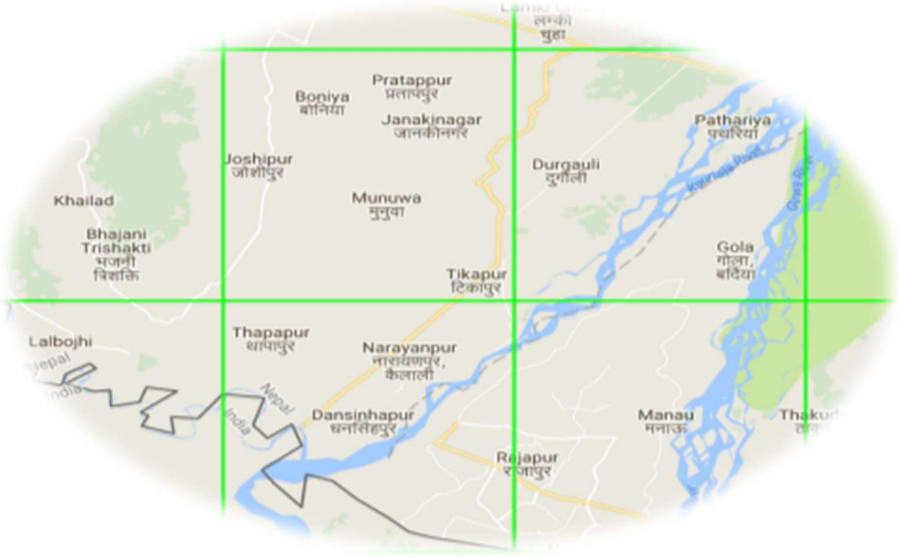

Figure 2-1 General overview of the project area

2.1.2 Climate, Hydrology and Meteorology

Temperature is directly related to season and altitude. It is lowest in the winter and highest in the summer. With the season, the project area witnesses winter from December to February, spring from March to May, summer from April to June and autumn from September to November.

The climate of Tikapur is warm and temperate. In winter, there is much less rainfall than in summer. The average temperature in Tikapur is 24.6 °C. The average annual rainfall is 1757 mm. The driest month is November. There is 4 mm of precipitation in November. Most precipitation falls in July, with an average of 516 mm. With an average of 31.0 °C, May is the warmest month. In January, the average temperature is 15.6 °C. It is the lowest average temperature of the whole year (Appendix B).

Figure 2-2 shows the river drainage and relative settlements density in the project district. In the Project area it can be depicted that the settlements are mostly concentrated near the river/canal networks.

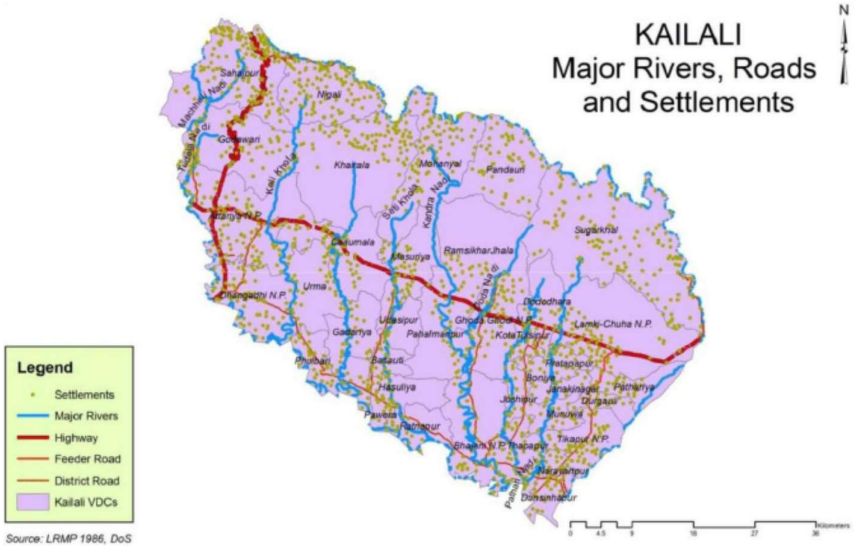

Figure 2-2. River drainage and settlement density in the project area

2.1.3 Climate Vulnerability

The Kailali is vulnerable to the flood related hazards due to less low land area and high variability in rainfall (Figure 2-3) including as well the impacts of climate change. The Table 2-1 presents the Climate Vulnerability Assessment (CVA) of the district. The CVA of the Kailali district as per the table below is low. Therefore, it can be broadly concluded that the vulnerability of the climatic variables in the Projects AoI will be more or less similar to the district level scenarios.

Table2-1: Climate Vulnerability Assessment of Kailali District (Source: District Climate and Energy Plan 2014)

S.N	Vulnerability Indices	Ranking	Range of indices for ranking
1	Rainfall and temperature	Very Low	0-0.218
2	Ecological	Low	0.079-0.192
3	Landslide	Very Low	0
4	Flood	Medium	0.337-0.533
5	Drought	Low	0.181-0.331
6	GLOF	Very Low	0
7	Combined	Low	0.181-0.355

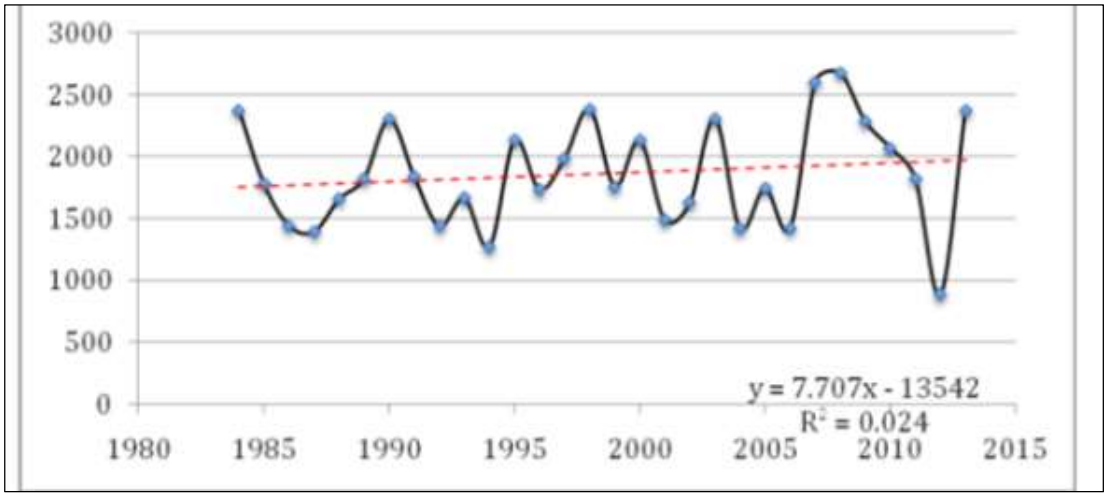

Figure 2-3: Total annual rainfall pattern of Kailali (1984-2014) (Source: District Climate and Energy Plan 2014)

2.1.4 Geology

Nepal Himalaya is about 800 km in length extending from Mechi in the East to Mahakali in the West with tectonic zones extending East to West parallel to each other. Nepal landscape is divided into five physiographic zones (Figure 2-4).

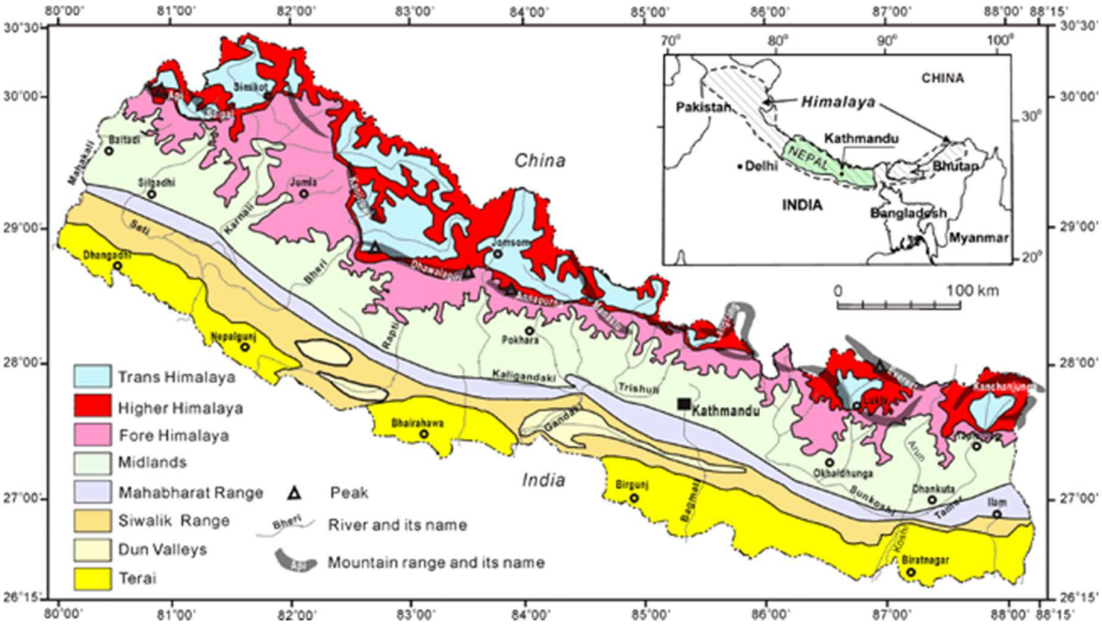

Figure 2-4. Physiographic divisions of Nepal landscape[4]

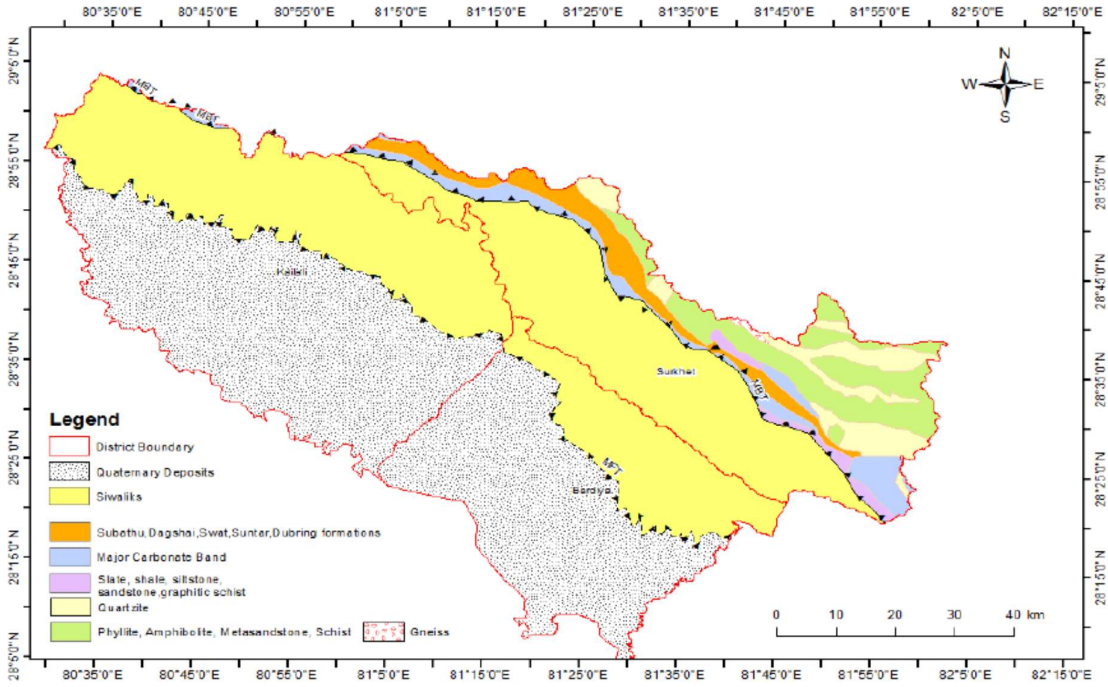

Figure 2-5. Geological characteristics of the site[5]

Figure 2-5 indicates the geological characteristics of the region including Kailali, Bardiya and Surkhet districts. The RJKIP is in the Nepali portion of the Gangetic plain extending from the Indian shield in the

[4] http://www.ranjan.net.np/index.php/resources/engineering-geology-of-nepal (Dahal R.K., 2010, Engineering Geology of Nepal, published in personal home page www.ranjan.net.np)

[5]http://www.sgp.org.np/doc/baseline_assessment_report_for_OP6.pdf

South to the Sub-Himalayan zone to the north. The plain is below 200m above mean sea level with thick alluvial sediments. The alluvial sediments mainly contain boulder, gravel, sand, silt and clay. The RJKIS system lies in the middle and southern Terai extending up to Chure Bhabar landscape in the north.

2.1.5 Present Land cover

The present land cover in the command area is cultivated area, Bush area, Forest area, Flood plain (sandy area), Grass land, Orchard, Water bodies, Swampy areas and Barren Land (Table 2-2). The cultivated land is above 90% in Rani and Kulariya Command Area, whereas in Jamara only 75.35% of the command area is cultivated. On the other hand, forest area is highest in the Jamara system (18.96%) as compared to around 3% in Rani System and 0.65% in the Kulariya irrigation system. The land cover map of the Rani Jamara and Kulariya command area are presented in Appendix C.

Table 2-2 Land cover in DIA (Project Command Area)

Land Cover	Rani	Jamara	Kulariya
Cultivated Area	90.44	75.35	95.88
Bush Area	3.43	2.89	0.00
Forest Area	2.86	18.96	0.65
Sandy area	1.49	0.64	1.29
Grass land	1.08	0.05	1.01
Orchard	0.45	0.26	0.34
Water bodies	0.18	1.23	0.83
Swampy area	0.06		
Barren land		0.61	

2.1.6 Air, Water, and Noise

The project AOI is devoid of industrial activities potential to generate air, noise and water pollution. However, the Bashulinga DSM Sugar Mill[6] established in 1996 in Chuha VDC of Kailali district used to discharges its effluents into the Pathariya River. The quality of such industrial effluents has not been monitored and locals have reported a decrease in fish population in the river segment immediately below the point source of discharge. The WUA and local authorities in future need to be vigilant once this mill come into operation, currently it is closed or any such new industrial development in that area.

It was also reported that the household and farm related anthropogenic activities such as firewood burning, crop harvesting etc are the key factors with some potential of pollution Use of agrochemical fertilizers and pesticides in the agricultural farmlands is limited and its potential of soil and water pollution is also negligible. Considering the above realities, the quality of water, air and noise is near to the natural state and suitable to human habitation and the wildlife of the area.

[6] WWF- STATUS, DISTRIBUTION AND CONSERVATION THREATS OF GANGES RIVER DOLPHIN IN KARNALI RIVER, NEPAL

2.1.7 Erosion and Sedimentation

Erosion of the river bank and flooding of associated agricultural land due to Karnali, Pathariya and Mohana is evident in the command area. At present the farmers of all three irrigation systems are diverting water from the Karnali River and/or its branches. Hence, there is sediment deposition in the irrigation canal. Moreover, widening of canals and raising their beds due to bank erosion and sedimentation is also seen during field visit. Also, several secondary canals have been constructed using large quantity of brushwood and boulders as regulators that has led to formation of gullies and erosion.

2.1.8 Fire Hazard

The project area lies in the high level of fire vulnerability according to the district level assessment (Figure 2-6). However, interaction with the stakeholders' reveals that no major fire hazards were noticed during the phase I implementation.

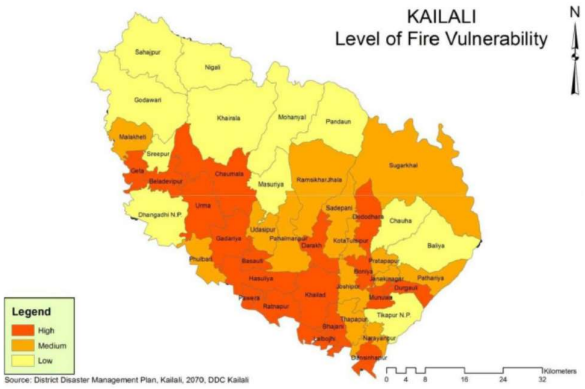

Figure 2-6 Fire Vulnerability level of the Project district

2.1.9 Extraction of river bed materials

The crusher industries along the East-West highway and other accessible areas in the Churia and plain Terai are extracted sand and boulder from the rivers and Churia hills that has raised long term environmental issues especially for Churia. The project's AOI is also south of Churia hills and the environmental concerns related to mining of sand and gravel poses high risk to the sustainability of the RJKIP.

2.2 Biological Environment

The assessment of forest and biodiversity in MoRJKIS Phase 2 has been carried out separately in the Biodiversity Assessment Study. The following chapters provide the brief summary of biological environment (vegetation, wildlife and aquatic life) in and around the project area.

2.2.1 Area of Conservation Significance

The project's DIA lie outside the geographical limits of the Bardia National Park (968 sq km). Thus, the proposed project lies outside the Buffer Zone of Bardia National Park (BNP) and does not affect the recognized National Park (NP) or Buffer Zone. In addition, there will be no construction activities in the forest area under MoRJKIS Phase 2 except continuation of remaining activities of Phase-1 such as afforestation and conservation activities.

2.2.2 Forest and Biodiversity

Besides the National Park Forest, there are a number of forests in the project region. A number of forests in the Western part of the Karnali River are managed by communities (Table 2-3), while other stretches

of the forests along the River corridor are under state management. The common tree species of these community forests are Sal, Asana, Sisau, Jamun, Khayar etc.

Table 2-3 Community forest in the Command Area

S.N	Community Forest (CF)	Area (Ha)	Tree species
1	Chetana C.F	38	Sal, Asana,Jamun,Haldu,Sisau
2	Chatiwan C.F	650	Khayar,Sisau
3	Kalika C.F	47	Sal, Asana,Sisau,Haldu,Kusum
4	Shivashakti CF	161	Sal,Asana,Sisau,Haldu,Khayar,Simal,Jamun
5	Jagatpur CF	192	Sal, Asana, Sisau, Haldu, Khayar, Siris
6	Kailaseshowr CF	460	Sal, Asana, Sisau, Kusum, Mauwa

The anthropogenic activities in the forest has led to the open and degraded status with presence of cattle and human movements in the forest. The forest status has also declined due to population pressure, unscientific utilization and logging. The presence of medicinal plants and Non Timber Forest Products (NTFP) is validated form the stakeholders and community members[7].

2.2.3 Wild Life and their Movement

The Kailali district has records of 34 species of wild animals. Some frequently recorded animals in and around the district are tiger, elephant, bear, leopard, spotted deer, barking deer, blue bull, wild pigs, marten, leopard cat, field rat, hare, mongoose, langur monkey and rhesus monkeys. Dolphins are also the main attraction of this district at least in high water season along the Karnali, Mohana, Kadha, Kandra and Paththariya tributaries. However, the project's AOI is not the habitat for these animals, but they are frequently sighted because the Bardiya National Park in the East and Dudhwa National Park of India in the south border the district. These two National Parks are the main habitats for these large mammals and other animals.

There are two known wildlife movement corridors in the region: the Khata corridor in the East and the Basanta corridor in the West of the Rani Jamara Kulariya Irrigation Scheme. However, no wildlife movement corridors has been identified in the DIA of MoRJKIS Phase 2 and these wildlife movement corridors are around 7 km away from the project sites. The Basanta Corridor, which is used by large mammals for occasional movement between Bardia NP and Dudhwa NP, is located about 10 km west of project command area and falls on one feeder canal constructed under phase I of RJKIP. The project has constructed canal crossings at adequate spacing along the feeder canal as shown in figure below:

[7]Medicinal species recorded are Pipari, Amala, Sikakai, Jamun, Gurjo, Aakasbeli, Pahelopate, Harro, Barro, Sindure, and occur naturally but are told disappearing because of the demand for it.

Figure 2-7 Canal Crossing in the Feeder Canal

Similarly, it was informed by the local residents that a herd of 10-12 Elephant used to roam around for 2-3 months in this area but now it has not been sighted for last two years. The migratory route for elephant seems along the Karnali River to the base of Churia hills. A feeder canal downstream of the hydropower location which is not part of MoRJKIS Phase 2 falls in this elephant route (Figure 2-8) and the project has proposed to construct an animal guide to facilitate the elephant movement. The assessment of impacts on wildlife movement is carried out in the Biodiversity Assessment Study and quintessential elements are included in the EMP.

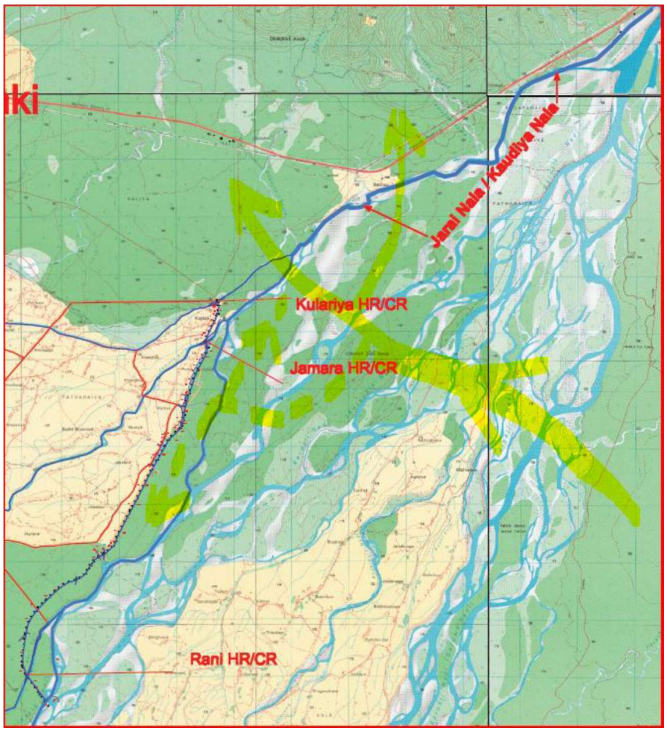

Figure 2-8 Occasional Wildlife movement corridor

2.2.4 Aquatic Life

The Karnali River is known for the freshwater dolphins and prefer the confluence of rivers such as Mohana, Kandha, Kandra, Patthariya during monsoon when water levels are high enough and fish diversity is plenty. The dolphin census of July 2016 reported more than 63 dolphins in the Mohana River. In 2017, 20 adult dolphins and 2 infants were reported. Dolphins favor the confluence of tributaries that are less noisier and undisturbed areas of river system. The fish species common in this area are Sedhari, DIRA, Charangi, Rawa, Darahi, Kurasa, Rohu, Saunri, Singhi, Dongi, Khesati, Tengra, Bam, Parani, Dhori, Harat and Mailawa. In addition, Smooth-coated otter *(Lutrogale perscipillata*) Marsh Mugger (*Crocodylus palustris*), Gharial (*Gavialis gangeticus*) and several species of turtles are also recorded as sighted in the lower Karnali River Basin Area. The MoRJKIS Phase 2 project will not directly affect the aquatic life of Karnali River. Nevertheless, the assessment of impacts on aquatic life and mitigation measures is carried out in the Biodiversity Assessment Study and quintessential elements are included in the EMP.

2.3 Socio economic and cultural Environment

The assessment of on social and cultural environment in MoRJKIS Phase 2 has been carried out separately in the Social Assessment. The following chapters provide the brief summary of social environment in and around the project area.

2.3.1 Demography and Population

According to the population census of Nepal, 2011 the total household and population of the project command area is 26,601 and 1, 35,062 respectively. The average household size varies between 4.53 and 5.95. The population of the project area composed of different castes and ethnicity. The Indigenous Tharu community has highest population of 48% followed by Chhetri (17%), Brahmin (10%), Dalit (15%) and others (7%) (National Census 2011). The details of the household and population of the DIA is presented in the SA report. The settlement distribution in the DIA is presented in Appendix D. It can be broadly assessed that the settlement in the DIA is mostly concentrated around the canal or drainage networks in the area.

2.3.2 Income and Livelihood

The main source of livelihood for majority of the inhabitant of the DIA is agriculture. However, in the absence of year round irrigation facilities, agriculture production from own farm land is not sufficient for living. Hence, almost all poor households rely on supplement income from off-farm sources including daily wages and seasonal migration. Seasonal migration to India and youths migration to gulf is common. Nearly 80 percent male seasonally migrate to India after paddy plantation and they come back for harvesting (SIA report).

2.3.3 Present water management practices

Implementation of Water Resources Act 2049 and Water Resources Regulation 2050 allowed the establishment of Water Users Association (WUA).The irrigation regulation has simplified the registration process of WUA by allowing them to be registered in the concerned irrigation office.

The enticed provisions of irrigation policy and regulation convinced the traditional irrigation institutions of Rani, Jamara and Kulariya *Kulos* to enter into formal WUA system. A Committee of Rani, Jamara and Kulariya was registered in the District Water Resources Committee, Kailali in 1999., In addition, WUAs for all three *Kulos* were also registered as per the provision of water resources and irrigation regulation.

The main committee of WUA represents all the three WUAs while coordinating and making decisions with the RJKIP PIO. The operation and maintenance responsibilities of the three *Kulos* are undertaken by the respective WUAs. Recognizing the importance of *Badghar's* role in the traditional system, the WUAs system also retained the *Badghars* in their committee and assigned similar responsibility in the water management and in the operation and maintenance of canal systems. As long as water is enough, water is delivered to the field of all farmers as per demand and requirement. Water distribution in other cases is done by the *Badghars* in close consultation with the respective WUAs. The present water management system still retains some traditional system mixed with a more structured WUA system.

2.3.4 Energy uses

The majority of population in the project district use firewood as fuel. Out of total household of 142,480 in the district, around 15 percent are using some kind of alternative energy (Table 2-4)[8]. Use of fuels in the project area is somehow identical with the district level scenario.

Table 2-4: Usage of fuel in household (National Census, 2011)

Types of fuel	HH number	HH %
Wood/firewood	122,344	85.91
LP Gas	9,687	6.80
Bio gas	8,309	5.83
Not stated	769	0.54
Kerosene	679	0.48
Cow-Dung	308	0.22
Other	272	0.19
Electricity	45	0.03
Total	142,413	100.00

2.3.5 Land holdings and tenancy system

The land holding (Table 2-5) pattern has evolved over years in Nepal through various level of land reform interventions. The land holding size is 0.42 hectare in the project site (Table 2-6). The parental property normally divided equally among the offspring. This system results into land fragmentation. The above factors contribute to the land plot size in the project area. Other key factors influencing the land plot size are outmigration, urbanization, commercialization and resettlement. The common land tenancy systems in the project area are: *Battaya, Thekka, and Bandhaki*[9].

[8]District Profile (http://ddckailali.gov.np/wp-content/uploads/2015/09/1.2-District-_-Profile-_-Kailali-_-English-_-Final-_-23-March.pdf)

[9]In the *Battaya* system, the land owner and tenants have 50-50 share in the inputs costs and agricultural products and the labor cost is fully born by the tenants. In the *Thekka* system, the landowner leases the land for certain amount of cash or in-kind. The tenant is free to choose crop to cultivate. In the *Bandhaki* system, the tenants lease on cash for a defined period. The tenant is free to use of land for cultivation or any other use. The majority of the land owners and tenants prefer *Battaya* system in the project area.

Table 2-5. Land holding size in Nepal

Size	Percent
No holding	3
Holding with land	97
< 0.1 ha	9
0.1 – 0.5 ha	43
0.5 – 2.0 ha	40
2.0 5.0 ha	5
5 ha and above	0.30

Table 2-6 Land holding size in RJKIP

Land Holding Size	Percentage of Holding
No holding	7
Holding with land	93
< 0.1 ha	34
0.1 – 0.5 ha	45
0.5 – 1.0 ha	9
> 1 ha	4

The agricultural systems of the project site is cereal crop based (Table 2-7). However other produces are grown for the local consumption such as vegetables[10], fruits[11] and rearing of livestock[12].

[10] Cauliflower, onion, tomato, potato, cabbage, peas, beans, bottle gourd, bitter gourd, eggplant, okra, snake gourd, cucumber, pumpkin, radishes. The common spices grown in the area include coriander, ginger, garlic, turmeric and chilly.

[11] Mango, guava, papaya, banana, litchi, pineapple, jackfruit, pomegranate, lemon etc. High value crops (HVCs): Tomato, banana, bitter gourd, cauliflower, chilli, cucumber, potato, onion, and garlic are considered as high value crops for the project area.

[12] Ruminants, poultry, pigs and fish.

Table 2-7. Cropping pattern

Paddy – Wheat – Maize
Paddy – mustard – maize
Paddy – mustard – lentil
Maize – mustard- fallow
Paddy – mustard – paddy
Paddy – mustard – sunflower
Paddy – vegetables-fallow
Paddy – wheat – paddy
Paddy – mustard – paddy
Paddy – wheat – fallow

2.3.6 Physical Cultural Resources

Besides the cultural resource such as historical, religious, vernacular architecture and areas of socially sensitive importance, the age old irrigation canals themselves represent the social and ecological integrity as a cultural resources endured by the communities. Understanding such relationship between communities and the land, helps in making effective adaptability solutions towards resilient communities. Local Residents of the project area celebrate more than two dozen of festivals[13] that are connected to their agricultural practices.

As highlighted in the Social Assessment report, *Kulo Chaudhary* come from an economically strong Tharu family and tenure is dependent on his own desire, whereas, the tenure of *Badghar* is subject to renewal or dismissal annually. Each year on Maghi (the first day of Magh), the water users elect their *Maujas Badghar*. The water management responsibility of *Maujas* is undertaken by *Badghar* and *Sahayak Chaudhary*. In addition, the function of *Badghar* is to take care of community of *Mauja* in respect of social, political and judicial matters. Thus, *Badghars* have a very important role in the overall management and preservation of indigenous traditional system. The indigenous governance system of *Kulo Chaudhary* is based on command and control system that lays the foundation of operation, maintenance and water management of RJKIS.

[13]Main festivals are Dashain, Tihar, Maghi, Gaura, Holi, Teej, Aitbari, Shreepanchami, Shree Krishna Janma Astami (God Krishna's Birthday), Shivaratri (God Shiva's Birthd ay), Devijat, Jesta Purnima (Full Moon of Raji Caste), Charai (Festival of Rana Tharu Caste), Dhuriya Pooja, Bhutuwa Pooja, Ran Putla (Brahmin Kshetri), Annantya, Bhuwa (Demonstrating Fighting Skills in War), Pouse 15, Olke, Ashare 15, Ganga Dashahara, Nag Panchami, Rakcha Bhandhan, Bishu, Tihar, Chaite Dashi Ram Nawami etc.

2.4 Institutional arrangements

The project office is located at Tikapur. The staffing for technical and non-technical personnel is approved by the Ministry of Irrigation through DOI. At the ministry level, Project Steering Committee is setup under the chairmanship of the secretary of MOI. A liaison office is setup at the Department for co-ordination and consultation.

The WUA has strong organizational setup at three levels. The lowest level of WUAs is at the sub-branch canal. The next WUA is at the branch canal level. WUA main committee is at the top level to coordinate with the project, other stakeholders and to participate in the decision making process of the project. WUA committee at each level has their own assembly where project related matters are discussed in depth and issues are resolved. Since the existing organizational structure of WUA and the project are functioning well, there is no necessity to change it. However, it is recommended that the farmers of Lamki Canal System to be organized into WUA and kept under the main WUA of RJKIP.

In the existing organizational structure of RJKIP, the Senior Sociologist is chairing the Environment and Social Unit. During the implementation of Phase I environmental activities, the project had recruited an environmental expert. However, the continuity of the consultant was not assured throughout the project period. Considering the scope of MoRJKIS Phase 2 development activities, the organization chart of RJKIP and WUA is provided in Environment Management Plan.

3. Legal and Regulatory Requirement

3.1 Legal and institutional framework

The present study is guided by the ToR for required assessment. The Environment Protection Act (EPA) of 1997 and the Environment Protection Rules (EPR) of 1997[14] are key to the environmental assessment system in Nepal. In the case of the present study, rehabilitation and "modernization" of existing irrigation systems, the EPA and EPR do not have threshold for IEE or EIA. The projects, requiring EIA or IEE, are included in Schedules 1 and 2 of the EPR, 1997.

The World Bank as per OP 4.01 requires environmental assessment (EA) of the projects prior to Bank financing to ensure that the proposed project is environmentally safe and sustainable, and thus to provide confidence in decision making. The key prerequisites of OP 4.01 are: environmental screening, EA of project, institutional capacity, public consultation, disclosure and implementation etc.

3.2 Environmental and legal and regulatory requirements

The present study followed Government of Nepal's cross-sectoral environmental guidelines applicable to the project including national requirements and broadly followed the World Bank's safeguard policy requirements. The Environment Protection Act 2053 (1997) is the overreaching Act[15]. The Local Government Operation Act 2074 that is recently promulgated is one of the key Act applicable to the project site. The Act includes several interconnected issues of biodiversity, environment, waste management and social empowerment[16]. The Treaties, Acts, Rules/Regulation, Policies, Strategies and Directives relevant with the proposed project are tabulated in Appendix E. In addition, Table 3-1 presents the World Bank Safeguard Policies that are triggered by the implementation of MoRJKIS Phase 2.

Table 3-1. World Bank Safeguard Policies that triggers in case of RJKP

Safeguard Policies	Yes	Potential	No
Environmental Assessment OP/BP 4.01	X		
Natural Habitats OP/BP 4.04	X		
Forests OP/BP 4.36	X		
Pest Management OP 4.09	X		
Physical Cultural Resources OP/BP 4.11	X		
Indigenous Peoples OP/BP 4.10	X		
Involuntary Resettlement OP/BP 4.12	X		
Safety of Dams OP/BP 4.37			X
Projects on International Waters OP/BP 7.50			X
Projects in Disputed Areas OP/BP 7.60			X

[14] EPA and EPR have been enforced since 24 and 26 June 1997 respectively in Nepal.

[15] The Act is to "maintain clean and healthy environment by minimizing, as far as possible, adverse impacts likely to be caused from environmental degradation on human beings, wildlife, plants, nature and physical objects; and to protect environment with proper use and management of natural resources, taking into consideration that sustainable development could be achieved from the inseparable inter-relationship between the economic development and environment protection."

[16] https://publichealthupdate.com/local-government-operation-act-2074/

4. Impact Assessment

4.1 Introduction

Chapter 2 sets the existing baseline condition of the DIA and IIA in the regional as well as national context. This chapter is on the environmental impacts in terms of magnitude, extent and duration likely to occur during construction and operation phases evaluated by overlaying the project foot prints and proposed phase II activities on the baseline environment. The issues are separated as beneficial and adverse environmental impacts, including direct, indirect, and induced impacts in the project influence area.

4.2 Beneficial Impact

A range of beneficial impacts on the physical, biological and socio-economical spheres of the project area envisaged during the field study and review of the project documents which are listed below (Table 4-1).

Table 4-1: Beneficial Impacts of the Project in the DIA

S. N.	Stage[17]	Beneficial Impacts
1	O	Optimization of GoN land and reduction in forest encroachment
2	O	Reduction in the dependency on rain fed agriculture
3	O	Strengthen Water User Association
4	C/O	Employment opportunities at local level
5	O	Productivity enhancement due to Improved Irrigation
6	O	Cropping patterns intensification in Project Areas
7	O	Flood Control by command area protection works
8	C	Revenue generation opportunities for the local government
9	C/O	Awareness on improved water management technology, silt and sediment management and erosion protection etc.
10	C/O	Awareness on Forest Management and Natural Resources Conservation
11	O	Enhanced vegetation cover due to afforestation
12	C/O	Local produce marketing/business opportunities
13	O	Irrigation Canal Acts as Natural Line of Fire

The canal helps delineate boundary between government, public and private lands and subsequently reduces likely encroachment in government and public lands. Canals also act as a natural barrier to protect communities from fire hazards from the adjoining forest areas. They will also benefit farmers with improved irrigation system and reliability. Although RJK irrigation system is an age old functioning system, the WUAs can assist communities to use latest platform to manage, operate, and maintain an irrigation system. The synergy between the age old and new system can be used toward long-term sustainable future and the hands-on trainings.

The need for skilled, semi-skilled and unskilled labor required in the project will create alternative employment opportunities to the communities. It can also curtail out migration and can have long reaching social benefits. The local entrepreneur can benefit from rentals and establishing small scale

[17] C: construction stage; O: Operation stage

income generating activities such as hotels, tea shops, restaurants. The local products such as vegetable, cereals, milk, ghee, meat will find new market opportunities during construction phase.

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4.3 Adverse impacts

The proposed irrigation project is in operation and maintenance by the contribution of the water user farmers for about a century and MoRJKIS phase II is intended for rehabilitation of existing canals and farm roads and construction of minor canal structures for water distribution. The following adverse environmental impact are identified from the implementation of this project:

4.3.1 Physical Environment

4.3.1.1 Construction Phase

1. **Impact due to Pollution related to water, air, land and noise[18]**

The project AOI is currently devoid of industrial activities potential to generate air, noise and water pollution. The potential source of water, air, land and noise pollution during construction phase are the activities of the construction workers, plying construction vehicles on the earthen or gravel roads, excavation works at canal and fill material sourcing sites, storage and handling of the construction materials and discharges of the camps and construction sites. However, the intervention during construction will be for a short period in a specific location and the impact shall be of short term and insignificant.

2. Impact due to Drainage disturbance and change in surface flow regime[19]

The RJK canal passes across natural drainage line and local streams in many places. The construction activities will obstruct these stream and rivulets. Since the area has high potential of inundation and flooding in the monsoon season, poor planning of construction activities could affect the surface flow regime of these rivulets and streams. The envisaged risk is likely but the impact is considered as insignificant, if properly planned.

3. Impact due to quarrying of construction materials

For the execution of the project activities, quarrying of the construction materials needs to be done. If not managed properly, the quarrying can trigger erosion and geological instability. This adverse impact is identified to be significant mostly during construction stage, will be local, medium and short- term.

4. Increased urbanization

As indicated in the social assessment report, the Project area has the trend of commercialization and resettlement. Under the Phase II activities, the project has envisaged the upgrading of the agricultural roads, construction of bridges and culverts. Such project activities are expected to improve the connectivity in the project area. Although, the connectivity would facilitate the farmers for agricultural activities, this could even lead to facilitate the increasing trend of urbanization leading to loss of agricultural land in the command area. The impact is envisaged to be moderately significant.

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[18] Significance of influence would prone to close by camp sites

[19] Sand and gravel use increases because of construction activities some mitigation strategies that can be applied area. implement controlled excavation along the canal such as excavation depths, slopes and aerial extension at to minimize soil loss or compaction, b. aerial extension of the excavation be limited to required width of the canal and service road only and c. sustainable use soil or aggregates from the sources such as mines and rivers, use flood plain in barren or degraded areas will avoid deep trenching.

4.3.1.2 Operation Phase

1. Drainage Disturbance and Change in Surface Flow Regime

The design has proposed super pass and under pass structures at sections where the canal cut across the natural drainages of the area. Since such structures have been designed to pass the natural flows of the streams and rivulets, adverse impacts on the drainage and flow regime is not anticipated.

2. Siltation and sedimentation of canal and agricultural fields

The sediment trap structure is already under construction from the Government funding to minimize the entry of silt from the source river in to the Rani Jamara and Kulariya system. However, the upstream areas of Kulariya system brings silt from the rapid flow of rivulets (e.g. Dhobiniya) altering the irrigation flow. The impact will be localized in the Kulariya subsystem (25-30 % of the DIA).

3. Inundation

Inundation[20] in the DIA might occur in the absence of adequate management of the sheet flow in the command area. Although inundation is temporary in nature because of the local environmental condition (e.g. soil porosity), its long term impact is influential to agriculture and human settlement. The project has already implemented provision of sheet flow management in the influence area of Phase I and their adequacy need to be monitored regularly.

4. Mismanagement of available Irrigation Water

Excessive irrigation of the agricultural fields increases the salinity with adverse implication on the agricultural production. Leaching of agrochemical as well as overloading of the dissolved solids of the irrigation water and associated increase in the ground water level vies-a-versa over irrigation exceeding evaporation losses beyond the capacity of salt extraction by the plants through evapo-transpiration leads to the salinization of the ground and decline agricultural productivity. The degree of influence of salinity increases over time in the DIA and high porosity increases the potential of leaching and also the loss of nutrients. The envisaged impact is moderately significant.

4.3.2 Biological Environment

The biological environmental issues of MoRJKIS Phase 2 have been investigated in depth in the Biodiversity Assessment Study to quantify the adverse impacts of the project on the existing baseline conditions. The following chapters provide the brief summary of the impacts on biological environment.

4.3.2.1 Construction Phase

1. Impact on Wildlife including Species of Conservation Significance

Direct loss of wildlife is not envisaged by the project during construction. Hence, there will be no direct loss of the species of the conservation significance also. However, increase in human and animal conflict might be an issue because of movements of large mammals from BNP to DNP and vice versa. The impact will be temporary and moderate.

2. Poaching and Logging in the Forests

There will be 50-100 construction workers in the construction camps and poaching and illegal logging will be a concern during construction. The risks of logging and poaching, and associated adverse impacts are identified as significant and moderate.

3. Impact on Aquatic Life

During construction, the project will not have directly impact on the dolphins, crocodile and other fish population and aquatic fauna. However, the induced impacts might include over fishing with illegal means

[20]One of the major inundation is the urban storm water management in City of Tikapur.

that will reduce dolphin prey; excessive noise and vibration from heavy construction machinery will have adverse impacts on dolphin movements; spillage of toxins, oils and lubricants into water bodies might kill infant and young dolphins and other aquatic faunas; and excessive use of sand mining might smother the breeding/spawning grounds for fish and crocodiles. The impact will be temporary and site specific and is considered moderate.

4. Impacts on Birds

The project will not have direct impacts on the bird life and their migration. However, during construction, disturbance to migratory patterns because of construction activities and illegal hunting and Poaching are the issues of concern. The impact will be temporary and of low significance.

4.3.2.2 Operation Stage

1. Entrapment effects on aquatic fauna[21]

The proposed project by its action does not initiate such entrapment effects. Envisaged impact of entrapment of aquatic life by the project is insignificant.

2. Impact on wildlife and their movement

The proposed project will not directly impact the core wildlife habitats and migratory routes but they might be influenced by the project structures to an extent because of the projects close proximity to BNP and DNP. The behavioral change in animals is also a possibility. The impact will be moderate but long term and permanent.

3. Impact on Feral Cattle

There is presence of isolated large heard of feral cattle as well as large number of abandoned cattle roaming in and around the project area The major impact on feral cattle is the risk of falling the cattle into the canal system. The impact will be significant and permanent.

4.3.3 Socio-economic and cultural environment

The social-economic and cultural environmental issues of MoRJKIS Phase 2 have been investigated in depth in the Social Assessment Study to quantify the adverse impacts of the project on the existing baseline conditions. The following chapters provide the brief summary of the impacts on social environment.

4.3.3.1 Construction Phase

1. Obstruction of access to land and property and community resources

In many part of the DIA the settlements and public properties such as school, temples etc (Appendix F) are close to the canal networks. During the initial construction period, the canal will restrict the local access. The envisaged impacts are considered as of high significance but short term.

2. Pressure to community infrastructures and services such as water supply, sanitation management, schools, markets, fuel supply

Moving of large number of outside construction workforce into the area with their families during the periods of construction has potential to cause pressure on the community infrastructures such as water supply, sanitation management, schools, markets and fuel supply. The envisaged impact is of moderate significance and temporary.

[21]See Biodiversity Assessment report including the Area of Influence.

3. Occupational health and safety risk

The construction works for the irrigation canal rehabilitation includes earth excavation by heavy equipment's and its transportation. All of these activities confine in the active construction sites where the construction workers are exposed to multiple kinds of pollution streams and hazards of various degrees. The envisaged impacts are rated as of high significance and short term on the workers occupational health and safety.

4. Community health and safety risk

The accidental risks from the construction vehicles plying on the public road, construction wastes and solid waste from construction camp will increase the community health and safety risks.. Given the hot and humid climatic condition of the area, possible degradation of the sanitary conditions is likely to provide suitable environment for diverse types of disease vectors. Potential of epidemic outbreaks in the construction camps and in the adjoining community could not be ruled out. In addition, transmission of STD is a possibility considering the awareness level of DIA communities. The envisaged impacts are considered short term and high.

5. Gender and child discrimination/exploitation risk

. There will be possibility to employ child labors due to the unavailability of local work force. It is observed that the youths from that area migrates to gulf countries and India. In addition, discrimination in wages to women is also revealed during informal discussion with the locals of the project area.. The impact is considered moderate and temporary.

6. Intrusion in local culture and traditions

The envisaged impacts related with the influence of the outside workforce in rural setting of the project sites. The outside workforce might have different culture and traditions and are likely to influence the local culture and traditions adversely. Project DIA being Tharu dominated area with distinct culture and traditions may be negatively affected. Envisaged impacts are rated as moderately significant and temporary.

4.3.3.2 Operation Phase

1. Community health and safety risk

The irrigation canal is expected to provide round the year water availability to the area. Water and particularly polluted water is a breeding ground for many of the disease vector mosquitoes. Poor drainage and water pollution close to the dwellings of the communities will increase the chance of diseases such as malaria, dengue, and encephalitis including other water borne diseases such as jaundice, typhoid, dysentery and diarrhea etc. These diseases appear recurrently in the project AoI and the likelihood of increased of such diseases is a possibility. The conceived impacts are rated as moderately significant and long term.

4.4 Adverse environmental impact categorization

Table 4-1 Potential impact of the project during construction stage

Sector/Activity	Potential Impact	Location	Significance	Duration
Physical Environment	Impact due to Pollution related to water, air, land and noise	CS	LS	T
	Impact due to Drainage disturbance and change in surface flow regime	CS	NS	T
	Impact due to Quarrying of construction materials	CS	S	T
	Increased urbanization	CA	MS	P
Biological Environment	Loss of standing crop	CS	MS	T
	Impact on Wildlife including Species of Conservation Significance	IIA	S	T
	Poaching & Logging in the Forests	CF	S	T
	Impact on Aquatic Life	KB	MS	T
	Impact on Birds	DIA	NS	P
Socio economic and cultural environment	Obstruction of access to land and property and community resources	CS	HS	T
	Pressure to community infrastructures and services such as water supply, sanitation management, schools, markets, fuel supply	DIA	MS	T
	Occupational health and safety risk	CS	HS	T
	Community health and safety risk	DIA	HS	T
	Gender and child discrimination/exploitation risk	CS	MS	T
	Erosion of local culture and traditions	DIA	MS	T

Location: CS: Construction Site, TM: Tikapur Municipality, CF: Community Forest,
Direct Impact Area (DIA),- KB: Karnali Basin, IIA: Indirect Impact Area
Significance: LS Low significance; MS: Moderately significant; S Significant
Duration: T: Temporary; P: Permanente

Table 4-3: Potential impact of the project during Operation stage

Sector/Activity	Potential Impact	Location	Significance	Duration
Physical Environment	Siltation and sedimentation of canal and agricultural fields	KCA	HS	T
	Inundation	DIA	S	T
	Increase in Soil Salinity of Agricultural Fields	CA	MS	P
Biological Environment	Entrapment effects on aquatic fauna	CA	NS	T
	Impact on Wildlife and their movement	IIA	MS	P
	Impact on Feral Cattle	DIA	MS	P
Socio economic and cultural environment	Community health and safety risk	DIA	MS	P

5. Alternative Analysis

In conformity with the approved ToR, project alternatives are briefly presented hereunder.

5.1 Design

The prevailing canal sections of the proposed rehabilitation canal were in irregular shape and there was a need of reshaping the existing canals. DoI guidelines were used for the lined and unlined sections design based on the location, soil type and prevailing canal conditions. Standard engineering design good practices were used for the design of Cross Regulator, Head Regulator, Village Road Bridge, Drainage Underpass, Piped Outlets etc.

5.2 Project Alignment Alternatives

The concept was to follow the alignment of one of the existing canal system to avoid loss of agricultural and forest land, to provide irrigation facilities for the command area. The selected option is the best possible option meeting the above requirements.

5.3 Whether or not the risk resulting from the implementation of the proposal can be accepted

Nature of the construction works, construction scheduling, and the use of construction materials, do not pose risks to the local area both environmentally and socially. The envisaged risks are acceptable, but need timely management according to the best practice procedures.

5.4 No Project Option

Without the proposed RJKIP Project scenario, one would expect the followings:

- Irrigated agriculture is one of the most critical human activities sustaining civilization. The current world population of 6.8 billion people is sustained in a large part by irrigated agriculture. According to the FAO the approximate 1,260 million ha under rain fed agriculture, corresponding to 80% of the world's total cultivated land, supply 60% of the world's food; while the 277 million ha under irrigation, the remaining 20% of land under cultivation, contribute the other 40% of the food supplies. On average, irrigated crop yields are 2.3 times higher than those from rain fed ground. These numbers demonstrate that irrigated agriculture will continue to play an important role as a significant contributor to the worlds food supply and Nepal is not exception to it[22].

- More and more youths will leave their hometowns in search of jobs in the third countries for livelihood earnings due to lack of in country opportunities in the field of agriculture and related sectors;

- Irrigated land has improved drainage and serves two purposes such as it reduce water logging and, equally important, to control and reduce salinization that inevitably accompanies water logging in the semi-arid and arid regions. Proper drainage also allows crop diversification and intensification, the growth of high-yielding varieties, effective use of inputs such as fertilizers, and mechanization.

- Improved irrigation facility has positive implication on GDP currently about 33.1 % of its GDP and more than 50 % of its export depend on agriculture[23]

[22] FAO Annual Report 2015

[23] www.mof.gov.np/uploads/document/.../Agriculture_NPPR-2015_20150913011507.p..

- The recent trend of shifting from traditional agriculture to modern commercialized agriculture practice will decline with negative repercussion.

Therefore, in conclusion, no project scenario is more alarming both at national and local level, while with the project, many of the local level environmental and social concerns could be addressed effectively with contribution to the regional, national and global level, though in a small way. Therefore the "no project" option was rejected in favor of the project.

6. Environmental Impact Mitigation

For each of the identified and evaluated risks/impacts, mitigation measures are designed in compliance to the mitigation hierarchy principles to avoid, minimize, offset or compensate the evaluated risks/impacts within the constraint of the project design and operational requirements.

Since, avoidance measures have already been internalized in the project design and operation the mitigation measures prescribed in this chapter mostly incorporates minimization, offset, or compensatory measures. Where the prescribed measures were envisaged to be of uncertain nature, adaptive management strategy has been adopted to ensure that the envisaged impacts/risks are duly addressed in the project lifecycle.

6.1 Adverse Impacts

6.1.1 Physical Environment

6.1.1.1 Impact due to Pollution related to water, air, land and noise

To minimize the risks of water, air, land and noise pollution following measures will be implemented.

Air pollution control and management: The construction vehicles speed, particularly, in the dusty roads will be limited to less than 10km to minimize the risks of fugitive emissions. The active construction sites and the aggregate and soil mining sites will be sprinkled with water every three hours to arrest the fugitive emissions. Excavated soil and aggregates will be protected against wind borne fugitive emissions. Project will ban all sorts of open burning to prevent air pollution. The trucks carrying soil and aggregates will be covered by adequate cover. Open burning of solid waste by the workers will be strictly prohibited.

Water pollution control and management: The construction wastes and spoils will not be disposed or placed on the water bodies or at the path of potential runoff channels. The construction camps including workshops and workers camp will have drainage facilities to divert the runoff water from the effluent (liquid wastes) generated in the camps and workshops. The used or spent oils and lubricants will be collected in drums and stored in separate bonded areas. Haphazard disposal of the used lubricants will be prohibited.

Land pollution control and management: Haphazard disposal of Solid wastes from construction sites (unused, concrete slurry, mucks, plastic and metal containers, jute bags, plastic bags and wrappers, metal weirs, metal pieces, worn out tiers etc.), and construction camps (food wastes, plastics, papers, wrappers, inert wastes, worn out plastic containers, broken glasses etc) in the open land and water bodies will be prohibited.

Noise pollution control and management: Construction vehicles and equipment's will be maintained to minimize the body noise of the equipment's and vehicles. Honking of horns will be prohibited. Construction works near the settlements and sensitive facilities such as schools, temples, healthcare facilities etc. will be highly avoided to the extent possible and if not possible, will be limited to day time zone from 7.30 AM to 18.30 PM

6.1.1.2 Impact due to Drainage disturbance and change in surface flow regime

Mitigation

The risks related to drainage disturbance and change in surface flow regimes will be minimized implementing following mitigation measures.

- **Maintenance of drainage pathways:** Any construction activities across the natural drainage pathways will provide a temporary drainage pathway across the canal to bypass the surface run off. Temporary pathways shall be demolished only after the permanent pathways across

the canal are established. All natural drainages shall be provided with free pass way across the canal.

- Drainage will be linked to the canal because canal serves as the drainage of the area. The design will include super pass and under pass structures at sections where the canal cuts across the natural drainages to avoid the related risks.

6.1.1.3 Impact due to Quarrying of construction materials

Mitigation

The risks related to uncontrolled extraction of river bed materials will be minimized implementing following mitigation measures.

- Contractor will not be allowed to collect sand, gravel and boulders within 50m distance of the right embankment of the Karnali River. Not more than a depth of 1m of excavation will be allowed while mining. The project authority and the Environmental consultant will regularly monitor this.
- The Forest Users Groups of community forests adjoining Karnali River will be made aware for not allowing excess mining in their corresponding reaches of Karnali River.
- Implementation of plantation program on the right bank of Karnali River in coordination with the District Forest Office, WUAs, and Forest Users Groups.

6.1.1.4 Increased urbanization

Mitigation

The risk related to possible increase in urbanization might be reduced by implementation of following measures at the project level. For optimum, risk reduction this issue shall be addressed at the national policy level.

- Project implementation shall have least priority for the areas likely to turn into urbanization.
- Development of zoning awareness through municipalities, WUA and other CBOs.
- Establishment of ordinances to avoid agricultural areas to convert and develop into land parcels for housing plots.
- Regurgitate the role of Local Environmental and Management Committee (LEMC) for the betterment of communities in the project area.

6.1.1.5 Drainage Disturbance and Change in Surface Flow Regime

The risk related to natural drainage disturbance will be avoided through the following measures

- The design shall propose super pass and under pass structures at sections where the canal intersects the natural drainages to avoid the related risks.

6.1.1.6 Siltation and sedimentation of canal and agricultural fields

The risk related to the siltation the irrigation canal and agricultural fields particularly of the Kulariya command area can be minimized by following possible mitigation measures.

- Construct wetland to receive storm water and immediate siltation
- Develop a joint program with GoN, Rastrapati Chure Conservation Program Coordination Unit of the Ministry of Forest and Soil Conservation;
- Rapid flow control structures (such as check dams, dykes etc.) shall be planned and constructed to control the flash flood that affects the downstream area of Chure hill;
- Carry out detailed baseline assessment of the Kulariya command area for suitable intervention.

6.1.1.7 Inundation

The risk related to the inundation of the DIA can be minimized with adoption of following mitigation measures.

Mitigation

- Monitor the performance of the measures implemented under phase I of RJKIP to formulate necessary adjustments.
- Drainage area management will be addressed during the command area protection activities.
- Awareness program regarding inundation for Water User Committee
- Establishment of a master plan for command area protection

6.1.1.8 Increase in Soil Salinity of Agricultural Fields

The above risks of the irrigation canal will be minimized with the following measures.

Mitigation

- Establishment of awareness campaign on likely salinity problems;
- Establishment of regular testing program and undertake assessment of present salinity level;
- Adding organic nutrients to the soil and practicing rotational cropping, investigate nutrient deficit and enhancement options and suitability of crops in the command area[24].
- **Implementing Adoptive Management Strategy:** This will include annual checkup of the soil salinity of the command area and development of mitigation plan to minimize soil salinity. In case the salinity level is increasing, site specific additional measures will be implemented based on the field conditions that relates to increase in salinity.

6.1.2 Biological Environment[25]

6.1.2.1 Impact on Wildlife including Species of Conservation Significance

Mitigation measures to reduce the risk of loss of wildlife including species of conservation significance include:

- Preparation of Site Specific Environment Management Plan (SS_EMP) by the Contractor and duly approved by the Project before beginning of the construction activities in sensitive areas
- The illegal wildlife trade by construction work force will be prohibited. Any encounter of wildlife during the construction will be reported to the concerned authority
- Install CCTV at locations where required to monitor wildlife movements in the project area during construction
- Prohibition to enter into the forest
- Restriction on construction activities during peak migration period
- Construction activities during night discouraged
- Leftover food and items will be disposed properly in pits or designated places
- Night movements of labor forces will be strictly controlled
- Labors will be kept in group in the camp
- Labors Labor camps will be away from forest boundary
- will be prohibited to keep dogs and chickens with them during their stay in the camps that are near to the forest
- Awareness Campaign to the Labors, stakeholders and local communities

[24] Indicated in the Pest Management Plan report.
[25] Refer Biodiversity Assessment Report for the details of the mitigation measures for biological environment.

6.1.2.2 Poaching and Logging in the Forests

Mitigations:

- Provision to be made for continuous supervision of construction camps nearby the forest area to make sure that poaching and illegal logging is prohibited. The WUA or Forest Users group shall also be aware to vigil the adjoining forest and reporting to the project Environmental Officer.
- The CFUG member shall also represent in Local Environmental Monitoring Committee (LEMC)
- Awareness campaigns against Poaching and illegal Logging shall be launched. The awareness shall be targeted to the contractor workforce and beneficiaries from project area
- Alternative fuels, e.g. gas/ kerosene, for cooking and light shall be provided to the contractor workforce

6.1.2.3 Impact on Aquatic Life

Mitigation

- Effluent will be passed through series of settling ponds before disposing into the main water bodies;
- Heavy machine works during migration or presence of Dolphins will be avoided;
- Sand and boulder mining shall be strictly avoided from the spawning areas;
- Maintaining the water levels at Dolphin movement areas;
- Spillage of toxins and other lubricants will be strictly controlled and prohibited;
- Facilitate to encourage controlled fishing with licensing
- Facilitate for heavy penalty or imprisonment for illegal fishing taking support from the GoN and local administration;
- Regularly monitor fishing activity and dismiss any laborer caught fishing by any method;
- Regular monitoring of DO, temperature, pH, turbidity, Total suspended Solid (TSS) etc. to maintain the river water quality suitable for aquatic fauna;
- Disposal of effluent from Tikapur Municipality will be discouraged in coordination with the Tikapur Municipality;
- Effluent treatment lagoon will be constructed for treating the sewerage before disposing it to main water bodies maintaining the Effluent Standard prescribed by the GoN.
- The ecosystem of lower Karnali River will be considered as a single conservation unit and priority will be given to preserving all of its components including fishes that provide food for the dolphins as well as the indigenous people. Efforts will be made to establish the entire area as conservation area and its management shall be given to local bodies[26];
- Unless the local people recognize the significance of wildlife values of their immediate surrounding and the river dolphins as a whole, implementing many of the recommendations that involve local participation do not yield desirable success. Both local and national media, print (newspaper and magazines) and electronic (radio and TV), will extensively be made use of, in highlighting the issues on the existing dolphin population[27];
- The study has found that the local communities have religious and cultural belief regarding dolphin as a holy animal, conservation effort will be built on their existing belief rather than trying to impose a scientific basis for conservation at the very beginning[28].

6.1.2.4 Impact on Birds

Following mitigations are proposed for impact on birds

[26]WWF Nepal May 2006, Status, Distribution and Conservation Threats of Ganges River Dolphin in Karnali River, Nepal
[27]WWF Nepal May 2006, Status, Distribution and Conservation Threats of Ganges River Dolphin in Karnali River, Nepal
[28]WWF Nepal May 2006, Status, Distribution and Conservation Threats of Ganges River Dolphin in Karnali River, Nepal

- Prohibition of illegal hunting & poaching
- Avoid or minimize felling large canopy trees;
- Conduction of awareness program

6.1.2.5 Entrapment effects on aquatic fauna[29]

Mitigation

- Use local conservation organizations (governmental and non-governmental) to build awareness and stewardship programs (e.g. Dolphin Conservation Center). Incentivize conservation as tool for livelihood opportunities (e.g. tourism). Use other benefit enhancement measures.

6.1.2.6 Impact on Wildlife and their Movement during Operation

Mitigation

- Facilitate for increment of Buffer Zone area and aware locals on potential area of conflicts with the wild animals
- Install CCTV where ever required and necessary to monitor the wild life movement with the help of TAL project to reduce human animal conflict and poaching.
- Involve CFUG members especially youth to monitor the illegal poaching and identify the root causes for the incidents

6.1.2.7 Impact on Feral Cattle

Following mitigation are proposed for the impact on feral cattle

- Encourage development of controlled community managed raring centers;
- Encourage castration to control the reproduction
- Fencing along both side of canal to control grazing as well to control cattle falling into the canal system;
- Awareness program on income generation from feral cattle

6.1.3 Socio-economic and cultural environment[30]

6.1.3.1 Obstruction of access to land and property and community resources

To avoid the risks of obstruction of access and to maintain the community access to the property and resources following measures will be implemented.

Provision of temporary access in every 300 to 500 meters of the canal. The project will ensure to provision temporary access facilities across the canal in every 300 to 500 meters during construction phase such that the communities and people are not barricaded from their property and resources. As far as possible, such facilities will be located close to the existing trails and roads used by majority of the community users.

Establish permanent cross over facilities for the community users at the end of construction: Village road bridges are proposed in several locations to provide the access to the people and animal crossing.

6.1.3.2 Pressure to community infrastructures and services such as water supply, sanitation management, schools, markets, fuel supply

Risks to the community infrastructures will be minimized by implementing the following measures.

[29] See Biodiversity Assessment report including the Area of Influence.

[30] Refer Resettlement Plan Framework (RPF) and Vulnerable Community Development Plan (VCDP) for detailed mitigation for socio-economic and cultural environment.

Establishment of infrastructure facilitated labor camps: The project ensure to establish labor camps with the following facilities: i) well ventilated rooms ii) lighting facilities, iii) adequate toilet and bathroom facilities iv) common cooking and dining facilities, v) adequate communication facilities, vi) recreation facilities, vii) first aid facilities, viii) runoff drainage facilities, ix) solid waste collection and storage and transportation facilities, x) water supply facilities, xi) grosser and consumable shops, xii) LPG gas facilities for cooking etc.

Discourage outside workforce to stay outside the camps: Staying of workforce outside the construction camps will be discouraged in the project employment.

Encourage local labor force for project employment: The project will implement a policy of providing maximum job opportunities to the local people from within the DIA.

6.1.3.3 Occupational health and safety risk

Occupational health and safety risks to the workers in the construction works will be minimized by the following measures.

- ***Appropriate facility provisions at the work place****:* The work place will be facilitated with access for approach and exit, temporary toilets, drinking water provisions, first aid kits etc. Safe distances will be maintained between the earthmoving equipments and working labors. Work will be stopped in the heavy raining days and extreme temperatures and hot wave days.
- ***OHS communication and trainings****.* The workforce will be trained prior to the start of construction work with regard to the likely occupational health and safety hazards (physical, Chemical, biological) faced in the work environment and the precautions that should be taken for each types of hazards. The training materials will cover; i) on how to get rescue medicines and procedures to be followed in case of the accidents, ii) different hazard codes used in the construction sites and materials used and how to keep safe in areas or materials designated by the hazard codes and iii) Use of different types of Personnel Protective Equipments (PPE) to safe guard from the different hazards etc.
- ***Provisioning of PPE***: The construction workers will be provided with the PPEs for the safety of the workers depending on the nature of the works. Irrespective of the nature of the works, all the workers will be provided with worker's jacket, helmets, gloves, air mask, and boots. Workers involved in high hazard area of specific types, additional PPE as required will be provided. Use of PPEs at all times in the construction sites will be ensured through supervision and monitoring.

6.1.3.4 Community health and safety risk

Mitigation

To minimize the risks on community health and safety following measures will be implemented.

- ***Awareness building****:* The local community will be provided with awareness program on the potential community health risks of the construction works and the measures to safeguard from the related hazards.
- ***Water quality and water availability****:* The project will ensure that the community water supply will not be used for the project related works and activities that are potential to cause community water supply quality degradation will be identified and actions will be taken to protect the water quality. The construction camps and works will be facilitated with separate/self-standing water supply system.
- ***Safety against pollution (air, noise, wastes etc):*** The project will ensure that the pollution due to construction works and construction traffic is minimized by implementing management measures

such as air pollution control, noise pollution control, and waste control as specified before. Discharge of wastes of all kinds from the construction sites and workers camps will be prohibited.

- ***Structural Safety****:* Active canal and its structural works will be barricaded for general public to avoid risks of accidents. The temporary crossing facilities and permanent crossing facilities over the canal will ensure structural safety.
- ***Traffic Safety***: For the construction traffic related risks to the community, the project ensures to manage a dedicated parking area for the construction vehicles and regulate parking of the construction vehicles on the road sides. The drivers of the construction vehicles will be given training on the speed limits, hazardous routes, time of likely interaction of the traffic with the community movements such as school opening hours and closing hours etc. such that drivers take needed precautions to avoid traffic accidents. The local traffic police will be coordinated for the traffic management. The construction traffic will be supervised monitored regularly to ensure the given instructions are complied.
- ***Disease prevention****:* To minimize the risks of disease to the community at large and the construction workforce in particular, the project will carry out the followings: i) health checkup of the workers before employment, ii) regular health checkup of the workers, iii) providing health care to the infected workers in isolation, iv) implementing integrated vector control program with the local health offices, and v) assisting local health offices with medicines and health workers if required so in case of emergency.
- ***Emergency Preparedness and Response****:* To tackle the outbreaks of epidemics, an emergency preparedness and response will be designed to administer, organize, communicate, and follow up procedures with required funds and human resources needed.

6.1.3.5 Gender and child discrimination/exploitation risk

Mitigations

To minimize the risks of exploitation of construction workforce on the basis of gender, under aged, migrant workers, non-migrant workers, forced laborers etc following measures will be implemented.

- ***Prohibition on employment of under aged child****:* Under aged child of less than 18 years will not be employed in the project works
- ***Prohibition on employment of forced labor***: Forced labor will be prohibited in the project construction works.
- ***Employment on the basis of equal opportunity****:* The construction workforce will be employed on the basis of equal opportunity to all No worker will be discriminated in the aspects of wage rates, trainings, or other benefits and services
- ***All employees will be employed only after providing documented employment letter****:* A documented employment letter will be provide to each of the workers prior to engagement in the construction works stating their rights related to hours of work, wages, overtime, compensation, and benefits as per the national labor law.
- ***Retrenchment:*** Retrenchment of workers without prior notification on the basis of work relationships will be prohibited. The workers will be paid all his dues and benefits prior to dismissal from the work.

6.1.3.6 Intrusion in local culture and traditions

Mitigation

The measures to be implemented to minimize the risks on local culture and traditions are as under:

- ***Respect to local culture and traditions****:* The project personnel, contractors and the outside workforce will be instructed to respect local culture and traditions at all times.
- ***Support Local communities for the conservation of local culture and traditions***: The project at all times will support the efforts made by local communities for the conservation of local culture and traditions in cash or kinds

6.1.3.7 Community health and safety risk during Operation

Mitigation

- ***Awareness building****:* The local community will be provided with awareness program on the potential community health risks of the irrigation canal and irrigated agricultural fields. The communities will be provided with the safeguard measures to protect themselves from the potential health hazards.

7. Environmental Management Plan (ESMP)

7.1 Background

The Environmental and Social Management Plan (ESMP) identifies the principles, approaches, procedures and methods that will be used to control and minimize the environmental and social impacts of all construction and operational activities associated with the project development. The ESMP also ensures that the commitments made by the Project to minimize project related environmental and social impacts are upheld throughout all project phases.

The ESMP is also a companion document to the Biodiversity Management Plan (BDP), Integrated Pest Management Plan (IPMP), Resettlement Plan Framework (RPF) and Vulnerable Community Development Plan (VCDP) that aim to mitigate social and biodiversity impacts arising from the project. The basic principles under which the EMP will be implemented are:

- Fulfill all environmental and social conditions associated with project approvals.
- Develop, promote, and foster a shared sense of responsibility for environmental and social performance of the project.
- Promote environmental awareness to employees and contractors.
- Define stakeholder's roles and responsibilities on environmental and social management relating to project
- Encourage an understanding of social and cultural sensitivities of local communities and minimize project impacts on culture.
- Monitor environmental and social performance throughout the project and implement an adaptive management approach for continuous improvement
- Respond to grievances of affected communities and stakeholders effectively.
- Work with local communities and project affected stakeholders to ensure that they benefit as a result of project development; and
- Maintain an ongoing commitment to informing, engaging and involving local stakeholders throughout all phases of the project.

7.2 Legal requirements

The project management will be responsible for fulfilling the provisions of the all relevant legally binding documents during implementation of the project which is described in chapter 3.

7.3 Environmental standards

- Generic Standard Part I :Tolerance Limits for Industrial Effluents to be discharged into Inland Surface Waters2058 ,
- Nepal Ambient Air Quality Standards 2069
- Drinking Water Quality Standards 2063
- National Noise level Standard 2069

7.4 ESMP Structure and Organization

This environmental and social management plan has two components; the environmental and social management actions and the activities implementing agency.

7.5 Environmental Management Actions

The environmental and social management activities is a synthesised plan incorporating the elements of environmental and social mitigation and enhanement measures. The environmental mitigation and enhancement measures are bundled in a series of activities in the project life

cycle (refer Table 7-5 A and B). In addition, the Contractor will be responsible for designing and implementing the following plans which will be approved by RJKIP prior to the intiation of work:

- Health and Safety Plan
- Labor and Working Conditions
- Debris and Spoil Management Plan
- Traffic Management Plan
- Terrestrial Ecological, Biodiversity Management Plan
- Resource efficiency and pollution prevention plan
- Grievance management Plan

7.6 Institutional Arrangements

While developing the environmental and social management plans, the capacity of the implementing organs (institutions/stakeholders) have also been taken into considerations. From the past experiences it has been proven that timely engagement of local people through a local organization can bridge Project and People to implement environmental and social plans and. RJKIP will be the primary agency to plan, implement and monitor the project related both environmental and social action plans.

An organizational setup for ESMP is necessary for effective coordination to ensure compliance with policies and procedures and implementation of mitigation measures. The RJKIP management will be responsible for overall project coordination and management of ESMP implementation and budget arrangement. RJKIP EU will design plans and programs that will be implemented and monitored at project level. The RJKIP will set up offices for RJKIPEU with required number of experienced staff to implement the planned activities and periodic monitoring. The RJKIPEU will liaise with all relevant local GOs, NGOs and CBOs.

Figure 7.1: Organization chart for planning and implementation of ESMP- Refer BA and BMP

In addition to RJKIPEU, the Local Environment Management and Monitoring Committee (LEMC) will be formed in coordination with WUAs for effective compliance and implementation of mitigation and monitoring of environmental and social safeguards. The LEMC will be a bridge between WUA and RJKIP and will facilitate RJKIPEU for carrying out environmental and social mitigation and monitoring in the project area. The key responsibility of the RJKIPEU is to implement the ESMP along with the mitigation measures spelled out in the projects standalone safeguard documents (refer Social Assessment Study, Biodiversity Assessment Study and Integrated Pest Management study for the recommended mitigation actions). Figure 7-2 shows the key relationships of RJKIPEU.

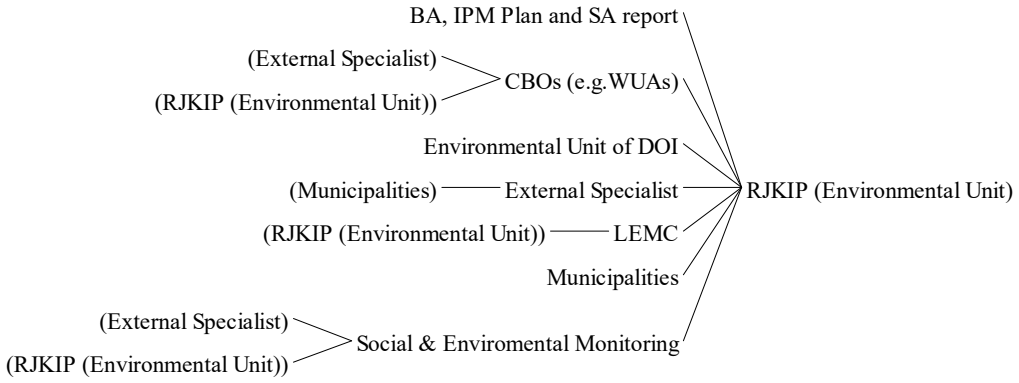


Figure 7-1. Fish diagram showing key relationships within RJKIP Environmental Unit

7.7 Grievance Redress Mechanism

The project company will establish grievance redress mechanism to allow PAPs to appeal any disagreeable decisions, practices and activities arising from compensation for land and assets.
All grievances relating to the project will be referred to the Project Grievances Redress Cell, Grievance Redress Committee (GRC) at local level, Grievances Committee (GC) at central project level and formal court of appeal system.

At field project level, the project will open a Public Information Centre (PIC) at site. A project introduction booklet will be developed and distributed among the communities. The project company will designate a Grievance Redress Officer (GRO) to receive routine emerging complaints of PAPs and stakeholders with clear responsibility to address their concerns. PAPs as well as local people can lodge their complaints at this cell related to acquisition and construction related activities. Grievance recording register will be established at RJKIP site offices and all grievances, filed orally or in writing, will be registered.

The local level GRC will be comprised of GRO, one representative from LEMC and one representative from the civil contractors. The chair and the convening person will be the GRO and this committee will meet every week or as deemed necessary to review all cases referred to by the cell.

The central project level GC will be comprised of Project Manager, Chief District Officer (CDO) and Chairman of the Local Environment Management and Monitoring Committee (LEMC). The CDO and the Chairman of LEMC will be the independent members of this committee. This committee will convene as deemed necessary and the Project Manager will be the chair and the convening person. The GC will look after the grievances that cannot be resolved at the site by GRO and GRC. Proposed mechanism for grievance resolution is given below:

Stage 1:
Complaints of PAPs on any aspect of compensation, or unaddressed losses shall in first instance be settled verbally or in written form in field based project office. The complaint can be discussed in an informal meeting with the PAP by the concerned personnel to settle the issues at the local level to GRO. All the grievances will be reviewed and the decision will be made and informed in writing to the complaining party within two weeks of receipt of the complaint.

Stage 2:
If the complaining party is not satisfied with the response from the cell, the complaining party can appeal to the GRC. While lodging the complaint, the complaining party must produce documents to support his/her claim. All the grievances will be reviewed and a decision will be informed to the concerned party within two weeks of the receipt of complaint.

Stage 3:
If the complaining party is not satisfied with the response from the GRC, the complaining party can appeal to the GC. While lodging the complaint, the complaining party must produce documents to support his/her claim. All the grievances will be reviewed and a decision will be informed to the concerned party within four weeks of the receipt of complaint.

Any complaining party can exercise its constitutional right to approach the court of law at any time if he/she chooses to do so.

7.8 Environmental and Social Management Plan (ESMP)

The ESMP includes impact, mitigation measures, role of agencies, timeline, monitoring agency, estimated cost and various phase of construction that applies to each elements of mitigation of impacts on physical, biological and social environment. The total EA cost shall be as tabulated below:

Table 7-1 ESMP for Construction/Operation Phase

Sector/Activity	Potential Impact	Loc	Sig	Dur	Proposed Mitigation	Responsibility	Monitoring Authority	Estimated Cost	
								NPR	US$
A. Physical Environment	Cost for physical parameters have already been included in the Technical Design and CostTAB (awareness program, wetland construction, watershed management etc.). Hence cost is not included in EA Study.								
B. Biological Environment	Refer BMP for detail cost estimates								
Total (A+B)	US$ 2990571.00								
Socio economic and cultural environment	Refer SA, VCDP and RPF for detail cost estimates								

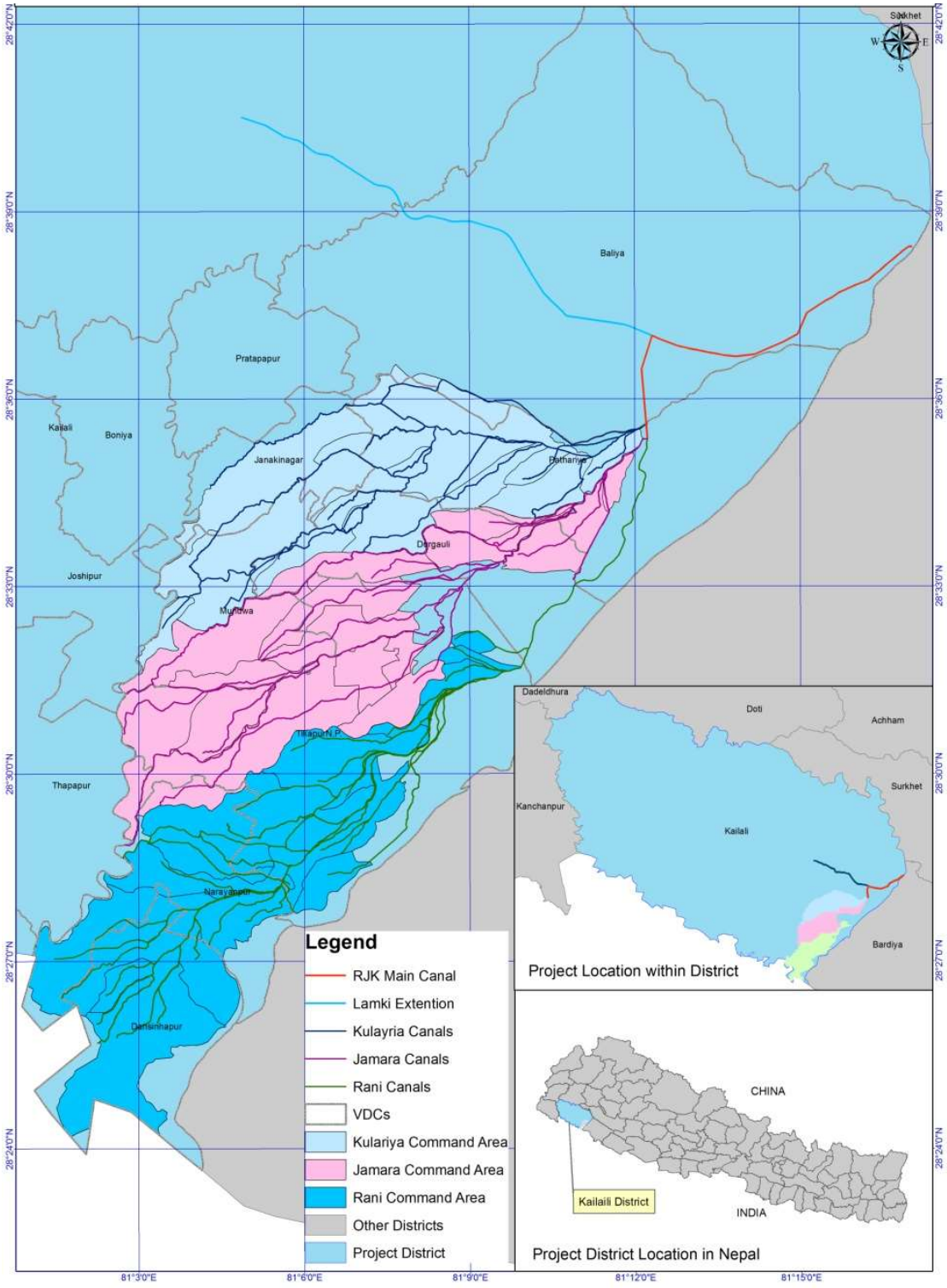
7.9 ESMP Monitoring Management Plan

Environmental monitoring plans include the activities to be monitored (parameters and indicators) during Pre-construction, Construction and Operation phases. The purposes of monitoring are to investigate and understand the quality of the environment prior to project and keep records of the project impact on the environmental quality during construction and operation phases of the project so as to provide reliable information and scientific basis for environmental management. Therefore environmental monitoring is a mechanism which evaluates whether the mitigation and monitoring actions were actually carried out or not and evaluates the effectiveness of the implementation measures to curb the perceived impacts or identified unforeseen impacts for further corrective actions to avoid or minimize the impacts before it is too late. The ESMP monitoring management plan further details the activities include the cost and other details as in the Table 7-2.

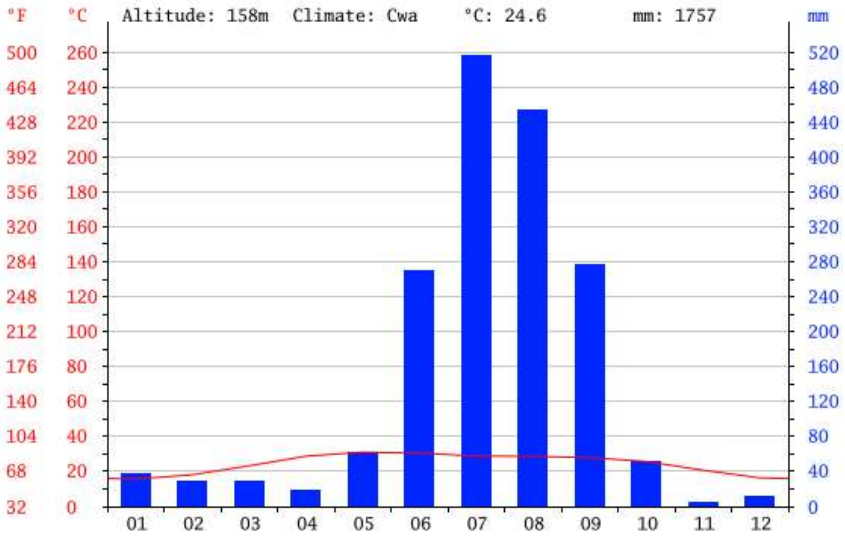
Table 7-2. ESMP Monitoring Plan (Construction and Operation Phase)

Area	Indicator	Res.	Frequency	Estimated Cost (NPR)	Estimated cost (US$)
Physical Environment					
Air Quality	TSP, PM 10 and PM 2.5	EU	Once in a year	300,000.00	3,000.00
Noise Level	Sound Pressure Level dBA	EU	Once in a year	100,000.00	1000.00
Water quality	Chemical and Physical parameter as listed in Generic Standard Part I : Tolerance Limits for Industrial Effluents to be discharged into Inland Surface Waters 2058 , andDrinking Water Quality Standards 2063	EU	Twice in year	100,000.00	1000.00
Total				500,000.00	5000.00
Biological Environment	Refer BA and BMP for detail information				
Socio- economic and Cultural Environment	Refer SA, VCDP and RPF for detail information				

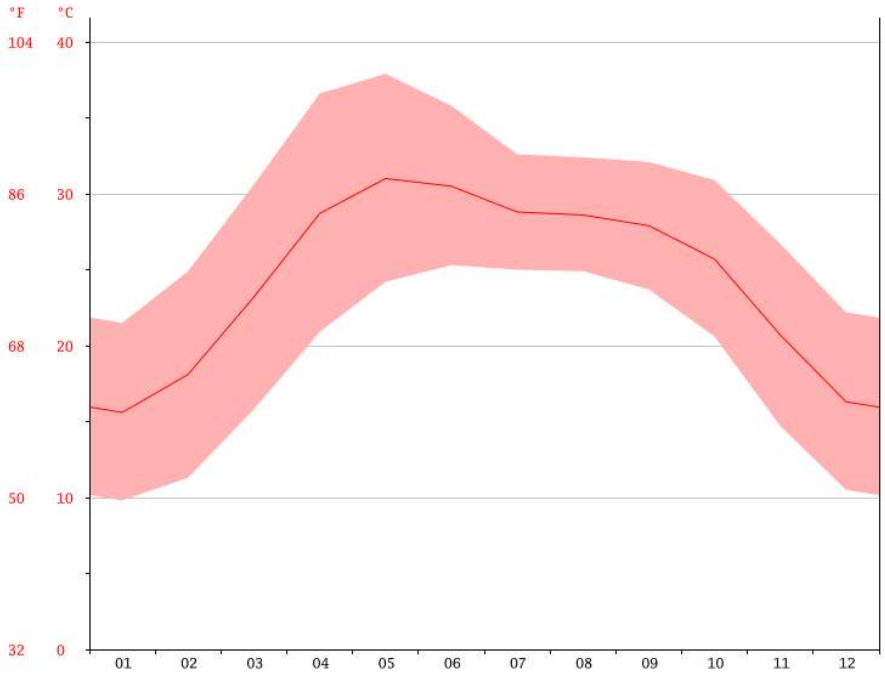
Appendix A: Location map of RJK irrigation system



Appendix B: Climate and Temperature Regime of Tikapur

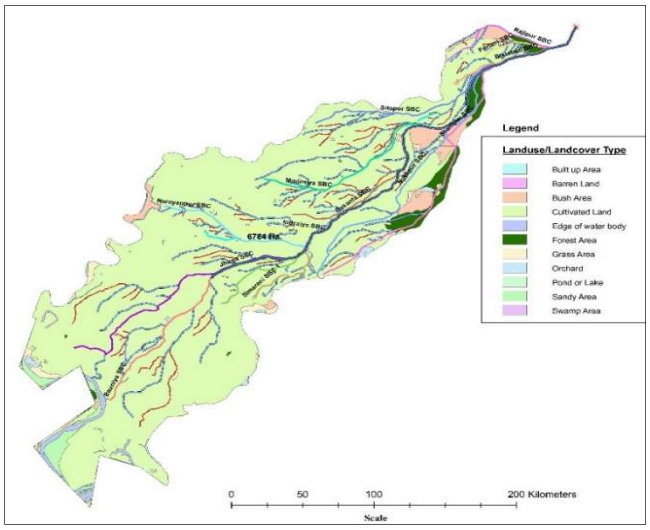


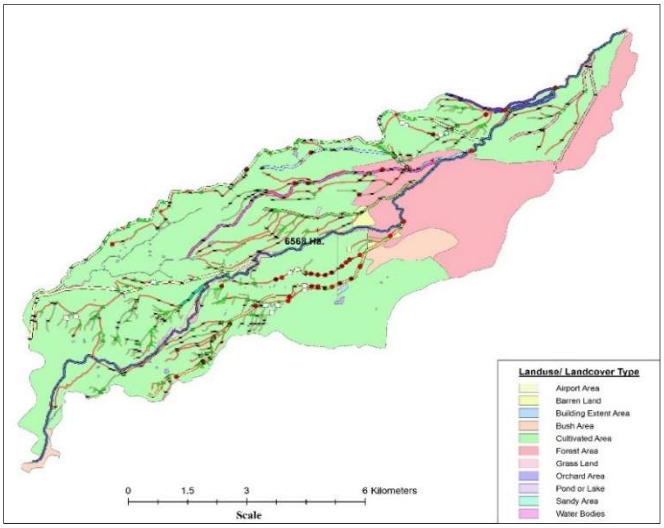
Climograph of Tikapur (*Source: en.climate-data.org*)

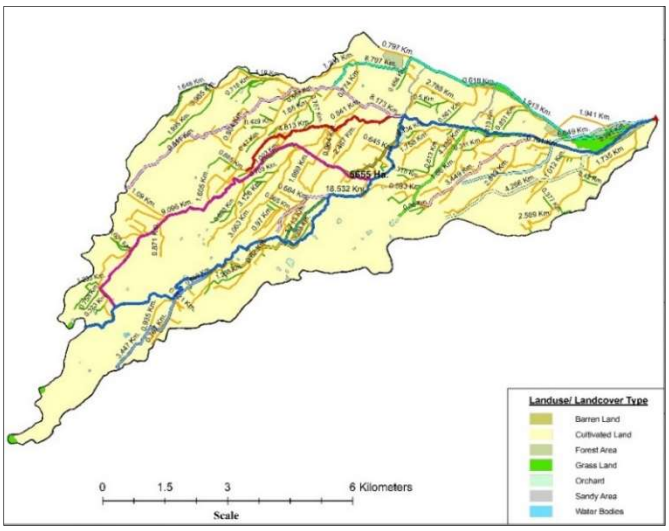


Temperature graph of Tikapur (*Source: en.climate-data.org*)

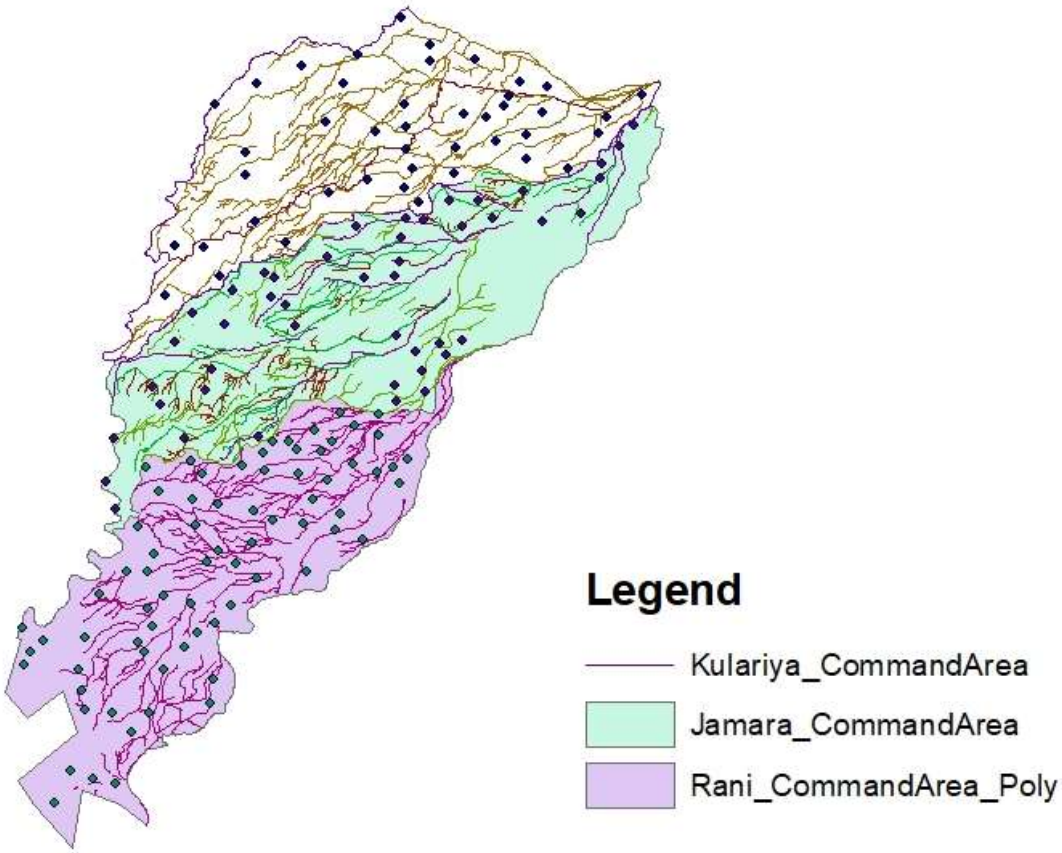
Appendix C: Land Cover mapping of the Project Area (Rani, Jamara and Kulariya)







Appendix D: Settlement distribution in the Command Area



Appendix E: Legal and Regulatory Requirement

Relevant Acts, Rules, and Regulations

Soil and Watershed Conservation Act 1982 (2039 BS) Article 10 stipulates provisions to prohibit actions within any protected watershed area pursuant to Article 3 of this Act; Article 24 stipulates provision of no obstacle to use and developing of water resources by the government of Nepal. Although this act does not directly pertain to the present project activities, it however, requires contextualization because of the presence of the National Park and the connectivity with the area influence.
Solid Waste Management Act 2068 BS (2011) Minimizing the solid waste at source, re-using, processing or disposing of the solid waste, and to maintain the clean and healthy environment by minimizing the adverse effects of the solid waste in the public health and environment.
Forest Act 1993 (2049 BS) and amendments 1995 Attain social and economic development and to promote a healthy environment and to ensure the development and conservation of forest and the proper utilization of forest products and extend co-operation in the conservation and development of private forest by managing the national forest in the form of government managed forest, protected forest, community forest, leasehold forest and religious forest.
Local Self Governance Act 1999 (2055 BS) Section 28 and 96 relating to functions, duties, and power of the VDCs/Municipalities on forest, sanitation and environment, soil erosion and river control, physical development, Section 33 and 101 related to judicial power on compensation for damage crops, labour wages etc; Section 47 and 115 relating to co-ordination with the governmental and non-governmental institutions; Section 55 relating to natural resource utilization tax; section 70 and 165 relating to punishment against the act provisions.
Water Resources Act 1992 (2049 BS) Article 3 stipulates the water resource right to the Government; Article 4 prohibits use of water resources without obtaining license except the specified uses under the Act; Article 7 establish the priority order on the utilization of water resource; Article 8 stipulates procedure for water resource licensing; Article 16 empowers government to utilize the water resources and acquisition of others land and property for the development of water resource as stipulated in the Act; Article 18 stipulates the right of the government to fix the quality standards of water; Article 19 prohibits pollution of water resource above prescribed pollution tolerance limits; Article 20 stipulates not to cause harm and adverse effect on environment while developing the water resource project;
Land Acquisition Act 1977 (2034 BS) Article 3 stipulates power to the government to acquire any land anywhere for public purpose subject to compensation under this Act; Rule 4 empower government to acquire land upon request

by institutions subject to the payment of compensation and all other expenses under this Act; Rule 5, 6, 7 and 8 stipulates provisions and procedures for initiating initial land acquisition process and estimating compensation rates; Rule 9 and 8 stipulates procedures and provisions for notification to land acquisition; Rule 11 stipulates provision of right to file complain by the affected on the public notice with regard to the land right; Rule 13, 14, 15 stipulates procedures and provisions of Compensation Fixation; Rule 16 and 17 stipulates criteria for compensation fixation; Rule 19 stipulates discloser of the compensation entitlement through public notification; Rule 25 stipulates provision of Complain against the compensation rates to the Ministry of Home affairs. The decision of the Ministry of Home affairs on the complaint is final.
National Parks and Wildlife Conservation Act 1973 (2029 BS) Article 5, stipulates provisions of restriction on damage to forest product and to block, divert any river or stream flowing through national park or reserve, or any other source of water, or use any harmful or explosive materials without obtaining a written permission; Article 9 lists the protected wildlife prohibited for hunting; Article 13 prohibits collection of samples from National parks and Reserves without obtaining license.
Lands Reform Act 1964 (2021 BS) Section 7 relating to land ceiling and rights of tenant; Section 12 relating to exemption from upper ceiling; section 25, 26, and 29 relating tenancy right; section 51 relating to land use, control of land fragmentation and plotting.
Labor Act 1991 (2048 BS) Section 3 relating to classification of the posts; section 4 relating to appointment letter; Section 5 prohibition on child labour and restriction on minor and women; Section 10 on job security; section 12 related to retrenchment and reemployment, section 16, 17, 18 and 19 relating to working hours; section 20, 21, 22, 23, 25 and 26 related to remuneration; section 27 to 36 relating to occupational health and safety; section 37 to 44 relating to welfare arrangements; section 46 related to special arrangement is the construction sites; Section 50 to 60 related to conduct and penalties; section 72 to 82 related to settlements of labour disputes.
Irrigation Rules 2056 BS (2000) Rule 3 stipulates the provision of registration of the User's Association developed and operated by government or the farmer groups. Rule 4 provisions for the election and dissolution of the executive committee of the User's Association. Rule 5 outlines for functions and duties and roles and responsibilities of the User's Association. Rule 10 has a provision of handover of the government developed irrigation system to the User's Association in terms and conditions as stipulated in Rule 11.Rule 42 stipulates requirements of public participation and compensation to the land contributed to the structures of irrigation system by the farmer.
Environment Protection Rule 1997 (2054 BS) as amended Rule 3 stipulates environmental screening criteria for undertaking IEE/EIA study; Rule 4, 5 and 6 stipulates procedures for determining scope for IEE/EIA including public notification and approval of IEE/EIA scope of works; Rule 7, and 10 stipulates provisions for conducting IEE/EIA

assessment including public notification and public hearing for IEE/EIA works and requirement of recommendation letters from the project development VDCs/Municipalities; Rule 11 stipulates approval procedures including disclosure of IEE/EIA report; Rule 12 mandates developer to comply with the approved IEE/EIA provisions to avoid, mitigate, and monitoring of the impacts, Rule 13 stipulates the responsibility of the concerned body to monitor the project implementation; Rule 14 stipulates the responsibility of the Ministry to conduct Environmental examination of the project after 2 years of construction completion; Rule 15, 16, 17, 18, 19 and 20 stipulates provisions to prohibition and control of pollution; Rule 26, 27, 28, 29, 30, 31, 32 and 33 stipulates procedures and provisions for the conservation of Natural Heritage and Environmental Conservation Zones; Rule 45. 46 and 47 stipulates procedures and provisions for compensation to the affected.
Forest Rules 1995 (2051 BS) Rule 7 prohibit forest cutting without obtaining license; Rule 8 stipulates the procedures of licensing for forest products; Rule 65 make the national priority project developer using national forest area responsible for the compensation of the loss or harm to any local individual or community due to the project and also make the developer responsible to meet the entire expenses required for the cutting, making in to pieces and transporting the Forest Products in a Forest Area to be used.
Wildlife Reserve Rules 1977 (2034 BS) Rule 4 stipulates provision of entry pass to enter into the Parks or Reserve, Rule 6 stipulates restricted activities within the Parks and Reserves, Rule 11 stipulates prior approval for any research activities or study within the parks or reserves.
Local Self Governance Rules 1999 (2056 BS) Rule 49 relating to approval of construction works; Rule 68 and 138 relating to approval and clearance of the project; Rule 69 and 139 relating to supervision and monitoring of the project; Rule 149 relating to application for permission.
Water Resources Regulations 1993 (2050 BS) Rule 12 to 21 stipulates the provision and procedures of licensing for the water resource utilization; Rule 32 to 35 stipulates provisions, procedures and responsibilities for the acquisition of land and property for the development of water resources.

Policy Relevance to the Project

14th Three Years Interim plan 2073-2076 BS To enhance year-round agricultural production, the Plan focuses on dependable and sustainable irrigation services that promote employment, social inclusion and geographically balanced development.
Irrigation Policy 2070 BS The primary objective of the irrigation policy is i) provide round the year irrigation facility, ii) develop institutional capability of Water Users and iii) enhance the knowledge, skill and institutional working capability of technical human resources, water users and non-governmental association / organization relating to development of irrigation sector. To meet the above objectives, the policy have developed a working policy frameworks on i) Study, Identification and Selection Of The Project, ii) project implementation procedure, iii) water users association, iv) Resource Mobilization And People's Participation, v) System Management, vi) Irrigation Service Charge And Other Income Source, vii), Maintenance And System Operation, viii) Person, Group Or Non-Governmental Association / Institution, ix) Liability And Responsibility, x) Environment Protection And Water Supply, xi) Development Of Technology And Technical Manpower, xii) Co-Ordination With Other Institution, and xiii), Evaluation And Monitoring, The primary focus of the policy is garnering community participation in the planning, implementation, and operation of the irrigation projects with due care to the environmental resources affected by the irrigation projects.
Climate Change Policy 2067 BS (2011) Realising the changes in rainfall patterns (high, low, and intensive rainfall) and seasons due to climate change, the climate change policy emphasises on the management of direct and indirect impacts on water resources, agriculture, forests, and biodiversity, health, infrastructure development, tourism, and livelihoods. The key policy strategies adopted are i) Climate adaptation and disaster and risk reduction, ii) Low carbon development and climate resilience, iii) Access to financial resources and utilization, iv) Capacity building, peoples' participation and empowerment, v) Study and research, vi) Technology development, transfer and utilization, and vii) Climate-friendly natural resources management. The policy has focused on the water management a key instrument of adaptation against the impacts and risks of the climate change on agriculture sector.
National Agriculture Policy, 2061 BS (2004) The long-term vision of the agricultural sector is to bring improvement in the standard of living through a sustainable agricultural development by transforming the current subsistence oriented farming system into a commercial and competitive farming system. The key policy strategy adopted focus on the following policy principals; i) Agricultural production and productivity, ii) Special Facilities for Target Groups, iii) Development of a Commercial and Competitive Farming System, iv) Conservation, Promotion and Utilization of Natural Resources and the Environment, and v) Implementation and Monitoring Arrangement. The primary strategy is to promote development of irrigation facilities, agricultural roads, rural electrification and use of appropriate agricultural technologies.

National Land Use Policy, 2069 BS The policy objectives of the National Land use policy are: i) Land classification as to the land optimum use ii) Promote protection, use and management of the classified land use classes, iii) Promote planned urban development and manage land fragmentation, iv) balance development and environment, v) Conserve areas of geographical, historical, cultural, and religious importance, vi) Develop land use plans in compliance to land use policy, vii) Determine minimal land tax based on the land use and viii) bring unused lands in comprehensive use management. The policy emphasize on the restriction of conversion of productive agricultural lands to other land uses for optimum agricultural production.
National Water Strategy 2002 (2059 BS) Section 4, (related to Social development principles, and environmental sustainability principles); Section 5, strategic output 2 (related to Sustainable Management of Watersheds and Aquatic Ecosystems), strategic output 5 (related to cost effective and sustainable water resource development).
Nepal Water Plan 2005 Part D, Section 6 (related to environmental management, inclusive of impact identification, mitigation actions, monitoring, auditing and institutional mechanism)
Forest Sector Policy 2000 (2056 BS) Section 7, sub-section 7.1 (related to land use planning and change in land use categories), sub-section 7.2 (related to conservation of bio-diversity, eco-systems and genetic resources).
National Biodiversity Strategy and Action Plan: 2014-2020 Chapter 5, section 5.1, sub-section 5.1.1 (relating to landscape planning), sub-section 5.1.4 (relating to in-site conservation of habitat and species), sub-section 5.1.8 (relating to cross-sectoral co-ordination for bio-diversity conservation), sub-section 5.1.13 (relating to IEE/EIA of development projects to avoid significant impacts on bio-diversity and implement the provisions to minimize the impacts), and Section 5.2, sub-section 5.2.1 (5.2.1.2) (related to cross-sectoral co-ordination for Protected Area conservation),
Nepal Environmental Policy and Action Plan, 1993 The five policy principles: a) to manage efficiently and sustainably natural and physical resources; b) to balance development efforts and environmental conservation for sustainable fulfilment of the basic needs of the people; c) to safeguard natural heritage; d) to mitigate the adverse environmental impacts of the development projects and human actions; and e) to integrate environment and development through appropriate institutions, and adequate legislation and economic incentives, and sufficient public resources.

National Conservation Strategy, Nepal, 1988

The policy principles a) to ensure the sustainable use of Nepal's land and renewable resources; b) to preserve the biological diversity of Nepal in order to maintain and improve the variety and quality of crops and livestock and to maintain the variety of wild species both plant and animal; and c) to maintain the essential ecological and life-support systems such as soil regeneration, nutrient recycling and the protection and cleansing of water and air.

Appendix F: Distribution of public places in the command area