Initial Environmental Examination

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Nepal: Irrigation Modernization Enhancement Project

Farmer Managed Irrigation Systems

Prepared by the Department of Water Resource and Irrigation, Government of Nepal for the Asian Development Bank (ADB).

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Nepal: Irrigation Modernization Enhancement Project-Farmer Managed Irrigation Systems

CURRENCY EQUIVALENTS
(as of 16 September 2024)

Currency unit	–	Nepali Rupee (NR)
NR1.00	=	$0.0075
$1.00	=	NRs134.238

ABBREVIATIONS

AO	–	Association Organizer
ADB	–	Asian Development Bank
AKC	–	Agriculture Knowledge Center
BES	–	Brief Environment Study
BOQ	–	Bill of Quantities
CAMO	–	Central Agriculture Development Office
CBD	–	Convention on Biodiversity
CGF	–	Credit Guarantee Fund
CO	–	Community Organizer
COVID-19	–	Coronavirus disease 2019
CPMO	–	Central project management office
CPR	–	Community Property resources
CSD	–	Central Safeguard Desk
DDR	–	Detail Design Report
DWRI	–	Department of Water Resources and Irrigation
EA	–	Executing Agency
EIA	–	Environmental Impact Assessment
EMP	–	Environmental Management Plan
EPA	–	Environmental Protection Act
EPR	–	Environmental Protection Regulations
ESS	–	Environmental Safeguard Specialist
ESM	–	Environmental Safeguard Monitor
FMIS	–	Farmers-managed irrigation system
GoN	–	Government of Nepal
GRC	–	Grievance Readdress Committee
GRM	–	Grievance Readdress Mechanism
IBAT	–	Integrated Biodiversity Assessment Tool
IEE	–	Initial Environmental Examination
IFC	–	International Finance Corporation
IMEP	–	Irrigation Modernization Enhancement Project
IP	–	Indigenous People
MEWRI	–	Ministry of Energy, Water Resources and Irrigation
MOM	–	Management, operation, and maintenance
NAAQS	–	National Ambient Air Quality Standard
NOENQS	–	National Occupational Exposure Noise Quality Standard

NPHC	–	Nepal Population and Housing Census
O&M	–	Operation and maintenance
OHS	–	Occupational, Health and Safety
PIMS	–	Project Implementation Management and Support
PIU	–	Project implementation unit
PPE	–	Personal Protective Equipment
REA	–	Rapid Environmental Assessment
SEMP	–	Site-Specific Environmental Management Plan
SEMRs	–	Semi-Annual Environmental Monitoring Report
SLO	–	Safeguard Liaison Officer
SMU	–	Subproject Management Unit
SPS	–	Safeguard Policy Statement
SPPR	–	Subproject Preparation Report
UN	–	United Nation
WUA	–	Water Users' Association
WHO	–	World Health Organization
WUC	–	Water User Cooperatives
WRIDD/SD	–	Water Resources and Irrigation Development Division/Subdivision

WEIGHTS AND MEASURES

%	–	Percentage
°C	–	degree Celsius
µg/m3	–	Microgram per cubic meter
CFS	–	Cubic Feet per Second
dBA	–	decibels audible
ha	–	Hectare
km	–	Kilometer
m^3	–	cubic meter
mm	–	Millimeter

NOTES

In this report, "$" refers to United States dollars.

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EXECUTIVE SUMMARY

The Irrigation Modernization Enhancement Project (IMEP) will (i) improve the productivity, profitability, and climate resilience of 113 farmer-managed irrigation systems (FMIS) across five provinces and (ii) institutionalize irrigation modernization and integrated crop and water management (ICWM).[1] The project will help improving incomes of approximately 56,000 families. The project will (i) modernize 32,000 hectares (ha) of surface water irrigation systems; (ii) pilot innovative hill lift irrigation systems to irrigate 1,400 ha of dry uplands (Tar); (iii) strengthen capacity of local government institutions in integrating agriculture, water management and irrigation; and (iv) introduce climate smart agriculture and support in agriculture value chain services. The project will have the following outcome: productivity, sustainability, and profitability of farms increased. To meet the project objectives the project will have three outputs:

(i) Output 1: Irrigation infrastructure modernized, will have physical components with modernizing the FMIS infrastructure in Bagmati, Koshi, Lumbini, and Madhesh provinces to improve performance and increase resilience to climate change.
(ii) Output 2: Irrigation and Agriculture Agencies and Farmer Organizations Strengthened, is designed to develop the management and institutional framework to ensure the project investments meet their targets of irrigation efficiency, productivity, and sustainability.
(iii) Output 3: Modern agriculture and value chain facilities introduced, will address core weaknesses in agriculture including the limited uptake of modern agriculture technologies, lack of mechanization and agriculture facilities

FMIS Scope. The IMEP aims to strengthen the existing Farmer Managed Irrigation Systems (FMIS) enhancing the agricultural production in the Koshi, Madhesh and Bagmati Provinces. A total of 100 irrigation subprojects are proposed for the rehabilitation covering a total command area of 17,452 ha. of land area. The main planned irrigation facilities are intake, water distribution canals and other structures; division box, drop structures, outlets and protection structures. In each subproject it has provisioned to support development of a self-sustained, and long-term crop intensification and diversification, and market support services that are tailored to the local needs. Based on the readiness in terms of completion of subproject preparation report and advance stage of technical design, the shortlisted schemes were further prioritized following stage wise implementation. Accordingly, out of 100 subprojects in Priority 1a - 61 irrigation sector project (ISP) (i.e., 40 in Hill Area and 21 in Terai Area) and in Priority 1b - 39 ISP (**Figure 1**). Priority 1a subprojects are already done with the detailed designs of the schemes, while the subprojects under Priority 1b are undergoing designs as of the period of IEE preparation.

This consolidated IEE is prepared on the basis of the irrigation subprojects located in different physiographic regions of Nepal. The proposed Irrigation subprojects aim to increase agricultural production and productivity through the intensification and diversification of crops with assured irrigation facility. Presently, farmers cannot divert sufficient irrigation water for crops in the cropping seasons due to absence of permanent intake and other infrastructure in the canal system. Besides these, the high seepage losses from the canal system also aggravate the sufficiency of water in the canal. In addition, the farmers have limited access to appropriate seeds of good quality, chemical fertilizer and other agro-chemicals. Other problems are associated with a lack of appropriate equipment for the application of insecticides/ fungicides and inadequate market information.

Categorization. The proposed FMIS under the IMEP is classified as Environmental Category “B”

[1] These include Bagmati, Gandaki, Koshi, Lumbini, and Madhesh provinces.

as per ADB's Safeguards Policy Statement (SPS), 2009 and accordingly this Initial Environmental Examination (IEE) is carried out. In particular, the IEE's goal is to find out what impact the project activities might have on the environment and suggest measures to avoid or reduce risks during the planning, construction, and operation stages of the Project. The CPMO shall not award any works contract under the project components until (i) relevant provisions from the EMP are incorporated into the works contract; (ii) this IEE is updated to reflect project components detailed design and CPMO has obtained ADB's clearance of such updated IEE; and (iii) The proposed FMIS rehabilitation works are limited within the existing canal systems. There are no construction of new head works and change in the main canal systems. Thus, per the Nepal Government requirements, the project component does not trigger BES/IEE/EIA.

Description of the Environment. The proposed FMIS subproject area has diverse features in terms of physiography, climate, elevations as well as geology. Tarauli ISP lies in the Quaternary deposit with soil characteristics of Alluvium boulders, gravels, sands and clays. Dhuple Khola ISP lies in the Mid Land Group of the Upper Pre-cambrian-Late Paleozoic in the Ranimatta Formation with Grey greenish gritty phyllites grilstones with conglomerates & white quartzites in the upper parts. Sopyang Khola Gattako Kulo ISP lies in the Kathmandu Group in the Sarung Khola Formation with fine-grained dark green-grey biotite & quartzitic. Nunsari ISP and Purwari Pachiyari ISP lie in Siwalik Group with fine-grained, hard, grey sandstone.

The proposed project area will not cover any forest areas. The dominant vegetation in and around the project area are Amala (*Emblica offficinalis*), Chilaune (*Schima wallichi*), Sisau (*Dalbergia sisso*), Utis (*Alnus nepalensis*), and Simal (*Bombax ceiba*). The major wildlife species around the project area are Common Leopard (*Panthera pardus*), Rhesus Monkey (*Macaca mulatta*), Golden Jackal (*Canis aureus*), House Rat (*Rattus rattus*), Indian Grey Mongoose (*Urva edwardsii*), and Yellow Throated Marten (*Martes flavigula*). The commonly found birds in the Subproject area are House Sparrow (Passer domesticus), Bengal Florican (*Eupodotis bengalensis*), Rose-ringed Parakeet (*Psittacula krameri*), House Crow (*Corvus splendens*), Red Jungle Fowl (*Gallus gallus*), Common Hill Myna (*Gracula religiosa*), Laughing Dove (*Streptopelia senegalensis*) and Cattle Egret (*Bubulcus ibis*). Commonly found Reptiles in the area are Golden Monitor Lizard (*Varanus flavescens*), Changeable Lizard (*Calotes versicular*), Asian Common Toad (*Bufo melanostictus*), and Common Rat Snake (*Ptyas mucosus*).

There are two subprojects in the buffer zone of the two National Parks. The Tarauli ISP of Chitwan district is in the Buffer Zone of the Chitwan National Park. Meanwhile, Dhuple Khola ISP is located in the buffer zone of Langtang National Park. No subprojects are located within the core national park area, and all the proposed irrigation subprojects are the existing irrigation canal systems. The animal habitation disturbance due to the construction activity is negligible. However, WRIDD needs to get no objection certificate from the respective national park administration office prior to works.

The beneficiaries' population of the subproject area has a household size of 6.2. It is mixed in caste and ethnicity and dependence on farming as a primary occupation and source of income. The households of all subprojects are mixed, both in caste and ethnicity, and depend on farming as their primary occupation and source of income. In the Sopyang Khola Subproject and Nunsari Subproject, for example, households belonging to Brahmin ethnic groups are in the majority. At the same time, Chhetri is the majority household in the Purwari Pachiyari Subproject. In the Tarauli Subproject area, Tharu/Chaudhari are the majority of households. In the Dhuple Khola Subproject, Tamang is the majority of households.

Potential Environmental Impacts and Mitigation Measures. The FMIS scope of work is mainly limited to rehabilitating the existing canal structures. There will be no canal extension work or construction activities in the forest patches and the agricultural command area, but there will be strengthening works for the intake and main canal section. The potential impacts were identified in relation to pre-construction, construction, and operation phases. Potential environmental impacts were assessed using secondary data, stakeholder consultations, and field visits. The project will not encroach upon protected areas, buffer zones, sensitive ecosystems, and ancient heritage sites. The project's key activities that attract environmental concerns are intake rehabilitation for surface water diversion, riverbank protection, strengthening irrigation infrastructure, labour camp, and quarry operation. The environmental impacts predicted during implementation are mainly restricted to the construction stage and will be site-specific, short in duration, local in extent, temporary and reversible, and of low significance, such as dust during construction, sediment flow from construction in the rivers, noise pollution, and camp operation. Various construction activities will result in various occupational health and safety risks, which need to be mitigated through compliance with the safety protocols. During the operation stage, the use of increased fertilizer, pesticides and other agricultural chemicals increases the risk of soil contamination and water pollution. Thus, awareness activities for the farmers and proper training on the sustainable use of water and the appropriate use of fertilizers and pesticides shall be provided by the agriculture unit. There are FMIS located in key biodiversity areas and buffer zones, that would cause temporary disturbance to wildlife during civil works.

Environmental Management Plan. All impacts identified during the environmental assessment are found to be moderate, and mitigation measures are readily available. Most of these impacts are linked to civil works and predicted to be of moderate significance, short-term, and localized, which can easily be avoided (through good design and construction planning) or mitigated through the proper implementation of the EMP proposed in this report.

The specific management measures laid down in the IEE will successfully address any adverse environmental impacts due to the subproject. Implementation of appropriate measures during the design, construction, and operation phases will minimize negative impacts to acceptable levels. To ensure that these mitigation measures are implemented, and negative impacts avoided, the measures will be included in the contractor's contract specification. Contractors' conformity with contract procedures and specifications and implementation of the approved site-specific environmental management plan (SEMP) during civil works will be carefully monitored by the Central Project Management Office (CPMO). Further, the environmental monitoring plans also provide adequate opportunities for course correction to address any residual impacts during construction or operation stages.

In the event of unanticipated environmental impacts not considered significant during implementation and not considered in the IEE and EMP, the CPMO shall prepare a corresponding time-bound and budgeted corrective action plan acceptable to ADB and ensure that the contractor implements it and report accordingly in environmental monitoring reports to ADB.

Implementation Arrangement. The Ministry of Energy, Water Resources and Irrigation (MEWRI) will be the Executing Agency (EA), and the Department of Water Resources and Irrigation (DWRI) will be the implementing agency of the project. The Central Project Management Office (CPMO) will be responsible for the project's overall implementation and compliance with ADB's environmental safeguards requirements. The CPMO will establish a "Central Safeguard Desk" (CSD) and comprise a Safeguard Liaison Officer (SLO) supported by an Environmental Safeguard Specialist (ESS) of PIMS. The SLO will ensure full compliance with the overall environmental and social safeguards requirements of the project. The SLO will work closely with the environmental

and social development focal points of the Water Resources Irrigation Development Division (WRIDD).

The ESS will support the CPMO and field offices in maintaining overall environmental safeguards and OHS requirements in the project. The ESS will prepare an e-MIS and support the safeguarding of field monitors at field offices in monitoring environmental and OHS activities. The CPMO will mobilize a full-time Environmental Safeguard Monitor (ESM) at the project site. ESM will work under the guidance of ESS of PIMS. The contractor supporting civil works under DWRI shall include the cost for preparing and implementing site-specific environmental management and OHS plan (SEMP) along with mobilizing the Environment Health and Safety (EHS) officer and include the cost in their BOQ. The inclusion of sufficient cost for EMP and safeguard/OHS staff shall be verified and assured by the senior environment specialist at CPMO. The integrated SEMP will be approved by the employer prior to their field mobilization.

Consultation, Information Disclosure and Grievance Redress Mechanism. Consultations were undertaken in the FMIS subprojects by the WRIDD offices during the feasibility and detail design study period, with the requirements pertaining to social and environmental considerations. Prior to consultation meetings with local stakeholders, advance notification was circulated, and coordination was established with stakeholders through the project office. The consultations also focused on seeking stakeholders' opinions, especially the local government's views on potential physical and economic impacts and key risks, including mitigation measures and many more. The FMIS scope of rehabilitation works in the existing canal system was communicated to local government officials. The participants were in complete agreement about the benefits of the subproject and expressed full support for it. The ADB safeguard requirements on environmental assessment, involuntary resettlement, GRM procedures, etc., were shared with Municipal authorities and the Water User Association (WUA).

ADB SPS 2009 also requires establishing a project-specific, responsive, readily accessible, and culturally appropriate grievance redress mechanism (GRM). The GRM is a three-tier arrangement that facilitates time-bound grievance resolution at each level. Responsible persons and agencies/offices are identified to address grievances and seek appropriate advice at each stage, as required. Institutional arrangements, including the constitution of grievance redress committees (GRC) at various levels, will be ensured to function throughout the project duration. The CPMO shall ensure the constitution of these committees and oversee the implementation of grievance redress processes, including adherence to time limits, record keeping, and documentation at each level. The presence of GRM or seeking relief from GRM is not a bar to taking grievances and complaints to the judiciary system of the land. Further, there is an ADB Accountability Mechanism whereby people adversely affected by ADB-financed projects can express their grievances, seek solutions, and report alleged violations of ADB's operational policies and procedures, including safeguard policies.

Monitoring and Reporting. CPMO will monitor the overall progress of EMP implementation of all the components of IMEP. The CPMO, PIMS and contractor safeguard team will undertake their respective roles in site inspections and document review to verify compliance with the EMP and SEMP and progress toward the final outcome. The contractor will conduct day-to-day implementation of the SEMP and submit monthly reports to the CPMO. The PIMS will submit quarterly environmental monitoring reports to CPMO, including a summary of the contractor's monthly monitoring activities and results of any independent monitoring or inspection activities of the project. CPMO, with support from the PIMS, shall accomplish semi-annual environmental monitoring reports (SEMRs) starting from the effectivity date up to the end of the construction phase, which shall be submitted to ADB for review and disclosure on the ADB website. The CPMO

shall prepare and submit an annual environmental monitoring report during the operation phase until ADB issues a project completion report.

Conclusions and Recommendations. The proposed rehabilitation work of FMIS Irrigation subprojects in the three provinces districts will benefit the local farmers and people. The magnitude of potential impacts and environmentally sensitive areas in the subproject influence areas are less significant. Considering this under ADB's Safeguard Policy Statement (2009), the project is categorized as category B for an environment requiring the preparation of an IEE. As per GoN, EPR 2020 rules have defined thresholds and equivalent environmental assessments (i.e., BES, IEE and EIA). The proposed FMIS rehabilitation works are limited to the existing canal systems. There is no construction of new headworks and changes in the main canal systems, but it is limited to strengthening the existing canal structures. Thus, as per EPR 2020, the project component scope does not trigger BES/IEE/EIA.

In the subproject implementation, there are no significant impacts during construction and operation, and they will be low to moderate, temporary and short-term (i.e., most likely to occur only during peak construction periods). With the EMP in place, the potential impacts will either be eliminated or minimized to insignificant levels. IEE will be updated when unanticipated impacts occur during the project implementation. EMPs will also be updated based on the specific conditions of areas when beneficiaries and actual sites are defined. Throughout the implementation, the environmental safeguard requirements of ADB SPS (2009) and relevant government policies will be complied with by the project through the CPMO and PIU with support from PIMS.

I. INTRODUCTION

A. BACKGROUND

1. ADB has supported Nepal since the 1980s through five FMIS sector projects consisting of 1,190 subprojects (456 small and 734 medium scale) irrigating a total area of 140,704 ha. Although the projects were evaluated as successful,[1] there are however key issues that need to be addressed to meeting the needs of productivity and climate resilience including; (i) the devolved irrigation and agriculture agencies lack capacities and resources to support the irrigation and agriculture management, issues include slow progress in passing needed legislation, deploying staff, as well as lack of clarity on mandates and responsibilities and coordination among the three tiers of government; (ii) the management performance of the WUA remains weak, with insufficient capacities and resources to meet present needs and future requirement under climate change; (ii) there is a need for a strong nucleus organization at the field level for integrated management of irrigation and agriculture to meet operational requirements including, improved irrigation efficiencies, agriculture productivity and climate resilience; (iii) there is a lack of communications to the dispersed schemes, effective communication to the different subproject stakeholders is critical to meet long term long term needs of irrigation and agriculture including advisories on weather, climate change, water and agriculture management, crop technologies; (iv) farmers face many challenges including climate change, acute labor shortages, low productivity and lack of access to inputs, marketing constraints, food and nutrition security and lack of dissemination of technologies. The government must support the sector in preparing a national strategy to address the increasing risks and understanding of climate change to make the systems resilient and self-sustainable.

2. The project is closely aligned with (i) ADB's Strategy 2030's operational priorities on gender equality, climate resilience, and rural development and food security; (ii) Sustainable Development Goals on economic growth, social inclusion and environmental protection;[2] and (iii) ADB's Water Sector Directional Guide aims to address poverty reduction, gender equality, climate resilience, food security, and capacity building.[3] The project also aims to: (i) empower women farmers, (ii) ensure water security and build climate resilience, and (iii) increase food security and reduce rural poverty.[4]

B. IMPACT AND OUTCOME

3. The project will be aligned with the following impact: national food security increased. The project will have the following outcome: climate resilient irrigated agricultural productivity and sustainability enhanced. The project beneficiaries will be small and marginal farmers who will benefit through access to water, knowledge of managing modern and resilient infrastructure, increased yields, and incomes. The project will mainstream FMIS investments into the national financing system to reduce the country's reliance on external donor support.

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[1] ADB. 2020. Completion Report: Community Irrigation Project in Nepal. Manila. Covered small scale FMIS in Lumbini, Karnali and Sudurpaschim Provinces. Whereas the (i) ADB. Nepal: Irrigation Sector Project (1988), (ii) ADB. Nepal: Second Irrigation Sector Project (16 May 1996), (iii) ADB. Nepal: Community-Managed Irrigated Agriculture Sector Project (17 Nov. 2004), and (iv) Nepal: Community-Managed Irrigated Agriculture Sector Project–Additional Financing (10 April 2014) were the four medium scale FMIS supported by ADB, which covered Koshi, Madhesh, Bagmati, Gandaki, Lumbini, Karnali and Sudurpaschim Provinces.

[2] SDG 1.5- build resilience of poor, 2.4- resilient agricultural practice, 5.1- gender equality, 10.2- inclusive development, 12.2- sustainable use of natural resources, 13- combat climate change

[3] ADB.2019. Strategy 2030. Manila and ADB. 2022. Strategy 2030 Water Sector Directional Guide. Manila

[4] Nepal has built an enabling legal and regulatory framework to spur climate action and its climate change commitments are embedded in a Green, Resilient and Inclusive Development (GRID) approach. The government issued the Kathmandu Declaration for the GRID Partnership in 2021.

C. OUTPUTS

4. The project will have the following outcomes: increased productivity, sustainability, and farm profitability. To meet the project objectives, the project will have three outputs, as summarized below.

5. **Output 1: Irrigation Infrastructure Modernized**: This output will modernize FMIS infrastructure in Bagmati, Koshi, Lumbini, and Madhesh provinces to improve performance and increase resilience to climate change. Across those irrigation systems, the project will (i) provide gated intake structures and protect riverbanks and hill slopes to reduce flood and sediment ingress; (ii) improve irrigation efficiency, stability, and equitable management of irrigation water through targeted canal lining and improved control structures and provision of cross drainage; (iii) support on-farm irrigation by upgrading minor canals and expanding use of modern pipe distributions; (iv) introduce hill lift irrigation schemes in the largely unirrigated mid hill upland areas (Tar). The program will include:

(i) Rehabilitation and upgrading of about 33,000ha of surface water irrigation, including (i) 66 hill irrigation schemes (5,889ha), 34 terai irrigation schemes (11,563ha) in Koshi, Madhesh and Bagmati provinces; and (iii) upgrading for modernization of key infrastructure of the Rajapur Irrigation Project (RIP- 14,500 ha) in Lumbini Province. In addition, the project will construct 12 new pilot hill lift schemes (1,400 ha) with modern lifting and high-efficiency piped irrigation in the mid-hill areas of Gandaki and Lumbini Provinces.

(ii) Improved on-farm irrigation will be supported at all the FMIS subprojects and Rajapur. Advanced on-farm irrigation, including piped, micro irrigation, and polyhouses, will be supported at the hill lift subprojects.

(iii) Pilot a community conjunctive groundwater program at three selected terai FMIS locations, focusing on electrifying farmers and other tubewells.

6. **Output 2: Irrigation and Agriculture Agencies and Farmer Organizations Strengthened**. The output is designed to develop the management and institutional framework to ensure the project investments meet their targets of irrigation efficiency, productivity, and sustainability. The program will be implemented through a new and modernized approach to integrated Crop and Water Management (ICWM) incorporating climate change, sustainable operation and maintenance (O&M) of the irrigation infrastructure, empowered farmer organizations, support the development of agri-enterprises, support in market chain and access to finance. The output will strengthen the capacity of WRIDDs, AKCs and the irrigation and agriculture units at the local level in integrating irrigation management and agriculture development in overall FMIS sector development. At the farm level, the project will; (i) strengthen WUAs capacity to operate better and maintain irrigation systems;[5] and (ii) establish in selected irrigation systems Water User Cooperatives (WUCs) at pilot level who will have integrated irrigation management and agribusiness functions designed to maximize the opportunities of irrigation investments including improved access to government subsidies and rural finance, support for the market chain, facilitate agro-enterprises, and network with private agri-enterprises.[6] For the hill lift irrigation schemes the WUCs will operate as water utilities using metered charging systems and will collect fees to help meet full cost recovery for operating costs. The output will develop new ICWM guidelines, including design, management and extension support, and climate change risks, as well as a road map for the long-term strategy

[5] The WUAs will remain as core organization for irrigation management in all subprojects,

[6] The WRIDDs will support farmers in the initial establishment and registration of the WUCs through the cooperative units at the local level. Irrigation management functions will be supported by the WRIDDs and Agribusiness functions supported by the AKCs. The board of directors of the WUCs will initially incorporate the key representatives of the WUA.The twenty pilot WUCs will initially include 12 hill lift, 3 terai FMIS, 2 hill FMS and 3 Rajapur). Subject to the results of the pilots and farmer interest, the WUC program would be upscaled to other subprojects.

for investment and management of the FMIS schemes in Nepal. The guidelines and parallel training modules will be used to support the project programs and wider training of irrigation and agriculture extension workers in Nepal. The program will include:

(i) Training and strengthening of the devolved institutions focusing on the WRIDDs, AKCs and the irrigation and agriculture units at the local level.

(ii) Strengthening of field level management, including (a) strengthening of WUAs and (b) exploring the establishment of parallel new WUCs who could enhance support in irrigation management operations and agribusiness functions. The WUCs will be initially piloted in 20 subprojects (12 hill lifts, 3 terai FMIS, 2 hill FMS and 3 Rajapur). Subject to the results of the pilots and farmer interest, the WUC program would be upgraded to other subprojects. The farmers will work with the WRIDDs, who will support them in the initial establishment and registration of the WUCs through the cooperative units at the local level. Irrigation management functions will be supported by the WRIDDs/hill lift offices, and agribusiness functions will be supported by the AKCs. The WUC management will initially incorporate the key representatives of the WUA.

(iii) Enhanced Access to Rural Finance: The project will review current policies and programs for finance and subsidies for irrigation and agriculture. Based on the review, the project will work with selected local administrations, lending agencies, the private sector, WUA and WUC to train and pilot new and workable models to improve access and better target financial support for farmers to invest in farm enterprises, on-farm irrigation, upgrading of irrigation etc. The program will also address alternative ways to meet financing costs for irrigation maintenance and repairs beyond the farmers' capacities.

7. **Output 3: Modern agriculture and value chain facilities introduced:** The program will **address** core weaknesses in agriculture, including the limited uptake of modern agriculture technologies, lack of mechanization and agriculture facilities. The program will explore upstream and downstream opportunities to promote value addition, including demonstration and training in (i) adopting climate-smart agricultural practices to improve crop yield, quality and production (ii) adopting advanced agricultural technologies, including modern farm machinery and equipment to enhance efficiency, productivity, and address labor shortages; (iii) value adding through agriculture facilities including crop collection and processing, crop storage, and buying and selling of inputs and outputs. The Project will support the establishment of digital advisory services, which, through digital apps and mobile phones, will provide information on weather, marketing and agriculture advisory services, which will improve farmers' operational efficiency and decision-making. As the farmers and farmer organizations lack access to finance, the project will pilot the provision of partial financing to selected WUAs/WUCs who, based on viable and sustainable business models, want to invest in modern agriculture machinery and construction or rehabilitation of agriculture facilities, including marketing, storage and processing. The WUA/WUC will be required to contribute 50% of financing for machinery and 15% for facilities, following the working directives of the DOA. The program will include:

(i) Development: of agricultural technologies and enterprise development focusing on the interventions that will make the most impact on the needs of farmers in the subproject areas and will include planning and management of cropping patterns using farmer field school approach, training and demonstrations including seed multiplications, green manuring, zero tillage, nature-based solution for soil conservation, and consolidated farming amongst others. The training will identify potential business opportunities and promote the establishment of agriculture enterprises.

(ii) Demonstrations: of (a) agriculture equipment and machinery to support mechanization to reduce reliance on scarce agricultural labour; (b) agriculture facilities to improve the marketing and processing, including agriculture collection centres, grain storage, WUC storage facilities and playhouses. The project will procure equipment for the

demonstrations, which will be assigned to the WUAs/WUCs for future rental to farmers once the demonstrations are completed.

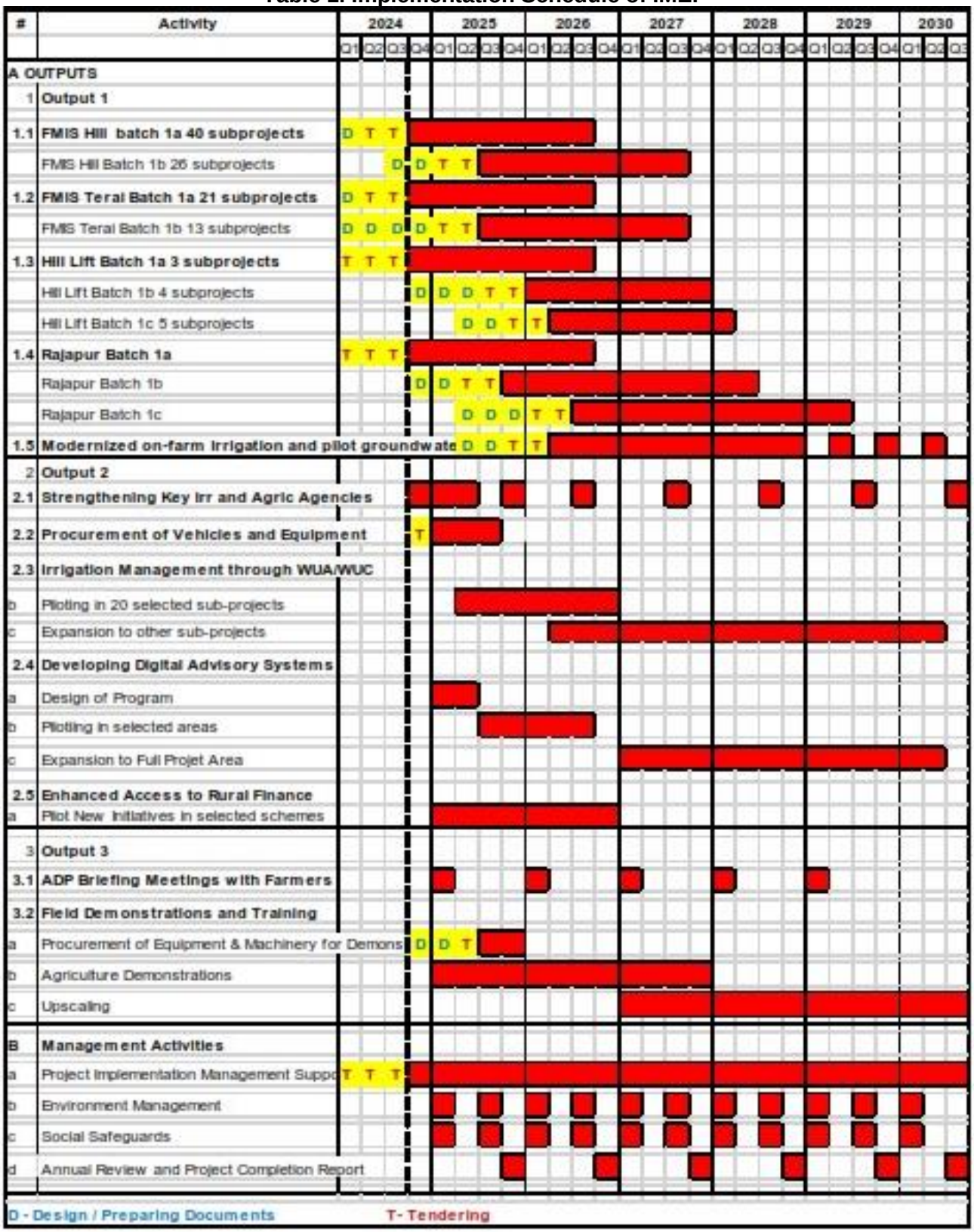
(iii) Upscaling: Following the demonstrations the project will provide financial support for selected WUAs/WUCs to invest in modern agriculture machinery, polyhouses and agriculture facilities. Support will be provided to WUA/WUCs to construct or rehabilitate WUA/WUC facilities for crop storage and agro processing. The aim will be to support selected investments that can demonstrate a viable and sustainable management and business model, be self-financing, and show a significant impact on the viability of the subproject. The project will procure and assign equipment and facilities to the relevant WUA/WUC, contributing 50% of the costs for machinery and 15% for the WUA/WUC facilities.

(iv) Establishment: of communications through digital advisory services to provide cost-effective access to information to the dispersed and remote irrigation areas and stakeholders. The program will include targeted weather, climate change, marketing, and agricultural advisory services. The system will build on existing social media and include videos, SMS, and apps emphasizing user experience focusing on how to meet the needs of different demographic groups of farmers, government, private sector and small-scale entrepreneurs.

D. PROJECT IMPLEMENTATION PLAN

8. The overall project implementation plan of the IMEP is presented in the table below.

Table 1. Implementation Schedule of IMEP



E. FMIS SUBPROJECT SCOPE AND LOCATIONS

9. The IMEP aims to strengthen the existing Farmer Managed Irrigation Systems (FMIS), enhancing the agricultural production in the Koshi, Madhesh and Bagmati Provinces. A total of 100 irrigation subprojects are proposed for the rehabilitation covering a total command area of 17,452 ha.. The main planned irrigation facilities are intake construction, strengthening water distribution canals and other structures, division boxes, drop structures, outlets and protection structures. Each subproject has been provisioned to support the development of self-sustained and long-term crop intensification and diversification, as well as market support services tailored to local needs. The screening result shortlisted 100 subprojects for preparing a subproject preparation report (SPPR).

10. Based on the readiness to complete the subproject preparation report and advanced stage of technical design, the shortlisted schemes were further prioritized following stage-wise implementation. Accordingly, out of 100 subprojects in Priority 1a - 61 irrigation sector project (ISP) (i.e., 40 in Hill Area and 21 in Terai Area) and in Priority 1b - 39 ISP (**Figure 1**). Priority 1a subprojects are already done with the detailed designs of the schemes, while the subprojects under Priority 1b are undergoing designs as of the period of IEE preparation.

11. The following table presents a summary of work under the FMIS component.

Table 2. Scope of work under FMIS

S. N	Scope of Work	Unit	Number	Remark
1	Intake structure (Guide and Afflux Bund, Head / Cross Regulator)	Number	100	64 side intakes 36 weir structures
2	Lining (running meter)	Running meter	132,213	Rehabilitation works Canal lining
3	Pipe laying	Running meter	196,93	Joining
4	Other structures (division box, drop structures)	Number	1772	Distribution structures
5	Footbridge, VRBs	Number	571	Community infrastructures
6	Outlets	Number	1143	Water openings along the canal sections

Source: Compilation from subproject design report 2022-23

12. Under the scope of the FMIS component, the project supports medium- and small-community-led projects that are mostly focused on rehabilitation and/or repair of existing irrigation infrastructure, where the improvement process will not change their existing footprints. These interventions are small undertakings, barely needing complex structures that could significantly impact the social environment. Thus, none of the project activities will require additional land. Around 30.51 per cent of project beneficiaries belong to the Indigenous people. The project area of the FMIS component is spread over 35 districts with varied ecological regions. Almost all ethnic groups available in the country will be the beneficiaries of the FMIS. All FMIS under the proposed intervention have been operational for a long time and upgrading/improving the existing system will not adversely impact Indigenous people.

F. PURPOSE OF INITIAL EXAMINATION

13. The objective of the IEE is to provide an overview of the environmental issues, viz., legal compliance, environmental impacts, mitigation measures to be employed, monitoring and reporting aspects to be covered during the implementation of the FMIS components by the CPMO, WRIDD of the 3 provinces, its Consultants and Contractors. This ensures that the project

is implemented in an environmentally responsible manner, ensuring that all negative effects are prevented or mitigated, and positive impacts are enhanced.

G. METHODOLOGY

14. This IEE report was prepared by conducting site visits, conducting stakeholder consultations, collecting primary and secondary data, assessing the existing environmental conditions at the project component locations, identifying the potential environmental impacts that may occur during project implementation, and developing the relevant mitigation measures, including monitoring. Baseline environmental monitoring for air quality, noise level and river water quality will be done before the start of construction activities.

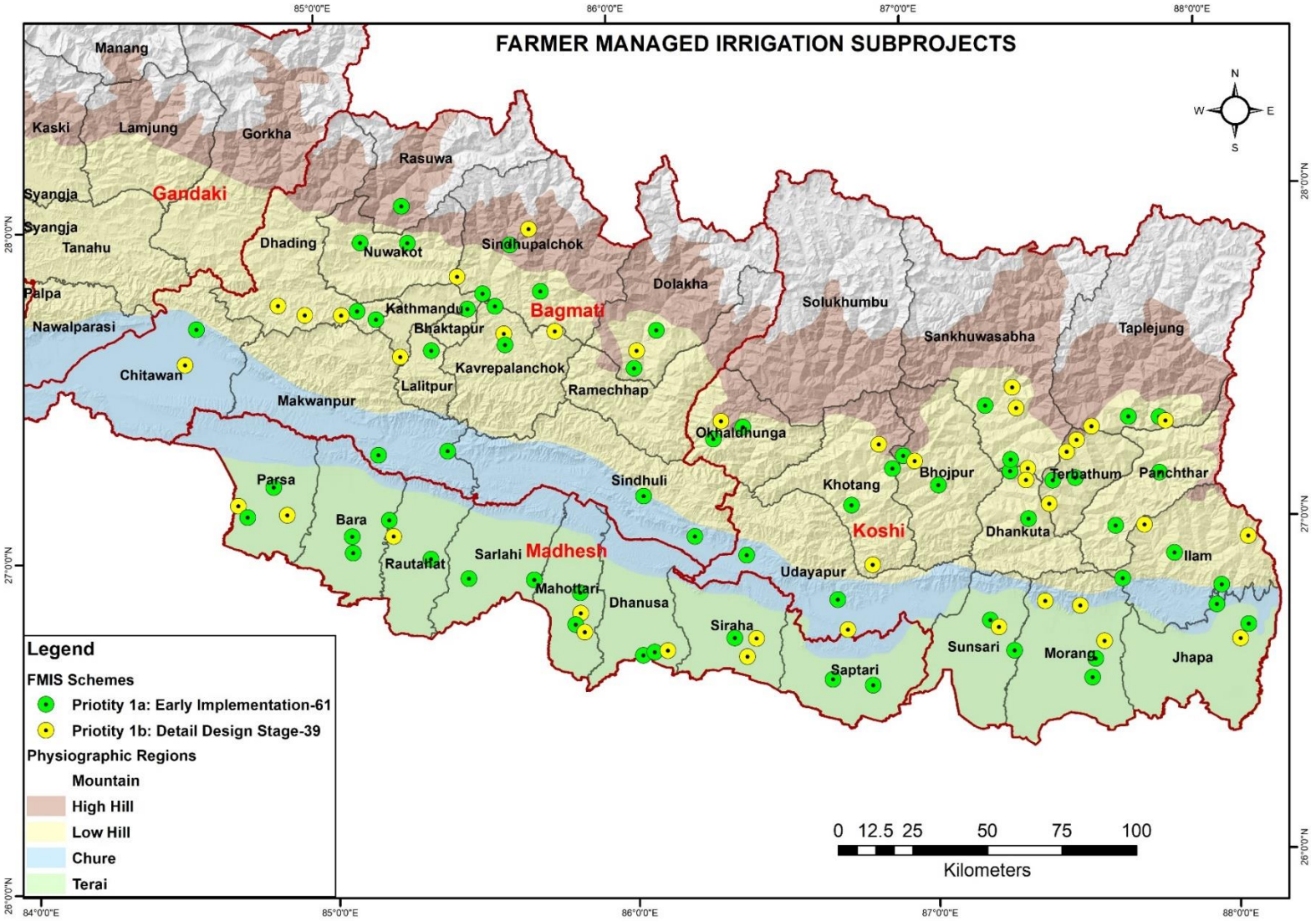
15. During the IEE study, public consultations were conducted with the ward representative, officials of respective municipalities and community people. Their views were incorporated into the IEE and in the planning and development of the project components.

H. Structure of IEE Report

16. The report has been structured to include the following chapters:

(i) Introduction;
(ii) Policy, Legal, and Administrative Framework;
(iii) Description of the Project;
(iv) Description of the Environment;
(v) Anticipated Environmental Impacts and Mitigation Measures;
(vi) Environmental Management Plan;
(vii) Information Disclosure, Consultation, and Participation;
(viii) Institutional Arrangements and Grievance Redress Mechanism;
(ix) Monitoring and Reporting;
(x) Conclusion and Recommendations.

Figure 1: Farmer Managed Irrigation Subprojects Location in three Provinces under IMEP



(Source: Administrative boundary, Survey Department Nepal and Detail Design Report 2023)

II. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

A. ADB SAFEGUARD POLICY STATEMENT, 2009

17. ADB requires the consideration of environmental issues in all aspects of ADB's operations, and the requirements for environmental assessment are described in ADB SPS, 2009. ADB environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts. A project is classified based on the most environmentally sensitive component and assigned with one of the four environmental categories (A, B, C, or FI) defined in the SPS. These categories are as follows.

(i) **Category A**: Project that is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect areas larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA), including an environmental management plan (EMP), is required.

(ii) **Category B**: Project with potential adverse environmental impacts that are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE), including an EMP, is required.

(iii) **Category C:** Project likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications must be reviewed.

(iv) **Category FI**: The project is classified as category FI if it involves the investment of ADB funds to or through a financial intermediary.

18. Initial screening using ADB's rapid environmental assessment (REA) checklist was conducted for the subproject. The results of the rapid assessment show that the project is unlikely to cause any significant adverse impacts and is therefore classified under Category B per ADB SPS. Thus, this IEE report has been prepared following ADB SPS requirements for projects with Category B classification.

19. **Environmental Assessment**. Environmental assessment shall include a description of environmental and social baseline to provide an understanding of current conditions, forming the benchmark against which project components' impacts are assessed. Environmental impacts and risks will be analyzed for all relevant stages of the project cycle, including the design and planning stage, construction, operations, decommissioning, and post-closure activities such as rehabilitation or restoration.

20. **Environmental Planning and Management**. The Central Project Management Office (CPMO) shall prepare an environmental management plan (EMP) to be included in the IEE report. The EMP shall describe and address the potential impacts and risks identified by the environmental assessment. The EMP's level of detail and complexity and the priority of the identified measures and actions will be commensurate with the subproject's impact and risks. The EMP shall include the proposed mitigation measures, environmental monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators.

21. **Public Disclosure**. The CPMO shall submit the following to ADB for review, clearance, and disclosure. ADB will disclose acceptable reports received and endorsed by the DWRI on its website so affected people, other stakeholders, and the public can provide meaningful input into the

subproject design and implementation.[8]

(i) Draft / updated / final IEE upon receipt;
(ii) a new or updated IEE and corrective action plan prepared during subproject implementation, if any, upon receipt; and
(iii) environmental monitoring reports submitted during subproject implementation upon receipt.

22. **Consultation and Participation**. The CPMO shall carry out meaningful consultation[9] with affected people and other concerned stakeholders, including civil society, facilitating their informed participation. The consultation process and its results will be documented and reflected in the environmental assessment report.

23. **Grievance Redress Mechanism**. The CPMO shall establish a mechanism to receive and facilitate the resolution of affected peoples' concerns, complaints, and grievances about the subproject's environmental performance. The grievance mechanism shall be scaled to the risks and adverse impacts of the subproject.

24. **Monitoring and Reporting**. The CPMO shall monitor, measure, and document the progress of implementing the EMP. If necessary, the CPMO will identify the necessary corrective actions and reflect them in a corrective action plan. The CPMO will prepare and submit to ADB semi-annual environmental monitoring reports that describe progress with implementing the EMP, compliance issues, and corrective actions, if any. For subprojects likely to have significant adverse environmental impacts during operation, reporting will continue until ADB issues a project completion report.

25. **Unanticipated Environmental Impacts**. Where unanticipated environmental impacts become apparent during subproject implementation, CPMO shall update the environmental assessment and EMP or prepare a new environmental assessment and EMP to assess the potential impacts, evaluate the alternatives, and outline mitigation measures and resources to address those impacts.

26. **Pollution Prevention and Control Technologies**. During the design, construction, and operation of the project component, the CPMO shall apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the International Finance Corporation (IFC) World Bank Group's Environmental, Health and Safety Guidelines. These standards contain performance levels and measures that are normally acceptable and applicable to subprojects. When the government regulations differ from these levels and measures, the subproject shall achieve whichever is more stringent. If less stringent levels or measures are appropriate in view of specific project circumstances, DWRI, through CPMO, will provide full and detailed justification for any proposed

[8] Per ADB SPS, 2009, prior to disclosure on ADB website, ADB reviews the "borrower's/client's social and environmental assessment and plans to ensure that safeguard measures are in place to avoid, wherever possible, and minimize, mitigate, and compensate for adverse social and environmental impacts in compliance with ADB's safeguard policy principles and Safeguard Requirements 1-4." Upon its receipt of acceptable safeguard documents and endorsement by CPMO, ADB discloses the same on ADB website.

[9] Per ADB SPS, 2009, meaningful consultation means a process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;1 (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

alternatives that are consistent with the requirements presented in ADB SPS.

27. **Occupational Health and Safety**. The CPMO shall ensure that workers are provided with a safe and healthy working environment, considering risks inherent to the sector and specific classes of hazards in the subproject work areas, including physical, chemical, biological, and radiological hazards. CPMO shall ensure to take steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work by (i) identifying and minimizing, so far as reasonably practicable, the causes of potential hazards to workers; (ii) providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment; (v) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.

28. **Community Health and Safety**. The CPMO shall identify and assess the risks to and potential impacts on the safety of affected communities during the project's design, construction, operation, and decommissioning and will establish preventive measures and plans to address them in a manner commensurate with the identified risks and impacts.

29. CPMO shall ensure the application of preventive and protective measures for both occupational and community health and safety consistent with international good practice, as reflected in available national standards on environmental, health, and safety. Where national standards are not available, internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines will be adhered to[10]. CPMO shall also adhere to necessary protocols in response to emerging infectious diseases, such as coronavirus disease (COVID-19), consistent with the guidelines of relevant government healthcare agencies and the World Health Organization.

30. **Physical Cultural Resources**. The CPMO is responsible for siting and designing the project components to avoid significant damage to physical and cultural resources. Such resources likely to be affected by the subproject will be identified, and qualified and experienced experts will assess the subproject's potential impacts on these resources using field-based surveys as an integral part of the environmental assessment process. When the proposed location of a subproject component is in areas where physical, cultural resources are expected to be found as determined during the environmental assessment process, chance finds procedures shall be included in the EMP.

31. **Bidding and Contract Documents**. IEE, which contains the EMP, shall be included in bidding and contract documents and verified by CPMO. The CPMO shall also ensure that bidding and contract documents include specific provisions requiring contractors to (i) comply with all other conditions required by ADB[11] and (ii) to submit to CPMO, for review and approval, a construction environmental management plan (CEMP), including (i) proposed sites/locations for construction work camps, storage areas, hauling roads, lay down areas, disposal areas for solid and hazardous wastes; (ii) specific mitigation measures following the approved EMP; (iii) monitoring program as

[10] World Bank Group, 2007. Environmental, Health, and Safety General Guidelines. Washington, DC.

[11] Contractors to comply with (i) all applicable labor laws and core labor standards on (a) prohibition of child labor as defined in national legislation for construction and maintenance activities; (b) equal pay for equal work of equal value regardless of gender, ethnicity, or caste; and (c) elimination of forced labor; and with (ii) the requirement to disseminate information on sexually transmitted diseases, including HIV/AIDS, to employees and local communities surrounding the project sites.

per CEMP; and (iv) budget for CEMP implementation, among others as may be required. No work can commence prior to the approval of CEMP. A copy of the EMP and/or approved CEMP will always be kept on-site during the construction period. Non-compliance with, or any deviation from, the conditions set out in the EMP and/or CEMP constitutes a failure in compliance and shall require corrective actions.

32. **Conditions for Award of Contract and Commencement of Work**. CPMO shall not award any works contract under the project components until (i) relevant provisions from the EMP are incorporated into the works contract; (ii) this IEE is updated to reflect project components detailed design and CPMO has obtained ADB's clearance of such updated IEE; and (iii) The proposed rehabilitation works of the FMIS are limited within the existing canal systems. There are no construction of new head works and changes in the main canal systems. Thus, for the GoN requirements, the project component does not trigger BES/IEE/EIA

B. NATIONAL ENVIRONMENTAL LEGISLATIONS

33. Most of GoN's national policies and laws are oriented towards achieving environmentally sound economic development and growth and conserving the country's natural resources and cultural heritage. The following are summaries of the relevant policies, acts, regulations, and guidelines.

34. **The Constitution of Nepal, 2015**. This is the fundamental law of the country, and the sections pertaining to environmental protections are as follows:

35. **Article 30 (1)** of the constitution guarantees a "clean environment" as a fundamental right and elaborates that "every citizen shall have the right to live in a clean and healthy environment".

36. **Article 30 (3)** encourages the state to formulate legal frameworks to balance environment and development.

37. Nepal has enacted comprehensive environmental policies and laws that cover a broad range of environmental and sector issues. The Environmental Protection Act (EPA) of 2019 and the Environmental Protection Regulations (EPR) of 2020 are two important legal frameworks for environmental protection. According to the EPA and EPR, all development projects should first be screened using criteria that are based on the scale of the project stipulated in Schedules 1, 2 and 3 of EPR to determine the level of environmental assessment required. Projects that could result in some environmental impacts are required to conduct brief environmental study (BES) BES, projects having moderate environmental impacts are required with the initial environmental examination (IEE), and large projects that could result in major and adverse environmental impacts are required to undergo an environmental impact assessment (EIA) process. The EPA makes necessary arrangements to disclose EIA reports to the general public to render opinions and suggestions.

38. **Environment Protection Act 2019 (2076 BS).** The act emphasizes new aspects, such as provisions of BES, IEE, and EIA, under the jurisdiction of local authorities, provincial governments, and central governments. This act is a pre-requirement for any development project in the country to comply with the environmental safeguards. Article 2 (3) 1 of this act provides environmental assessment. This clearly mentions that the environmental assessment is a prerequisite before the implementation of any project. The details of the criteria are indicated in Environment Protection Rules 2020.

39. **Environment Protection Rules 2020 (2077 BS).** This rule has defined thresholds and equivalent environmental assessments (i.e., BES, IEE and EIA). The proposed FMIS rehabilitation works are limited to the existing canal systems. There are no construction of new head works and changes in the main canal systems, but it is limited to strengthening the existing canal structures. Thus, as per EPR 2020, the project component scope does not trigger BES/IEE/EIA. The irrigation projects have the following requirements for environmental assessment as per EPR 2020, listed in **Table 3.**

Table 3. Irrigation Projects Requiring Environment Assessment as per GoN-EPR, 2020

Schedule 1- BES	Schedule 2- IEE	Schedule 3- EIA
Water Resources Sector:		
• Construction of up to 100-hectare irrigation area of lift irrigation project	• *Irrigation with new system* a) Irrigation of 200 to 2000-hectare area in Terai and inner Terai region (d) Construction of more than 100-hectare irrigation area of lift irrigation project • *Rehabilitation of Irrigation system* a) Construction of new headwork or operation of rehabilitation project with the change in the main canal • Water Resource Development Work with the resettlement of 25 to 100 population	• Irrigation with new system a) Irrigation of more than 2000-hectare area in Terai and inner Terai region • Water Resource Development Work with the resettlement of more than 100 population • Construction of Multipurpose water dam • Transfer of water from one water source to another (inter-basin water transfer) for the utilization

Source: Environment Protection Rules 2020

40. Other relevant government laws and regulations. Government environmental acts, rules, policies, and regulations will govern the implementation of project components proposed under the project. The contractors for FMIS will need to comply with all the government laws and regulations stated in **Table 4** below.

Table 4. Relevant Government Laws and Regulations

S.N.	Policies, Acts, Regulations, Guidelines	Relevant Provisions
1	**Fifteenth Five Years Plan, 2020−2024, Nepal**	• Requires all projects to be formulated and constructed basedon methods that optimally utilize local skills and resources andgenerate employment opportunities. • Attention is paid towards minimizing the impacts of climate change and protecting the environment. It aims to minimize the adverse impacts of disasters on people, property, culture, environment, and economy. • The policy aims to integrate disaster risk management in all development activities to reduce the loss of people and property.
2	**Forest Act 2076 (2019)**	• Pertaining to Chapter 12, Section 42(1), if there is no other alternative to the use of forest area for the operation of a national priority project, a plan of which the Investment Board approves investment, project of national pride. It appears from the environment examination referred to in the prevailing law that if the operation of such a plan does not result in significant adverse effects on the environment, the Government of Nepal may approve, as prescribed, the use of any part of the national forest to operate such a plan. • Similarly, in providing the forest area for the operation of a plan pursuant to sub-section (1), to the extent possible, a land that is adjoining to the national forest area near the project site and situated in the same geographical and ecological belt and has such landscape where forest can be developed shall be provided to plant trees at least in the area equal to the forest area that has to be used.
3	**Forest Regulations, 2079 (2022)**	• Pertaining to Rule 87 (2), in the case of a development project related to the use of forest land, coordination with the concerned division forest office during the feasibility study and environmental study must be done. • Rule 88, Application needs to be submitted in case of use of national forest land from

S.N.	Policies, Acts, Regulations, Guidelines	Relevant Provisions
		the feasibility study, and application needs to be submitted to the Ministry of Forests and Environment through the subjective ministry • Rule 89, following Rule 88, the Ministry of Forests and Environment directs the Division Forest Office through its department for detailed field information, which should also be submitted to the provincial ministry. • Under Rule 90, following Rule 89, the Division Forest Office should submit the information with field monitoring (if necessary) to the Ministry of Forests and Environment. If the applicable information and letters are received, the ministry will ensure the use of forest land and give permission to the respective project by binding the rules stated in the Forest Regulations. • Rule 91, following Rule 90, after the decision made by the government of Nepal for the permission to use the forest land, the development project should make the availability of the applicable land for the forest development as per the Forest Act (2076), Section 42 (2). • Under Rule 92, following Rule 91, if the applicable land is not available, it must be sought through the Land Acquisition Facilitation Committee at the district level. • Rule 93, following Rule 92, states that in case the land acquisition through the Committee fails, the respective department should give permission to the project to Collect amounts in the government fund as per the land purchases for the development project specified in Shedule-51. • Rule 93 (5), the compensation for the loss of 1 tree loss should be made with the plantation of 10 trees with the amount based on the cost of the trees in the ratio of 1:10 and Rule 93 (5), the amount must include bi-annual production or purchase of trees, trees transportation, afforestation of 1600 trees per hectare, fencing and boundary for the protection of trees and require number of people for look after.
4	**Conservation Area Government Management Area Rules 2001**	• Contains a number of regulatory measures to minimize environmental impacts within the forests, national parks, wildlife reserves and conservation areas. Prior to implementation, the EPA 2076 B.S. (2019 AD) requires a proponent to undertake BES, IEE or EIA for a proposed project and have the report approved by the concerned ministries. Introducing the exotic species on the specific location may require an IEE before implementing the project as per the EPR, 2020 Appendixes 1, 2 and 3 Rule 3 a, b, and c.
5	**Water Resource Act, 1992**	• Water Resource Act, 1992 of clauses 3, 7, 18, 20, 22 and 24 implies state ownership of any surface/stream bodies of Nepal and stresses the utilization of water resources by any individual or organization without causing harm to others. It embodies that the Government of Nepal can fix, monitor and formulate regulations pertaining to water quality standards, pollution tolerance levels and development of water resources. It prohibits any action that may pollute water resources surpassing the threshold value. It has prioritized the use of water resources in successive order: drinking/domestic use, irrigation, fishery, electricity, water transport, and recreation. It urges that resources be utilized without causing any considerable damage to the environment, such as soil erosion, floods, and other similar natural hazards. The Act fails to address the mandatory license for water extraction, even from the landowner.
6	**Water Resource Regulation, 1993**	• The Water Resources Act was published in the Nepal Gazette on (2050/5/1). Persons interested in using water resources on an institutionalized basis may form a consumer association consisting of at least Seven persons as officials and members. There shall be a Water Resources Committee in each District to issue a license pursuant to Sub-section (1) of Section 8 of the Act in order for the utilization of Water Resources contained within Nepal. The government of Nepal, may, giving due consideration to the types, structure, and capacity of the project relating to utilization of wat16 of the Act, prohibit from using the house or land situated within the area of the project specifying the fixed distance for the site for a specified worker resources for the purpose of Sub-section (3)
7	**Irrigation Rules, 2000 (Amendment in 2060)**	• Irrigation Rules, 2000 Chapter 2 provides the formation of the user's association in a format as prescribed in Schedule –1 and the procedure for transferring the project. Under Rule 12, the Users' association may plant trees on the side or right of way of a Canal, Branch or Secondary Canal, Minor or Tertiary Canal, Water course or Field Channel after the approval of the community forest work - plan according to the

S.N.	Policies, Acts, Regulations, Guidelines	Relevant Provisions
		prevailing Forest Act and Rules from the concerned Forest Office. In determining the place for the plantation, coordination shall be made with the concerned Irrigation Office. Until the work plan pursuant to Sub-rule (1) is approved, the Users' Association may sell the rotten or fallen trees lying on the side of the Canal, Branch or Secondary Canal, Minor or Tertiary Canal, Water course or Field Channel and the trees which need pruning may be pruned upon the approval of the committee. • Similarly, under Chapter 6, an irrigation project shall be constituted to implement the large-scale irrigation project designated by the GoN. It also deals with the function, duties and power of the designated project committee, staff and the establishment of the Project Unit Office.
8	**Irrigation Policy (2013)**	• The Irrigation Policy document sets out the rationale for subsector development and policy objectives and approaches for project development, water user associations, irrigation service charges and irrigation system operation and maintenance
9	**Soil and Watershed Conservation Act, 2039 BS**	• In order to properly manage the watersheds of Nepal, the Soil and Watershed Conservation Act 1982 was enacted. Section 3 of the Act empowers GoN to declare any area as a protected watershed area. Section 4 of the Act provides that a watershed conservation officer has the authority to implement the following works in protected watershed areas: • Construct and maintain dam, embankment, terrace improvements, diversion channels and retaining walls, • Protect vegetation in landslide-prone areas, undertake afforestation programs, and • Regulate agricultural practices pertinent to soil and watershed conservation. • Under Section 10 of the Act, power is extended to the Watershed Conservation Officer to grant permission to construct dams, drainage ditches, and canals, cut privately owned trees, excavate sand, boulders and soil, discharge solid waste, and establish industry or residential areas within any protected watershed. The Act outlines the essential parameters for proper watershed management (including rivers and lakes). The Act applies to protected watersheds.
10	**Soil and Watershed Conservation Regulations, 2042 BS**	• Under the powers conferred by Section 25 of the Soil and Watershed Conservation Act 1982, the Government of Nepal has framed Soil and Watershed Conservation Regulations, 2042 BS. Pursuant to sub-rule (1) of rule 10 natural calamity clause (a), (b), (c), (d), (e), (f), (g) of section 10 of the Act and (h) if anyone has to do the work mentioned in the reason to do so. An application has to be submitted to the Watershed Conservation Officer in the format of open schedule 4 (2). After receiving the application as per sub-rule (1), the watershed protection officer, in case of any action contrary to the purpose of the Act, in the format of Schedule 5 as per schedule. will allow.
11	**Water In duced Disaster Management Policy 2015 (2072)**	• The latest policy of the Government of Nepal recognizes climate change as one of the main causes of water-induced disasters in Nepal. • This policy is introduced to achieve the objectives of the National Water Resources Strategy and National Water Plan on water-induced disaster management through the participation and coordination of public, cooperative, and private sector institutions. It encourages people to contribute land to flood protection works voluntarily. • Its main objective is to make infrastructure sustainable, and its policy involves communities, cooperatives, and the private sector. It stresses the need for medium—and long-term disaster prevention and control programs and makes them climate-resilient and environment-friendly.
12	**Land Acquisition Act, 2034 BS (1978AD)**	• The government can acquire land at any place in any quantity by giving compensation pursuant to the act for any public purposes or the operation of any development project initiated by government institutions.
13	**Labor Act, 2074 (2017 AD)**	• This Labor Act was done under the management of parliament under sub-clause 1 of clause 296 of the Constitution of Nepal. Sub-section 3 of Section 2 states that the employees should not be compelled to do work other than what they are assigned. In addition, Sub-section 5 of Section 2 prohibits child labour in any organization, and Sub-section 6 of Section 2 states that there should not be any discrimination among employees regarding religion, ethnicity, gender, origin, language intelligence, or other kind of character.
14	**Child Labor**	• As per section 3 of this act, no child who has not attained the age of 14 years shall be

S.N.	Policies, Acts, Regulations, Guidelines	Relevant Provisions
	(Prohibition and Regulation) Act, 2056 (2000 AD)	engaged in work as a labourer.
15	**Solid Waste Management Act, 2068 (2011 AD)**	• This act has been formulated to minimize solid waste production from the target area by setting rules and regulations on solid waste management (SWM) in the country in order to develop a better environment for the systematic and effective management of solid waste and to involve all the concern stakeholders in SWM practice. The main feature of this act is a discussion of the 3R principle (Reduce, Reuse and Recycle). The 3R principle seems to be very beneficial as it not only increases the life of landfill sites but also saves money, which could be used for other infrastructure development. Section 4 of the act assigns the local body to manage or use the solid waste discharged or dumped in a collection center, transfer station or treatment plant or collected during cleaning.
16	**Solid Waste Management Rules, 2070 (2013 AD)**	• The solid waste management rule was formulated as per the provision made in Article 50 of the Solid Waste Management Act of 2068. This regulation emphasizes the segregation of waste at source and mentions that the responsibility for proper disposal and management of sources belongs to the producers. Section 3 of the rule describes the segregation and management of solid waste. It has been mentioned that it is essential to segregate degradable and non-degradable solid waste at the source.
17	**The National Parks and Wildlife Conservation Act (1973AD)**	• This Act deals with the conservation and management of wildlife and habitat. The Act restricts entry into national parks without prior permission of the concerned authority. Hunting of animals or birds, building or occupying houses, shelters or structures, occupying, clearing, planting or growing in any part, cutting, felling, removing or overshadowing any tree and removing any quarry or any other activities in national parks are banned. • Wildlife Reserve Regulation, 1977, entry, construction of houses or sheds, clearance of forest and forest products, quarrying and overnight stay in a reserve area is prohibited unless authorized inwriting by the relevant GoN authority. • Buffer Zone Management Regulation, 1994, clearance of forests and forest products, acquisition of land, use of quarry sites and hunting in buffer zones is restricted unless written approval of the relevant GoN authority is obtained.
	Local Self Governance Act (1999AD)	• This Act gives Local Government the functions, duties and power to, among others; (i) conserve and protect their local environment and natural resources; (ii) plan, implement and/or operate and maintain local water supply projects; (iii) implement and/or arrange for implementation local sanitation/sewerage and drainage projects; (iv) protect cultural heritage and religious sites and/or (v) monitor project activities within their jurisdictions.

C. INTERNATIONAL ENVIRONMENTAL AGREEMENTS

41. The table lists the international environmental agreements that Nepal is party to and their relevance with the WUC Project.

Table 5. International Environmental Agreements and standards ratified by GoN

International Convention	Year*	Relevant Provisions	Remarks
World Heritage Convention	1978	Parties are to ensure the protection and conservation of the cultural and natural heritage on the territory primarily belongingto the State. World Heritage sites are identified as per this convention.	The project components will not impact physical and cultural resources and natural heritage during implementation and operation.
Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (Ramsar	1987	Parties should conserve and wisely use wetlands (i.e., maintain their ecological character) as a contribution to achieving sustainable development locally and worldwide. This convention will identify the Ramsar areas.	The project components are not located in wetlands, but they are classified as Ramsar sites.

International Convention	Year*	Relevant Provisions	Remarks
Convention)			
Convention on Biodiversity (CBD)	1992	Parties require the environmental assessment of projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects. The CBD also identified the biodiversity identified the hot spot areas.	The project will not impact the country's biodiversity hot spot areas. The project component's scope is the rehabilitation of the existing canal structures.
UN Framework Convention on Climate Change	1992	Parties to take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects.	The project will help the Government of Nepal comply with this agreement. Theproject will ensure the implementation of farmers' resilience to climate change.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	1996	Parties to, among others, minimize the amount and toxicity of hazardous waste generated, manage the hazardous and other wastes they generate in anenvironmentally sound mannerand as close as possible to the source of generation.	The project will ensure the implementation of its EMP as a measure to avoid or minimize the generation and disposal of any hazardous wastes.

**(Year) - Year last amended.*

D. APPLICABLE ENVIRONMENTAL STANDARDS

42. **National Ambient Air Quality Standards for Nepal, 2003.** As shown in the table below, the air quality standards for Nepal have set standards for 7 parameters: total suspended particles (TSP), PM10, Sulphur Dioxide (SO_2), Nitrogen Oxide (NO_2), Carbon Monoxide (CO), Lead (Pb) and Benzene.

43. **The World Health Organization (WHO) Air Quality Guidelines.** The WHO guideline has set quality standards for 4 parameters PM10, PM2.5, SO_2 and NO_2. According to ADB SPS 2009, when host country regulations differ from international levels and measures, the project will achieve whichever is more stringent. Both policies provide guidelines and comply with the more stringent standards during the construction period.

Table 6. Standards for Ambient Air Quality for both GoN and WHO

Parameter	Averaging Period	Nepal's Ambient Air Quality Standard (µg.m^3) *	WHO Air Quality Guidelines (µg.m^3)	
			Global Update 2005**	Second Edition^ 2021
TSP	Annual	-	-	-
	24-hour	230	-	-
PM $_{10}$	Annual	-	20	15
	24-hour	120	50	45
PM $_{2.5}$	1-year	-	10	5
	24-hour	-	25	15
SO_2	Annual	50	-	-
	24-hour	70	20	40
	10-minutes	-	500	-
No_2	1-year	40	40	10
	24-hour	80	-	25
	1-hour	-	200	-
CO	8-hour	10,000	-	4 (24-hr)
	15-minutes	100,000	-	-

Parameter	Averaging Period	Nepal's Ambient Air Quality Standard (µg.m^3) *	WHO Air Quality Guidelines (µg.m^3)	
			Global Update 2005**	Second Edition^ 2021
Pb	1-year	0.5	-	-
Benzene	1-year	20	-	-

*Source: *National Ambient Air Quality Standard for Nepal, 2003. Obtained from Environment Statistics of Nepal, 2011, National Planning Commission Secretariat, Central Bureau of Statistics, Nepal.*

** WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide. *Global update 2005*. WHO. 2006.

^ Global Air Quality Guidelines. WHO 2021.

44. **Emission standard for diesel generator EPR-14, 2020**. The emissions standards set for new DG imports are equivalent to Bharat Stage III standards, and for in-use DGs, they are equivalent to Bharat S Inventories and Black Carbon Emissions in Kathmandu Valley, Nepal. Emission standards are set for four major pollutants: CO, HC, NOx, and PM.

45. **National Noise Standard Guidelines, 2012**. The guidelines set standards for noise levels, measured in dBA, in industrial, commercial, rural, urban, mixed, residential, and quiet areas. They also provide standard values for the noise level generated by water pumps and DG.

46. For international standards, WHO Noise Level Guidelines have set the noise levels measured in dBA for two areas: residential and commercial areas. The project will achieve whichever is more stringent. Both policies provide guidelines to follow and comply with the more stringent standards during the construction period.

Table 7. Standards for noise levels for both GoN and WHO

Receptor/Source	National Noise Standard Guideline 2012 (dBA)		WHO Guidelines Values for Noise Levels Measured Out of Doors*(One Hour LA_q in dBA	
	Day	Night	07:00-22:00	22:00-07:00
Industrial Area	75	70	70	70
Commercial Area	65	55		
Rural Settlement Area	45	40	55	45
Urban Residential Area	55	50		
Mixed Residential Area	63	55		
Quiet Area	50	40	-	-
Water Pump	65		-	
Diesel Generator	90		-	

**Guidelines for Community Noise, WHO, 1999*

47. **Nepal Water Quality Guidelines for Irrigation Water, 2008**. The guidelines set the standards for irrigation water, with the targeted quality range for the different parameters (Table 8). The guideline also shows the acceptable concentration limits for the plant species.

Table 8. Nepal Water Quality Guidelines for Irrigation Water

S.N.	Parameter Name	Target Water Quality Range	Remarks
Microbiological constituents:			
1	Coliforms (fecal)	< 1 count /100 ml	1 – 1000 count / 100 ml could be used for plants for which edible parts are not wetted
Physical Constituents:			
1	pH	6.5 – 8.5	Adverse effects on plants outside this range
2	Suspended Solids	< 50 mg/L	Above the limit problem with sedimentation and irrigation system
3	Electrical Conductivity	< 40 mS/m	Up to 540 mS/m depending upon the sensitivity

S.N.	Parameter Name	Target Water Quality Range	Remarks
			of crops
Chemical Constituents:			
1	Aluminum	< 5 mg/L	Up to 20 mg/L max. acceptable conc.
2	Arsenic	< 0.1 mg/L	> 2 mg/l creates a severe problem
3	Beryllium	< 0.1 mg/L	0.1 – 0.5 mg/L max. acceptable conc.
4	Boron	< 0.5 mg/L	Up to 15 mg/L depending upon species.
5	Cadmium	< 0.01 mg/L	0.01 – 0.05 mg/L max. acceptable conc.
6	Chloride	< 100 mg/L	Up to 700 mg/L depending upon species
7	Chromium	< 0.1 mg/L	Up to 1.0 mg/L max. acceptable conc.
8	Cobalt	< 0.05 mg/L	Up to 5.0 mg/L max. acceptable conc.
9	Copper	< 0.2 mg/L	Up to 5.0 mg/L max. acceptable conc.
10	Fluoride	< 2.0 mg/L	Up to 15 mg/L max. acceptable conc.
11	Iron	< 5.0 mg/L (non-toxic)	> 1.5 mg/L creates problem in drip irrigation system
12	Lead	< 0.2 mg/L	Up to 2.0 mg/L max. acceptable conc.
13	Lithium	< 2.5 mg/L	For citrus < 0.75 mg/l
14	Manganese	< 0.02 mg/L	Up to 10 mg/L max. acceptable conc.
15	Molybdenum	< 0.01 mg/L	Up to 10 mg/L max. acceptable conc.
16	Nickel	< 0.2 mg/L	Up to 2.0 mg/L max. acceptable conc.
17	Nitrogen (inorganic)	< 5 mg/L	Higher concentrations may affect sensitive plants and may contaminate groundwater
18	Selenium	< 0.02 mg/L	Up to 0.05 mg/L max. acceptable conc.
19	Sodium Adsorption Ratio (SAR)	< 2.0	Up to 10 depending upon the sensitivity of crops.
20	Sodium	< 70 mg/L	Up to 460, depending upon the sensitivity of crops
21	Total Dissolved Solids (as EC)	< 40 mS/m	Up to 540 mS/m depending upon the sensitivity of crops
22	Uranium	< 0.01 mg/L	Up to 0.1 mg/L max. acceptable conc.
23	Vanadium	< 0.1 mg/L	Up to 1.0 mg/L max. acceptable conc.
24	Zinc	< 1.0 mg/L	Up to 5 mg/L max. acceptable conc.

Source: Nepal Water Quality Guidelines for Irrigation, DWRI (Nepal Gazette (Number 10.16 June 2008)

III. DESCRIPTION OF THE SUBPROJECT

A. DESCRIPTION OF THE SUBPROJECTS

48. The IMEP aims to strengthen the existing FMIS, thus enhancing the agricultural production in 35 districts of the Koshi, Madhesh and Bagmati Provinces. A total of 100 irrigation subprojects are proposed for the rehabilitation works. The immediate objective of the FMIS is to significantly increase agricultural productivity by making targeted improvements to the irrigation system. This involves not only rehabilitating and enhancing existing infrastructure but also ensuring that these systems can deliver a reliable water supply throughout the year. By addressing issues such as seepage, inefficiency, and the absence of regulatory structures, the projects aim to maximize water availability and distribution. This, in turn, supports more consistent and higher-yielding crop production cycles, essential for the economic well-being of the local farming communities.

49. Another crucial component of these FMIS is enhancing the capacity of Water User Associations (WUAs). These associations play a pivotal role in the operation and maintenance (O&M) of irrigation systems. Strengthening WUAs involves providing training and resources to improve their management skills and technical knowledge. Effective WUA management ensures that the irrigation infrastructure is maintained sustainably, and that water distribution is equitable among farmers. This organizational empowerment is vital for the long-term success and sustainability of the irrigation systems, promoting a collaborative approach to resource management among community members.

50. Moreover, the FMIS aims to improve agricultural production methods and access to agricultural inputs and marketing. This includes introducing modern farming techniques, providing better access to high-quality seeds, fertilizers, and other essential inputs, and enhancing market access for farmers' produce. By facilitating better agricultural practices and ensuring that farmers can easily obtain necessary resources and sell their products at fair prices, these initiatives help to increase farm incomes and food security. Ultimately, the combined focus on irrigation improvements, WUA capacity building, and enhanced agricultural practices creates a robust framework for achieving higher agricultural productivity and improving farmers' livelihoods in the project areas.

FMIS Schemes

51. Across the Terai, Hill, and Mountain belts, FMIS subprojects are tailored to address the unique challenges of each ecological zone. The Terai belt focuses on large-scale irrigation to support extensive agricultural fields. The Hill belt addresses irrigation in areas with moderate slopes and diverse cropping patterns, while the Mountain belt emphasizes the development of resilient infrastructure for steep and rugged terrains. Each subproject aims to enhance water management and agricultural productivity, ensuring sustainable livelihoods for the local communities. Below is the summary of the FMIS subprojects, and **Appendix 1** shows the complete list.

Terai Region

52. The Terai belt, spanning the Madhesh and Koshi Provinces, hosts many FMIS subprojects due to its extensive agricultural land and fertile plains. These projects focus on maximizing agricultural productivity by supporting large command areas. In the Madhesh Province, Bara District houses projects like the Jokaha Dora ISP in Mahagadhimai Municipality, covering 300

hectares, and the Bhaluhi Suklaiya Patti in Karaiyamai RM, covering 360 hectares. Mahottari District features the Rato Bhagwatipur ISP in Balawa Municipality, which spans 515 hectares, alongside the Chakkarghatta ISP in the same municipality with 670 hectares. Additionally, the Rato Kokila ISP in Loharpattei and Jaleshwor NP supports a vast command area of 1,120 hectares.

53. In Sirha District, the Gagan ISP in Sukhipur has a command area of 835 hectares, while Baburam and Saraswati in Laxmipur Patari cover 400 and 276 hectares, respectively. Sarlahi District includes the Haripurwa ISP, managing 414 hectares, and the Laukat Dhangada ISP in Bansbariya RM, covering 375 hectares. In Rauthat District, the Dorapaini Raghunathpur ISP in Garuda and Aruwa Khola ISP in Phatuwa, Bijayapur, cover 255 and 430 hectares, respectively, while Aruwa Aknowa ISP spans 264 hectares. In Dhanusha District, the Soharna and Bachharaja ISPs in Bideha span 430 and 325 hectares, while the Let ISP in Kamla covers 250 hectares. Parsa District projects include the Hadahi ISP in Jagarnathpur RM (275 hectares), Gadi ISP in Paterwa Sugauli RM (280 hectares), Oriya in Jagarnathpur (145 hectares), and Megha in Parsagadhi (200 hectares). Finally, Saptari District projects like Kajra ISP in Dakneswari and Jita Khola ISP in Mahadeva RM cover 400 and 227 hectares.

54. In Koshi Province, Morang District houses several significant projects. The Sita Dans Kerkha ISP in Sunbarshi Municipality spans 370 hectares. The Sira Jimdari ISP in Kerabari RM covers 300 hectares. Pathri Sanischare Municipality hosts the Adarsa Paini ISP with 230 hectares and the Indreni ISP with 200 hectares. Sunsari District includes projects like the Kajara Khola Kataghara Bandh ISP in Ramdhuni, covering 131 hectares, and the Shankar Beli project, spanning 72 hectares, both in Ramdhuni. In Jhapa District, the Haldar Paini ISP in Arjundhara Municipality covers 250 hectares, and the Hadiya Khola Abi Nahar ISP in Mechinagar Municipality spans 265 hectares. In comparison, Pathivara Krishi Kulo in Mechinagar covers 165 hectares.

Hill Region

55. The Hill belt, extending across the Bagmati and Koshi Provinces, focuses on improving irrigation in areas with moderate slopes and diverse cropping patterns. These projects, though supporting smaller command areas, are crucial for sustaining local agriculture. In Bagmati Province, Kavre District features projects like the Barasai Saathi ISP in Panchkhal (58 hectares) and Kumaitaar ISP (25 hectares). The Salleni Khola Pahari Basti ISP in Bhumlu RM covers 50 hectares, while the Muhane Mul Kulo ISP in Mandan Deupur spans 65 hectares.

56. Sindhuli District includes the Purwari Pachiyari ISP in Dudhauli Municipality, covering 170 hectares, and the Sakhamadi Chadaha ISP in Tinpatan, managing 90 hectares. In Lalitpur District, the Godavari (Right) Rajkulo ISP in Godawari covers 80 hectares, and the Chimti ISP in Paanchpokhari Thaangpal spans 105 hectares. Makwanpur District projects like the Chyau Chyau ISP in Bakaiya RM and the Bagmati ISP in Bagmati RM cover 80 and 75 hectares. In Nuwakot District, the Samari ISP in Bidur and the Dorkhu Khola ISP in Tadi RM manage 25 and 40 hectares, respectively. Kathmandu District includes the Phaku Khola project in Dakshinkali (30 hectares), Bishombhar (90 hectares) and Chisapani Laharedevi ISP (30 hectares) in Shankharapur.

57. In Koshi Province, Bhojpur District features projects like Simle Ghatte ISP in Bhojpur Municipality (25 hectares), Yangtang Khola Mailung Kulo ISP (45 hectares), and Hinkuwa Khola ISP (30 hectares) in Temkemaiyung RM. Dhankuta District houses the Birendra ISP (106 hectares), Chayalu Laktang ISP (188 hectares), and Leguwa Khola ISP (250 hectares) in Mahalaxmi Municipality, and the Tin Dovane Kerabari ISP in Dhankuta Municipality (98 hectares).

Ilam District includes Mangaltar Dhansar ISP in Rong Rural Municipality (95 hectares), Satake ISP in Fakfokathum RM (121 hectares), and Nunsari ISP in Chulachuli RM (91 hectares), alongside other projects with varying priorities. Terhathum District hosts projects like Lambu Kulo ISP in Laliguras RM (300 hectares), Maynkhuwa Khola ISP (135 hectares), and Guranse ISP (85 hectares) in Menchhayayem RM, and others. Khotang District features the Sabju Khola Bhalu Khola ISP in Sakela Rural Municipality (86 hectares), Kharuwa Khola Aek Chhahe ISP (234 hectares) in Diprung Chuichumma RM, and several other projects. Udaipur District includes Beladaha ISP in Katari (105 hectares) and other projects in Triyuga N.P.

Mountain Region

58. The Mountain belt, particularly in Bagmati and Koshi Provinces, emphasizes the development of resilient irrigation infrastructure to manage water distribution in steep and rugged terrains. In Bagmati Province, Dhading District hosts projects like Sopyang Khola Gatta Ko Kulo ISP (50 hectares), Liti ISP (110 hectares), Jhagadiya Sikre ISP (45 hectares), Parbang ISP (100 hectares), and Dharmasala ISP (120 hectares). Dolkha District includes Nimkot Besi ISP (50 hectares), Nause Besi Kulo ISP (72 hectares), and Ghyang Khola ISP (301 hectares). Sindhupalchowk District features projects like Pokhre Tipling Khola Siran Kulo ISP (65 hectares), Mahadev Khola Sisneghari Dittiya ISP (76 hectares), and Bimreni Dhunge ISP (66 hectares). Rasuwa District includes Dhuple Khola ISP in Naukunda RM (35 hectares).

59. In Koshi Province, Sankhuwasabha District includes projects like Pangma Khola Badreni ISP in Khandbari Municipality (41 hectares), Kenwa Khola Fituwa Malibheg ISP in Dharmadevi Municipality (55 hectares), Thado Khola in Panchakhapan Municipality (44 hectares), and Sang Khola in Savapokhari RM (38 hectares). Taplejung District hosts Nebu Khola ISP (87 hectares) and Major Singh ISP (67 hectares) in Sirijangha RM, Khokse Nangkholyang ISP (63 hectares) in Pathibhara Yangbarak RM, and Chuwa ISP (90 hectares) in Aatharai Tribeni Gaunpalika.

Conditions of the FMIS

60. The stability of the riverbed varies significantly, with subprojects experiencing riverbed degradation, which could lead to structural and ecological issues. In contrast, other subprojects maintain stable riverbeds, providing a more reliable foundation for water management infrastructure. Other subprojects face riverbed aggradation, where sediment accumulation could impact water clarity and flow. Riverbank stability is also a concern, with erosion affecting both banks in some regions. At the same time, other areas report stable banks, which are crucial for preventing land loss and maintaining structural integrity.

61. The main river flow conditions also show variability, with some regions having confined flows that might restrict natural movement and affect the aquatic ecosystem. Other areas report concentrated flow on one side of the bank or unstable flow, leading to unpredictable water movement and potential hazards during high flow periods. The types and conditions of diversion structures used in these projects highlight significant issues. Temporary boulder/brushwood weirs are common, but they have sustained major damage in several areas, questioning their durability and effectiveness in water management. In two areas, no diversions are in place, which simplifies the structure but may reduce flexibility in water management

62. Intake control is another critical aspect, with all subprojects reporting uncontrolled intakes, which have sustained major damage in most cases. This lack of control can significantly affect water quality and distribution. Furthermore, the absence of bank or flood protection across all areas highlights a substantial vulnerability to environmental impacts. The drainage quality varies,

with some areas having well and rapid drainage systems capable of handling significant water flow without flooding. Other regions report good or natural drainage, but flooding during monsoon seasons and partial erosion indicate that existing measures are ineffective. The presence or absence of water logging and erosion further emphasizes the need for improved infrastructure and preventative measures to ensure sustainable water management and protection against environmental hazards.

B. CURRENT ISSUES IN FMIS SUBPROJECTS

63. Present cropping patterns, cropping intensity, yields, and varieties being grown on both irrigated and rain-fed areas have been identified together with the present inputs of seeds and fertilizer and availability of agricultural inputs and market. Crops are currently grown in three seasons – monsoon, winter and spring. The major crops grown in the command area are Paddy and Wheat. The other crops include Maize, Vegetables, and Pulses. Some farmers are using improved crop varieties.

64. Presently, farmers cannot divert sufficient irrigation water for crops in the cropping seasons due to the absence of permanent intake and other infrastructure in the canal system. Besides these, the high seepage losses from the canal system also aggravate the sufficiency of water in the canal. In addition, the farmers have limited access to appropriate seeds of good quality, chemical fertilizer and other agrochemicals. Other problems are associated with a lack of appropriate equipment for the application of insecticides/ fungicides and inadequate market information. The present performance of the irrigation system can be summarized as follows:

Table 9. Status of Irrigation Services in Subprojects

Indicators	Present Situation	Causes	Proposed Measures
Delivery of an adequate quantity of water	Water shortage in the tail of the system in the spring and winter seasons	• Dominant head reach farmers • Absence of control structures in the canals	Improving water control and water distribution arrangements
Equitable distribution	• First come, first serve management system • Agreed allocation of water to head, middle and tail users	• Dominant head reach farmers • Absence of control structures in the canals	Improving water control and water distribution arrangements
Timely Delivery	No timely delivery in the tail end in spring and winter	Absence/poor condition of a water management system	Improved coordination in scheduling of water delivery

65. *Delivery of an adequate quantity of water.* The present situation indicates a water shortage at the system's tail during the spring and winter seasons. This shortage can be attributed to two primary causes: the dominance of head-reach farmers who likely have priority access to water, reducing availability downstream, and the absence of control structures within the canals, which hampers effective water regulation and distribution. To counter these issues, the proposed measure is to improve water control and distribution arrangements. Implementing such improvements could involve the installation of gates or valves that regulate flow or the redesign of canal structures to ensure more balanced water distribution across all sections of the system.

66. *Equitable Distribution.* Currently, water distribution operates on a first-come, first-served basis, with an agreed allocation that appears to favour head, middle, and tail users. Similar to the issues in water quantity delivery, the causes include the dominant position of head-reach farmers and a lack of control structures. This system inherently benefits those positioned at the head of the supply line, often to the detriment of those at the tail. The proposed solution again emphasizes the need to improve water control and distribution arrangements, ensuring a more equitable

allocation of water resources to all users regardless of their position along the canal.

67. *Timely Delivery*. There is a noted lack of timely water delivery at the tail end during the critical growing seasons of spring and winter. This is primarily due to the absence or poor condition of the water management system. The lack of effective management and deteriorating infrastructure impede the capacity to schedule and deliver water when it is most needed by users at the tail end of the system. The measure proposed to address this problem is the improvement of coordination in the scheduling of water delivery, which would likely involve both physical upgrades to infrastructure and enhancements in the management practices that dictate how water is allocated and delivered.

68. The overarching issues highlighted across all indicators involve a combination of infrastructural inadequacies and management inefficiencies. Dominant farming interests at the head of the canal system, coupled with a lack of adequate control mechanisms, exacerbate the inequity and inefficiency of the water distribution system. The recurring proposal to improve control and distribution infrastructure, alongside better management practices, indicates a comprehensive approach to addressing the systemic flaws. These changes are crucial for achieving a fair, adequate, and timely distribution of water resources, ultimately supporting the sustainability and productivity of the agricultural sector reliant on this water system.

C. THE PROPOSED PROJECT STRATEGY

69. The immediate objective of the subproject is to increase agriculture productivity through improvements in the irrigation system and enhancing the capacity of the WUA. The other objectives of developing the scheme are.

(i) Rehabilitation & improvement of the existing irrigation infrastructure.
(ii) Develop the capacity and roles of WUA for O&M of irrigation systems to ensure scheme sustainability.
(iii) Enhance agriculture support services for yield improvement, crop diversification and marketing.
(iv) Livelihood support for disadvantaged groups in the subproject area
(v) Raise the environmental management awareness among the villagers

70. The proposed cropping pattern and total crop water requirement for the proposed crops in different months are based on evapotranspiration, crop coefficients, and the area's effective rainfall. Based on the application efficiency and conveyance efficiency of the canal system, the diversion requirement at the headwork and water balance are proposed.

71. The net command area of the subprojects was estimated by deducting the area under natural vegetation, human settlement, roads, other built forms, and barren land from the gross command area. Implicit in this assessment is that all the areas currently cropping located on different terraces in the subprojects would be irrigated by the proposed irrigation system. One inherent limitation in considering the existing area under cropping as a potentially irrigable area is that it does not consider the future expansion of human settlement, which will definitely involve the conversion of agricultural land into human settlement and other land uses. The estimates of the gross and net command areas of the Subprojects will be refined in due course as the Consultants proceed with design and the area facing land use conversion from farming to non-farm uses and micro-level differences in topography that limit the access to irrigation become apparent.

72. The WUA will be responsible for the operation and maintenance of the proposed irrigation

system. In recognition of the need for a significant capacity-building program to accompany the civil works, prominence will be given to the development of the management of the distribution component of the scheme. This will also include water management, operation, and maintenance of the subproject to maximize the effectiveness of the investment. The operation procedure can be done as follows:

(i) Manually operated regulators will be used to control flow in the main canal and at the entrance to branch canals.
(ii) Flow to field channel will be controlled by on/off gates.
(iii) Collection of water fees will be improved so that the WUAs can meet the O&M costs for sustainable system operation,
(iv) Active involvement of the beneficiaries in O&M will be promoted through WUA,
(v) Operation of the field channels in accordance with a rotation system developed by the beneficiaries will be promoted to allow farmers to manage flow to their fields.

Water Balance

73. The water balance analysis in the subproject areas considers the crop and irrigation water requirements to ensure efficient water distribution and usage. The crop water requirements of various crops grown in the command area are calculated based on evapotranspiration, crop coefficients, and effective rainfall. These calculations help determine the total crop water requirement for different months of the year. The proposed cropping pattern and total crop water requirement are presented to align with the available water resources, ensuring that there is sufficient water to irrigate the proposed cropped area in all seasons.

74. The irrigation water requirements and water balance are calculated based on the application efficiency and conveyance efficiency of the canal system. This involves determining the diversion requirement at the headwork and balancing it against the mean monthly flow of the stream. The water balance calculations show that the water available is sufficient to meet the irrigation needs of the crops throughout the year, thereby supporting the proposed cropping patterns and ensuring sustainable agricultural productivity.

75. For example, in the Tarauli ISP in Chitwan, a detailed water balance calculation is performed to design an appropriate cropping pattern based on the mean source flow. The project's total water requirement is determined by factoring in the efficiencies of different components of the irrigation system. The field crop water requirement is adjusted based on a 60% farm application efficiency and 80% distribution canal efficiency. This leads to a tertiary headwater requirement, further adjusted by a 70% main canal efficiency. This process ensures that the total diversion requirement is accurately estimated, allowing the water balance to be calculated by comparing this requirement with the mean monthly flow of the water source. The subproject ensures sufficient water to meet the irrigation needs throughout the year, with specific values provided for different crops and seasons. **Appendix 2** shows a sample balance calculation.

Sample Water Balance Analysis in Appendix 2

76. Appendix 2 Table D.1 provides information on the water flow from the source throughout the year, segmented into two parts: the first half and the second half of each month. These segments help in understanding how the water availability varies within each month, which is essential for effective irrigation planning and management. The first and second half month discharge simply refers to the total flow rate of water, measured in liters per second, for the first half of the month without considering the specific characteristics of the catchment area. This general discharge measure is used for practical planning of water use, such as for irrigation. The

first and second half month discharges provide the overall flow rate without specific considerations. In water balance applications, general discharge is used for practical water management, such as determining how much water is available for irrigation during a specific period.

77. Practical Example. In July, which typically experiences higher rainfall and water availability, the discharge values are significantly higher. The first half month discharge is 10,246.32 liters per second, while the second half month discharge is 12,275.52 liters per second. This substantial increase in water flow during July indicates an abundance of water available for irrigation, which can support the high-water demand of crops during this period.

78. Table D.2 in Appendix 2 is crucial for understanding the evapotranspiration (ETo) values, which play a significant role in determining the water requirements of crops. ETo represents the amount of water lost from the soil and plant surfaces due to evaporation and transpiration. By analyzing ETo, we can estimate how much water needs to be supplied to crops through irrigation to maintain optimal growth conditions.

79. Climatic Parameters Affecting ETo. The table lists various climatic parameters on a monthly basis, which are essential for calculating ETo. These parameters include:

- Precipitation (mm): This indicates the monthly average rainfall in millimeters. Precipitation contributes to the natural water available for crops, reducing the need for additional irrigation. For instance, in January, the table shows 7 mm of rainfall.
- Minimum and Maximum Temperature (°C): The table provides the average minimum and maximum temperatures for each month in degrees Celsius. Temperature is a key factor in evapotranspiration, as higher temperatures generally increase the rate at which water is evaporated from the soil and transpired by plants. For example, in January, the minimum and maximum temperatures are 5.80°C and 18.7°C, respectively.
- Mean Relative Humidity (%): This column shows the average relative humidity for each month as a percentage. Relative humidity influences the rate of evapotranspiration, with higher humidity levels typically reducing ETo because the air holds more moisture, slowing down evaporation. In January, the mean relative humidity is 61.44%.
- Wind Speed (km/day): The average daily wind speed is recorded in kilometers per day. Wind speed can significantly affect ETo by moving moist air away from the crop surface more quickly, which increases the rate of water loss. For January, the wind speed is 86.4 km/day.
- Sunshine Hours (hours): This indicates the average number of sunshine hours per day for each month. More sunshine generally leads to higher ETo values because the energy from the sun increases evaporation from the soil and plant surfaces. In January, there are 6.4 sunshine hours per day on average.

80. ETo Calculation and Its Importance. The calculated ETo values, presented in millimeters per day (mm/day), integrate these climatic parameters to estimate the amount of water that is evaporated and transpired by crops. For instance, the ETo value for January is 1.87 mm/day. This value is crucial for determining the crop water requirement (CWR), which combines ETo with crop-specific coefficients to understand the actual water needs of different crops during various growth stages.

81. Practical Application. By using the data from Table D.2, irrigation planners and farmers can make informed decisions about water management. For example, knowing the ETo values helps in planning irrigation schedules to ensure that crops receive the right amount of water at

the right time, optimizing growth and yield. This is particularly important in regions where water resources are limited, as efficient water use can lead to better crop production and resource conservation.

82. Table D.3 in Appendix 3 is important for understanding the net CWR for various crops. This table helps determine the amount of water needed to meet the evapotranspiration demands of the crops, ensuring optimal growth and yield. By providing specific water needs for each crop type at different growth stages, the table guides effective irrigation planning and water resource management.

83. Components of Table D.3 in Appendix 2. The table lists different types of crops grown in the region, each with unique water needs influenced by factors such as growth stage, climate, and soil type. The water requirements are broken down by different growth stages of the crops, such as germination, vegetative, flowering, and maturation stages. For each stage, the Net CWR is provided, measured in liters per second (l/s). These values account for the ETo and crop coefficients, which adjust the ETo values to reflect the specific water needs of each crop. For example, paddy rice might have a Net CWR of 0.5 l/s during the germination stage, increasing to 1.2 l/s during the vegetative stage, peaking at 1.5 l/s during the flowering stage, and decreasing to 0.8 l/s during the maturation stage.

84. Adequate and timely water supply based on the Net CWR helps optimize the growth and health of crops, leading to better productivity and improved quality of produce. Efficient water use, based on accurate CWR data, also helps reduce wastage and conserve water resources, contributing to environmental sustainability. It minimizes the risk of over-irrigation, which can lead to soil erosion and nutrient leaching.

85. Practical Application. In practical terms, Table D.3 of Appendix 2 provides a roadmap for farmers to follow throughout the growing season. During peak water demand periods indicated in the table, farmers can ensure their irrigation systems are fully operational and that water delivery is optimized to meet high demands. Conversely, during periods of lower water demand, irrigation can be reduced, conserving water for future use. This precise and efficient use of water ensures that crops receive the necessary water to thrive, supporting sustainable agricultural practices and enhancing food security.

86. Table D.4 in Appendix 3 provides a comprehensive overview of the water balance calculation for various crops in the irrigation scheme. This table integrates several key components, including the net CWR, field crop water requirement, tertiary head water requirement, total diversion requirement, and the mean monthly flow, to assess the overall water availability and usage.

87. The Net CWR column lists the net water needs of crops, adjusted for factors like ETo and specific crop coefficients. The CWR reflects the precise amount of water required by crops during different growth stages to maintain optimal health and productivity. This baseline measurement is crucial for understanding the fundamental water needs of different crops under ideal conditions.

88. The Field Crop Water Requirement considers the efficiency of water application at the field level. It adjusts the net CWR to account for losses during water application, ensuring that the actual water reaching the crop roots meets the crops' needs. This adjustment is necessary because some water is invariably lost during the process of irrigation due to factors such as evaporation and runoff.

89. The Tertiary Head Water Requirement further adjusts the field crop water requirement by considering conveyance losses in the distribution system. This ensures that the water reaching the tertiary units, where it is distributed to individual fields, is sufficient to meet the crops' water demands. Conveyance losses occur as water travels through canals and pipes, making it important to account for these losses to ensure adequate water delivery to the fields.

90. The Total Diversion Requirement represents the total amount of water that needs to be diverted from the source to meet the tertiary head water requirements. It accounts for all potential losses in the irrigation system, from the source to the fields. This comprehensive figure is critical for planning how much water to divert from natural sources to meet agricultural needs.

91. The Mean Monthly Flow provides the average amount of water available from the source each month. This value is critical for comparing the total diversion requirement against the available water, ensuring that the irrigation plan is feasible. Understanding the mean monthly flow helps in determining whether the water supply can meet the demand during different times of the year.

92. The Water Balance is the difference between the mean monthly flow and the total diversion requirement. A positive water balance indicates that there is sufficient water to meet the irrigation needs, while a negative balance suggests a potential water shortage. This calculation is essential for proactive water management, helping planners take measures to address potential shortfalls.

93. For instance, in a typical month like January, the table might show a Net CWR of 12.2 l/s for the first half and 19.0 l/s for the second half. The Field Crop Water Requirement could be 20.3 l/s and 31.7 l/s, respectively, after adjusting for application efficiency. The Tertiary Head Water Requirement, accounting for conveyance losses, might be 25.4 l/s and 39.6 l/s. The Total Diversion Requirement, representing the overall water needs including all losses, might be 36.3 l/s for the first half and 56.6 l/s for the second half. With a Mean Monthly Flow of 1149.1 l/s and 1044.2 l/s, the Water Balance would be positive, showing 1112.8 l/s and 987.6 l/s available, indicating a surplus of water for irrigation.

Infrastructure Development

Headwork Component

94. The Diversion Works/Headwork component of the irrigation projects encompasses several critical aspects necessary for ensuring efficient water management and protection against flooding and erosion. The primary objective is to improve the intake structures, enhance flow control, and ensure the stability and protection of the riverbanks. Key elements include the construction of headworks, controlled gated head regulators, and gabion protection for flood control (**Figure 2**). The design and drawings of these components are typically detailed in the project appendices, ensuring precise implementation and adherence to safety standards.

95. *Construction of Headworks.* The construction of headworks is a pivotal element in irrigation projects, serving as the foundation for water diversion and management. Headworks are structures built at the point where water is diverted from a source, such as a river or stream, into an irrigation canal system. These structures are designed to manage the water flow, ensuring a consistent and controlled supply to the irrigation channels. In the context of the Sopyang Khola ISP and similar projects, headworks typically include components like weirs, gates, and silt traps to regulate and maintain the water flow. The headworks are strategically constructed to handle

the maximum expected water flow, preventing overflow and ensuring the sustainability of the irrigation system during varying seasonal flows. These structures are essential for protecting downstream areas from excessive water flow and minimizing the risk of erosion and flooding.

96. *Controlled Gated Head Regulators.* Controlled gated head regulators are integral to effectively managing water flow in irrigation systems. These regulators are installed at the headworks and along the main canals to control the amount of water entering the irrigation system. The gates can be adjusted to regulate the flow based on the water requirements of the crops, ensuring efficient water distribution and preventing wastage. In projects like the Chakkarghatta ISP, the implementation of controlled gated head regulators allows for precise control over the water flow, enhancing the efficiency of the irrigation system. These regulators also help manage water distribution during different crop growth stages, ensuring that each phase receives the appropriate amount of water. Additionally, they play a crucial role in mitigating the impact of floods by controlling the release of excess water during high-flow periods, thus protecting the infrastructure and agricultural lands from damage.

97. *Gabion Protection for Flood Control.* Gabion protection is a crucial method used in flood control and bank stabilization in irrigation projects. Gabions are wire mesh containers filled with rocks, concrete, or sometimes sand and soil, used to form flexible, permeable structures that protect riverbanks and canal sides from erosion. In the context of the Purwari Pacchiyari ISP, gabion protection is implemented upstream and downstream of the headworks to shield the river channel from the erosive forces of flowing water. This protection is essential in maintaining the integrity of the irrigation infrastructure, especially during high-flow conditions. Gabions help dissipate the energy of flowing water, reducing its velocity and the associated erosive potential. By stabilizing the riverbanks and preventing erosion, gabions ensure the longevity and reliability of the irrigation systems, safeguarding the agricultural lands and infrastructure from flood-related damages.

Conveyance Facilities and Structures

98. Conveyance facilities and structures play a crucial role in irrigation projects, ensuring efficient and effective water distribution from the source to the fields. These facilities include the main canals, distributary canals, field channels, and related structures that transport water over long distances. For the various subprojects, these conveyance systems are designed to optimize water delivery and minimize losses due to seepage and evaporation. For instance, the main canal receives water directly from the headworks and then distributes it to secondary and tertiary canals, which further convey water to the fields. The design of these canals includes considerations for slope, lining materials, and cross-sectional shape to ensure the smooth and efficient flow of water.

99. The conveyance facilities are designed to handle varying water flows and ensure that all parts of the command area receive adequate water supply. This includes the construction of control structures such as gates and weirs within the canals to regulate flow and manage water distribution effectively. Additionally, structures like siphons, aqueducts, and culverts navigate the canal network over natural and man-made obstacles, ensuring uninterrupted water delivery. Including proper drainage systems alongside these conveyance facilities also helps manage excess water and prevent waterlogging, thereby maintaining soil health and agricultural productivity.

100. Conveyance facilities are enhanced with the construction of retaining walls, lined channels, and sedimentation basins. These structures help maintain the structural integrity of the canals and reduce maintenance costs by preventing erosion and sediment buildup. The lined

channels are vital in reducing water loss through seepage and improving water use efficiency. Moreover, the sedimentation basins are designed to trap sediments and prevent them from entering the conveyance network, which can otherwise lead to blockages and reduced water flow. This holistic approach to designing and constructing conveyance facilities and structures ensures the long-term sustainability and efficiency of the irrigation system, providing reliable water supply to agricultural lands throughout the year.

Figure 2. Typical drawing of Head and Cross Regulator proposed for the Irrigation Subprojects

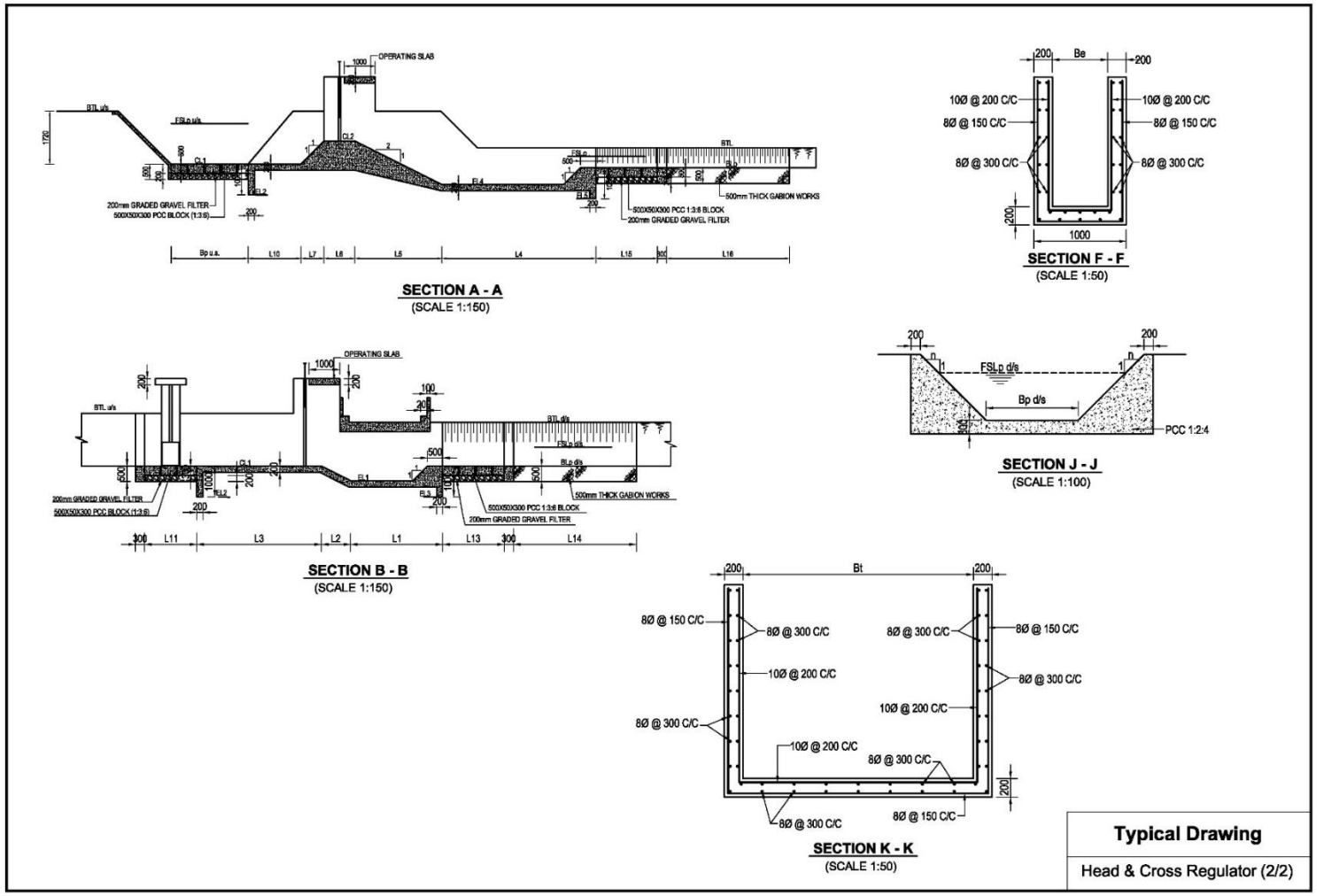


Figure 3. Typical drawing of Canal Lining details proposed for the Irrigation Subprojects

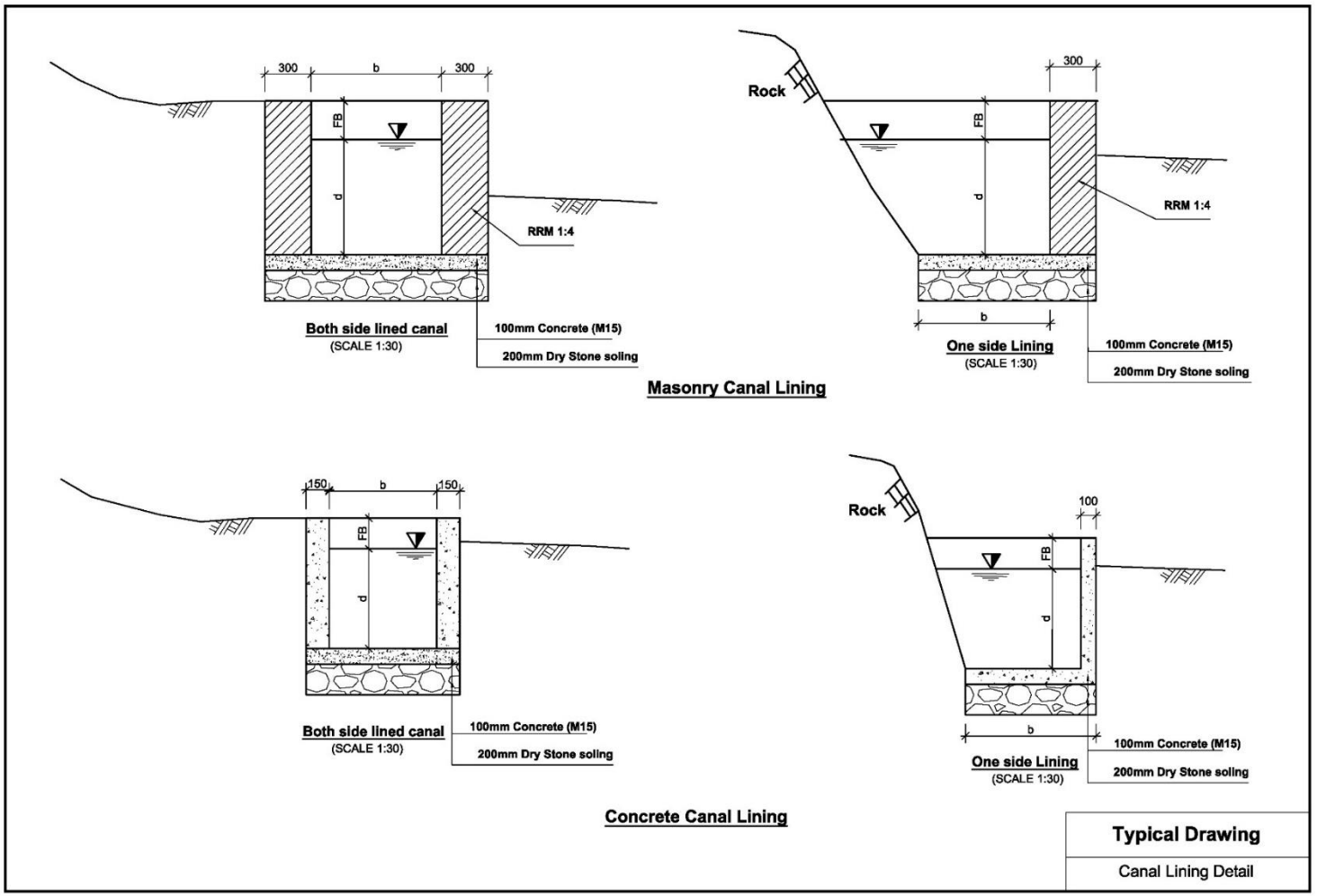


Figure 4. Typical drawing of direct outlet proposed for the Hill Irrigation Subprojects

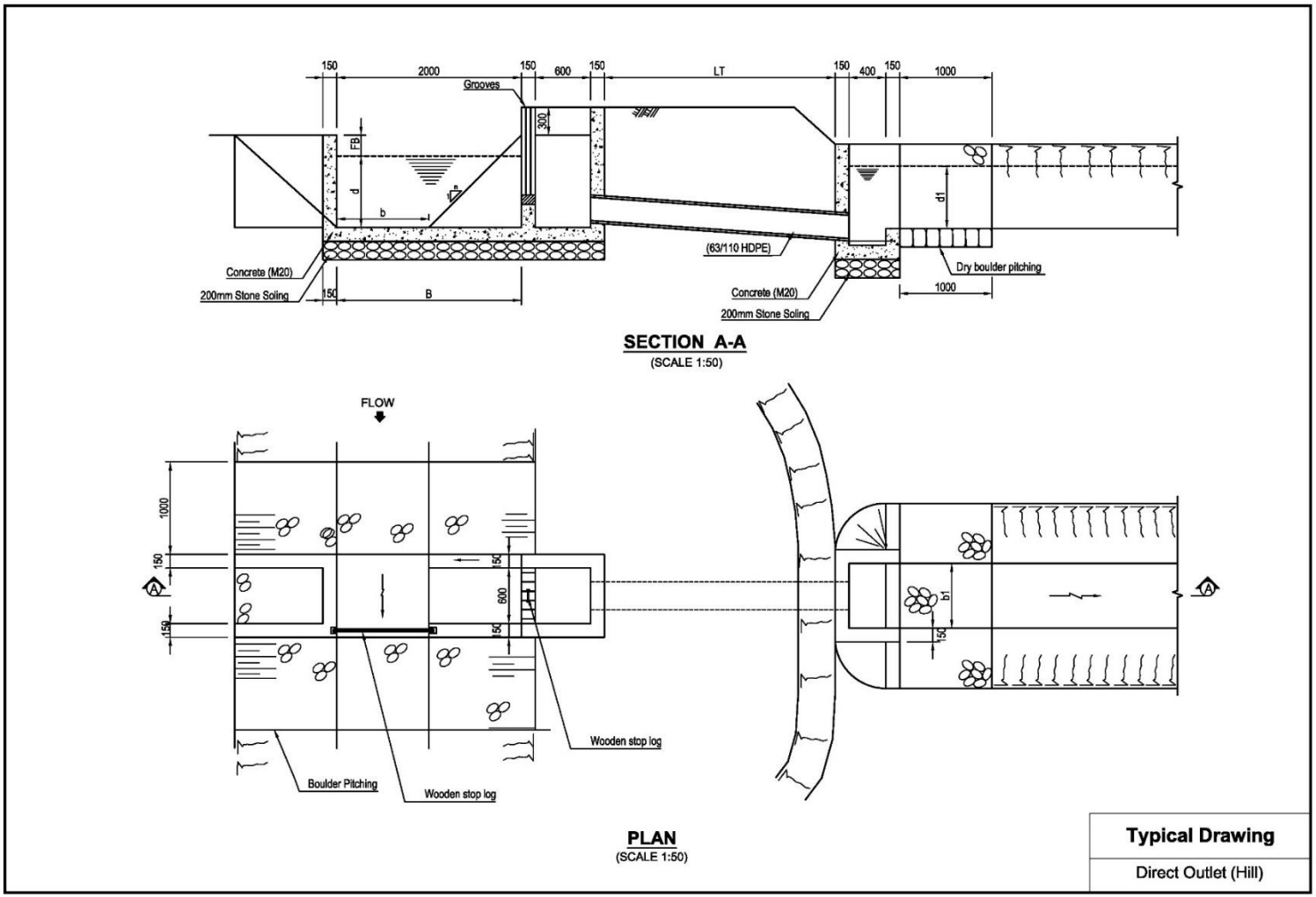


Figure 5. Typical drawing of direct outlet proposed for the Terai Irrigation Subprojects

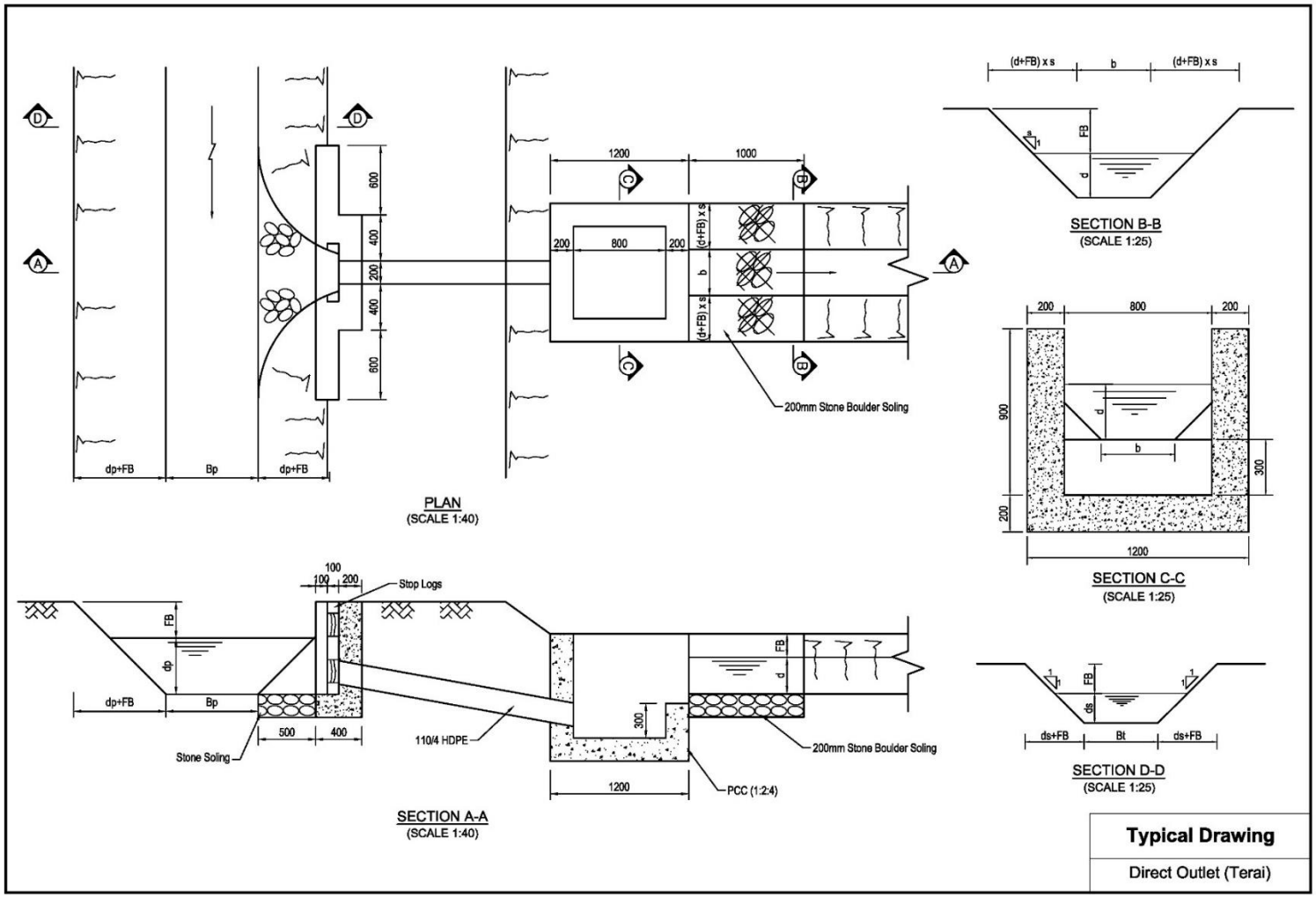


Figure 6. Typical drawing of Drop Structure proposed for the Irrigation Subprojects

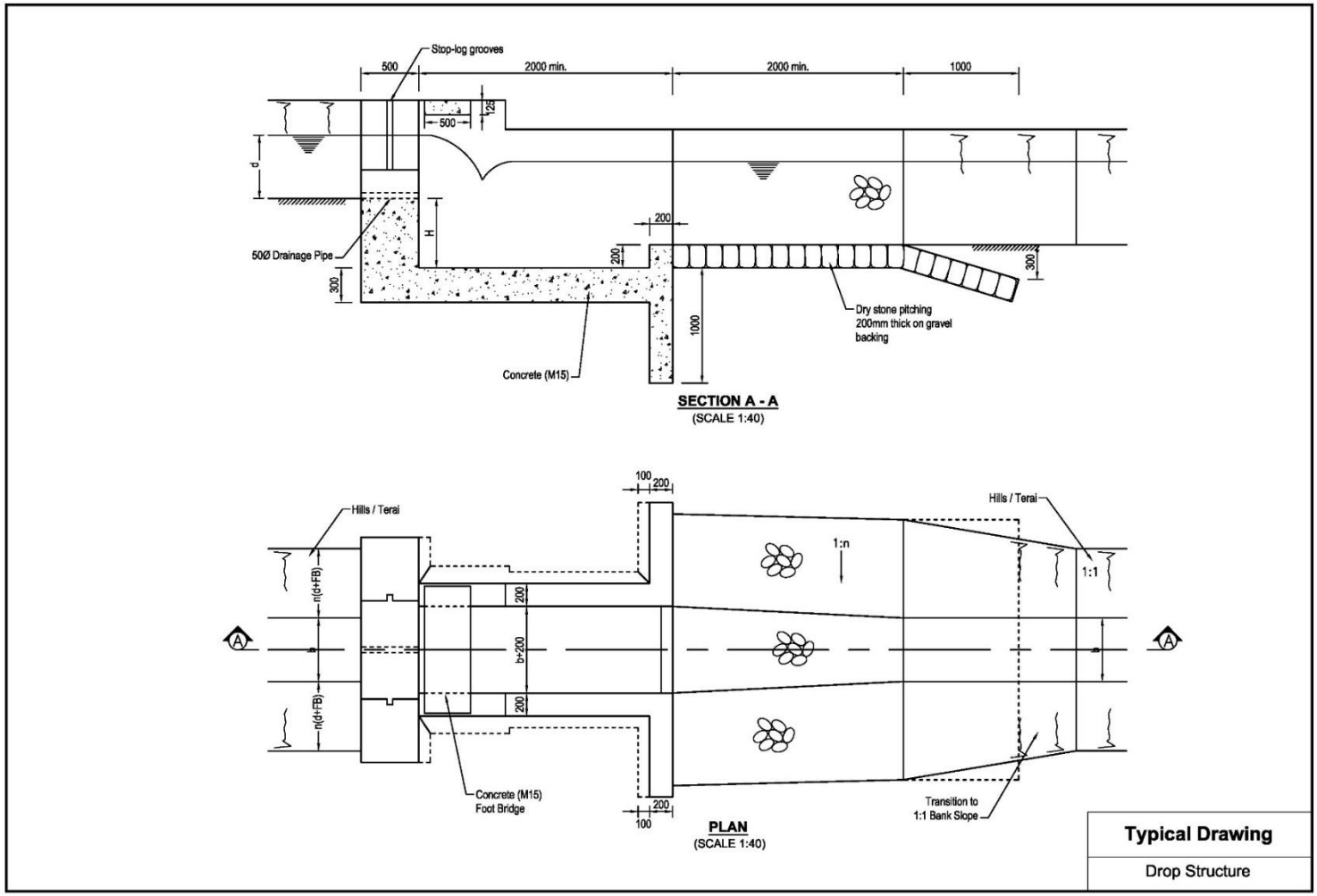


Figure 7. Typical drawing of Foot Bridge proposed for the Irrigation Subprojects

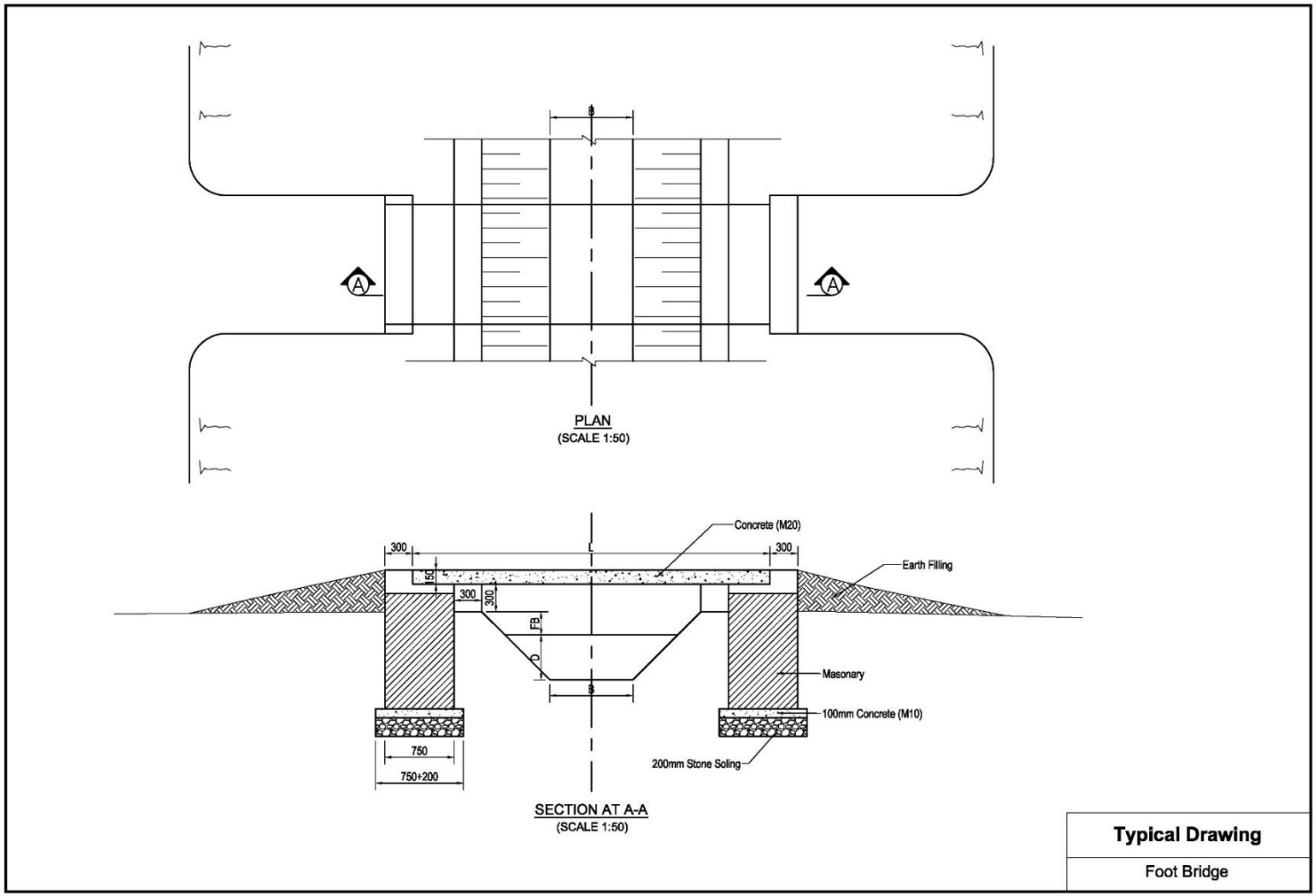
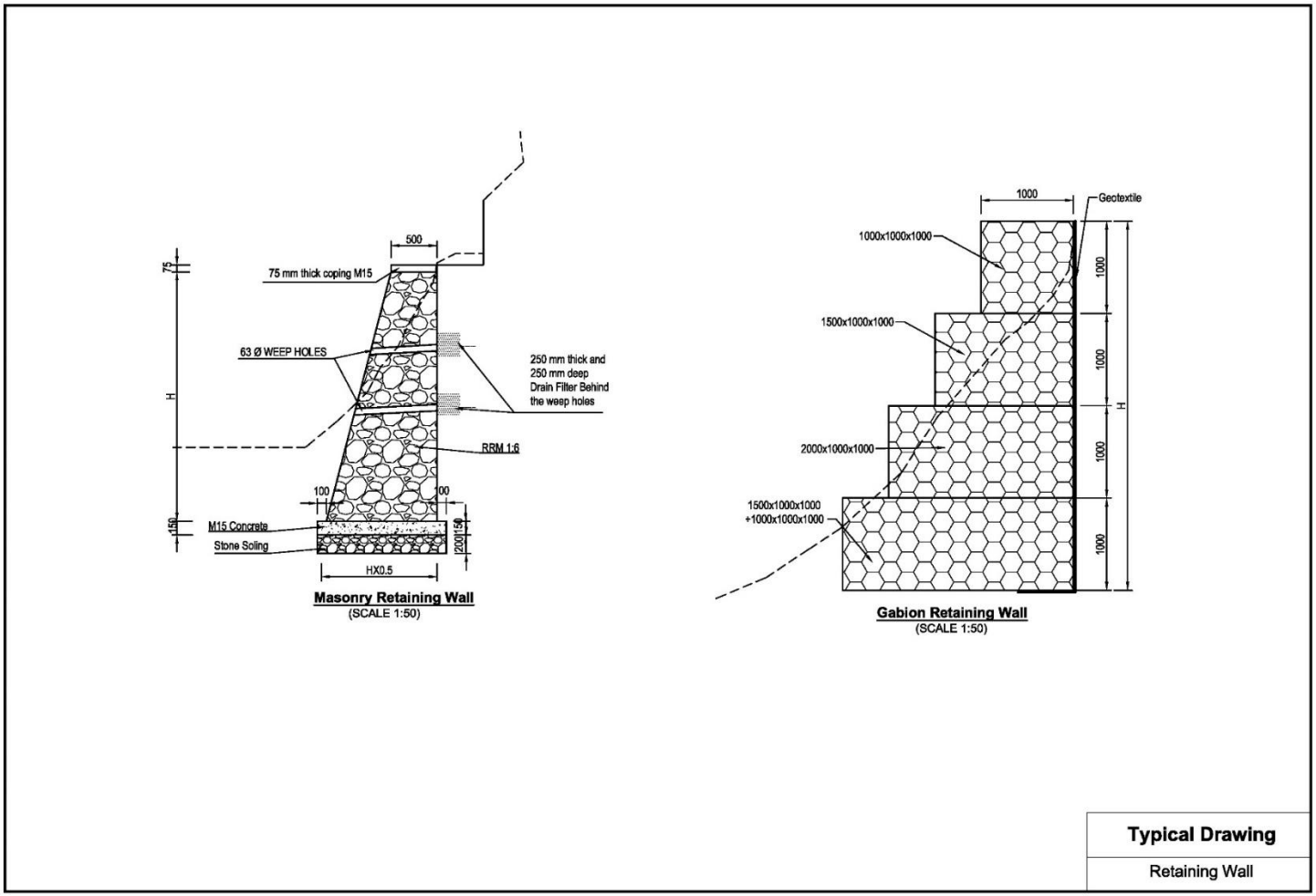


Figure 8. Typical drawing of Retaining Wall proposed for the Irrigation Subprojects



Operation and Maintenance (O&M) in FMIS

101. The O&M is a critical component for the sustainability and efficiency of FMIS. Effective O&M ensures that the irrigation infrastructure functions optimally, providing reliable water supply to the agricultural fields. The operation phase involves the regular monitoring and management of water distribution through the canal network. This includes the adjustment of gates and regulators to control the flow of water according to the crop water requirements and seasonal variations. Regular inspections are conducted to identify any issues, such as leaks, blockages, or structural damages, that could impede water flow.

102. Maintenance activities aim to preserve the physical condition of the irrigation infrastructure. This includes routine cleaning of canals and drains to remove sediment and debris, repairing any damages to the canal lining, gates, and other structures, and reinforcing embankments to prevent erosion. Maintenance also involves periodic desilting of canals and sedimentation basins to ensure unobstructed water flow.

103. The role of WUAs is pivotal in the operation and maintenance of FMIS subprojects. WUAs are responsible for organizing the community for collective management of the irrigation system, ensuring equitable distribution of water, and mobilizing resources for maintenance activities. The WUA undertakes regular training and capacity-building programs to enhance their skills in system management and maintenance techniques. This participatory approach not only empowers the local community but also ensures the long-term sustainability of the irrigation systems by fostering a sense of ownership and responsibility among the users.

Priority and Readiness of FMIS Schemes

104. Based on the readiness and technical design stages, the subprojects in the irrigation sector are categorized into two main priorities: Priority 1a and Priority 1b. This categorization is essential for understanding the implementation timeline and the level of preparedness of each project. Priority 1a consists of 61 irrigation sector projects that have completed detailed designs and are ready for immediate implementation. These projects are spread across various regions, including 40 projects in the Hill Area and 21 in the Terai Area. The completion of detailed designs indicates that these subprojects have undergone thorough planning, technical evaluations, and feasibility studies, ensuring they meet all necessary criteria for execution. Priority 1b includes 39 projects currently undergoing design stages as of the IEE preparation period. These projects are in various phases of technical preparations, ensuring that all aspects of design, environmental considerations, and feasibility are thoroughly evaluated before implementation.

105. **Appendix 3** of the IEE document provides a comprehensive overview of FMIS subprojects under the IMEP. The appendix categorizes the subprojects based on their implementation readiness into Priority 1a (early implementation) and Priority 1b (detailed design phase). The projects are further divided into various provinces, detailing the scope of works for each subproject.

106. The scope of works for these subprojects involves various infrastructural components designed to enhance irrigation efficiency and agricultural productivity. Common works include the construction of main and branch canals, headworks and diversion structures, canal lining, outlets, super passages, HDPE pipe canals, drop structures, VRBs (Village Road Bridges), and culverts. Main and branch canals are essential for directing water from the source to the fields, with lengths varying significantly across subprojects depending on the command area and topography. Headworks and diversion structures control the flow of water into the irrigation canals, with

common types including concrete weirs, RCC (Reinforced Cement Concrete) core walls, and gabion protection. Canal lining with concrete or other materials helps prevent water seepage, ensuring efficient water delivery to the fields. Outlets and drop structures manage the distribution and flow of water within the irrigation network, maintaining appropriate water levels and preventing erosion. Super passages and HDPE pipe canals allow for the efficient conveyance of water across difficult terrain or under obstacles. VRBs and culverts facilitate the crossing of canals by roads and pathways, ensuring that irrigation infrastructure does not impede local transportation and access.

107. In Koshi Province, several subprojects are planned in the hill areas. In Bhojpur District, the Simle Ghatte ISP, covering 25 ha, includes the construction of a 3000-meter main canal, a concrete weir headworks, and 900 meters of canal lining. The Hinkuwa Khola ISP, with a command area of 30 ha, features a 3050-meter main canal, RCC core wall headworks, and 1700 meters of canal lining. The Yangtang Khola Mailung Kulo ISP serves 45 ha and involves a 3050-meter main canal, an RCC cutoff wall, and 1500 meters of canal lining. In Dhankuta District, the Tin Dovane Kerabari ISP, spanning 98 ha, includes a 3050-meter main canal, bed bar/gabion protection, and 2722 meters of canal lining. The Chayalu Laktang ISP (188 ha) and Leguwa Khola ISP (250 ha) are currently in the design phase without specified canal lengths or headworks.

108. In Madhesh Province, various subprojects are planned in the Terai areas. In Bara District, the Jokaha Dora ISP covers 300 ha, and the Bhaluhi Suklaiya Patti ISP spans 360 ha, both without specified canal lengths and headworks. In Mahottari District, the Rato Bhagwatipur ISP (515 ha), Ladakawa ISP (345 ha), Chakkarghatta ISP (670 ha), and Rato Kokila ISP (1120 ha) are significant projects, with the latter two currently in the design phase. In Sirha District, the Gagan ISP covers 835 ha, while the Baburam ISP (400 ha) and Saraswati ISP (276 ha) are in the design phase. In Sarlahi District, the Haripurwa ISP spans 414 ha, and the Laukat Dhangada ISP covers 375 ha. In Rauthat District, the Dorapaini Raghunathpur ISP covers 255 ha, and the Aruwa Khola ISP spans 430 ha, with the Aruwa Aknowa ISP (264 ha) in the design phase. In Dhanusha District, the Soharna ISP covers 430 ha, and the Bachharaja ISP spans 325 ha, while the Let ISP (250 ha) is in the design phase. In Parsa District, the Hadahi ISP (275 ha), Gadi ISP (280 ha), Oriya ISP (145 ha), and Megha ISP (200 ha) are notable projects. In Saptari District, the Kajra ISP covers 400 ha, and the Jita Khola ISP spans 227 ha.

109. In Bagmati Province, several subprojects are planned in the hill and mountain areas. In Dhading District, the Jhagadiya Sikre ISP (45 ha) includes a 2800-meter main canal and RCC core wall headworks. The Parbang ISP (100 ha) and Dharmasala ISP (120 ha) are in the design phase, with core wall headworks planned. The Sopyang Khola Gatta Ko Kulo ISP (50 ha) involves a 2204-meter main canal and single orifice side intake. The Liti ISP (110 ha) is in the design phase with core wall headworks. In Dolkha District, the Nimkot Besi ISP (50 ha) includes a 2347-meter main canal and core wall with side intake, while the Nause Besi Kulo ISP (72 ha) features a 3212-meter main canal and maintenance of an existing gabion headwall. In Kathmandu District, the Chisapani Laharedevi ISP (30 ha) includes a 2700-meter main canal and RCC core wall headworks, while the Bishombhar ISP (90 ha) features a 3700-meter main canal. In Kavre District, the Muhane Mul Kulo ISP (65 ha) includes a 7200-meter main canal and concrete core wall headworks, and the Barasai Saathi ISP (58 ha) has a similar scope. The Kumaitaar ISP (25 ha) is in the design phase. In Khotang District, the Lapuwa Khola ISP (85 ha) includes a core wall and side intake, the ChimChima Khola ISP (53 ha) features a core wall and gabion headworks, and the Kharuwa Khola Aek Chhahe ISP (234 ha) involves an RCC structure for permanent diversion.

110. Based on the water balance of several available information of FMIS, the diversion

requirements at the headworks are balanced against the mean monthly flow of the streams to ensure efficient water distribution and usage. For example, the Tarauli ISP requires a diversion of 295 liters per second (lps), which constitutes 9.83% of the mean monthly flow of the Tarauli River. Similarly, the Sopyang Khola ISP has a diversion requirement of 270 lps, accounting for 10.80% of the mean monthly flow of Sopyang Khola. The Purwari Pacchiyari ISP has a higher diversion requirement of 300 lps, which is 25.00% of the mean monthly flow of Thakur Khola. For the Nunsari ISP, the diversion requirement is 250 lps, representing 12.50% of the mean monthly flow of the Nunsari River. The Dhuple ISP requires a diversion of 230 lps, which is 15.33% of the mean monthly flow of Dhuple Khola. Lastly, the Chakkarghatta ISP has a diversion requirement of 280 lps, making up 12.73% of the mean monthly flow of Chakkarghatta River. These values provide a clear picture of the water availability and the proportion of water diverted for irrigation purposes for each subproject.

IV. BASELINE ENVIRONMENT OF THE PROJECT

111. Nepal is a small landlocked country located in South Asia, between the People's Republic of China and India. It is situated in the Himalayas and is home to the world's highest peak, Mount Everest. The terrain of Nepal is mostly mountainous, with the Himalayas running across the northern and western parts of the country. It occupies an area within latitude 26° 22' N to 30° 27' N and of longitude 80° 4' E to 88° 12' E. The central and eastern regions are also hilly, while the southern lowlands are primarily flat. Nepal has a diverse range of climates, from subtropical in the lowlands to alpine in the high mountains, with variations in the climate within different belts.

A. PHYSICAL ENVIRONMENT

Geography

112. Nepal has diverse features in terms of physiography, climate, elevation as well as geology. The different geographical features have their own different characteristics. Based on these characteristics, the whole country and its features are identified as the following:

Table 10. Physiographic Regions in Nepal

Physiographic region	Altitude (m)	Area (km^2)	Topographic features	Climate	Mean temperature
Terai	60-50	21,104 (14.3%)	Flat land with a slope gradient from 0.2 % to 1%	Hot Monsoon and mostly tropical	
Siwalik	200-1000	18,858 (12.8%)	Consisting of Dun valleys, about 25% gradient <300 m and rarlely>1000m (75%)	Hot monsoon and mostly sub-tropical	<20
Middle Mountain	1000-2000 2000-3000	44,436 (30.1%)	Tropical valleys and elevated plains, about 6%, relief up to 1000 m is common, maximum up to 2000 m (94%)	Subtropical to warm temperate monsoon	15-20
High Mountain	3000-4000 4000-5000	29,594 (20.1%)	Sub-tropical –temperate valleys, about 10%, average relief 2000m	Sub-alpine Alpine	100-15
High Himalaya	Above 4,000	33,492 (22.7%)	Dry Trans-Himalayan area	Tundra type and arctic	<10

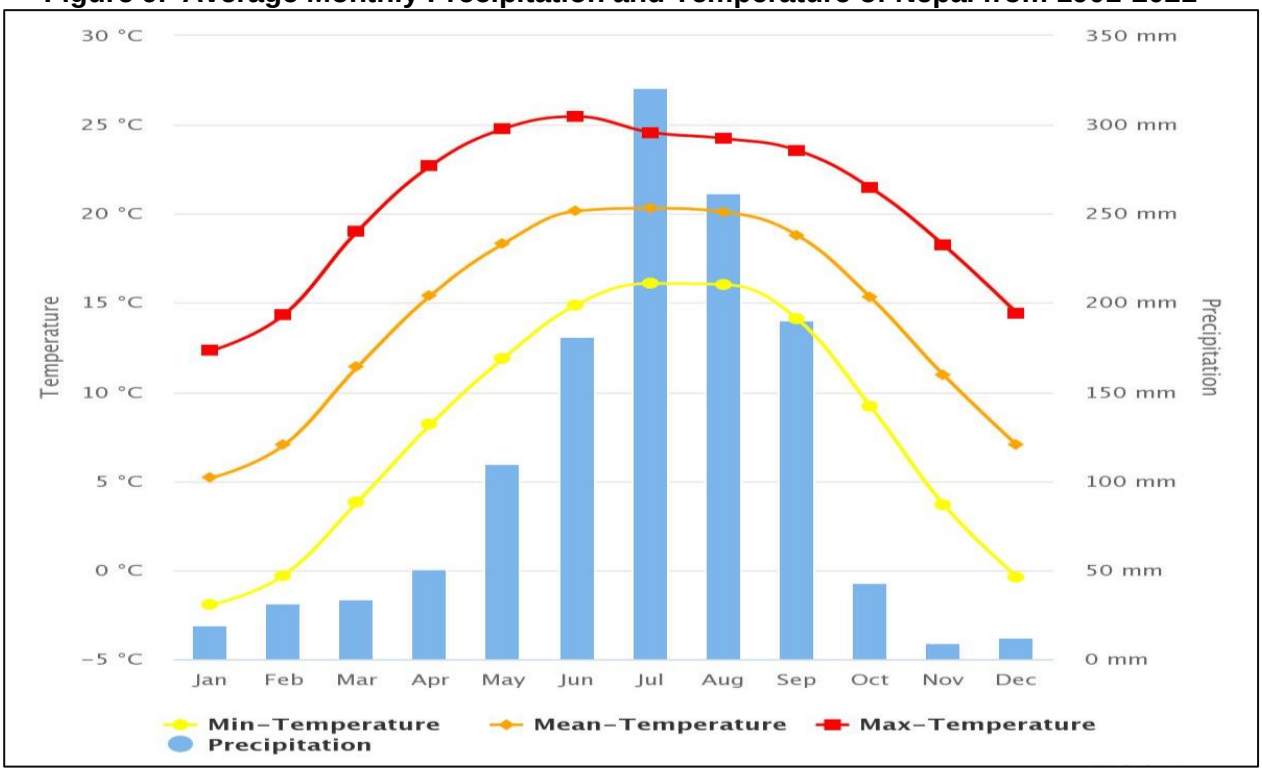
Source: Country Environment Note: Nepal (adb.org), 2015

113. The target subproject sites will be at Middle Mountain. Accounting for 64% of the total land of Nepal, the Hill region stands to be the region covering the most land area of the country and inhabits about 43% of the total population of the country. The plains of Nepal are known as the Terai, and they occupy 17% of the land, stretching from the far west to the far east, covering the entire southern part of the country. With a sub-tropical climate, the land here is exceedingly fertile and produces the bulk of the food grains for the country's population.

Climate

114. Nepal's climate varies considerably both seasonally and according to altitude. Average temperatures decline from a peak of over 24°C in the south down to sub-zero temperatures in Nepal's highest mountains. Precipitation is spatially variable, with some central and northerly pockets of the country receiving more than 3,000 millimetres (mm), the central and southern plains typically receiving 1,500 – 2,000 mm, and some high-altitude areas in the north receiving less than 1,000 mm. Based on the WBG Climate Change Knowledge Portal (2022), the mean annual temperature is 13°C to 22°C, and the mean annual rainfall is 1,340.9 mm, which is recorded from 1991 to 2021.

Figure 9. Average Monthly Precipitation and Temperature of Nepal from 1901-2021[12]



Climate Conditions in Koshi Province

115. Koshi has climatic variations, which are associated with the diverse nature of its topography and altitude, pronounced by dry and wet monsoon seasons. Koshi has an average rainfall of between 110-300 mm in Terai and inner Terai, 27.5-230mm in mid and high mountains and 15-20mm in the Himalayan region. The area between the Mahabharat range and the Himalayas has a temperate climate; the temperature varies between 10^0c and 20^0c. The average rainfall is about 27.5 to 230 cm.

Climate Conditions in Bagmati Province

116. Bagmati province has climatic variations, which are associated with the diverse nature of its topography and altitude. The climatic zone of Bagmati province starts from High Himal in the north, above 5000 m with tundra and arctic climate, to the Siwalik region in the south, 500-1000 m with the sub-tropical climatic zone. The annual precipitation also varies from 150-200 mm in the high Himalayas to 1100-3000 mm in the southern plains. Similarly, the average annual temperature of the province varies from below 3^0c to 25^0c.

Climate Conditions in Madhesh Province

117. Madhesh Province has climatic variations, which are associated with the diverse nature of its topography and altitude pronounced by dry and wet monsoon seasons. On hot and sunny days, the temperature rises to 38 to 40 ^{0}c. Winter is cold, with the temperature decreasing to 5 to 10 ^{0}c. Province

[12]`https://climateknowledgeportal.worldbank.org/country/nepal/climate-data-historical

2 has an average rainfall of between 1100-2100 mm.

Land Use

118. The rugged and mountainous landscape of the Himalayas largely defines the country's terrain. The highest peak in the world, Mount Everest, is located in the Himalayan region of Nepal. The Hill Region, between the Himalayan and Terai regions, is characterized by lower elevations and hilly terrain. The Terai Region, in the southern part of the country, is characterized by flat or gently undulating terrain and is home to many agricultural areas.

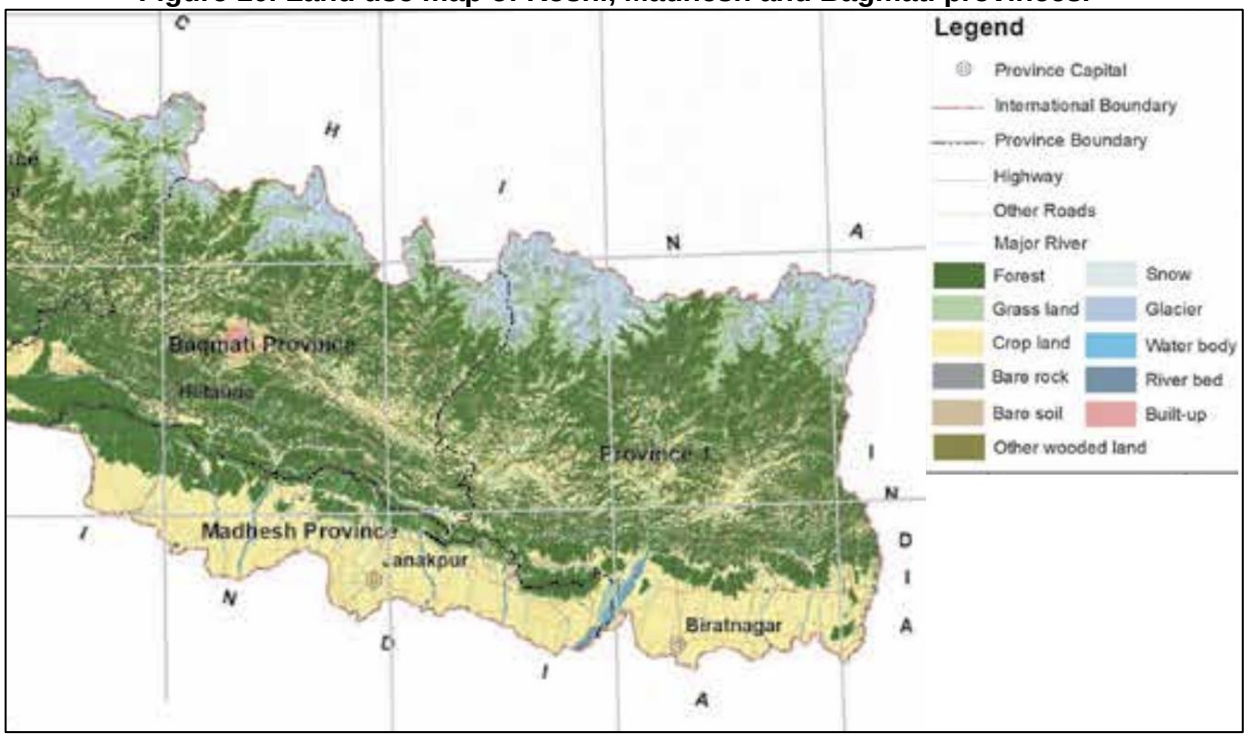
119. There are many water resources in the project area, where the main source in the hilly areas of Nepal is surface water. The hilly region is a mountainous area, which does not generally contain snow. It is situated in the south of the Himalayas (the snowy mountain region). The hilly region (target areas) begins at the lower Himalayan range, where a fault system called the main boundary thrust creates an escarpment 1,000 to 1,500 m (3,000 to 5,000 ft) high, to a crest between 1,500 and 2,700 m (5,000 and 9,000 ft). It covers 68% of the total area of Nepal.

120. Land use in Bagmati Province is diverse, influenced by its varied topography and urbanization patterns. The province encompasses a mix of urban areas, with the capital city Kathmandu, agricultural lands, and forested regions. Urbanization has rapidly led to significant land use changes that impact the region's ecosystem services. These changes include increased built-up areas, reduced agricultural lands, and deforestation, particularly in and around urban centers. Agriculture remains a crucial part of Bagmati's land use, especially in rural areas where farming is the primary livelihood. However, urban expansion and infrastructure development have led to decreased agricultural land, which poses challenges for food security and rural livelihoods. Forested areas in Bagmati are significant for biodiversity conservation and act as crucial carbon sinks, but they are also under pressure from deforestation and land conversion for agriculture and urbanization.

121. Koshi Province of Nepal's land use is diverse, encompassing agriculture, forestry, urban development, and conservation efforts. Agriculture is prevalent in the Terai regions, where fertile soil supports intensive rice, maize, and wheat farming. Hillier regions, with favourable microclimates, support various grains, pulses, vegetables, and cash crops like tea and cardamom. Forestry covers vast areas, providing biodiversity, timber resources, soil and water conservation, and livelihood support. Urbanization, particularly in major urban centers like Biratnagar, is rapidly increasing, leading to a reduction in agricultural land and challenges for sustainable land management. Conservation areas like the Koshi Tappu Wildlife Reserve protect biodiversity and promote eco-tourism, providing economic benefits to the region.

122. Land use in Madhesh Province, situated in the southeastern region of Nepal, is heavily influenced by its geographic positioning in the fertile Terai plains. This province is marked by a predominance of agricultural activities due to its rich alluvial soils, ideal for intensive farming. Madhesh Province is notable for having the highest percentage of irrigated land in Nepal, making it a critical area for the country's food production. Agriculture in Madhesh Province covers a substantial portion of the land, with a significant emphasis on cereal crops such as rice, wheat, and maize. The province also supports sugarcane cultivation, vegetable farming, and fruit orchards, contributing to its reputation as a highly productive agricultural region. However, the pressure of agricultural expansion has led to land use changes that might impact the long-term sustainability of these lands. Urbanization is another significant aspect of land use in Madhesh Province. The growth of urban areas, particularly around major cities like Janakpur, is rapidly transforming the landscape. This urban expansion often occurs at the expense of agricultural lands, leading to concerns over food security and the loss of green spaces.

Figure 10. Land use map of Koshi, Madhesh and Bagmati provinces.[13]



Geology and Soil

Madhesh Province

123. Madhesh Province, situated in the Terai region of Nepal, exhibits a unique geological and soil profile crucial for its predominantly agricultural economy. The province is characterized by the alluvial plains of the Terai, which result from sediment deposits from the Himalayas. This geological feature creates fertile lands highly suitable for agriculture, contributing to Madhesh's reputation as the "granary of Nepal".

124. The soils in Madhesh Province vary widely but generally include a mix of alluvial soils rich in nutrients. These soils are typically well-drained and highly fertile, suitable for the extensive agricultural activities that dominate the region. The National Soil Science Research Center provides detailed maps and data on soil types across Nepal, highlighting the prevalence of soils with high organic matter and adequate nitrogen content, which are advantageous for crops like rice, wheat, and maize, commonly grown in the province.

125. Elevation and the relatively flat terrain also play significant roles in the agricultural viability of Madhesh Province. The flatlands of the Terai make it easier to manage and cultivate the land, although they are also prone to flooding during the monsoon season. This geographical setting demands robust water management strategies to prevent soil erosion and ensure sustainable agricultural practices.

[13] Source: https://frtc.gov.np/uploads/files/Study%20Report%20Inner-final.pdf

Koshi Province

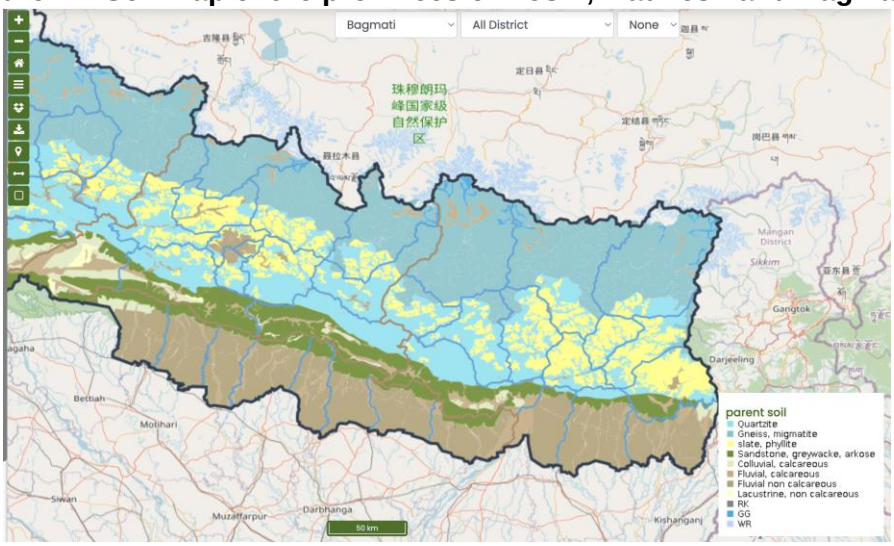
126. Koshi Province in Nepal, renowned for its varied and dynamic geology, spans from the high mountainous terrains to the fertile plains of the Terai. The province encompasses the eastern part of the country. It includes the catchment areas of several major rivers, such as the Sapta Koshi, which significantly influences the region's geology and soil characteristics. The geology of Koshi Province is shaped by its location within the Himalayan range, making it a region with diverse geological features. This province houses some of the highest peaks in the world, including Mount Everest, as well as lower elevations in the Terai, providing a stark contrast in geological formations within a relatively compact area. The high mountain regions are characterized by rocky and rugged terrain, predominantly metamorphic rocks. At the same time, the lower areas, particularly in the Terai, consist of more recent sedimentary deposits that contribute to fertile soils.

127. The soil varies significantly due to the differences in elevation and precipitation. The upper regions of the province, with steep slopes and high rainfall, are prone to significant soil erosion, particularly in areas with less vegetation cover. This has been a major environmental concern, as it affects both agriculture and the stability of the terrain. In the lower elevations, especially in the Terai, the soils are predominantly alluvial, enriched by centuries of river deposits. These soils are highly fertile and are extensively used for agriculture, a major economic activity in the region. The alluvial soils can support a wide variety of crops, and the flat topography of the Terai facilitates agricultural mechanization and management.

Bagmati Province

128. The soil in Bagmati Province varies considerably across different altitudes and terrains. In the mountainous regions, the soil is generally thin, stony, and prone to erosion, particularly on steeper slopes. In contrast, the valley areas, especially the Kathmandu Valley, have richer, more loamy soils that have developed from alluvial deposits. These valley soils are generally fertile, and support varied agricultural activities but are also susceptible to pollution due to urban runoff and industrial waste, particularly in the Bagmati River Basin.

Figure 11. Soil map of the provinces of Koshi, Madhesh and Bagmati.[14]

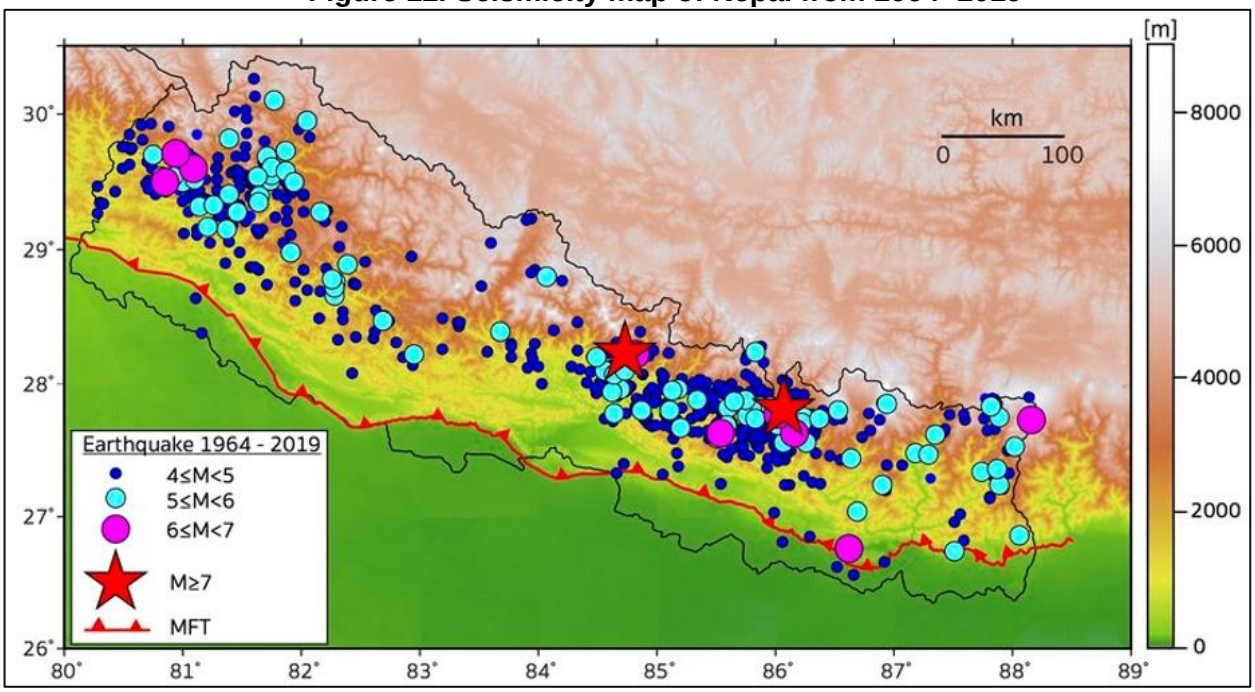


[14] Source: https://soil.narc.gov.np/soil/soilmap/

Seismology

129. The entire country of Nepal is in a seismically active zone caused by the subduction of the Indian tectonic plate. According to the National Seismological Center of Nepal, several big earthquakes have been felt in Nepal; earthquakes of magnitude 6 to 7 are mostly confined to the Main Himalayan Thrust (MHT) between the foothills and the Higher Himalayas. Moreover, earthquake generation is confined to the crustal depth of 20 km. However, shallow earthquakes at depths down to 6 km are generated due to strike-slip faults. Therefore, the sump well and the reservoir tank will be designed and operated in accordance with seismic design requirements and best engineering practices. The seismic activity in Nepal between 1964 and 2019, as in the IUSGS portal, is shown in **Figure 12.**

Figure 12. Seismicity map of Nepal from 1964 -2019[15]



River Network

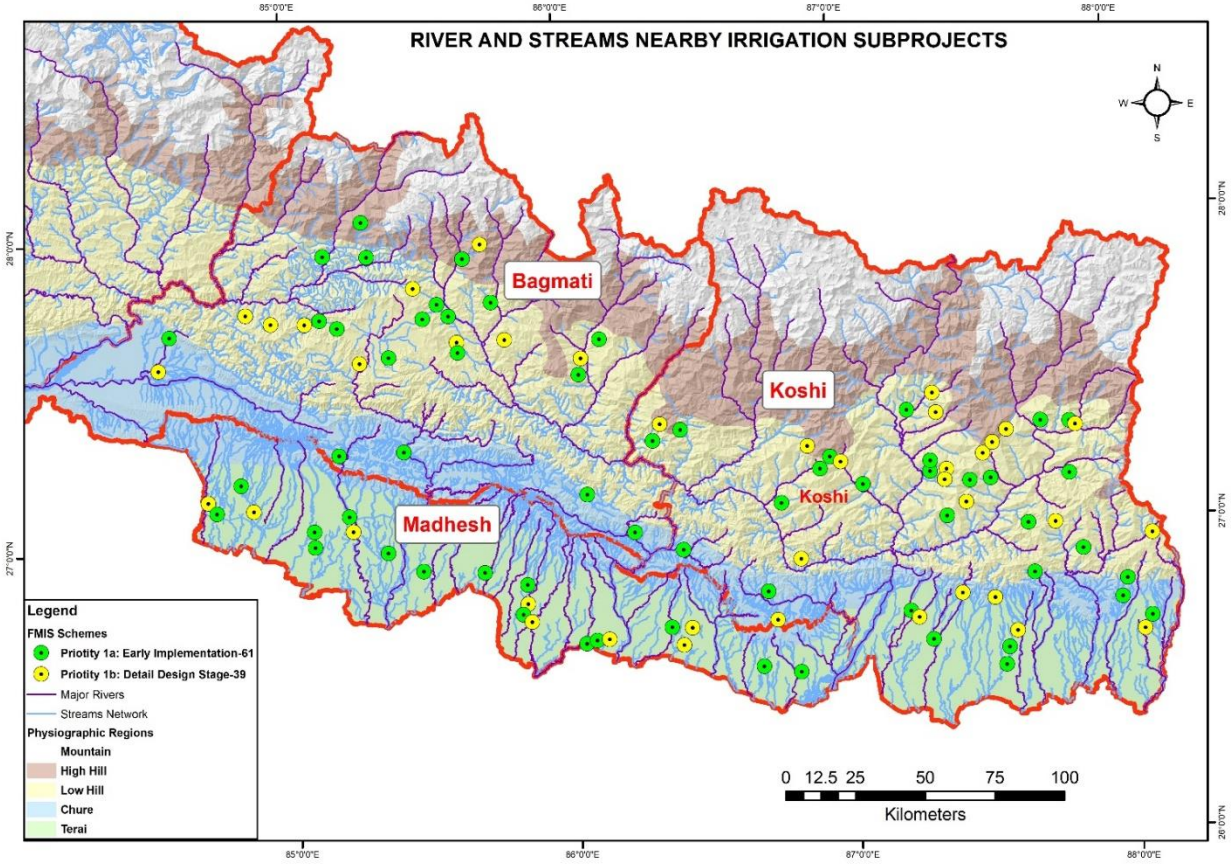
130. Nepal is divided into mountains, hills, and low, with three categories of rivers according to its sources. Altogether, there are more than 6000 rivers in Nepal. The first category of rivers originates from the Himalayan region. Koshi, Gandaki and Karnali are the main rivers of the first category. Each of them has seven branches, and they are called Sapta Koshi (Seven Koshi), Sapta Gandaki (seven Gandaki) and Sapta Karnali (Seven Karnali). They flow from the east, middle and western parts of Nepal, respectively. They originate from the high mountains, and most are full of water in all the seasons. Only a few rivers originate from the Mahabharat or Chure region of Nepal. Most of these rivers flow from north to south direction.

131. The first kind of rivers originate from the Himalayas, glaciers, snow mountains, and lakes, which are permanent water sources. The water flows all seasons of the year in such rivers. The three main rivers are categorized into this group. In the same way, the second category of the river originates from the middle hill region. They also are the source of water for the Terai region. They also join the big

[15] Source: USGS catalogue, 2019

rivers and flow down towards the low land. We can find water flowing even in the dry season in such rivers. Similarly, the small rivers that originate from the Churia hills are called the rivers of third categories. Therefore, they remain dry during the dry season. Such rivers flood in the rainy season. They originate from the Churia range and reach up to the big rivers. Some of them reach up to Ganga and some of the rivers originated from Churia dismiss in the Terai region also. These rivers are not so important for irrigation and agriculture. However, they are important for sand and stones.

Figure 13. Rivers and Streams Near the Irrigation Subprojects



Water Quality

132. There is no known source of chemical pollutants that could affect the water quality of small rivers or streams of irrigation canals; however, the runoff from the agricultural land around the river may influence the water quality of the river. The baseline water quality monitoring of all the streams that are the sources of the irrigation subprojects will be done before the start of construction activities.

Air Quality

133. The Environmental Performance Index (EPI) of Nepal's air quality ranked 177th out of 180 countries. According to a report by the World Health Organization (WHO), the maximum status of fine Particulate Matter (PM2.5) in urban areas of Nepal was noted to be 140 µg/m3, which is 10 times higher than the desirable value. Ministry of Science and Technology, in 2012, published a guideline on "National Ambient Air Quality." The values set on these parameters were still higher than those set by WHO. The targeted PM10 and PM2.5 values were 120 µg/m3 and 40 µg/m3, respectively, approximately two times higher than the WHO targeted value**.**

134. According to the Department of Environment, in 2022, the 24-hour average of Total Suspended Particles (TSP) in a site in Kathmandu was 104.3 µg/m3, the average PM10 was 203.19 µg/m3, and the PM2.5 was 85.09 µg/m3. To find out the seasonal variation of air pollution, a study conducted in Kathmandu Valley measured NO2, CO, and PM2.5 concentrations on a daily basis in all four seasons of the year.

135. The air quality of Dhankuta (Province no 1), as per the Department of Environment, the PM1 instantaneous is 34.5 µg/m^3. The PM10 is 44.9 µg/m^3 and PM2.5 is 36.2 µg/m^3. Whereas the air quality of Khumlatar (Bagmati Province) is recorded as PM1 instantaneous is 70.3 µg/m^3. The PM10 is 203.19 µg/m^3 and PM2.5 is 85.09 µg/m^3. And the air quality of Madhesh Province (Simara)) as PM 1 instantaneous is 26.1 µg/m^3. The PM10 is 36.09 µg/m^3 and PM2.5 is 28.29 µg/m^3.

Table 11. Air Quality Monitoring Data of the Proposed Project Area [16]

Parameters (Instantaneous)	Province 1 (Dhankuta)	Bagmati Province Khumlatar)	Madhesh Province (Simara)
Air Temperature (°C)	16.29	17.1	17.79
https://en.wikipedia.org/wiki/ParticulatesPM 1 (µg/m^3)	34.5	70.3	26.1
https://en.wikipedia.org/wiki/ParticulatesPM 10 (µg/m^3)	44.9	203.19	36.09
https://en.wikipedia.org/wiki/ParticulatesPM 2.5 (µg/m^3)	36.2	85.09	28.29
Relative Humidity (%)	72.9	999.9	73.19
Wind Speed (m/s)	2.29	0.2	0.89
Wind direction	239.89 °	107.8°	333.89 °
http://www.hcdoes.org/airquality/monitoring/tsp.htmTotal Suspended Particulate (µg/m^3)	46.2	104.3	67

B. BIOLOGICAL ENVIRONMENT

Protected Areas

136. The proposed 100 subprojects are distributed throughout the three provinces Bagmati, Koshi and Madhesh Provinces. With such magnificent and diverse terrain, from subtropical rainforest to alpine desert, Nepal has some incredible biodiversity on display. In fact, 118 ecosystems have been identified in different physiographic zones across the country. There are as many as 175 different kinds of mammals, at least 800 kinds of birds (half of which can be seen in and around the Kathmandu valley alone), 147 reptile and amphibian species, 180 species of fish, 640 species of butterfly and above 6000 species of moth. In addition, there are over 6500 species of flowering plants, over 1500 fungi species and 350 lichen species.

137. In Nepal's dense Terai forests are exotic animals like the Asiatic elephant, the one-horned rhino and the Royal Bengal tiger. There is also an array of mammals like leopards, monkeys, langurs, hyenas, jackals, wild boars, antelopes, wild cats, wolves, sloth bears, chital or spotted deer and barking deer. Wild buffalo, locally called 'Arna', are found in the Koshi Tappu region. Nepal even has its own variety of dolphins found in the fresh waters of the Narayani, and the Himalayan region is home to the elusive snow leopard and red panda. The country also has two indigenous species of crocodile: the fish-eating gharial with the long, narrow snout and the marsh mugger, which is omnivorous, eating anything it can catch.

138. There are a number of beautiful national parks across the country: Royal Chitwan National Park, located between the Shivalik and home to nearly 50 different varieties of mammals and 450

[16] Source: https://pollution.gov.np/portal

species of birds; Sagarmatha National Park, located above 9000 feet, is the highest wildlife reserve in the world with it is snowy peaks and skies of various vivid species of Himalayan birds; and Makalu Barun National Park, which is renowned for incredible flora, many of which have medicinal properties. There is Koshi Tapu Wildlife Reserve and Langtang National Parks.

Protected Areas in the FMIS Provinces

139. These protected areas in Koshi, Bagmati, and Madhesh Provinces play a crucial role in preserving Nepal's rich biodiversity, supporting endangered species, and promoting sustainable development through community involvement and ecotourism. They also provide essential ecosystem services, such as water purification and flood control, and contribute to the overall ecological health of the region. These protected areas are described in the following

140. Koshi Tappu Wildlife Reserve, situated in the Saptari, Sunsari, and Udayapur districts of eastern Nepal, is renowned for its vast wetlands and diverse birdlife. As a Ramsar site, it holds international importance for conserving waterfowl and wetland habitats. Spanning 175 square kilometres, the reserve encompasses the floodplains of the Koshi River, providing critical habitat for the last remaining population of wild water buffalo (Arna) in Nepal. The reserve's extensive grasslands and marshes support over 485 species of birds, including migratory species that arrive from as far as Siberia. This biodiversity hotspot also shelters various mammals, reptiles, and fish, making it a significant site for ecological research and wildlife tourism.

141. Makalu Barun National Park, located in the Sankhuwasabha and Solukhumbu districts, covers an area of 1,500 square kilometers. It is named after Mount Makalu, the fifth-highest peak in the world. It includes a range of habitats from subtropical forests at lower altitudes to alpine meadows and glaciers at higher elevations. This park is a haven for rare and endangered species such as the snow leopard, red panda, and Himalayan black bear. The diverse flora includes more than 3,000 species of flowering plants, 67 species of medicinal herbs, and 25 species of rhododendrons. The park’s varied ecosystems are crucial for maintaining the region’s biodiversity and offer breathtaking landscapes for trekkers and nature enthusiasts.

142. The Kanchenjunga Conservation Area, situated in the Taplejung district, covers 2,035 square kilometres and includes parts of Mount Kanchenjunga, the third-highest mountain in the world. Its pristine forests, alpine meadows, and high-altitude lakes characterize this conservation area. It supports a variety of wildlife, including the elusive snow leopard, red panda, Himalayan black bear, and numerous bird species. The conservation area also holds cultural significance, with several ethnic communities within its boundaries. These communities are involved in conservation efforts through community-based management practices that balance environmental protection with sustainable development.

143. Chitwan National Park Chitwan National Park, Nepal's first national park, established in 1973, covers 932 square kilometers across the Chitwan, Nawalpur, Parsa, and Makwanpur districts. This UNESCO World Heritage Site is famous for its rich biodiversity and successful conservation programs. The park's varied ecosystems include dense sal forests, grasslands, and riverine forests, which provide habitat for numerous species. It is particularly noted for its populations of Bengal tigers, one-horned rhinoceroses, and Asian elephants. The park also supports a wide variety of other wildlife, including gharials, leopards, and over 500 species of birds. Chitwan's effective management strategies and community-based conservation programs have made it a model for wildlife preservation in Nepal.

144. Langtang National Park, located in the Rasuwa, Nuwakot, and Sindhupalchowk districts, covers an area of 1,710 square kilometers. This park is renowned for its stunning landscapes, which

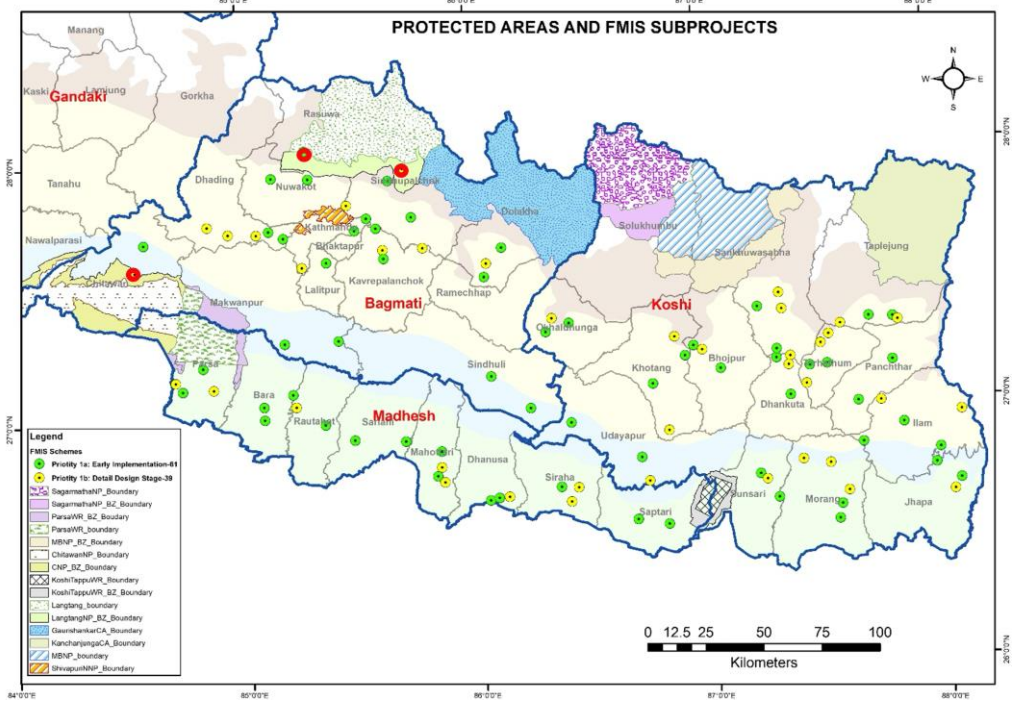
range from subtropical forests to alpine meadows and glaciers. It is home to the endangered red panda, snow leopard, and numerous other mammals, birds, and plant species. The park is also culturally significant, containing several sacred sites, such as the Gosaikunda Lake, attracting thousands of pilgrims yearly. Langtang is a popular destination for trekkers, offering trails that pass through traditional Tamang villages, dense forests, and high mountain passes, providing a rich experience of both natural beauty and cultural heritage.

145. Situated on the northern fringe of the Kathmandu Valley, Shivapuri Nagarjun National Park spans 159 square kilometers across the Kathmandu, Nuwakot, and Sindhupalchowk districts. The park protects the valley's watershed, which supplies drinking water to the capital. Its diverse habitats support a variety of wildlife, including leopards, Himalayan black bears, and numerous bird species. The park is also a popular destination for hiking and birdwatching, with several trails leading to viewpoints offering panoramic views of the Kathmandu Valley and surrounding mountains.

146. Parsa National Park, extending over 627 square kilometers, is located in the Parsa, Bara, and Makwanpur districts. Initially a wildlife reserve, this park was initially upgraded to a national park to enhance protection efforts. It is part of the larger Terai Arc Landscape and provides crucial habitat for species such as tigers, elephants, and leopards. The park's diverse ecosystems include tropical and subtropical forests rich in flora and fauna. Parsa National Park also serves as a vital corridor for wildlife, linking Chitwan National Park with other protected areas in the region.

147. Chitwan National Park (partially) Chitwan National Park, extending into Madhesh Province, is critical for conserving large mammals like tigers, rhinoceroses, and elephants. The park's effective management practices have led to a significant increase in the population of these species. Its diverse habitats, including grasslands, forests, and wetlands, support a wide variety of wildlife and offer numerous opportunities for wildlife viewing and ecotourism. The park's community-based conservation initiatives involve local residents in protecting wildlife and managing natural resources sustainably.

Figure 14. Locations of FMIS subprojects (red circles) inside buffer zones of national parks



148. Out of 100 Irrigation subprojects, 3 subprojects are located in the buffer zone of the two National Parks. The Tarauli ISP of Chitwan district is located in the Buffer Zone of the Chitwan National Park. Similarly, Dhuple Khola ISP and Chimti ISP of Rasuwa district are located in the Buffer Zone of the Langtang National Park. No subprojects are located within the core national park area, and all the proposed irrigation subprojects are the existing irrigation canal systems.

Floral Species

149. The flora of the Koshi, Madhesh, and Bagmati provinces in Nepal showcase a diverse range of species, each contributing uniquely to the ecological balance and traditional practices of the region. In Koshi Province, species like *Emblica officinalis* (Amala), *Pieris ovalifolia* (Angeri), and *Schima wallichii* (Chilaune) are prevalent in the hilly regions. Amala is highly valued for its high vitamin C content, its use in traditional medicine, and its use as a food source. Angeri, found in the mid-hills and lower Himalayan regions, is known for its ornamental and medicinal uses. Chilaune is prized for its timber and its role in traditional medicine, thriving in the dense forests of the hills. Additionally, *Bassia butyracea* (Chyuri) and *Neolamarckia cadamba* (Kadam) are found in the lower regions and mid-hills, respectively, with Chyuri being significant for its butter-like extract used in cooking and cosmetics, while Kadam is known for its fast-growing timber and ornamental value. *Pinus roxburghii* (Pine) is another important species in the mid-hill regions, valued for its resin and timber, and *Cinnamomum glaucescens* (Sugandawal), found in forested regions, is notable for its aromatic properties and use in traditional medicine.

150. In Madhesh Province, the flora is adapted to the plains and lower hills. *Terminalia bellirica* (Barro), *Melia azedarach* (Bakaino), and *Terminalia tomentosa* (Indian laurel) are prominent species. Barro is renowned for its medicinal properties, particularly in Ayurveda, while Bakaino, widely found in the Terai region, is known for its insecticidal properties and is used as a shade tree. Indian laurel is commonly used for timber and traditional medicine. *Shorea robusta* (Sal) is predominant in the Terai and is valued for its hardwood timber, while *Acacia catechu* (Khayer), found in the plains, is important for its use in tanning and traditional medicine. *Dalbergia sisso* (Sisau) is widespread in the Terai and is known for its high-quality timber used in furniture making. *Bauhinia vahlii* (Bhorla), found in the plains and lower hills, is used for fodder and as a cover crop, supporting both agricultural practices and local ecosystems.

151. Bagmati Province is characterized by a mix of mid-hill species that thrive in its varied climatic conditions. *Cedrealla toona* (Tuni) and *Lagerstroemia indica* (Ashare Phul) are common in the mid-hills, with Tuni valued for its timber and medicinal uses and Ashare Phul known for its ornamental value in gardens and parks. *Adhatoda vasica* (Asuro), common in the lower and mid-hills, is extensively used in traditional medicine for respiratory ailments. *Rhus wallichii* (Bhalayo) and *Ficus semicordata* (Khanayo) are also found in the mid-hills, with Bhalayo used for timber and medicinal purposes and Khanayo valued for its edible fruits and medicinal applications. *Engelhardtia spicata* (Mauwa) is found in the higher hills and is known for its timber and medicinal properties, while *Albizia chinensis* (Siris), widely found in the mid-hills, is used for timber, fodder, and traditional medicine.

152. Certain species are common across all three provinces, highlighting their ecological versatility. Bombax ceiba (Simal) is valued for its timber and medicinal properties and is found in varied regions. *Tectona grandis* (Teak), although more common in the Terai, is planted across various regions for its valuable timber. *Dalbergia latifolia* (Satisal), found in the Terai and mid-hills, is known for its high-quality timber, which is highly prized in furniture making.

153. Overall, these plant species contribute significantly to the biodiversity and ecological health of Koshi, Madhesh, and Bagmati provinces. They provide essential ecosystem services, including timber,

medicinal resources, and food, and play a crucial role in traditional practices and local economies. The conservation and sustainable management of these species are vital for maintaining the ecological balance and supporting the livelihoods of local communities.

Table 12. Major Types of Vegetation in the Subproject Area

S.N.	Local name	Scientific Name	Family
1	Amala	*Emblica offficinalis*	Euphorbiaceae
2	Angeri	*Pieris ovalifolia*	Ericaceae
3	Tuni	*Cedrealla toona*	Meliaceae
4	Ashare Phul	*Lagerstroemia indica*	Lythraceae
5	Asuro	*Adhatoda vasica*	Acanthaceae
6	Bakaino	*Melia azedarach*	Meliaceae
7	Barro	*Terminalia bellirica*	Combretaceae
8	Bhalayo	*Rhus wallichii*	Anacardiaceae
9	Chilaune	*Schima wallichii*	Theaceae
10	Chyuri	*Bassia butyracea*	Sapotaceae
11	Kadam	*Neolamarckia cadamba*	Rubiaceae
12	Khanayo	*Ficus semicordata*	Moraceae
13	Mauwa	*Engelhardtia spicata*	Juglandaceae
14	Pipal	*Ficus religiosa*	Moraceae
15	Siris	*Albizia chinensis*	Leguminosae
16	Utis	*Alnus nepalensis*	Betulaceae
17	Pine	*Pinus roxburghii*	Pinaceae
18	Simal	*Bombax ceiba*	Bombacaceae
19	Titepati	*Artemesia capillaries*	Asteraceae.
20	Kurilo	*Aspasgus officinalis*	Asparagaceae
21	Khayer	*Acacia catechu*	Fabaceae
22	Sisau	*Dalbergia sisso*	Fabaceae
23	Indian laurel	*Terminalia tomentosa*	Combretaceae
24	Teak	*Tectona grandis*	Lamiaceae
25	Sal	*Shorea robusta*	Dipterocarpaceae
26	Satisal	*Dalbergia latifolia*	Leguminosae
27	Bijayasal	*Pterocarpus marsupium*	Fabaceae
28	Chadmaruwa	*Rauvolfia serpentine*	Apocynaceae
29	Sugandawal	*Cinnamomum glaucescens*	Lauraceae
30	Kutmero	*Litsea polyantha*	
31	Khayer	*Acacia catechu*	Fabaceae
32	Bhorla	*Bauhinia vahlii*	
33	Katus	*Castanopsis indica*	Fagaceae
34	Koiralo	*Bahunia variegata*	Fabaceae
35	Chutro	*Berberis aristata*	Berberidaceae
36	Timur	*Zanthoxylum armatum*	Rutaceae

Source: Field Visit, 2022

Mammalian Species

154. The surrounding Subprojects area also has a few common wild animal species- Rhesus Monkey (*Macaca mulatta*), Golden Jackal (*Canis aureus*), House Rat (*Rattus rattus*), Indian Grey Mongoose (*Urva edwardsii*), and Yellow Throated Marten (*Martes flavigula*). **Table 13** describes the animal species found in the nearby forest in the proposed subproject area.

Table 13. Commonly found Mammal Species in the Forest Areas FMIS provinces

S.N.	Name			CITES*	IUCN	NPWC Act
	Local	English	Scientific			
1	Buanso	Grey Wolf	*Canis lupus*	-	LC	-
2	Chituwa	Common Leopard	*Panthera pardus*	-	VU	-
3	Dumsi	Indian Crested Porcupine	*Histrix indica*	-	LC	-
4	Syal	Golden Jackel	*Canis aureus*	III	LC	-
5	Muso	Hill Mouse	*Mos hosmour*	-	LC	-
6	Ban biralo	Jungle Cat	*Felis chaus*	-	LC	-
7	Lokharke	Common Palm Squirrel	*Funambulus palmarum*	-	LC	-
8	Malsapro	Yellow Throated Marten	*Martes flavigula*	-	LC	-
9	Rato Bandar	Rhesus Monkey	*Macaca mulatta*	-	LC	-
10	Bandar	Assamese Monkey	*Macaca assamensis*	-	NT	-
11	Mirga	Northern Red Muntjac	*Muntiacus munjak*	-	LC	-
12	Hatti	Elephant	*Elephas maximus*	-	EN	-
13	Gaida	Greater One-horned Rhino	*Rhinoceros unicornis*	I	VU	Protected
14	Gaurigai	The Indian Bison	*Bos gaurus*	I	VU	Protected
15	Bagh	Bengal Tiger	*Panthera tigris*	I	EN	Protected
16	Bandel	Indian Boar	*Sus scrofa*	-	LC	-
17	Nyauri Musa	Indian Grey Mongoose	Urva edwardsii	-	LC	-

Source: Field Visit, 2022
Note: LC-Least Concern, EN- Endangered, VU-Vulnerable, NT-Not Threatened

155. Parsa National Park in Madhesh Province, located in the southern lowlands, is a key habitat for Asian Elephants (*Elephas maximus*) and Bengal Tigers (*Panthera tigris*). The park and adjacent forest corridors provide critical habitat for elephants, while tigers are found in the surrounding forest areas. In eastern Nepal, Koshi Province is home to the Koshi Tappu Wildlife Reserve and forests of the Jhapa district. Elephants in Koshi Province migrate seasonally, while tigers are found in the lowland forests and grasslands of the province. The forests of Koshi Province also provide critical habitats for tigers. In central Nepal, Bagmati Province is home to Chitwan National Park and surrounding buffer zones. Elephants in Bagmati Province inhabit forested areas, grasslands, and agricultural lands, with Chitwan National Park serving as a major habitat. Conservation efforts in Bagmati Province focus on habitat restoration, wildlife corridor creation, and community-based programs promoting coexistence. Neither species are present in the proposed sites of FMIS in the 3 provinces.

156. The Common Leopard, a highly adaptable species, is found in various habitats in Madesh Province, including Parsa National Park, Koshi Province, and Bagmati Province. It thrives in dense forests and protected areas, but conflicts can occur in areas like Birgunj and Hetauda. The Greater One-horned Rhino is occasionally found in floodplain areas near the border with India, with Parsa National Park providing a potential refuge. Conservation efforts in Koshi Province, particularly in Koshi Tappu Wildlife Reserve, are crucial. Bagmati Province, especially Chitwan National Park, is a major stronghold for the Greater One-horned Rhino, with successful conservation programs in municipalities like Bharatpur. The Indian Bison, or Gaur, is primarily found in the forested regions of Madesh Province, with the municipality of Birgunj near areas where Gaur is frequently observed. The Indian Bison's habitats are diverse and varied, with municipalities like Bharatpur close to areas where Gaur are commonly found. These species are not found at the proposed sites of FMIS.

Bird Species

157. The commonly found birds in the Subproject area are House Sparrow (Passer domesticus), Bengal Florican (*Eupodotis bengalensis*), Rose-ringed Parakeet (*Psittacula krameri*), House Crow (*Corvus splendens*), Red Jungle Fowl (*Gallus gallus*), Common Hill Myna (*Gracula religiosa*), Laughing

Dove (*Streptopelia senegalensis*) and Cattle Egret (*Bubulcus ibis*).

Table 14. Commonly found bird species in the FMIS Provinces

S.N.	Name			CITES*	IUCN	NPWC Act
	Local	English	Scientific			
1	Chyakhura	Hill Partidge	*Arborophila torqueola*	-	LC	-
2	Dhukur	Spotted Dove	*Streptopelia chinensis*	-	LC	-
3	Huchil	Eurasian Eagle Owl	*Bubo bubo*	-	LC	-
4	Jureli	Red-vented Bulbul	*Pycnonotus cafer*	-	LC	-
5	Kalij	Kalij Phesant	*Lophura leucomelano*	-	LC	-
6	Kafal Pakyo	Indian Cuckoo	*Cuculus micropterus*	-	LC	-
7	Lampuchure	Large-tailed Nightjar	*Caprimulgus macrurus*	-	LC	-
8	Sugaa	Rose-ringed Parakeet	*Alexandrinus krameri*	-	LC	-
9	Ghar Bhangera	House Sparrow	*Passer domesticus*	-	LC	-
10	Sarau	Common Myna	*Acridotheres tristis*	-	LC	-
11	Koilee	Western Koel	*Eudynamys scolopacea*	-	LC	-
12	Ghar Kaag	House Crow	*Corvus splendens*	-	LC	-
13	Luiche	Red Jungle Fowl	*Gallus gallus*	-	LC	-
14	Chibe Chara	Bronzed Drongo	*Dicrurus aeneus*	-	LC	-
15	Phusree Dhanesh	Indian Grey Hornbill	*Ocyceros birostris*	-	LC	-
16	Thulo Dhanesh	Great Hornbill	*Buceros bicornis*	-	VU	-
17	Pangree Dhanesh	Oriental Pied Hornbill	*Anthracoceros albirostris*	-	LC	-
18	Nyauli	Great Barbet	*Megalaimazeylanica*	-	LC	-
19	Dangree	Jungle Myna	*Acridotheres fuscus*	-	LC	-
20	Parewa	Rock Dove	*Columba Livia*	-	LC	-
21	Giddha	Egyptian Vulture	*Neophron Percnopterus*	-	EN	-

Source: Field Visit, 2022

Note: LC-Least Concern, EN- Endangered, VU-Vulnerable

158. The Great Hornbill, a species of bird known for its size and distinctive casque, is found in dense forest habitats in Madesh Province, particularly Parsa National Park. The park's extensive forested areas provide the necessary environment for these birds, which rely on large trees for nesting and feeding. The presence of the Great Hornbill is less common in Koshi Province, but the forests in the Jhapa district and areas surrounding the Koshi Tappu Wildlife Reserve can sometimes host them. The Chitwan National Park in Bagmati Province is home to one of the most important habitats for the Great Hornbill in Nepal, with its dense forests and diverse flora providing an ideal environment for their diet and nesting sites.

159. The Egyptian Vulture, listed as Endangered, is known to inhabit open areas, cliffs, and human settlements where food sources are readily available. The municipality of Birgunj reports frequent sightings of Egyptian Vultures around garbage dumps and slaughterhouses. The areas around Chitwan National Park and Hetauda are known for frequent sightings of Egyptian Vultures, taking advantage of the park's rich biodiversity and nearby human settlements' waste.

Reptile Species

160. Commonly found Reptiles in the subproject area is Golden Monitor Lizard (*Varanus flavescens*), Changeable Lizard (*Calotes versicular*), Asian Common Toad (*Bufo melanostictus*), and Common Rat Snake (*Ptyas mucosus*).

161. The King Cobra, the longest poisonous snake in the world, has a major home in Parsa National Park in the Madesh Province. The vast tracts of forest and great biodiversity inside the park provide the perfect habitat for snakes, with plenty of undergrowth and a wide variety of prey. King Cobra sightings are sometimes reported from the municipality of Birgunj, particularly during the monsoon

season. Known for its birds, Koshi Tappu Wildlife Reserve is home to a number of reptile species, including the King Cobra. Various animals are supported by the reserve's diversified ecology, which includes grasslands, marshes, and wooded regions. Usually located in the more wooded areas, king cobras may hunt and find cover from the elements. The King Cobra's survival depends on Chitwan National Park, especially in Bagmati Province, where a broad range of plants and animals supports a strong prey population.

Table 15. Herpetofauna (Reptiles and Amphibians) in the Surrounding Area

S.N.	Name			CITES*	IUCN	NPWC Act
	Local	English	Scientific			
1	Dhaman	Common Rat Snake	*Ptyas mucosa*	II	LC	-
2	Harayu	Mountain Pit Viper	*Ovophis monticola*	-	LC	-
3	Chheparo	Changeable Lizard	*Calotes versicolor*	-	LC	-
4	Bhyaguto	Asian Common Toad	*Bufo melanostictus*	-	LC	-
5	Ranibhyaguto	Stream Frog	*Rana cyanophylectis*	-		-
6	Sun Gohori	Golden Monitor Lizard	*Varanus flavescens*	I	I	Protected
7	Kachhuwa	Land Tortoise	*Testudinidae species*	I	-	-
8	Goman	Indian Cobra	*Naja naja*	II	LC	-
9	Raj Goman	King Cobra	*Ophiophagus hannah*	II	VU	-
10	Chheparo	Changeable Lizard	*Calotes versicolor*	-	LC	-
11	Ajingar	Indian Python	*Python molurus*	I	NT	-
12	Karet	Common Krait	*Bungarus caeruleus*	-	LC	-
13	Bhyaguto	Asian Common Toad	*Bufo melanostictus*	-	LC	-

Source: Field Visit, 2022

Note: LC-Least Concern, EN- Endangered, VU-Vulnerable, NT-Not Threatened

Key Biodiversity Area (KBA)

Mai Valley Forest

162. The Mai Valley, located in the northeastern part of Nepal, is a KBA. The Mai watershed spans from 70 m in the tropical zone to 3050 m in the subalpine zone, with the largest town being Ilam. The main sources of income in the area are tea and cardamom plantations. The remaining woods are mostly in lower and upper temperate zones, with a small tropical evergreen forest and subtropical semi-evergreen woods. Birds in the Mai Valley include the tropical evergreen and semi-evergreen forests, mixed broadleaf forests, and wet broadleaf oak Quercus forests.

163. The Mai Valley has around 300 species, with over 200 species found in the upper valley. Some of the species that depend on the woods include Rufous-throated Wren Babbler, Spiny Babbler, and Hoary-throated Barwing. The area has also seen the Lesser Adjutant and White-rumped Vulture nesting at the edges of the woods. Non-bird biodiversity in the Mai Valley is less known, but it is home to the Assam Macaque, Asian Black Bear, Common Leopard, Golden Jackal, Leopard Cat, Hanuman Langur, Black Giant Squirrel, Indian Muntjac, and Yellow-throated Marten.

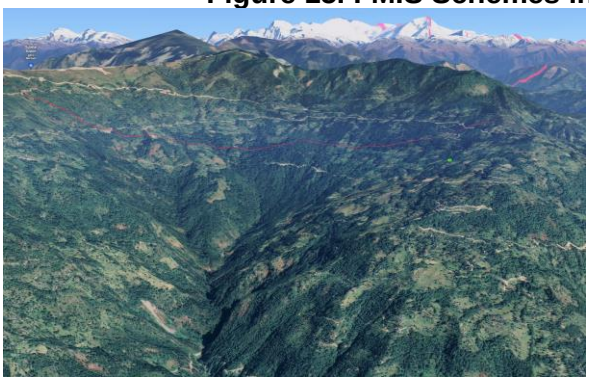
164. Two irrigation schemes—Run Sung and Mangaltar Dhamsar—are proposed for financing in the Mai Valley Forest region. These schemes, part of FMIS Project, already exist but require rehabilitation to enhance efficiency and sustainability. The irrigation schemes have been in use for years, however, now need rehabilitation due to damage. The proposed work includes repairing and upgrading canal structures, ensuring efficient water distribution, and reducing water loss through seepage.

165. The land use in Rung Sung is characterized by a combination of dense forests and terraced agricultural fields. The terraced fields are a traditional agricultural practice in the hilly regions of Nepal, designed to manage water efficiently and prevent soil erosion. These terraces are used to grow crops

such as rice, maize, and millet, which are staples for the local population. The dense forests surrounding the agricultural land consist of broadleaf species, rhododendrons, and other native flora, crucial for maintaining biodiversity and ecological balance. Rung Sung is situated in a mid to high elevation zone within the Mai Valley Forest. The topography features steep slopes and deep valleys, typical of the eastern Himalayan foothills. The forests in Rung Sung consist of a mix of broadleaf species and other native flora. The terraced fields visible in the image are indicative of the local agricultural practices adapted to the hilly terrain. These terraces help in efficient water management and maximize arable land on steep slopes, which is essential for subsistence farming. Such practices are crucial for preventing soil erosion and maintaining soil fertility, which are significant concerns in hilly agricultural landscapes. The region relies heavily on small-scale irrigation systems to support agriculture.

166. The land use in Mangaltar Dhamsar is characterized by a mix of dense forests and extensive agricultural fields. The agricultural land is predominantly terraced, a traditional practice in the hilly regions of Nepal to manage water efficiently and prevent soil erosion. These terraces are used for growing various crops such as rice, maize, and millet, which are staples in the local diet. Mangaltar Dhamsar is situated in a hilly terrain, with elevations varying from mid to lower elevations compared to other parts of the Mai Valley. The site is valley floor surrounded by hills, indicating a significant elevation gradient. The steep slopes and deep valleys are typical of the Himalayan foothills, posing both opportunities and challenges for agriculture and infrastructure development. The forests in Mangaltar Dhamsar consist of a mix of broadleaf species and other native flora. The terraced fields indicative of the local agricultural practices adapted to the hilly terrain. These terraces help in efficient water management and maximize arable land on steep slopes, essential for subsistence farming in this region. Such practices are crucial for preventing soil erosion and maintaining soil fertility, which are significant concerns in hilly agricultural landscapes.

Figure 15. FMIS Schemes inside Tamur valley and watershed



Khokse Nangkholyang

Chuwa

Tamur Valley and Watereshed

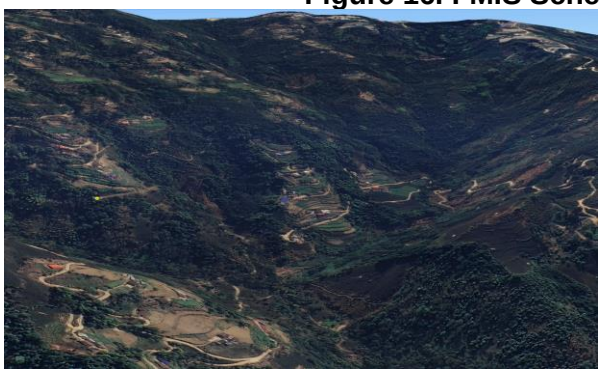
167. The Tamur valley in Nepal's Koshi Zone is a major basin formed by the Tamur River, extending from 100 meters above sea level in the tropical zone to 3800 meters in the alpine zone. The upper Tamur is part of the Kanchenjunga Conservation Area. The basin is home to mixed broadleaved forests, Quercus lamellosa forests, and Castanopsis spp. forests, with some patches featuring various types of rhododendrons. The upper temperate forests are primarily Quercus semecarpifolia, Abies spectabilis, and Rhododendron spp., making them the largest rhododendron forests in the world. The watershed is home to 260 species, with 215 possibly breeding. The area is home to large groups of species typical of the Sino-Himalayan Temperate Forest biome. Birds and animals in the area include the Assam Macaque, Hanuman Langur, Chinese Pangolin, Clouded Leopard, Leopard, Leopard Cat,

Grey Wolf, Yellow-throated Marten, and Indian Muntjac.

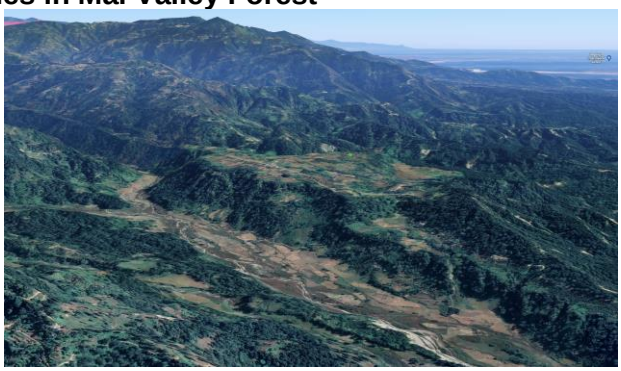
168. The Khokse Nangkholyang and Chuwa irrigation schemes in the Tamur Valley will undergo rehabilitation under the project will enhance agricultural productivity and sustainability. The Khokse Nangkholyang area is characterized by lush, dense forest cover, including broadleaf forests and other native flora such as rhododendrons and oaks. Interspersed within these forests are patches of agricultural land, primarily used for subsistence farming. The terraced fields are a common adaptation to the steep slopes, allowing for efficient cultivation and water management. The Tamur Valley spans from around 100 meters above sea level in the tropical zone to approximately 3800 meters in the alpine zone. The Khokse Nangkholyang area is situated in a mid-elevation zone, featuring hilly terrain with steep slopes and deep valleys.

169. The Chuwa irrigation scheme area features a diverse landscape with dense forest cover and terraced agricultural fields. The forests are composed of temperate and subtropical tree species typical of the eastern Himalayas, including broadleaf forests and patches of rhododendrons. The terraced fields indicate the presence of agricultural activities, allowing farmers to maximize arable land on steep slopes and manage water efficiently for crop cultivation. The Chuwa irrigation scheme area is situated in hilly to mountainous terrain with significant elevation variations, supporting diverse ecosystems from subtropical forests in lower elevations to temperate forests at higher elevations.

Figure 16. FMIS Schemes in Mai Valley Forest



Run Sung



Mangaltar Dhamsar

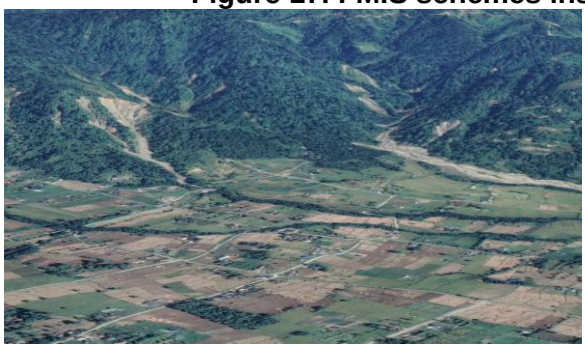
Dharam Forests

170. Dharan forests run from east to west through the Sunsari and Morang districts. They make up a big part of the woods that are still there in Sunsari. A mix of tropical evergreen tree species and Sal Shorea robusta makes up the main type of foliage. The only other large areas of this type of forest left in Nepal are in the lower Mai valley, which are more damaged and broken up. The forest is split in half by the main road that goes from Itahari to Dharan. Koshi Tappu Wildlife Reserve is about an hour's drive away. In the east, five gravel roads run next to the Dharan to Itahari road and connect the people of the Siwalik area to the terai.

171. To add to the variety of the area, this forest is home to about 300 different bird species, though a full list has not yet been made. Some of the widely threatened bird species that live in the area are the Lesser Adjutant, the White-rumped, and the Slender-billed Vultures. A lot of tropical forests are likely to be home to big groups of species that are typical of the Indo-Chinese Tropical Moist Forest and Indo-Malayan Tropical Dry Zone biomes. Animal variety that isn't birds: The Bengal Fox (*Vulpes bengalensis*), the Hanuman Langur (*Semnopithecus entellus*), the Wild Boar (*Sus scrofa*), the Black Giant Squirrel (*Ratufa bicolor*), and the Indian Hare (*Lepus nigricollis*) are some of the mammals that live here.

172. The Bhuwa and Jimdara irrigation schemes in the Dharam will undergo rehabilitation under the project to enhance agricultural productivity and sustainability. The land use in the Bhuwa and Sira Jimdara irrigation area is predominantly agricultural, with extensive fields spread across the valley floor. These fields are organized into a grid-like pattern, indicative of well-planned farming practices. The terraces and plots are used to cultivate crops such as rice, maize, and vegetables, which are staples for the local population. The presence of roads and small settlements within the fields suggests a community-based farming approach, with households managing their own plots of land. Surrounding the agricultural fields are dense forests that cover the steep hills and mountains. The valley floor is relatively flat, providing suitable conditions for extensive agriculture, while the surrounding hills rise steeply, creating a dramatic elevation gradient.

Figure 17. FMIS schemes inside the boundaries of Dharam Forest



Bhuwa

Sira Jimdara

Langtang National Park

173. Langtang National Park, established in 1976, is located in the middle Himalayas of Nepal, just 32 km north of the Kathmandu Valley. The park encompasses a diverse range of ecosystems: 60.7% of the area is covered by rocks and ice, 29.9% by forests, 4.9% by grasslands, 2.8% by shrubland, and 1.7% by farmland. The park features a variety of forest types, from tropical forests dominated by Sal (*Shorea robusta*) to subtropical forests with *Schima wallichii*, *Castanopsis indica*, and Chir Pine (*Pinus roxburghii*). As elevation increases, lower temperate forests with *Quercus lanata*, *Q. lamellosa*, and *Pinus wallichiana* are found, while upper temperate forests include *Q. semecarpifolia* and *Tsuga dumosa*. Subalpine and alpine zones, which together cover the largest portion of the park (21.5% each), host species such as *Abies spectabilis*, *Betula utilis*, and various rhododendrons and junipers. Unique to the subalpine area are Larix species. The Langtang Khola river valley's floodplains are characterized by hemlock woods, with higher elevations featuring Silver Fir and Blue Pine forests.

174. The park is home to 347 bird species, including the breeding Wood Snipe, Satyr Tragopan, and Yellow-rumped Honeyguide, as well as significant populations of Hoary-throated Barwing and Nepal Wren Babbler. The park supports typical species of the Sino-Himalayan Temperate Forest and Eurasian High Montane biomes. Additionally, 46 mammal species have been recorded, including the Red Panda, Himalayan Tahr, Serow, Assam Macaque, Asiatic Black Bear, and Himalayan Musk Deer, highlighting its rich non-bird biodiversity.

175. The Dhuple Khola scheme is proposed for financing within the buffer zone of Langtang National Park. These schemes if for rehabilitation to enhance water irrigation efficiency. The primary land use in the Dhuple Khola area is agriculture, with visible terraced fields on the valley slopes. These terraces are a traditional method used to manage water efficiently and prevent soil erosion, making them essential for farming in the hilly terrain of Nepal. The fields are likely used for growing staple crops

such as rice, maize, and millet, which are crucial for the local economy and sustenance.

176. The locations have small clusters of settlements scattered across the landscape, typically near agricultural fields. These settlements are indicative of a rural lifestyle where communities live close to their farmland, reflecting a close integration of living and farming spaces. Dhuple Khola is situated in a high-elevation zone, characteristic of the mid-Himalayan range. The steep slopes and high-altitude plains present in the image suggest significant elevation changes that influence local climate and vegetation types. The terrain is rugged, with steep inclines and sharp valleys. This varied terrain is typical of the Naukunda Municipality, requiring adaptive farming practices and resilient infrastructure to support the local population.

Figure 18. Dhuple Khola in Nukunda, Bagmati

Chitwan National Park

177. Chitwan National Park, established in 1973 as Nepal's first national park, is located in the central Terai region, nestled between the Siwalik Hills to the south and the Mahabharat Hills to the north. Adjacent to the east is the Parsa Wildlife Reserve. The park features a variety of ecosystems, including narrow grasslands along riverbanks and extensive Sal (*Shorea robusta*) forests covering about 70% of the park. There are also riverine forests dominated by *Acacia catechu* and *Dalbergia sissoo*, with small patches of tropical evergreen forest and Chir Pine (*Pinus roxburghii*) forests in the hills. The park's wetlands, formed by the Narayani, Rapti, and Reu rivers, include numerous small lakes, pools, and riverine woods, creating a diverse habitat for wildlife.

178. Chitwan National Park is designated as a KBA. The park is home to 540 bird species, including globally endangered species like the Bengal Florican, Grey-crowned Prinia, Slender-billed Babbler, and Lesser Adjutant. The park is also a critical breeding ground for the Indian Spotted Eagle and hosts

significant populations of near-threatened birds, particularly in its wetlands. Additionally, Chitwan supports over 50 mammal species, including two-thirds of the world's Indian Rhinoceros population, and other globally threatened species such as the Gaur, Asian Elephant, Tiger, and Ganges River Dolphin. These diverse habitats make Chitwan a crucial site for both avian and mammalian conservation.

179. Tarauli scheme is proposed for financing which near the end of the boundary of Chitwan National Park. It is the existing irrigation canal system that requires rehabilitation. The scheme in Ratnagar Municipality shows an area predominantly used for agriculture. The landscape is marked by a patchwork of cultivated fields, indicative of farming practices. The fields are divided into numerous small plots, suggesting a high level of land utilization for crop cultivation. This pattern of land use is typical for rural areas in Nepal, where agriculture is a primary source of livelihood. The presence of a few settlements scattered throughout the agricultural land indicates a rural community where farming is likely the main economic activity. Tarauli is located in the Terai region of Nepal, which is characterized by its flat to gently undulating terrain. The elevation in this area is relatively low compared to the hilly and mountainous regions of Nepal.

180. Geographically, the Terai is the southernmost part of Nepal and forms a narrow strip of fertile land that extends along the border with India. The region is known for its rich alluvial soil, which is highly productive and supports dense agricultural activities. The presence of rivers and streams in the area is crucial for irrigation, providing the necessary water supply for crop cultivation. The red boundary in the image marks the extent of Ratnagar Municipality, indicating administrative demarcations that are essential for local governance and resource management.

Figure 19. Tarauli in Ratnanagar

Critical Habitat Assessment

181. Critical habitat refers to areas of high biodiversity value in which development would be particularly sensitive and require special attention. The purpose of a critical habitat assessment is to

identify the level of high biodiversity value within the subproject areas. Critical habitat is defined in ADB SPS 2009 as areas or sites:

(i) with high biodiversity value, including habitat required for the survival of critically endangered or endangered species;
(ii) having special significance for endemic or restricted-range species;
(iii) that are critical for the survival of migratory species;
(iv) supporting globally significant concentrations or numbers of individuals of congregatory species;
(v) with unique assemblages of species or that are associated with key evolutionary processes or provide key ecosystem services;
(vi) having biodiversity of significant social, economic, or cultural importance to local communities

182. Moreover, based on ADB SPS 2009, critical habitats can be either natural or modified or a combination of both. These include legally protected areas or those officially proposed for protection, such as areas that meet the criteria of the World Conservation Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's world natural heritage sites.

183. The area of analysis (AoA) for assessing critical habitat is assigned for the locations of subproject areas (i.e. FMIS structures). To assess critical habitats, the boundaries around each subproject location at 500m, such as FMIS structures, are established. Existing ecological data are used to identify critical habitats within the AoA. This step ensures that all significant ecological areas are considered in the assessment.

184. To support the critical habitat assessment in subproject sites, International Finance Corporation's (IFC) Guidance Note 6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources is used to determine any trigger as per SPS 2009.[17] The guidance note defines critical habitat as areas of high biodiversity value that include or meet at least one of the following:

(i) Criterion 1: Critically Endangered (CR) and/or Endangered (EN) species
(ii) Criterion 2: Endemic or restricted-range species
(iii) Criterion 3: Migratory or congregator species
(iv) Criterion 4: Key evolutionary processes
(v) Criterion 5: Areas having biodiversity of significant social, economic, or cultural importance to local communities.
(vi) Criterion 6: Protected Areas

185. ***Criterion 1*: *Critically Endangered (CR) and/or Endangered (EN) species***. Species threatened with global extinction and listed as CR and EN on the IUCN Red List of Threatened Species shall be considered as part of Criterion 1. Critically Endangered species face an extremely high risk of extinction in the wild. Endangered species face a very high risk of extinction in the wild. Thresholds and analysis for Criterion 1 are the following:

(i) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units of a CR or EN species).
(ii) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to

[17] International Finance Corporation's Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (ifc.org)

EN or CR and meet the thresholds in (a).

(iii) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

186. The following species listed below are categorized as vulnerable (VU), and endangered (EN), and there have been no first hand sightings of these animals in the subproject areas. Nevertheless, these species may be present in the provinces of FMIS according to secondary information.

(i) *Panthera tigris,* EN (Bengal Tiger): Bengal Tiger belongs to order Carnivora and family Felidae. The Bengal Tiger populations exist in fragmented locations in the Terai region and core sub populations are concentrated in the protected areas of Chitwan National Park, Parsa Naional Park. Most tigers exist within protected areas however approximately a quarter remain outside. The global population of this species is about 3200. According to the Annual Report of DNPWC (2019), its population is 235.

(ii) *Elephas maximus,* EN (Asian Elephant): Asian Elephants are distributed across the Terai region of Nepal and estimated to be present within 22 districts of Nepal. They are present in Chitwan National Park, Koshi Tappu and Parsa National Park. The current estimated total number of elephants in Nepal is between 255 and 265 (plus 150 domestic Asian Elephants). The global population is currently estimated to be between 30000 to 50000 individuals.

(iii) *Neophron Percnopterus*, EN (Egyptian vulture) is widespread throughout Nepal, apart from in the east part of the country. It is listed as Endangered and is known to inhabit open areas, cliffs, and human settlements where food sources are readily available. The municipality of Birgunj reports frequent sightings of Egyptian Vultures around garbage dumps and slaughterhouses. The areas around Chitwan National Park and Hetauda are known for frequent sightings of Egyptian Vultures, taking advantage of the park's rich biodiversity and nearby human settlements' waste. The estimated population of the Egyptian vulture in Nepal is to be between 300 to 1000.

Figure 20. A sample photograph of Egyptian Vulture

Source: H. Rayaleh and M. Mcgrady. 2019. An observation the Indian subspecies of Egyptian Vulture Neophron percnopterus ginginianus in Djibouti. Vulture News. 77. 62-68. 10.4314/vulnew.v77i1.3.

(iv) *Bos gaurus,* VU (Indian Bison): Bos gaurus is found in Chure bhabar region, Parsa National Park, Chitwan National Park and Trijuga valley of Nepal. According to the Annual Report of DNPWC (2019), its population is 473. National red list of mammals categorizes it as a vulnerable species. It is protected because of its heavy habitat loss.

Figure 21. Image of Indian Bison (*Bos gaurus*)

Source: JungleDragon

(v) *Panthera pardus*, VU (Leopard): Recent studies and reports indicate that the leopard population in Nepal is relatively stable, though precise numbers are difficult to ascertain due to the elusive nature of these big cats. Estimates suggest that Nepal is home to several hundred leopards, but exact figures can vary based on the region and the methods used for counting.

(vi) *Rhinoceros unicornis,* VU (one-horned Rhino): One Horned Rhinoceros is native to Nepal and India. It is found Chitwan National Park and nearby forest, and Parsa National Park and nearby forest in Nepal. According to the Annual Report of DNPWC (2019), its population is 645. The legal status of this species in Nepal is Protected (Appendix I) under the National Parks and Wildlife Conservation Act 1973.

(vii) *Buceros bicornis* (Great Hornbill), VU: The population of this species in the eastern part of Nepal is estimated to be between 80 and 150 individuals. These hornbills are primarily found in protected areas such as Chitwan National Park, Bardia National Park, and the forests of Kapilvastu and Sarlahi Districts. Their habitat preference includes subtropical broadleaf forests and evergreen habitats typically below 2,000 meters.

187. There are subprojects within the Mai Valley Forest (two irrigation schemes—Run Sung and Mangaltar Dhamsar), Tamur Valley (two irrigation schemes— Khokse Nangkholyang and Chuwa irrigation schemes) and Dharan Forests (two irrigation schemes— Bhuwa and Jimdara irrigation schemes) area may possibly trigger item (c) of criterion 1 being Key Biodiversity Areas (KBA). However, the rehabilitation activities are confined to existing agricultural lands and involve minimal habitat disruption. These lands have been used for farming and irrigation purposes for many years, which means they are already modified environments with established agricultural practices. By limiting the scope of work to these areas, the project avoids encroachment into wildlife habitats that are more sensitive to environmental impacts, hence the FMIS schemes does not trigger item (c).

188. ***Criterion 2: Endemic and Restricted-range Species*.** For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an extent of occurrence less than 50,000 square kilometers (km^2). The threshold for Criterion 2 is area holds ≥10% of the global population size and ≥10 reproductive units of a species.

189. The species in the subproject areas can be found across multiple countries in South Asia, and while they may be significant to local ecosystems, these are not considered endemic or restricted range species limited to the specific subproject sites.

190. ***Criterion 3: Migratory and Congregatory Species.*** Migratory species are defined as any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem). While, congregatory species are defined as species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable. The thresholds for Criterion 3 are:

(i) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.
(ii) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.

191. The following species migratory in nature, and can be found at the subproject sites of FMIS based on secondary information:

(i) *Neophron Percnopterus* (Egyptian vulture) is widespread throughout Nepal, apart from in the east part of the country. It is listed as Endangered and is known to inhabit open areas, cliffs, and human settlements where food sources are readily available. The municipality of Birgunj reports frequent sightings of Egyptian Vultures around garbage dumps and slaughterhouses. The areas around Chitwan National Park and Hetauda are known for frequent sightings of Egyptian Vultures, taking advantage of the park's rich biodiversity and nearby human settlements' waste. The estimated population of the Egyptian vulture in Nepal is to be between 300 to 1000.

(ii) Indian Cuckoo (*Cuculus micropterus*), LC. It is a bird species widely distributed across Asia, including Nepal. Globally, its population is considered common and widespread. In Nepal, the Indian Cuckoo is a regular migratory species, thriving in various protected areas and forests such as Chitwan National Park, Shivapuri Nagarjun National Park, Annapurna Conservation Area, and Bardia National Park. These birds are typically found in tropical and subtropical moist forests during their breeding season, which spans from April to July.

Figure 22. A sample photograph of the Indian Cuckoo (*Cuculus micropterus*)

Source: Nepal Desk. Indian Cuckoo: The Eternal Melody of Nature

(iii) Large-tailed Nightjar (*Caprimulgus macrurus*), LC. Although specific population estimates for this species are not readily available, it is generally considered common in parts of its range. In Nepal, the Large-tailed Nightjar inhabits open woodlands and forests, often found in various protected areas. Its presence and migratory patterns contribute to the biodiversity of these ecosystems, although it is also resident in some parts of its range.

(iv) Western Koel (Eudynamys scolopacea), LC. It is widely distributed and considered common within its range. While detailed global population numbers are not well-documented, the Western Koel is known for its seasonal migrations between breeding and non-breeding areas. In Nepal, it is commonly found in forests, gardens, and urban areas during its migratory season. The Western Koel's migratory behavior and adaptability to various habitats make it a notable species in the avian community of Nepal.

192. The species above do not trigger the criterion 3.

193. ***Criterion 4: Key evolutionary processes.*** Topography, geology, soil, temperature, vegetation, and their combinations can affect evolutionary processes that create regional species and ecological features. Unique landscape features have been linked to genetically distinct plant and animal populations. Physical or geographical elements are commonly linked to species diversification as surrogates or spatial accelerators for evolutionary and ecological processes. In recent decades, biodiversity conservation has focused on maintaining these crucial evolutionary processes in a landscape and the resulting species (or subpopulations). Genetic diversity conservation is especially important. In a rapidly changing climate, species variety and genetic variation within species enable evolutionary flexibility.

194. There is no such site within the subproject area that is characterized as above. Thus, this criterion is not triggered.

195. ***Criterion 5: Areas having biodiversity of significant social, economic, or cultural importance to local communities.*** Areas having biodiversity of significant social, economic, or cultural importance to local communities. This criterion focuses on regions where biodiversity is intrinsically linked to the well-being of local communities through various means such as traditional

practices, economic benefits, cultural values, or social significance. Such areas often support livelihoods, maintain cultural heritage, and provide ecosystem services that are crucial for local communities. Identifying and conserving these areas is essential to ensure that biodiversity conservation efforts also support the social and economic fabric of the communities that depend on them.

196. The subproject sites of FMIS do not encompass regions where biodiversity is intrinsically linked to the well-being of local communities through traditional practices, economic benefits, cultural values, or social significance. The lands in these subproject sites are primarily agricultural lands that have been used for farming and irrigation purposes for many years, focusing on enhancing agricultural production.

197. *Criterion 6:* ***Legally protected or officially proposed for protection:*** This critical habitat requirement, as stipulated by the SPS 2009, focuses on areas that are either legally protected or officially proposed for protection.

198. Tarauli scheme is proposed for financing which near the end of the boundary of Chitwan National Park. It is existing irrigation canal system that requires rehabilitation. Tarauli is located in the Terai region of Nepal, which is characterized by its flat to gently undulating terrain. The elevation in this area is relatively low compared to the hilly and mountainous regions of Nepal. The scheme in Ratnagar Municipality shows an area predominantly used for agriculture. The landscape is marked by a patchwork of cultivated fields, indicative of farming practices. The presence of settlements scattered throughout the agricultural land indicates a rural community where farming is likely the main economic activity.

199. The Dhuple Khola scheme is proposed for financing within the buffer zone of Langtang National Park. This scheme is for rehabilitation to enhance water irrigation efficiency. The primary land use in the Dhuple Khola area is agriculture, with visible terraced fields on the valley slopes. The locations have small clusters of settlements scattered across the landscape, typically near the agricultural fields. These settlements are indicative of a rural lifestyle where communities live close to their farmland, reflecting a close integration of living and farming spaces.

200. This criterion is triggered by the presence of the these schemes in the buffer zones of the national parks.

201. **Conclusion:** Based on the guidelines provided by IFC GN6 and ADB SPS 2009 for CHA, the criteria 6 is triggered by the project due to the presence of 2 FMIS schemes in the buffer zones of Chitwan and Langtang National Parks. To meet the SPS 2009, FMIS needs to meet the critical habitat requirement, which are discussed in the following:

(i) There are no measurable adverse impacts, or likelihood of such, on the critical habitat (i.e. buffer zones of Chitwan and Langtang national parks) which could impair its high biodiversity value or the ability to function, and (ii) the project is not anticipated to lead to a reduction in the population of any recognized endangered or critically endangered species or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.

(ii) *Limited Scope of Work*: The FMIS subprojects are confined to the rehabilitation of existing canal structures rather than the construction of new canals or significant land alterations. This limitation in scope ensures that the environmental footprint of the project is minimized. By focusing on improving existing infrastructure, the FMIS avoids the extensive land disturbance typically associated with new construction. This approach inherently reduces the risk of disrupting habitats that are crucial for local

biodiversity.

(iii) *Localized Impacts:* The impacts of the rehabilitation work are localized and temporary. Activities such as canal lining, repair, and maintenance are conducted within confined areas and over short durations. This localized and short-term nature of the work further ensures that any potential disruptions to the habitat are minimal and reversible.

(iv) *Avoidance of Tree Cutting**:*** FMIS will explicitly avoid cutting down trees and clearing vegetation beyond what is strictly necessary for construction activities. By preserving existing vegetation, the project helps maintain the habitat structure that supports local wildlife.

(v) *Agricultural Land Use:* The areas selected for the FMIS subprojects are primarily agricultural lands that have been used for farming and irrigation for decades. These lands are modified environments, meaning they have already undergone significant changes from their natural state.

(vi) *Reduced Habitat Encroachment:* By focusing on agricultural lands, the project avoids encroaching into potential wildlife habitats. The delineation of project boundaries to existing agricultural zones ensures that natural habitats are left undisturbed. This strategic location helps in protecting critical habitats from potential adverse impacts of construction activities.

(vii) Any lesser impacts are mitigated. Mitigation measures will be designed to achieve at least no net loss of biodiversity. The Biodiversity Action Plan (BAP) detailed in Appendix 8 of the IEE provides a strategic framework designed to mitigate any significant adverse impacts on wildlife and biodiversity arising from the FMIS project. This comprehensive plan is developed in alignment with government regulations and the ADB Safeguards Policy Statement of 2009. The primary purpose of the BAP is to ensure that the rehabilitation and construction activities within the FMIS do not result in net biodiversity loss and maintain the ecological integrity of the areas affected.

Table 16. Summary of Critical Habitat Assessment

Critical Habitat defined by ADB (2009)	Quantitative Thresholds of Critical Habitat based in IFC PS-6	Species/sites	Likelihood to trigger criterion	Remark
Criterion 1: The area includes habitat required for the survival of critically endangered (CR) or endangered (EN) species	(a) Areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥ 5 reproductive units GN16 of a CR or EN species).	*Panthera tigris* (Bengal Tiger), EN	Unlikely	The population exist in fragmented locations in the Terai region and core sub populations are concentrated in the protected areas of Chitwan National Park, Parsa Naional Park. There are no such species at the subproject sites.
		Elephas maximus (Asian Elephant), EN	Unlikely	The current estimated total number of elephants in Nepal is between 255 and 265 (plus 150 domestic Asian Elephants). The global population is currently estimated to be between 30000 to 50000 individuals. There are no such species at the subproject sites.
		Neophron Percnopterus (Egyptian vulture), EN	Unlikely	It is known to inhabit open areas, cliffs, and human settlements where food sources are readily available. The municipality of Birgunj reports frequent sightings. However, there are no such species at the subproject sites.
	(b) Areas that support globally important concentrations of an IUCN Red-listed Vulnerable (VU) species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds of (a).	*Panthera pardus*, VU (Leopard)	Unlikely	The most recent data on the leopard population in Nepal estimates around 1,000 individuals. The global population is estimated to be between 50,000 and 100,000 individuals as of 2024. There are no such species at the subproject sites.
		Bos gaurus (Indian Bison), VU	Unlikely	According to the Annual Report of DNPWC (2019), its population is 473. This species is not found within the subproject area

Critical Habitat defined by ADB (2009)	Quantitative Thresholds of Critical Habitat based in IFC PS-6	Species/sites	Likelihood to trigger criterion	Remark
		Rhinoceros unicornis (One-horned Rhino), VU	Unlikely	According to the Annual Report of DNPWC (2019), its population is 645. This species is not found within the subproject area
		Buceros bicornis (Great Hornbill), VU	Unlikely	The population of this species in the eastern part of Nepal is estimated to be between 80 and 150 individuals. These hornbills are primarily found in protected areas such as Chitwan National Park, Bardia National Park, and the forests of Kapilvastu and Sarlahi Districts. There are no such species at the subproject sites.
	(c) As appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species	Mai Valley Forest Tamur Valley Dharan Forests	Unlikely	The rehabilitation activities are confined to existing agricultural lands and involve minimal habitat disruption. By limiting the scope of work to these areas, the project avoids encroachment into habitats.
Criterion 2: The area has special significance for endemic or restricted-range species;	a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species	NA	Unlikely	The species in the subproject areas can be found across multiple countries in South Asia
Criterion 3: The area represents a site that is critical for the survival of migratory species; or supports globally significant concentrations or numbers of individuals of congregatory species;	(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.	*Neophron Percnopterus* (Egyptian vulture), EN	Unlikely	It is widespread throughout Nepal, apart from in the east part of the country. The estimated population of the Egyptian vulture in Nepal is to be between 300 to 1000.
		Indian Cuckoo (*Cuculus micropterus*), LC.	Unlikely	It is a bird species widely distributed across Asia, including Nepal. Globally, its population is considered common and widespread.
		Large-tailed Nightjar	Unlikely	Although specific population estimates for this species are not readily

Critical Habitat defined by ADB (2009)	Quantitative Thresholds of Critical Habitat based in IFC PS-6	Species/sites	Likelihood to trigger criterion	Remark
		(*Caprimulgus macrurus*), LC		available, it is generally considered common in parts of its range.
		Western Koel (Eudynamys scolopacea), LC	Unlikely	It is widely distributed and considered common within its range. Western Koel is known for its seasonal migrations between breeding and non-breeding areas. In Nepal, it is commonly found in forests, gardens, and urban areas during its migratory season.
	(b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.	NA	Unlikely	The FMIS sites do not exhibit such area.
Criterion 4: The area includes unique assemblages of species that are associated with key evolutionary processes or provide key ecosystem services;		NA	Unlikely	There is no such site within the subproject areas.
Criterion 5: The area holds biodiversity of significant social, economic, or cultural importance to local communities;		NA	Unlikely	The subproject sites of FMIS do not encompass regions where biodiversity is intrinsically linked to the well-being of local communities through traditional practices, economic benefits, cultural values, or social significance.
Criterion 6: The area is either legally protected or officially proposed for protection, such as areas that meet the criteria of the World Conservation		Buffer zones of Chitwan and Langtang National Parks	Yes	The two FMIS subprojects are located in the buffer zones of Chitwan National Park and Langtang National Park. Although these existing irrigation canal systems have been in

Critical Habitat defined by ADB (2009)	Quantitative Thresholds of Critical Habitat based in IFC PS-6	Species/sites	Likelihood to trigger criterion	Remark
Union classification, the Ramsar List of Wetlands of International Importance, and the United Nations Educational, Scientific, and Cultural Organization's World natural Heritage sites.				use for years, they now require rehabilitation.

EN = Endangered, IUCN = International Union for Conservation of Nature, PAI =project area of influence, VU = vulnerable

C. SOCIO-ECONOMIC ENVIRONMENT

202. For the socio-economic assessment of project beneficiaries for the FMIS component, the respective Water Resource and Irrigation Development Divisions (WRIDDs) have collected social information for the subproject preparation. The socio-economic information presented in the DDR is principally obtained from two sources: a) compilation of information from subproject preparation reports and other available project documents and (b) figures are projected by applying the ratio of particular social indicators taken from Nepal Population and Housing Census 2021 for the same municipality/ ward in which the project area exists. The socio-economic assessment results are summarized in the following paragraphs.

203. **Population and Demography**: The proposed project area is spread over the 88 municipalities/ or rural municipalities of Koshi, Bagmati, Madhesh, Gandaki, and Lumbini provinces. According to statistics available in subproject preparation reports (SPPR), the total population likely to benefit from the improved irrigation services is 141,390, with an average household size of 5.3. The number of female populations is slightly higher (51%) than that of the male population (49%). The detailed populations of the subprojects are presented in **Appendix 4.**

204. **Cast and ethnicity:** The proposed project area consists of inhabitants of various castes and ethnicities having a diversity of cultures, customs, traditions, norms, and values associated with ethnic culture with which they are associated. The majority (59.55%) of project beneficiaries belong to Brahmin/Kshetri caste groups, followed by Janjaties (30.51%). Likewise, the Dalit population is 5.89%, whereas 4.05 % of project beneficiaries belong to Musalman.

205. **Population by Age group.** The age group of the project beneficiaries has been derived by applying the respective age group ratio of the municipality /ward population in which the project area exists. The population proportion has been taken from the statistics available in Nepal Population and Housing Census (NPHC) 2021[18]. Among the project beneficiaries, the majority of the population (62.52%) belonged to the age group ranging between 15-59 years. These groups of the population are considered economically active and can benefit from the temporary

[18] https://censusnepal.cbs.gov.np/results/downloads/ward

employment opportunity generated by project intervention. The rest of the population groups are dependent, i.e., the age group between 0-14 (26.71%) and the population above years (10.76%)**.**

206. **Educational Status**. The educational status of the project beneficiaries has been derived by applying the respective educational ratio of the municipality /ward population in which the project area exists. Among the project beneficiaries exceeding five years of age, the highest percentage (41.68%) of educational level lies in basic level or up to grade 8 of formal education, followed by higher secondary level 9-12 (27.19%). Only 3.2% of project beneficiaries have completed educational level 12 or above, whereas 27.9 percent of the population are illiterate.

207. The overall literacy rate among the project beneficiaries is 72.1%, which is slightly lower than the national average (76.2%[19]). The lower average might be attributed to the project area, which mostly lies in the remote hill and mountain terrain of Nepal. The figure is validated by the statistics available in NPHC 2021, which showed that out of the total population in urban municipalities, only 21 % are illiterate, whereas the illiterate rate of the population living in rural municipalities is 27.6%.

208. **Disability** The NPHS 2021 shows that 2.2 percent of the total population have one or the other type of disability. Among the project beneficiaries, around 2% population in the project area are disabled, which is slightly higher than the national average.

209. **Landholding**. Land is one of the most important livelihood assets for rural communities in Nepal. Around 45% of the project beneficiaries hold less than 0.5 ha of cultivated land, followed by 29.7% holding between 0.5-1 ha. Likewise, 18% of farmers hold above 1 ha, whereas around 7% of people don't have arable land in the command area of the system. It is expected that improved irrigation facilities will lead to an increase in cropping intensity, which will demand additional farm labor by creating on-farm employment opportunities for landless farmers or farmers with small holdings, who are the majority among project beneficiaries**.**

210. **Land Ownership.** Overall, agricultural land ownership is associated with lower poverty rates. The fourth Nepal Living Standard Survey (NLSS) -2023 highlighted that in rural areas, land ownership is negatively correlated with poverty rates – poverty headcount decreases as the area of land owned increases. In urban areas, however, poverty headcount is higher in households with less than one hectare of agricultural land compared to households with no land, is presented in the table below.

Table 17: Poverty and land ownership

Land ownership status	Incidence			Distribution:	
	Headcount rate	Poverty gap	Squared Poverty gap	Of the poor	Of the population
No Land	20.15	4.63	1.49	34.34	34.56
<0.2 ha.	23.32	5.22	1.76	22.62	19.66
0.2-1 ha.	20.36	4.27	1.37	35.16	34.98
1-2 ha.	16.14	4.25	1.51	6.18	7.76
2+ ha	11.38	2.2	0.65	1.7	3.04
Rural					
No Land	33.41	8.82	3.28	22.54	16.62
<0.2 ha.	27.13	6.56	2.23	22.34	20.3
0.2-1 ha.	23.48	4.97	1.61	46.3	48.62
1-2 ha.	16.88	3.23	0.95	7.36	10.74

[19] https://censusnepal.cbs.gov.np/results/literacy

Land ownership status	Incidence			Distribution:	
	Headcount rate	Poverty gap	Squared Poverty gap	Of the poor	Of the population
2+ ha	9.91	2.11	0.53	1.5	3.7
Urban					
No Land	17.86	3.91	1.19	41.32	42.42
<0.2 ha.	21.57	4.6	1.54	22.78	19.38
0.2-1 ha.	18.07	3.76	1.19	28.56	29
1-2 ha.	15.61	4.99	1.92	5.48	6.44
2+ ha	12.25	2.25	0.71	1.84	2.76

Source: Nepal Living Standard Survey 2023, Summary report: National Statistics Office, Office of the Prime Minister, and Council of Ministers: February 2024.

211. **Poverty:** The national poverty line is the aggregate of the food and the non-food poverty lines. The revised official poverty line in 2022-23 is estimated at NRs. 72,908 per person per year. In 2010-11, the poverty line was set at NRs. 19,261 per person per year, which, when adjusted for inflation over the 2010-11 to 2022-23 period - stands at NRs. 42,845 per person per year.

Table 18: Poverty lines (NRs., in 2023 prices)

	2010-11	2022-23
National Poverty Line	42,845	72,908
Food Poverty Line	26,936	35,029
Non-Food Poverty Line	15,909	37,879

Source Summary Report Nepal Living Standard Survey 2022/ 2023, National Statistics Office, Office of the Prime Minister, and Council of Ministers: February 2024

212. According to the 2022-23 official poverty line, an individual in Nepal is classified as poor if their annual per capita total consumption expenditure is less than NRs. 72,908. Based on the new poverty line, 20.27 percent of the population in Nepal lives below the poverty line. The incidence of poverty is higher in rural areas (24.66%) than in urban areas (18.34 %). The poverty status province is presented in the table below.

Table 19: Poverty by Province

Province	Poverty Incidence			Distribution	
	Headcount rate	Poverty gap	Poverty gap squared	poor	population
Koshi	17.19	3.84	1.25	13.80	16.26
Madhesh	22.53	4.62	1.36	25.08	22.56
Bagmati	12.59	2.64	0.89	12.68	20.42

Source: Nepal Living Standard Survey 2023, Summary report: National Statistics Office, Office of the Prime Minister, and Council of Ministers: February 2024

213. **Occupation, Employment, and Income Opportunities**. Farming, both crop production and livestock rearing on own land and sharecropping, is by far the most important occupation of the people, an important source of household and community level food security, and also an important contributor to households' income. The sources of employment and income opportunity of the households have, however, diversified over time with one or more members of the family engaged in the off-farm employment and income sources. With the increase in educational attainment, people have moved in large numbers for jobs in the government and private sector, or they have started their own businesses at the local level or in other parts of the country.

214. Increased migration of the people has produced some positive and also negative

consequences on the relationship of the people with land and land-based resources. The people's dependence on farming as the primary source of employment and income earning has reduced over time. This has also produced a tendency to keep a large proportion of land fallow or lease out for share cropping, contract farming (*Bandhaki)* arrangement on agricultural land. Increased shift of people to off-farm employment and income within the country or seeking foreign employment has, however, increased the flow of remittance to the area. The share of foreign employment in the annual family income is significantly large, although this depends on the destination of foreign employment and the educational attainment and skill of the person in foreign employment to seek high-paying jobs.

215. Although the income made from foreign employment goes primarily to meet the existential challenges- food, clothing, building houses, and meeting the expenses of marriages and other family rituals some returnees have also started income-earning enterprises, such as commercial scale dairy, goat rearing, and piggery. Many of the returnees who have started such enterprises in the subproject areas are those who returned home in the face of the COVID-19 pandemic and started farm- and off-farm-based income enterprises.

216. **Agriculture System and Livestock**. Agricultural systems and practices existing in the project area and production enterprise would be worth promoting in the area, considering farmers' willingness to adopt them with the availability of dependable irrigation. The farmers of different landholding sizes (small, medium and large) were consulted in assessing their needs for irrigation and preferences for agricultural production enterprises that they would like to initiate with the availability of irrigation. The likely transformation in the agricultural system and practices in the subprojects were assessed using the opportunities of market and marketability of the agricultural products, as well as the change and the likely increase and/or diversification of the income opportunities through the adoption of the identified production enterprises.

217. Livestock has traditionally been integral to the farming system in the four subproject areas, similar to other lower and middle hill areas in the country. Most farmers traditionally kept one or two cows and buffalo, goats, and a few poultry birds (chicken and pigeon) to meet the needs of milk, egg, and meat and also for sale for income. Goat rearing has traditionally been women specific enterprise in the area, as in other parts of the country. The farmers have innovated the traditional practice of livestock production with the increase in the demand for livestock products at the local level and in the adjoining urban areas and commercial centers. Some of the important innovations in livestock production have been- i) replacing the traditional breeds of cows with cross-bred cows of Jersey and Holstein breeds that have higher milk yield, ii) replacing the traditional Khari breed of goats that the farmers traditionally kept with cross-bred and pure blood Jamunapari and Boer breeds that have higher growth rate and high feed to meat conversion ratio, iii) some farmers also making investment to start dairy and goat husbandry to commercial scale, and iv) shift from traditional open grazing practice to stall feeding and improved animal husbandry practices in managing feed, fodder, parasite and disease control of the animals.

218. These innovations have led to a significant increase in livestock production and also an increase in the share of income from livestock production to the annual income of the farmers. The increase in the income from livestock production has also contributed to increasing the income earning and producing financial self-reliance on women, who have traditionally been involved in livestock rearing. These innovations in livestock production systems have been possible with the improvement in livestock services- breeding, feed supply, and nursery for fodder plantation and health care facilities and processing and marketing of livestock products promoted by government agencies, development organizations, and private sector agencies. Dairy cooperatives and access to credit facilities by the banks and micro-financial insurance and livestock insurance schemes

promoted by GoN have been instrumental in supporting the farmers' innovation on livestock production.

219. **Indigenous People**. Caste is as a multifaceted status hierarchy composed of all members of the society in Nepal, each of the hereditary classes of Hindu society, distinguished by the relative degree of rituals, purity or pollution, and of the social status. However, the Population Census 2011 of Nepal (CBS) has categorized the population of Nepal into ten major ethnic groups (Brahmin, Chettri, Gurung, Magar, Tamang, Newar, and Dalits). Ethnicity is the fact or state of belonging to a social group with a common national or shared cultural tradition. The Indigenous groups known as (Adhibasi/ Janajati) include some tribals (Tharu, Gurung, Magar, Tamang, etc.), and each and every Adhibasi/ Janajati recognizes their own language, culture, and costumes. The project area comprises a heterogeneous mix of caste and ethnic groups.

V. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

220. One of the environmental risks of FMIS is carried out at different stages, encompassing pre-construction, construction, and operation. Initially, the safeguards team conducted site visits to the proposed project locations and the surrounding areas. These visits were essential for directly observing and identifying any possible environmental impacts of FMIS activities. Throughout these site visits, the safeguards team engaged with local stakeholders through meetings focused on gathering a diverse range of perspectives and insights. The stakeholder engagement played a vital role in allowing the team to incorporate the insights and concerns of the local community into the environmental assessment. Furthermore, extensive field inspections were carried out, accompanied by meticulous data gathering, to guarantee a thorough analysis of the environmental baseline and potential disruptions.

221. The identified negative effects of these activities are important, as they will influence the development of the environmental management plan. This plan is designed to effectively manage and mitigate any potential environmental impacts that may arise during the construction and operations of FMIS. In order to provide a thorough analysis of the potential environmental impacts, it is essential to examine each phase of the project in detail.

222. The following subsections explore each of these phases, providing a thorough overview of the anticipated environmental obstacles and the strategic actions that have been developed to address them. This thorough environmental analysis ensures that the project adheres to sustainable practices and minimizes its environmental impact in accordance with both local regulations and global environmental standards.

A. BENEFICIAL IMPACT

(i) CONSTRUCTION BENEFITS

223. The development efforts, particularly the construction of the proposed FMIS subprojects, will have multifold beneficial impacts, i.e., an increase in crop production. Irrigation projects are generally intended to improve the economic and social welfare of the people.

a. Generation of Employment

224. The construction of the project generates employment opportunities for the local people. During the construction number of labor-skilled, semi-skilled, and unskilled workforce will be required. This wage labor opportunity will be available for the local people. People will be required for slope protection, concrete works, scaffolding, gabion box weaving, transportation, supervision, management, etc., during the construction of this project, and local people, based on their qualifications and skills, will have additional income opportunities. The impact is direct, has medium significance, and is local but short-term in nature.

225. These schemes contribute to local community development by providing employment opportunities during the construction and maintenance phases. This not only aids in the economic sustenance of the community but also skill development.

b. Enterprise Development and Commercialization

226. During the construction period, different types of commercial activities will come into

operation in order to meet the demand of labor groups, construction crews, and subproject teams. In general, the enterprises will include food and tea shops, groceries, lodges, and restaurants to serve large numbers of people. The demand for local products, such as pulses, vegetables, fruits, etc., will rise during the construction period, which may provide added impetus for local production and marketing. This will contribute to the local rural economy and may help reduce rural poverty. Such benefits may contribute to enterprise development, which often continues to be entrenched beyond the construction period. This impact will be direct, of moderate significance, local, and long-term in nature.

c. Increase in Economic Activities

227. During the construction period, various types of economic activities will take place in the locality in order to meet the everyday demands of the workforce, such as grain, vegetables, meat, fish, milk, etc. The demand for additional requirements of food and other commodities will contribute to the local economy. Such benefits may contribute to enterprise development, which often continues to be entrenched beyond the construction period. The impact will be direct, of medium significance local, and short-term in nature.

d. Revenue Generation to Local Body

228. The project will ensure buying materials that have paid the required royalties. This will prevent the market flow of illegally mined materials. The project will not delay the royalties that will be paid to the local body and other revenue-related agencies. The project will have regular financial monitoring and audit.

e. Skill Enhancement

229. The involvement of the local people in the construction activities will enhance their skills and knowledge, which will help them in future employment opportunities in similar types of construction work, and they may have better livelihoods in the future. The underlying policy of the labor-intensive approach is to employ local, specifically poor (unskilled) labor force, to the greatest extent possible, for work that can be carried out manually. This strategy not only provides employment opportunities for the local poor but also supports the transfer of skills and technical know-how while working in construction work such as masonry and gabion. The impact is direct, of high significance, and local and long-term in nature.

g. Women's involvement

230. The employment opportunities for local women will be encouraged by project proponents through contractors. In this context, women will not be discriminated against regarding wages based on equal job-equal wages. Gender violation and deviant behavior will be strictly prohibited. The impact is indirect, has medium significance, and is local and long-term.

(ii) OPERATION BENEFITS

a. Promotion in Agricultural Production

231. The improved irrigation facilities will ensure continuous and smooth production of agricultural crops in Thakre RM-01, Dudhauli Municipality-05, Ratnanagar-05, Naukunda-01, and Chulachuli RM-06. The proposed subproject assists in promoting vegetables and crops in the

Dharke Bazar, Dakaha, Tandi, Kalika, and Madhumalla as the major market centers through the availability of agricultural goods all year round. People will be lured to establish new businesses. Agriculture support services in the command area of the project are moderate. There are agro-vets and private agriculture co-operatives within the command area that supply agriculture input, especially seeds, manure, and plant protection materials.

232. The irrigation schemes are primarily focused on enhancing agricultural productivity. They facilitate reliable supplementary irrigation during both the monsoon and winter seasons, thereby significantly increasing cropping intensity and yield. For instance, the Dhuple Khola ISP in Rasuwa expects to raise cropping intensity from 147.14% to 181.43%, reflecting substantial improvements in agricultural output.

b. Promote the Aquaculture

233. Besides the increment in agricultural production through irrigation, it will provide opportunities for aquaculture which could increase food production and economic returns, enhance livelihoods and public health outcomes, and maintain key ecosystem services. The new aquatic habitat created by irrigation may provide opportunities for new fisheries. There is considerable scope to optimize the benefits of irrigation systems by integrating fisheries from the outset of project planning and design through to operation and management.

c. Quality of Life

234. The general provision of potable water and proper sanitation facilities will bring about better personal, household, and community hygiene practices, resulting in better health for the family and community and ultimately improving the locals' quality of life.

d. Social and Organizational Strengthening

235. The establishment and strengthening of Water User Associations (WUAs) are central to these subprojects. These organizations play a crucial role in the operation and maintenance of the irrigation systems, fostering community involvement and management capacity, which is crucial for the sustainability of the projects.

B. NEGATIVE IMPACT AND MITIGATION MEASURES

(i) CONSTRUCTION PHASE

236. The activities for intake structures, flood protection works, and canal construction involve land excavation, drilling, etc. These activities have an impact on the environment.

Physical Environment

a. Land Environment

237. **Impact on Soil Erosion/ Sedimentation:** The impact on soil will be localized in the area surrounding the scheme components. The main canals will be constructed/strengthened, such as in the Simle Ghatte ISP (25 ha) in Bhojpur Municipality, where a 3000-meter main canal and 900 meters of canal lining will be developed. Similarly, in the Hinkuwa Khola ISP (30 ha) in Temkemaiyung Rural Municipality, a 3050-meter main canal and 1700 meters of canal lining are

planned. Due to these activities, the fallow land at the canal side will be occupied with excavated soil and construction materials. Small areas are likely to remain exposed and will be subject to soil erosion due to changes in land use and local drainage patterns. Another impact on the soil will be during the construction period, as there will be contamination with dust and surface run-off. Adequate drainage will be provided to channel the rain-storm water during the monsoon season in the project component areas. This is essential for schemes like the Yangtang Khola Mailung Kulo ISP (45 ha) in Temkemaiyung Rural Municipality and the Tin Dovane Kerabari ISP (98 ha) in Dhankuta Municipality, where significant canal and structural works will be undertaken

238. The following are the mitigation measures for the potential impacts on land and soil.

(i) ***Promotion of Manual Labo****r*: Where feasible, manual labor should be promoted to reduce the dependency on heavy machinery, thereby minimizing the ecological footprint of the construction activities.

(ii) ***Controlled Excavation Practices*****:** All excavations should be conducted with the minimum dimensions necessary for safety and operational requirements to reduce the disturbance to the surrounding environment.

(iii) ***Integration of Agricultural Timelines:*** The cropping calendar should be carefully considered during the planning phase to avoid losing standing crops, thus supporting local agriculture.

(iv) ***Prompt Revegetation of Disturbed Areas:*** Any areas disturbed during construction should be promptly revegetated to reduce the risk of soil erosion and help maintain local biodiversity.

(v) ***Separate Handling of Topsoil:*** Any topsoil removal and storage activities should be conducted separately from other construction materials and placed on a pre-selected site that is protected from surface runoff to preserve soil quality and facilitate later use in land restoration efforts.

b. Air Environment

239. Air quality will be slightly affected by the proposed activities. The construction activities will involve causes to increase the level of some of the air pollutants present in the air. Emissions from concrete mixers, earth excavation, and loading unloading operations during construction activities pose potential impacts on air quality as an increase in PM level in the ambient on a temporary basis. Construction machinery, diesel generators, and project vehicles will release exhaust emissions containing carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen (NO_x), and particulate matter (PM). These emissions can deteriorate the ambient air quality in the project site and along the road leading to it. Furthermore, fuel combustion will release smoke emissions. For example, the Simle Ghatte ISP (25 ha) in Bhojpur Municipality will involve the construction of a 3000-meter main canal and 900 meters of canal lining. Similarly, the Hinkuwa Khola ISP (30 ha) in Temkemaiyung Rural Municipality, with its 3050-meter main canal and 1700 meters of canal lining, will also be affected. Additionally, the Yangtang Khola Mailung Kulo ISP (45 ha) in Temkemaiyung Rural Municipality, featuring a 3050-meter main canal and 1500 meters of canal lining, and the Tin Dovane Kerabari ISP (98 ha) in Dhankuta Municipality, with its 3050-meter main canal and 2722 meters of canal lining, are expected to have similar impacts on air quality due to their extensive construction activities.

240. The following are the mitigation measures for the potential impacts on Ambient Air Quality.

(i) The increase in all the abovementioned pollutants due to the project activities will be controlled up to the prescribed limit set by the National Ambient Air Quality Standard, 2012.

(ii) Vehicles delivering loose and fine materials like sand and aggregates shall be covered.

(iii) Dust suppression measures, like water sprinkling, will be applied in all dust-prone locations, such as unpaved haulage roads, earthworks, and stockpiles.
(iv) Locate stockpiles at least 500m from residential property to avoid inconvenience from fugitive dust and ensure they are enclosed by a fence or similar to minimize windblown dust.
(v) Position any stationary emission sources as far as practical from sensitive receptors (houses, schools, clinics, temples, etc.).
(vi) Regular checks and maintenance of construction equipment and vehicles are needed to keep them in good working order and meet emission standards.
(vii) Ensure workers working in close proximity to or having long exposure to vehicle exhausts and earthworks are provided with clean N95 dust masks to minimize inhalation of particulate matter and other pollutants
(viii) Enforce strict no-burn policies at temporary campsites and proper disposal protocols for construction waste to avoid open burning.
(ix) Develop a traffic management plan to reduce congestion and optimize routes for project vehicles to minimize idle time and associated emissions.
(x) Continuous monitoring of air quality at the construction site and surrounding areas to ensure levels of pollutants are within acceptable standards and to make adjustments to mitigation measures as necessary.
(xi) Educate construction workers on best practices for minimizing air pollution, including proper equipment operation and adherence to waste management procedures.
(xii) Keep the local community informed about the construction schedule, potential impacts, and the measures in place to mitigate air quality issues.

c. Noise Environment

241. The static sources include the construction equipment, such as concrete mixers and construction machinery. It is expected that construction activities will involve noise generation above 80 dB (A). The sound pressure level generated by a noise source decreases with increasing distance from the source due to wave divergence. Exposure to high noise levels may result in annoyance, fatigue, temporary shift of the threshold limit of hearing, permanent loss of hearing, hypertension and high blood pressure. For example, the Tarauli ISP (50 ha) in the Terai region involves significant construction activities, including the construction of a 1500-meter main canal and 500 meters of canal lining, which will generate considerable noise. Similarly, the Dhuple Khola ISP (35 ha) in the Hill region, which includes the construction of a 2000-meter main canal and 800 meters of canal lining, will also contribute to increased noise levels. Additionally, the Sopyang Khola Gattako Kulo ISP (40 ha) in the Hill region, featuring a 1800-meter main canal and 600 meters of canal lining, and the Nunsari ISP (45 ha) in the Mountain region, with its 2200-meter main canal and 700 meters of canal lining, are expected to generate noise increase during the construction phase.

242. The mitigation measures for the potential increase in the noise and vibration in the Subproject area are:
(i) Construction workers should be provided the Personal Protected Equipment (PPEs), which are earplugs, earmuffs, etc.
(ii) Any stationary equipment that produces high noise levels shall be positioned as far as is practical from sensitive receptors.
(iii) Construction traffic routes will be defined in cooperation with local communities and traffic police to minimize noise and nuisance. Regulate the speed of vehicles and mobile equipment on site to reduce noise emissions.
(iv) Limit the hours of operation for the noisiest equipment to less frequent periods, avoiding

early morning, late evening, and night, when possible, to minimize disturbance.

(v) Position noisy equipment as far away from sensitive receptors, such as residential areas and schools, as possible.

(vi) Notify local communities before periods of expected high noise levels and establish communication channels for complaints and concerns about noise.

(vii) Continuously monitor noise levels (EMoP) to ensure they stay within acceptable limits and review construction practices regularly to identify opportunities for noise reduction.

(viii) Train all staff and workers in the best practices for noise control and the importance of adhering to noise mitigation measures.

d. Water Environment

Water Quality

243. The construction activities in the FMIS areas have impacts on water quality, primarily due to sedimentation and contamination. Earth moving, excavation, and site clearance significantly increase the sediment load in nearby water bodies, reducing water clarity. Moreover, the use of construction materials and chemicals, such as lubricants and fuels, poses a risk of chemical contamination. Without proper management, spills and leakages can seep into surface water systems, introducing harmful pollutants that may temporarily degrade water quality. For instance, the Haripurwa ISP (414 ha) in Sarlahi involves construction, including a 3650-meter main canal and 800 meters of branch canal, which will likely escalate sedimentation and contamination risks. The Gagan ISP (835 ha) in Sukhipur, Sirha, featuring 6000 meters of main canal and 9950 meters of branch canal construction, underscores the potential for water quality issues due to excavation and material handling.

244. The mitigation measures for the potential impact on water resources are:

(i) ***Establishment of Dedicated Storage Facilities:*** Create dedicated stores for fuel, oil, and chemicals in impermeable, bunded areas to prevent spills and leaks from contaminating the soil and water.

(ii) ***Sanitation Management:*** Enforce a strict prohibition on open defecation and urination by construction workers, ensuring the availability of pit latrines or toilets at worker camps.

(iii) ***Proper Wastewater Management:*** Manage wastewater release by constructing separate soak pits in camp locations positioned away from any water bodies to prevent direct discharge and contamination.

(iv) ***Optimal Timing of Earthworks:*** Conduct earthworks during the dry season, as far as practical, to minimize the areas exposed to erosion by surface water runoff.

(v) ***Hazardous Waste Management Plan Implementation:*** Enact a hazardous waste management plan as approved by the Project Management Unit (PMU) to handle dangerous materials responsibly.

(vi) ***Continuous Water Quality Monitoring:*** Regularly monitor water quality to ensure it remains within acceptable limits and continually review construction practices to identify and implement improvements.

e. Solid Waste Generation

245. The impacts of construction due to solid waste generation are considerable and include environmental pollution, land degradation, health risks, and visual impacts. Improper construction waste management can lead to soil and water contamination, altering land profiles and reducing the land's value for agricultural purposes. Additionally, unmanaged waste can pose direct health risks to construction workers and nearby communities and degrade the aesthetic value of the

area, potentially affecting local property values. Furthermore, inefficient material usage reflected by solid waste generation contributes to the unnecessary depletion of resources.

246. The mitigation measures for the management of solid waste release during construction are:

(i) ***Borrow Pit Selection and Timing Operations:*** Careful planning and selection of borrow pits will be conducted, ensuring that the timing of cut and fill operations is optimized to minimize environmental disruption.

(ii) ***Material Reuse:*** Spoil and other materials from construction will be reused wherever possible, reducing the demand for new materials and minimizing waste.

(iii) ***Designated Stockpiling Sites:*** All construction materials will be stockpiled at designated, demarcated places to control and manage inventory efficiently and prevent environmental contamination.

(iv) ***Waste Segregation Facilities at Labor Camps:*** Labor camps will be equipped with proper facilities for waste segregation, and provisions will be made for the composting of biodegradable waste to promote recycling and reduce landfill use.

(v) ***Mobile Toilet Facilities:*** Temporary prefabricated mobile toilets will be provided at construction sites to ensure sanitary conditions and prevent environmental contamination.

(vi) ***Hazardous Waste Management:*** A separate provision for the collection and disposal of hazardous waste will be made, in compliance with government rules and regulations, to ensure safe and legal disposal practices.

(vii) ***Training on Waste Management:*** Training sessions will be conducted for workers and subcontractors to ensure they are familiar with and comply with waste management practices and the waste reduction plan.

(viii) ***Regular Waste Audits:*** Perform regular audits of the waste generated at construction sites to identify opportunities for waste reduction and to continuously improve management practices.

(ix) ***Waste Monitoring and Reporting:*** Monitor the amount and type of waste generated and regularly report this data to the relevant authorities. This will help track the effectiveness of the implemented waste management strategies and make adjustments as necessary.

Biological Environment

247. The proposed FMIS subprojects will occupy the agricultural land of the region for the construction of a canal to extend the project. These structures will have minimal impact on the biological environment of the area. No trees will be cut to construct the canal. There are subprojects in the buffer zone of the two National Parks. The Tarauli ISP of Chitwan district is located in the Buffer Zone of the Chitwan National Park. While Dhuple Khola ISP is located in the buffer zone of the Langtang National Park. No subprojects are located within the core national park area, and all the proposed irrigation subprojects are the existing irrigation canal systems, thus there is no need for EIA as per EPR 2020. The animal habitation disturbance due to the construction activity is expected to be not significant due to the locations of the FMIS schemes. There are FMIS inside KBAs as mentioned in Section VI, which could have impacts on wildlife during works.

248. The mitigation measures for the potential impact on biological resources are:

(i) ***Tree Conservation Measures:*** Prohibit tree cutting throughout the construction process. If tree removal is absolutely necessary, ensure that prior permission is obtained from the relevant environmental authority before any action is taken.

(ii) ***Soil Management:*** Set aside the excavated topsoil during excavation activities. This soil will be systematically returned to its original location after the completion of the excavation

works to ensure the restoration of the terrain and facilitate the re-establishment of vegetation.

(iii) ***Sustainable Energy Use in Labor Camps:*** Mandate the use of LPG for cooking and heating in the construction labor camp to minimize pollution and reduce the project's carbon footprint.

(iv) ***Environmental Awareness for Labor and Staff:*** Conduct awareness sessions for all laborers and staff to prevent illegal activities in adjacent forest areas. Emphasize the importance of adhering to environmental regulations and the legal consequences of non-compliance.

(v) ***Educational Programs on Environmental Conservation:*** Implement regular educational programs for workers about policies related to the conservation of existing flora and fauna. Extend these educational efforts to the community through meetings and discussion programs to foster a collaborative approach to environmental stewardship.

(vi) ***Ongoing Environmental Monitoring:*** Establish a routine for regularly monitoring construction sites to ensure strict compliance with environmental guidelines. Assign a dedicated environmental officer to oversee this process and take immediate corrective action if deviations occur.

(vii) ***Scheduling:*** Schedule construction activities outside the breeding and nesting seasons of sensitive wildlife species to avoid disruption. For instance, avoiding construction during the monsoon season when many species breed.

(viii) ***Pollution Abatement:*** Implement measures to reduce noise pollution, which can disturb and disorient wildlife. This includes using low-noise machinery and limiting nighttime construction activities.

(ix) ***Demarcation:*** Establish clear boundaries around construction sites to prevent encroachment into wildlife habitats. Use fencing to keep animals away from hazardous areas.

(x) ***Restoration:*** Restore any habitats that were disturbed or degraded during construction. This involves replanting native vegetation, rebuilding natural landscapes, and ensuring the restored habitat is suitable for wildlife return.

Socio-Economic Environment

a. Occupational Health and Safety

249. During the construction phase, the work personnel will be exposed to various health risks and hazards due to injuries to workers while working without adequate safety measures and equipment. Typical health hazards will be encountered during the handling of machinery movement. Health risks are commonly associated with poor labor camp conditions. Unsafe water sources and unhygienic conditions (lack of latrines and washing facilities) bear the risk of additional and often endemic diseases, such as dysentery, diarrhea, and cholera. Uncontrolled water logging and badly managed borrow pits bear the risks of spreading waterborne diseases like malaria fever. The ongoing epidemic of COVID-19 could be the most challenging health issue for health workers.

250. The following are the recommended mitigation measures for such potential impact.

(i) ***Maintain Excellent Housekeeping:*** Regularly enforce strict housekeeping protocols across all areas, including the construction site, worker camps, and storage areas, to ensure cleanliness and order.

(ii) ***Health and Sanitation Measures:*** Provide safe drinking water, sanitation, and latrine facilities as part of contingency planning to maintain the health and hygiene of all on-site workers.

(iii) ***Waste Management:*** Assign the contractor the responsibility for the safe removal and/or proper storage of all waste materials to prevent environmental pollution and protect the health of people and animals.

(iv) ***Safety and Site Management:*** Develop a site and safety plan that promotes using personal protective equipment (PPE) and other safety measures. Ensure the availability of dustbins to collect waste efficiently and manage the camp to provide adequate space, light, ventilation, drinking water, and toilet facilities.

(v) ***Disease Prevention Protocols:*** Implement a COVID-19 and disease management plan as approved by the PMU to handle ongoing and emergent health concerns.

(vi) ***Enforcement of Safety Regulations:*** Strictly enforce health and safety regulations on-site, particularly concerning the proper using machinery and tools.

(vii) ***Emergency Response Plan:*** Develop and implement an emergency response plan to effectively address accidents and disease outbreaks promptly.

(viii) ***Mandatory Use of PPE:*** Use appropriate PPE, including masks, gloves, and sanitizer, and enforce proper hygiene practices within all work and camp areas.

(ix) ***Incident Recording and Management:*** Maintain meticulous records of all incidents, accidents, near-misses, and fatalities associated with the project.

(x) ***Safety Training:*** Conduct regular training sessions for all workers to ensure they are proficient in safely handling machinery and using safety equipment correctly.

(xi) ***Trespassing Mitigation:*** Install barricade fencing around the site to prevent unauthorized access and mitigate trespassing risks.

(xii) ***Secure Excavation Sites:*** Provide barricades to temporarily enclose open excavated trenches and slopes to ensure site safety.

(xiii) ***Health and Safety Plans:*** Execute comprehensive health and safety management and community health and safety plans as approved by the PMU.

b. Community health and safety risks.

251. Residents in the area may have safety concerns due to the presence of construction vehicles and machines, as well as changes in traffic patterns. The increase in the number of vehicles on the road often leads to traffic congestion, which in turn raises the risk of accidents. These accidents can greatly affect vulnerable populations, such as schoolchildren and the elderly. These individuals frequently encounter increased risks as they navigate through areas that become more intricate and hazardous due to construction activities.

252. The following are the measures for this potential impact.

(i) ***Traffic Management Planning:*** Develop and implement a traffic management plan that coordinates construction activities with peak traffic hours to minimize congestion. This plan will include designating alternative routes for construction traffic and installing clear signage to direct vehicles efficiently.

(ii) ***Strategic Signage Installation:*** Install appropriate signage in areas impacted by construction activities. These signs will warn motorists and pedestrians of upcoming construction, altered traffic patterns, and the presence of heavy vehicles and direct pedestrians to safe crossing points.

(iii) ***Speed Control in Construction Zones:*** Enforce strict speed limits in construction zones using speed bumps, digital speed display signs, and the strategic deployment of flag persons to manage traffic flow, especially during peak hours and when schoolchildren are commuting.

(iv) ***Pedestrian Safety Measures:*** Establish and maintain safe crossing points for pedestrians, staffed with crossing guards during busy periods to assist vulnerable groups like school children and the elderly.

(v) ***Community Awareness Campaigns:*** Launch awareness campaigns to inform local residents about the construction schedule, potential hazards, and safety measures in place. This initiative will help the community adjust their routines and choose safer travel routes to circumvent construction areas.

(vi) ***Traffic Monitoring and Enforcement:*** Regularly monitor traffic conditions around the construction site through patrols. Enforce safety measures diligently to ensure adherence to traffic rules and reduce the risk of accidents.

(vii) ***Emergency Response Preparedness:*** Develop and maintain a clear emergency response plan for traffic-related incidents. Ensure that all construction personnel are trained in basic first aid and that procedures are in place for rapid emergency service response and access to the construction site.

253. **Impacts on the Cultural and Historical Environment**

254. No structure related to cultural and historical importance falls within the proposed project component area. However, construction activities associated with the project could potentially cause physical damage to nearby cultural and/or religious sites. This damage might arise from earth movements, vibrations from heavy machinery, and noise level increase.

255. The following are the recommended mitigation measures for such potential impact.

(i) ***Identification and Consultation:*** Proactively identify cultural and religious sites in collaboration with local community leaders to understand their significance fully. This step will involve detailed stakeholder consultations to gather accurate information and insights.

(ii) ***Community Engagement:*** Engage continuously with local communities, particularly religious and cultural leaders, to understand their values and concerns. Regular consultations will be maintained throughout the project to ensure community feedback is consistently incorporated into project planning and execution.

(iii) ***Cultural Sensitivity Training:*** Provide cultural sensitivity training for all project staff and workers. This training will foster respect for local traditions and practices, minimizing any inadvertent disrespect or harm to cultural practices. The training will help build a respectful working relationship between the project team and the local community.

(iv) ***Adaptive Construction Practices:*** Adapt construction practices to respect local cultural norms, including rerouting construction vehicles, creating alternative access paths during construction, or adjusting project timelines to accommodate important cultural and religious events. These adaptations will ensure minimal disruption to the community's cultural activities.

(v) ***Documentation and Education:*** Document cultural sites and practices with the community's assistance to create comprehensive records that can serve educational purposes and promote cultural understanding. Sharing this documentation will not only educate others about the local heritage but also foster pride in and facilitate the preservation of these cultural assets.

(ii) OPERATIONAL PHASE

LAND ENVIRONMENT

256. During the operations of FMIS or right after work, the accumulation of construction waste can create minor disturbance to both the landscape and local communities. Construction waste is not properly managed and disposed of, creating a visual nuisance that reduces the aesthetic appeal. This waste can also disturb local communities through increased dust and safety risks. Furthermore, accumulated waste may block areas previously used by the community, disrupting

daily routines and limiting social interactions.

257. The mitigation measures for the potential impact on land during the operation of the Subproject are:

(i) ***Comprehensive Site Cleanup:*** Conduct a thorough cleanup of the construction site to remove all construction debris, surplus materials, and any potential contaminants. This will involve systematically sorting the waste to ensure recyclable materials are recovered, and the remainder is disposed of responsibly.

(ii) ***Engagement of Specialized Contractors:*** Hire specialized contractors who are experienced and certified in the handling and disposing of hazardous materials. These contractors will perform their duties in strict accordance with national environmental regulations, ensuring that all hazardous waste is safely removed from the site and disposed of in a manner that prevents environmental contamination.

(iii) ***Restoration of Excavation Sites:*** Backfill and compact any pits or trenches that were excavated during the construction process. This step is crucial to stabilize the soil, prevent the formation of sinkholes, and avoid unintended water collection areas that could lead to mosquito breeding or undermine the structural integrity of nearby constructions.

(iv) ***Documentation and Reporting:*** Provide comprehensive documentation to the Employer's Representative outlining the entire waste disposal process. This documentation will include detailed receipts and records from the waste disposal companies involved, ensuring transparency and verifiability of proper handling and disposal of all waste materials.

WATER ENVIRONMENT

258. FMIS is expected to have a generally positive impact on the local water environment by meeting local water requirements through efficient irrigation methods, such as drip irrigation, which minimally impacts the environment. However, there are potential negative environmental consequences due to the increased use of pesticides and fertilizers. Pesticides, particularly organophosphorus and organochlorine compounds, are a common source of toxic substances in irrigation schemes. These chemicals are hazardous not only to aquatic ecosystems but also to birds, mammals, and humans, as they can be transported through the food chain and concentrate at harmful levels. Furthermore, the use of chemical fertilizers introduces high levels of nutrients like nitrates and phosphates into the environment. Nitrates, being highly soluble, can quickly infiltrate water bodies, potentially causing health issues. Phosphates, on the other hand, attach to soil particles and are carried into waterways during soil erosion. This nutrient overload can lead to eutrophication, characterized by increased algae growth which depletes oxygen in the water. Addressing these issues requires careful management of chemical inputs and ongoing monitoring of water quality to prevent the degradation of aquatic environments and protect public health.

259. The following are the recommended mitigation measures for such potential impact.

(i) ***Integrated Pest Management (IPM):*** Adopt IPM strategies to reduce reliance on chemical pesticides. IPM includes using biological pest controls, crop rotations, and other sustainable practices to minimize environmental damage.

(ii) ***Precision Agriculture:*** Implement precision agriculture technologies, such as drip irrigation systems, to apply water and nutrients more efficiently. This reduces runoff and leaching of chemicals into water bodies.

(iii) ***Education and Training for Farmers:*** Provide continuous education and training to farmers on the safe and efficient use of fertilizers and pesticides. Focus on educating them about the risks associated with overuse and the benefits of alternative, less harmful agricultural practices.

(iv) ***Use of Environmentally Friendly Chemicals:*** Encourage the use of organic or less toxic chemicals that are less harmful to aquatic life and the broader ecosystem. Promote products that degrade more rapidly and are less likely to accumulate in the food chain.

(v) ***Buffer Zones:*** Establish buffer zones around water bodies to filter out pollutants before they can enter aquatic systems. Vegetated buffer strips can effectively trap sediment, phosphates, and other pollutants.

(vi) ***Regular Monitoring of Water Quality:*** Implement a regular monitoring program to track the levels of nitrates, phosphates, and other harmful substances in water bodies. This data can help regulate and adjust agricultural practices in real time to prevent pollution.

(vii) ***Community Involvement:*** Engage local communities in monitoring and protecting their water resources. Community participation can increase compliance with environmental practices and enhance the effectiveness of local conservation efforts.

VI. ENVIRONMENT MANAGEMENT & MONITORING PLAN

A. Environmental Management Plan Overview

260. Following the requirements of the SPS 2009, an important component of an IEE report is the environmental management plan (EMP). The goal of the EMP is to develop the mitigation and monitoring measures for the impacts identified within the scope of the IEE procedures to be used in practice by the project implementing agency - the DWRI, and thus, bring its activities into compliance with the environmental and social requirements envisaged by the national legislation as well as with the environmental and social policies of the international finance organizations.

261. The given EMP is based on the information given in the previous chapters, in particular, activity specifics, background properties of the natural and social environment of the working area and expected negative impacts during the activity and their propagation area. The EMP is drafted for different stages of activity, including preparatory works planning phases. The EMP is a live document, and it can be detailed immediately during the accomplishment of the activities following the monitoring outcomes or other practical terms. Any changes or corrections to this EMP will be made based on the formal agreement between DWRI and ADB.

262. The EMP document will be incorporated into the work tender documents, and the tender participants will have the possibility to specify their environmental protection duties in their proposals. After the onset of the construction works, the EMP will be part of the agreement between the client and the construction contractor, and it will be necessary to accomplish during the construction works.

B. Institutional Arrangement

263. The Ministry of Energy, Water Resources and Irrigation (MEWRI) will be the Executing Agency (EA), and the Department of Water Resources and Irrigation (DWRI) will be the implementing agency of the project. The Central Project Management Office (CPMO) will be responsible for the overall implementation of the project and ensuring compliance with ADB's environmental safeguards requirements. The PIU is the Water Resources Irrigation Development Division (WRIDDs) office which is present in every district.

264. The CPMO will establish a "Central Safeguard Desk" (CSD) and comprise a Safeguard Liaison Officer (SLO) supported by an Environmental Safeguard Specialist (ESS) of PIMS. The SLO will ensure full compliance with the overall environmental and social safeguards requirements of the project. The SLO will work closely with the environment and social development focal points of WRIDD. The provincial office shall work under the guidance of CSD and report to their safeguard and safety details. The WRIDD Office Chief will be supported by one safeguard field monitor, one association organizer, and six community mobilizers for safeguard implementation in FMIS.

265. The Chief of the PIU or Engineer designated as site in-charge will act as safeguard focal person (SFP) at PIUs. The SFP will be supported by the Senior/Association Organizers of PIU and social mobilizers deployed at the subproject level. The contractor will appoint a safeguard and safety assurance officer in each contract package, as provisioned in the contract. PIMS provincial social development specialists and environment monitors will provide technical assistance while implementing safeguard-related activities. The safeguard desk at PIU will be responsible for:

(i) Lead implementation of IPP/RIP/EMP and monitor compliance with project safeguard requirements on a day-to-day basis, providing timely corrective measures to address the issues, if any.

(ii) Support PIMS social development consultant by providing field-level information to consolidate safeguard monitoring reports.
(iii) Organize or support organizing periodic consultations with beneficiaries/affected persons.
(iv) Form GRM at PIU, support/facilitate beneficiary farmer in registration grievance, if any.
(v) Collect/ maintain project-induced beneficial impacts

266. **Project Implementation and Management Support Consultants (PIMS).** The PIMS-ESS will support SLO in CPMO and DWRI. The ESS will have intermittent inputs of 15 months. The specialist will support the CPMO and field offices in maintaining overall environmental safeguards and OHS requirements in the project. The ESS will prepare an e-MIS and support the safeguarding of field monitors at field offices in monitoring environmental and OHS activities. The CPMO will mobilize a full-time Environmental Safeguard Monitor (ESM) at the project site. ESM will work under the guidance of ESS of PIMS. The monitor will coordinate with the WRIDD field team and monitor the contractors' safeguard compliance in project implantation activities. They will support field offices and the PIU field team in overall safeguards assurance monitoring, undertake corrective actions, and report to the senior environment specialist at CPMO.

267. **Civil Works Contract and Contractor**. The IEE with EMP will form part of the bidding and contract documents and be verified by CPMO. The contractor supporting civil works under DWRI shall include the cost of preparing and implementing site-specific environmental management and the OHS plan (SEMP). The integrated SEMP will be approved by the employer prior to their field mobilization. The contractor will submit the resume of the proposed senior safeguard officer and senior safety officer at least 15 days before their mobilization at the site. The SEMP shall include (i) the proposed locations and specification of workers' camp and associated facilities; (ii) the operation of the quarry; (iii) transport and storage of construction materials (aggregates, fabricated structural components, fuel, lubricants, paints, etc.); (iv) spoil management and waste disposal site; (v) OHS and emergency plan; (vii) budget for SEMP/OHS implementation; and (vi) template of daily safeguards reporting checklist. No work shall commence prior to the approval of the integrated SEMP and resume of the senior safeguard officer and a senior safety officer by the Employer. The contractor will fill daily safeguard assurance checklist and report to the safeguard monitors in the respective field offices.

268. A copy of the approved SEMP will be kept at the site during construction. Non-compliance with, or any deviation from, the conditions set out in the SEMP shall constitute a failure in compliance and will require corrective actions. Prolonged non-compliance upon repeated notices to correct may lead to financial punishment through deducting an agreed percentage of the claim in the interim bills up to termination of the contract if required. Such provision shall be clearly stated in the contract agreement. Any non-compliance with the EMP would be a breach of the contract and trigger penalties associated with the breach in accordance with the terms and conditions of the contract.

C. Environmental Management Plan (EMP)

269. The EMP is necessary on the grounds that it will manage the environment by offsetting the negative impacts with possible mitigation measures and enhancing the positive impacts within the allocated funds from the project. Thus, the main objectives of the EMP are to:

(i) Display a range of measures to mitigate potential impacts to minimal or insignificant levels;
(ii) Identify measures that could optimize beneficial impacts;
(iii) Establish a method of monitoring environmental management practices during all phases of development;

(iv) Ensure project implementation and operational phases are within the principles of ADB SPS 2009 and national environmental policies;
(v) Ensure that the health and safety recommendations are complied with;
(vi) Propose mechanisms for monitoring compliance with the EMP and reporting thereon; and
(vii) Specify time periods within which the measures contemplated in the final environmental management plan must be implemented, where appropriate.

270. The EMP Matrix for the Pre-Construction Phase, Construction Phase, and Operation Phase of the FMIS subprojects is presented in **Table 19**.

Table 19: Environmental Management Plan Matrix Applicable to FMIS

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
Design Phase				
Consents and Permits Requirements	The Works may be stopped, or the design may need to be revised in the event that the required approvals, clearances, and permits are not obtained.	• Obtain all the necessary consents and permits from the government before the start of civil works.	Contractor	District Irrigation Office DWRI and its consultants
Community awareness of project activities	Insufficient community knowledge of project operations may give rise to possible health and safety issues and grievances.	• Before the start of project construction, a meaningful consultation with the affected communities will be conducted. • Meaningful consultation will aim to engage community stakeholders, listen to their views, and arrive at a common understanding of how to implement the project.	District Irrigation Office Contractor	DWRI and its consultants
Preparation of construction environmental, health, and safety management plan (EHSMP) and environmental monitoring plan (EMoP)	Construction and operation-related environmental consequences would be uncontrolled without EHSMP and EMoP.	• Conduct a site reconnaissance survey to verify the data provided in the bid document and collect information from community and field conditions. • The contractor will prepare the construction EHSMP and EMoP based on the bid document, environmental management plan, survey results, and community consultation. • Contractor to prepare sub plans to complement EHSMP such as: - Traffic management plan - Health and safety management plan (e.g., IFC Health and Safety Guidelines) - Community Health and Safety plan (e.g., IFC Health and Safety Guidelines) - Emergency response plan - Labor camp plan - Wildlife Management Plan - Spoil management plan (construction areas)	District Irrigation Office Contractor	DWRI and its consultants

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
		- Solid waste management plan (labor camp) - Hazardous waste management plan - COVID-19 and other disease management plan • Submit construction EHSMP, EMoP, and forms to DWRI for approval.		
Environmental monitoring	Inadequate information about noise levels, water quality, and air quality	• Perform environmental quality tests at target areas (air, noise, and surface water). See EMoP Table	Contractor	DWRI and its consultants
Construction planning	Inadequate planning may result in major environmental consequences that prevent non-compliance with ADB and government environmental protection regulations, as well as the failure to apply the EHSMP.	• Recruit environment, health, and safety officers as per the requirement of the bidding document. • Conduct training on the implementation of the EHSMP to enhance general understanding and clarify responsibilities regarding implementation, including monitoring and reporting, must also be provided to all relevant staff of contractors. • No works can commence prior to approval of EHSMP.	Contractor	DWRI and its consultants
Camp establishment and construction mobilization	Soil erosion and landscape modification may result from clearing land for buildings and camps. Heavy equipment and machinery may worsen noise and air pollution.	• Clear land selectively and retain as much native vegetation as possible to maintain habitat and reduce erosion. • Establish proper sanitation facilities and wastewater treatment processes to prevent contamination of local water sources. • Provide workers with adequate living conditions, including safe housing, clean water, and sanitary facilities. • Implement the labor camp plan approved by PMU and/or PIMS	Contractor	DWRI and its consultants
Construction Phase				
Land and Soil/Siltation	Earthworks may lead to erosion and silt runoff.	• All excavations shall be done to the minimum dimension required for safety and working facility. • Any topsoil removal and storage should be done separately from other materials on a pre-selected site protected from surface runoff. • Limit the use of heavy equipment and machinery in agricultural land. • Manual labor shall be promoted in the construction works. • Promptly revegetating any disturbed areas to reduce the risk of soil erosion. • Cropping calendar shall be considered to avoid loss of standing crops.	Contractor	District Irrigation Office

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
Air Environment	Use of concrete mixers, earth excavation, site clearance, haphazard stockpiling of construction materials, and waste burning at campsites. Impacts on air quality include an increase in PM level in the ambient on a temporary basis. release exhaust emissions containing carbon monoxide (CO), sulfur dioxide (SO2), oxides of nitrogen (NOx), and particulate matter (PM) due to work.	• Ensure workers working in close proximity to or having long exposure to vehicle exhausts and earthworks are provided with clean N95 dust masks to minimize inhalation of particulate matter and other pollutants. • Vehicles delivering loose and fine materials like sand and aggregates shall be covered. • Dust suppression measures, like water sprinkling, shall be applied in all dust-prone locations, such as unpaved haulage roads, earthworks, and stockpiles. • Position any stationary emission sources as far as practical from sensitive receptors (houses, schools, clinics, temples, etc.). • Regular checks and maintenance of construction equipment and vehicles to keep them in good working order to meet emission standards. • Enforce strict no-burn policies at temporary campsites and proper disposal protocols for construction waste to avoid open burning. • Develop a traffic management plan to reduce congestion and optimize routes for project vehicles to minimize idle time and associated emissions. • Continuous monitoring of air quality at the construction site and surrounding areas to ensure levels of pollutants are within acceptable standards (See EMoP) and to make adjustments to mitigation measures as necessary. • Educate construction workers on best practices for minimizing air pollution, including proper equipment operation and adherence to waste management procedures. • Keep the local community informed about the construction schedule, potential impacts, and the measures in place to mitigate air quality issues. • Prompt revegetation of cleared areas to stabilize the soil and reduce erosion and dust. • Locate stockpiles at least 500m from residential property to avoid inconvenience from fugitive dust and ensure they are enclosed by a fence or similar to minimize windblown dust. • Position any stationary emission sources as far as practical from sensitive receptors (houses, schools, clinics, temples, etc.).	Contractor	District Irrigation Office

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
		• Develop a traffic management plan to reduce congestion and optimize routes for project vehicles to minimize idle time and associated emissions.		
Noise Environment	Exposure to high noise levels may result in annoyance, fatigue, temporary shift of the threshold limit of hearing.	• Construction workers should be provided the Personal Protected Equipment (PPEs), which are earplugs, earmuffs, etc. • Any stationary equipment that produces high noise levels shall be positioned as far as is practical from sensitive receptors. • Construction traffic routes will be defined in cooperation with local communities and traffic police to minimize noise and nuisance. Regulate the speed of vehicles and mobile equipment on site to reduce noise emissions. • Limit the hours of operation for the noisiest equipment to less frequent periods, avoiding early morning, late evening, and night, when possible, to minimize disturbance. • Position noisy equipment as far away from sensitive receptors, such as residential areas and schools, as possible. • Notify local communities before periods of expected high noise levels and establish communication channels for complaints and concerns about noise. • Continuously monitor noise levels (EMoP) to ensure they stay within acceptable limits and review construction practices regularly to identify opportunities for noise reduction. • Train all staff and workers in the best practices for noise control and the importance of adhering to noise mitigation measures.	Contractor	District Irrigation Office
Water Resources	Wastewater during the construction (release during the construction phase from the labor camp) discharges can pose a significant impact, if discharged directly	• Establish dedicated fuel, oil, and chemicals stores in impermeable bunded areas to avoid spills and leaks contaminating soil and affecting water quality. • Strict prohibition on open defecation and urination by construction workers and use of pit latrines or toilets for worker camps. • Wastewater release will be managed properly by constructing a separate soak pit away from the water body. • As far as practical, earthworks will be done during the dry season to minimize exposed areas subject to erosion by	Contractor	District Irrigation Office

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
		surface water runoff. • Establish dedicated fuel, oil, and chemicals stores in impermeable bunded areas. • Implementation of hazardous waste management plan) as approved by PMU. • Wastewater release will be managed properly by constructing separate soak pits in the camp locations to prevent direct discharge to the water body. • As far as practical, earthworks will be limited and short-term, done during the dry season to minimize exposed areas subject to erosion by surface water runoff. • Continuously monitor water quality (See EMoP) to ensure they stay within acceptable limits and review construction practices regularly to identify opportunities for improvement.		
Solid Waste Generation in Construction Areas	Local soil quality decline and land non-usability makes the area unsuitable for other purposes.	• Careful planning and selection of borrow pits and timing of cut and fill operations. • Reuse spoiled and other materials for construction purposes. • Stockpiling sites of construction materials will be designated at demarcated places. • Ensure that the labor camps have proper facilities for waste segregation and even for composting biodegradable waste. • Provide temporary prefabricated mobile toilets in the construction sites. • Separate provision for collection and disposal of hazardous waste, if any, as prescribed by government rules and regulations • Conduct training sessions for workers and subcontractors on waste management practices to ensure compliance with the waste reduction plan. • Perform regular audits of waste generated to identify opportunities for waste reduction and improve management practices. • Monitor the amount and type of waste generated and report it to the relevant authorities as required. This can help in tracking the effectiveness of waste management strategies.	Contractor	District Irrigation Office
Solid Waste Generation in Labor Campsites	Environmental degradation, polluting local soil and water	• Implement on-site waste segregation to enable the reuse, recycling, or appropriate disposal of materials. Separate bins for different types of	Contractor	District Irrigation Office

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
	resources, and creating unsanitary conditions	waste should be provided. • Encourage the recycling of materials such as metal, plastic, and concrete. Reuse materials whenever possible, both to minimize waste and to reduce the demand for new materials. • Ensure that all non-recyclable waste is disposed of in a responsible manner in accordance with local environmental regulations, using licensed waste management services. • Develop and implement a waste reduction plan for the project, which includes guidelines for minimizing waste at the source. • Properly handle hazardous waste such as oils, lubricants, and paints by storing them in designated areas and disposing of them according to hazardous waste disposal guidelines. • Conduct training sessions for workers and subcontractors on waste management practices to ensure compliance with the waste reduction plan. • Perform regular audits of waste generated to identify opportunities for waste reduction and improve management practices. • Monitor the amount and type of waste generated and report it to the relevant authorities as required. This can help in tracking the effectiveness of waste management strategies. • Implement a solid waste management plan (labor camp) as approved by PMU.		
Flora and Fauna	Wildlife disturbance and damage to their habitats.	▪ Ensure that there is no tree-cutting during construction. If unavoidable, the project should obtain prior permission from the concerned authority to cut any tree. ▪ The excavated topsoil will be placed in the original position after the completion of excavation works for the burying of distribution pipes. ▪ Ensure the construction labor camp uses clean energy sources (e.g., LPG gas for cooking). ▪ Labours and staff shall be made aware to avoid illegal activities in adjoining forest • Awareness programs regarding policy related to the conservation of existing flora & fauna to the workers prior to the construction and the community during various meetings and discussion programs.	Contractor	District Irrigation Office

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
		• Regularly monitor construction sites to ensure compliance with environmental guidelines and take corrective action when necessary. • Schedule construction activities outside sensitive wildlife species' breeding and nesting seasons to avoid disruption. For instance, avoiding construction during the monsoon season when many species breed. • Implement measures to reduce noise pollution, which can disturb and disorient wildlife. This includes using low-noise machinery and limiting nighttime construction activities. • Establish clear boundaries around construction sites to prevent encroachment into wildlife habitats. Use fencing to keep animals away from hazardous areas. • Restore any habitats that were disturbed or degraded during construction. This involves replanting native vegetation, rebuilding natural landscapes, and ensuring the restored habitat is suitable for wildlife return. • For schemes in KBAs and buffer zones, the contractor and WRIDD will apply the biodiversiry action plan (BAP) in Appendix 8.		
Socio-Economic Environment	Loss of crops during construction	▪ Communicate with the local farmers, wards, and Municipality personnel to start the work timely, making less impact on the growing crops in the command area. • Once construction is completed, implement land restoration measures to return the farmland to its original or better condition for agricultural use. • Engaging with the farming community to ensure their concerns are addressed and their cooperation is gained.	District Irrigation Office Contractor	DWRI and its consultants
Occupational Health and Safety	Construction activities could create health and safety risks to construction workers.	● Always ensure good housekeeping on the premises, including on construction sites, workers' camps, storage areas, etc. ● Provision of contingency planning, safe drinking water/sanitation, and latrine facility will help maintain the workers' health hygiene on the site. ● The Contractor will be responsible for the safe removal and/or storage of all waste in order to prevent environmental pollution of any type that may be harmful to people or animals. ● A site and safety plan will be prepared	Contractor	District Irrigation Office

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
		encouraging the use of safety measures and PPE. Dustbins will be provided at the work site to collect the waste; the camp will be well managed with adequate space, light, ventilation, drinking water, and toilet facilities. • Implement COVID-19 and other disease management plans as approved by PMU. • Enforce strict health and safety regulations on-site, including properly using machinery and tools. • Develop and implement an emergency response plan for handling accidents and outbreaks of diseases. • Appropriate PPE (OSHA recommended PPE): mask, gloves, and use of sanitizer with proper hygiene measures will be made compulsory within the work and camp area. • Record of incidents, accidents, near-miss, and fatalities associated with the project will be maintained • Records of issues raised will be maintained in accordance with the project GRM • Conduct regular safety training sessions for workers on handling machinery and properly using safety equipment. • Provide barricade fencing to mitigate trespassing • Provide a barricade to enclose open excavated trenches/slopes temporarily. • Implementation of (i) health and safety management plan and (ii) community health and safety plan as approved by PMU.		
Community health and safety	Accidents due to vehicle and machine operations	• Implement a comprehensive traffic management plan that coordinates construction schedules with peak traffic hours to minimize congestion. This should include the designation of alternative routes for construction traffic and clear signage to direct vehicles efficiently. • Install appropriate signage in areas affected by construction activities. These signs should warn of upcoming construction, altered traffic patterns, and the presence of heavy vehicles. They can also direct pedestrians to safe crossing points. • Enforce strict speed limits in construction zones, with speed bumps or digital speed display signs to ensure	Contractor	District Irrigation Office

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
		drivers adhere to the limits. Using flag people can also be beneficial to manage traffic flow, particularly during peak hours or when children are traveling to and from school. • Establish and maintain safe pedestrian crossing points equipped with crossing guards during busy times to assist school children and the elderly. Where possible, constructing temporary pedestrian bridges or tunnels may be beneficial. • Launch awareness campaigns to inform residents about the construction schedule, potential hazards, and safety measures in place. Providing this information helps the community adjust their routines and travel paths to avoid construction areas. • Regularly monitor traffic conditions and enforce safety measures through patrols or surveillance cameras to ensure compliance with traffic rules and construction safety protocols. • Develop a clear emergency response plan for traffic-related incidents, ensuring that all construction personnel are trained in first aid and that procedures are in place for rapid emergency services access to the construction site.		
Cultural and religious aspects	inadvertent disruptions to sites of worship or culturally significant landscapes	• Identify cultural and religious. This should involve consultation with local community leaders to understand the significance of these sites. • Engage with local communities, particularly religious and cultural leaders, to understand their values and concerns. These consultations should be ongoing throughout the project to ensure that community feedback is continuously incorporated. • Provide cultural sensitivity training for project staff and workers to foster respect for local traditions and practices. Understanding the cultural context can minimize inadvertent disrespect or harm to cultural practices. • Rerouting construction vehicles, creating access paths during construction or even adjusting project timelines to accommodate important cultural events. • Document cultural sites and practices with the community's help to create records that can serve educational	Contractor	District Irrigation Office

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
		purposes and promote cultural understanding. Sharing this documentation can help foster pride in the local heritage and facilitate its preservation.		
Post-construction				
Waste Management and Site Clean-up	Accumulations of construction waste can have a significant visual impact on the landscape and disturbance to local people	• Perform a comprehensive site cleanup, removing all construction debris, surplus materials, and any contamination. • Employ specialized contractors for the safe removal and disposal of hazardous materials in accordance with national regulations. • Backfill and compact any excavation pits or trenches used during construction to prevent sinkholes or unintended water collection. • Provide documentation to the Employer's Representative detailing the waste disposal process, including receipts and records from waste disposal companies.	Contractor	District Irrigation Office
Water Resources	Increase in the use of pesticides and agrochemicals due to farming activities	• Farmers should adopt IPM strategies to reduce reliance on chemical pesticides. IPM includes using biological pest controls, crop rotations, and other sustainable practices to minimize environmental damage. • Farmers must implement precision agriculture technologies, such as drip irrigation systems, to apply water and nutrients more efficiently. This reduces runoff and leaching of chemicals into water bodies. • The District Irrigation Office will provide continuous education and training to farmers on the safe and efficient use of fertilizers and pesticides. • The District Irrigation Office will encourage using organic or less toxic chemicals that are less harmful to aquatic life and the broader ecosystem. • Farmers will establish buffer zones around water bodies to filter out pollutants before they can enter aquatic systems. Vegetated buffer strips can effectively trap sediment, phosphates, and other pollutants. • Support consultants and the District Irrigation Office will implement a regular monitoring program to track the levels of nitrates, phosphates, and other harmful substances in water bodies. This data can help regulate and adjust agricultural practices in real time to prevent pollution. • The District Irrigation Office should	District Irrigation Office Farmers' association Support Consultants	DWRI

Environmental Components and/or Activities	Environmental Impacts	Mitigation Measures	Institutional Responsibility	
			Implementation	Monitoring/ Supervision
		engage local communities in monitoring and protecting their water resources. Community participation can increase compliance with environmental practices and enhance the effectiveness of local conservation efforts.		

D. Environmental Monitoring Program

271. Monitoring of mitigation measures during construction is the responsibility of the CPMO and WRIDD, supported by the PIMS Environmental Safeguard Specialist and Environment Safeguard Monitor. Table 31 shows the proposed Environmental Monitoring Program for the FMIS, which specifies the various monitoring activities, indicating location, frequency of monitoring, and responsibility.

Table 20. Environmental Monitoring Program

Activities or Items to Monitor	Location	Responsible for Activities	Monitoring Method	Monitoring Frequency	Monitoring Responsibility
PRE-CONSTRUCTION					
IEEs and EMPs are included in bid and contract documents	CPMO office	CPMO, PIMS	Copies of bid and contract documents	Before approval tender document	CPMO, PIMS
Site-specific EMP (SEMP) submitted by Contractor for approval by CPMO	CPMO office	Contractor, WRIDD	Copy of approved SEMP	Before construction activities commence	CPMO, PIMS
Secure all other necessary permits and licenses from relevant government agencies		Contractor, CPMO	Copies of permits and licenses	Before construction activities commence	CPMO, PIMS
Conduct baseline ambient air quality and noise level monitoring	Project site	Contractor	Site visits and observations, Contractor records, Results of Air Quality Sampling, and Noise Level measurements.	Pre-construction stage: 1 monitoring activity in 1 station	CPMO, WRIDD, PIMS
Conduct of baseline surface water quality monitoring	Project site	Contractor	Site visits and observations, Contractor records, Results of laboratory analyses	Pre-construction stage: 1 monitoring activity in 1 station	CPMO, WRIDD, PIMS
CONSTRUCTION					
Implementation of SEMP, including implementation of community and occupational health and safety measures.	Project site	Contractor	Site visits, Contractor records,	Weekly or as needed	CPMO, WRIDD, PIMS
Implementation of SMP	Project site	Contractor	Site visits, Contractor records,	Weekly or as needed	WRIDD, PIMS

Activities or Items to Monitor	Location	Responsible for Activities	Monitoring Method	Monitoring Frequency	Monitoring Responsibility
Conduct ambient air quality and noise level monitoring	Project site	Contractor	Site visits and observations, Contractor records, Results of laboratory analyses, Results of noise level measurements	Construction stage: 1 monitoring activity in 1 station * 3 construction seasons	CPMO, WRIDD, PIMS
Conduct of surface water quality monitoring	Project site	Contractor	Site visits and observations, Contractor records, Results of laboratory analyses	Construction stage: 1 monitoring activity in 1 station * 3 construction seasons	CPMO, WRIDD, PIMS
Provide EHS training for all personnel	Project site	Contractor	Contractor records; Interviews with workers	Monthly	WRIDD, PIMS
Keep accident reports and records	Project site	Contractor	Contractor records; Interviews with workers and community people	Monthly	WRIDD, PIMS
Employ workforce from communities near sites	Project site	Contractor	Contractor records	Monthly	WRIDD, PIMS
Implementation of EHS measures at construction camps	Construction campsite	Contractor	Site visits; Interviews with workers at camp	Monthly	WRIDD, PIMS

E. Capacity Development Training

272. The PIMS Consultant Environmental Safeguard Specialist will train the CPMO, WRIDD, and contractors. Training modules will need to cover safeguards awareness and management in accordance with both ADB and government requirements as specified below.

(i) sensitization on ADB's safeguard policy on the environment;
(ii) introduction to environment and environmental considerations in urban infrastructures;
(iii) review of IEEs and integration into the project's detailed design;
(iv) improved coordination within nodal departments; and
(v) monitoring and reporting system. The contractors will be required to conduct environmental awareness and orientation of workers before deployment to work sites.

273. **Methodology.** Capacity-building activities will be achieved through a combination of practical methodologies available such as lecture and workshop training by experts, on-the-job training and mentoring, and continuing team meetings and exercises. The PIMS Consultant Environmental Safeguard Specialist will spearhead the designing of specific programs appropriate for the target participants or stakeholders, including the execution of these programs during the different implementation phases of the IMEP, which includes the WRIDD. Pre-training and post-training assessment will be an integral part of the overall program to measure its effectiveness and identify any other interventions needed to improve effectiveness, if necessary.

274. As a fundamental component of the capacity building program, basic lectures and seminar

training sessions will be provided by the PIMS Environmental Safeguard Specialist to strengthen the awareness of project stakeholders on the requirements of ADB SPS and government environmental laws, rules, and regulations. Modules will be prepared and customized based on the skill set and needs of the different stakeholders. The entire training will cover basic principles of environmental assessment and management mitigation plans and programs, implementation techniques, monitoring methods, and tools. A proposed lecture and seminar training program, along with the frequency of sessions, is presented in the following table.

Table 21. Sample Lecture /Seminar Training Program for Environmental Management

Items	Pre-construction	Construction	
Training Title	Orientation workshop	Orientation program/ workshop for contractors and supervisory staff	Experiences and best practices sharing
Purpose	To make the participants aware of the environmental safeguard requirements of ADB and the Government of Nepal and how the project will meet these requirements	To build the capacity of the staff for effective implementation of the designed EMPs aimed at meeting the environmental safeguard compliance of ADB and the Government of Nepal	Improving the implementation of EMP
Contents	Module 1: Orientation ADB Safeguards Policy Statement Government of Nepal Environmental Laws and Regulations Module 2: Environmental Assessment Process ADB environmental process, identification of impacts and mitigation measures, formulation of an environmental management plan (EMP), implementation, and monitoring requirements Review of environmental assessment report to comply with ADB requirements Incorporation of EMP into the project design and contracts	Roles and responsibilities of officials/contractors/consultants towards the protection of the environment Environmental issues during construction Implementation of EMP Monitoring of EMP implementation Reporting requirements	Experiences on EMP implementation – issues and challenges
Duration	1day	1day	Best practices followed
Participants	CPMO and WRIDD staff (technical and environmental) involved in the project implementation	CPMO, WRIDD, Contractors	CPMO, WRIDD, Contractors

F. Environmental Management and Monitoring Plan Implementation Cost (Indicative)

275. Most environmental mitigation and enhancement measures are integrated into the design, and costs are included in the civil works contract. Some items need to be incorporated in this project's Bill of Quantities (BOQ), including the environmental monitoring costs. The environmental costs presented in the table below are tentative provisions based on experience of undertaking similar works under different DWRI projects. Individual contract package bid documents may be consulted for the details of environmental costs under civil works contracts. Contractors will bear the direct costs of all mitigation measures during construction, which will be included in the tender and contract documents; this includes features built into facility designs to prevent environmental impacts from arising. The project office CPMO will bear the costs of mitigation measures during operation. Costs related to environmental supervision during

construction will be borne by the CPMO (for the activities of the environmental consultants) and by the contractors (for monitoring work carried out by the OHS Officer/s).

Table 22. Indicative EMP budget line for the Hill Irrigation Subprojects

S. N.	Description of Work	Unit	QTY	Rate (NPR)	Amount (NPR)	Remarks
1	Personal Protective Equipment (PPE) to the entire satisfaction of the engineer-in-charge	Nos.	60	500	30000	Average 20 Workers in the Hill Area subproject
2	Provision of all requisite facilities (i.e., accommodation, drinking water supply, toilet with sanitation facilities and soak pits, waste disposal) at construction camps.	sq. meter	80	1150	92000	2.5 Aana for the temporary labor camp (Rate included Structure, flooring, and furnishing) in the hill area
3	Establish and maintain a first aid box and fire extinguisher at the campsite to the entire satisfaction of the engineer-in-charge.	Nos.	3	5000	15000	First Aid Box 2 and one Fire extinguisher
4	Water sprinkling for dust suppression in the access road to the construction sites and truck covers for transporting construction materials	Nos.	50	650	32500	Sprinkling on the earthen road in the village area, where the construction materials are transported to the intake site and canal sections
5	Erection of the Information Board in the project site near settlement area	sq. feet	40	200	8000	An information board in compulsory for each subproject
6	Installing clear warning signs and green nets at the construction sites to alert the public to the potential risks	Nos.	10	400	4000	Green nets, ribbons, and warning signage are compulsory
7	Monitoring of Air, Water, and Noise at the construction Sites	Nos.	10	3500	35000	At least 3 times in each sub-project for each component parameters
8	Training on EMP implementation, health & safety inductions to workers, and awareness & empowerment programs for the community	Nos.	3	5000	15000	1 EMP-related, 1 Health and Safety and 1 Community Awareness to be conducted by the contractor
9	Implementation of additional occupational health and safety measures related to prevention of COVID-19/other pandemic preparation *(If applicable, mention cost)*	L.S.	1	25000	25000	Pandemic preparation budget for the workers
10	Greenery activities with plantations along or near the canal system or intake area *(If applicable, mention cost)*	L.S.	1	15000	15000	Greenery activities with protection works
	Total				**271500**	

Table 23. Indicative EMP budget line for the Terai Irrigation Subprojects

S. N.	Description of Work	Unit	QTY	Rate (NPR)	Amount (NPR)	Remarks
1	Personal Protective Equipment (PPE) to the entire satisfaction of the engineer-in-charge	Nos.	300	500	150000	Average 60 Workers in the Terai Area subproject
2	Provision of all requisite facilities (i.e., accommodation, drinking water supply, toilet with sanitation facilities and soak pits, waste disposal) at construction camps.	sq. meter	250	1150	287500	8 Aana for the temporary labor camp (Rate included Structure, flooring and furnishing, toilet) in Terai area
3	Establish and maintain a first aid box and fire extinguisher at the campsite to the entire satisfaction of the engineer-in-charge.	Nos.	5	5000	25000	First Aid Box 3 with all medicines and Fire extinguisher 2 during the construction period
4	Water sprinkling for dust suppression in the access road to the construction sites and truck covers for transporting construction materials	Nos.	200	650	130000	Sprinkling on the earthen road in the village area, where the construction materials are transported to the head work site and canal sections
5	Erection of the Information Board in the project site near the settlement area	sq. feet	40	200	8000	An information board is compulsory for each subproject
6	Installing clear warning signs and green nets at the construction sites to alert the public to the potential risks	Nos.	50	400	20000	Green nets, ribbons, and warning signage are compulsory
7	Monitoring of Air, Water, and Noise at the construction Sites	Nos.	10	3500	35000	At least 3 times in each sub-project for each component parameters
8	Training on EMP implementation, health & safety inductions to workers, and awareness & empowerment programs for the community	Nos.	3	5000	15000	1 EMP-related, 1 Health and Safety and 1 Community Awareness to be conducted by the contractor
9	Implementation of additional occupational health and safety measures related to prevention of COVID-19/other pandemic preparation *(If applicable, mention cost)*	L.S.	1	25000	25000	Pandemic preparation budget for the workers
10	Greenery activities with plantations along or near the canal system or intake area *(If applicable, mention cost)*	L.S.	1	15000	15000	Greenery activities with protection works
	Tota				**710500**	

276. CPMO will monitor the overall progress of EMP implementation of all the components of IMEP. The CPMO, PIMS, and contractor safeguard team will undertake their respective roles in site inspections and document reviews to verify compliance with the EMP and SEMP and progress toward the final outcome. The contractor will conduct day-to-day implementation of the SEMP.

277. The contractor will submit monthly reports to the CPMO. The monthly reports will include a compilation of copies of monitoring sheets accomplished and duly signed by the contractor's Environmental Safeguard /Occupational Health and Safety Officers on a daily basis. This monitoring sheet is indicative and can be further enhanced depending on the situations at the subproject construction site.

278. The PIMS will submit quarterly environmental monitoring reports to CPMO, which will include a summary of the monthly monitoring activities of the contractor and results of any independent monitoring or inspection activities of the project. In conducting these independent inspection activities, CPMO will be supported by a PIMS consultant. A sample inspection checklist is in **Appendix 5**. This checklist is indicative and can be further enhanced depending on the actual situation at the project component construction site.

279. CPMO, with support from the PIMS, shall accomplish semi-annual environmental monitoring reports (SEMRs) starting from the effectivity date up to the end of the construction phase, which shall be submitted to ADB for review and disclosure on the ADB website. The CPMO shall prepare and submit an annual environmental monitoring report during the operation phase until ADB issues a project completion report. Submission of these reports to ADB will be within thirty (30) days from the end date of the reporting period.

VII. INFORMATION DISCLOSURE, CONSULTATION AND PARTICIPATION

A. Consultation and Participation

280. Meaningful consultation is an essential part of the environmental assessment process, which enables the incorporation of all relevant views of affected people and other stakeholders into decision-making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues. The process also helps avoid potential conflicts with stakeholders for smooth project implementation. The findings from the public consultations are documented and considered in the development of the EMP, especially in identifying the significant impacts of the proposed project components and developing the corresponding mitigation measures. The key stakeholders consulted were:

(i) Project beneficiaries' farmers and Water Users Association members;
(ii) Elected representatives, community leaders, and representatives of community-based organizations;
(iii) Local government and relevant government agency representatives, National Park Authorities, and other relevant government departments.

B. Public Consultation Conducted

281. The WRIDDs undertook consultations in the FMIS subprojects Project with the stakeholders in line with the requirements pertaining to social and environmental considerations. Prior to consultation meetings with local stakeholders, advance notification was circulated, and coordination was established with stakeholders through the project office. The consultations also focused on seeking stakeholders' opinions, especially the local government's views on potential physical and economic impacts and key risks, including mitigation measures and many more.

Table 24. FMIS Subproject - Summary of Public Consultation

S. N	Date and Place	Persons Consulted	Number of Participants			
			Male	Female	Total	Janjati (IP)
1	12 February 2024 Munsari Khola Irrigation Subproject Ilam	WUA representatives /local elected leaders	14	7	21	13
2	13 February 2024 Mangal Tar Irrigation Subproject Ilam	WUA representatives ward chairperson, beneficiary farmer	18	8	26	20
3	12 February 2024 Maebashi Irrigation Subproject Dolkha	WUA representatives, elected ward chairperson, beneficiary farmer	29	11	40	23
4	5 February 2024 Nimkotbesi Subproject Dolkha	WUA representatives, elected ward chairperson, beneficiary farmer	37	8	45	3
5	5 February 2024 Karange Kulo Irrigation subproject, Tehrathum	WUA representatives and beneficiary farmer	11	3	14	2
6	12 February 2024 Munsari Khola Irrigation Subproject Ilam	WUA representatives, elected ward chairperson, beneficiary farmer	22	5	27	6
7	9 February 2022 Lewa Khola ISP Ilam (Hill)	elected ward chairperson, beneficiary farmer	19	7	26	23
8	6 February 2024 Gagan Irrigation subproject Siraha (Terai)	WUA representatives, elected ward chairperson, beneficiary farmer	34	0	34	0
Total			**184**	**49**	**233**	**90**

Source: Focus group discussion, February 2024

Figure 23. FMIS- Photographs of public consultation.

Public consolations in Ilam

Consultation and observation of command area in Dolkha

Consultation with beneficiaries and snapshot canal observation: Gagan ISP Siraha

VIII. GRIEVANCE REDRESS MECHANISM (GRM)

A. Common Grievance Redress Mechanism

282. A common GRM will be in place to redress environmental and social safeguard concerns about the project. Grievance is defined as any issues/concerns resulting in the non-performance of obligations of any parties involved in project processes, particularly in safeguards implementation. The GRM described below has been developed in consultation with the stakeholders and will be applicable to all subprojects implemented by DWRI and CAMO under the IMEP. The GRM is anchored on the five principles, underpinning the grievance redress processes and the arrangements envisaged to implement these:

(i). **Transparency.** The GRM encourages comments and feedback (negative and positive) to improve the Project. The community must be aware of all complaints, grievances, and problems reported; must be involved in their redress; and must be kept informed on progress made in resolving grievances. A public awareness campaign will be conducted to ensure that awareness of the project and its grievance redress procedures is generated. The campaign will ensure that the poor, women, IPs, the vulnerable, and the disadvantaged groups are made aware of grievance redress procedures, and CPMO (the central office of the DWRI) and the CAMO (the central agriculture management office of DOA) will ensure that their grievances are addressed according to the time schedule, and feedback will be provided to the affected person or the complainant.

(ii). **Socially Inclusive**. The whole community, and even those outside, are given the opportunity to raise concerns and the right to receive a response. The GRM provides an accessible, inclusive, gender-sensitive, and culturally appropriate platform for receiving and facilitating the resolution of affected persons' grievances related to the project.

(iii). **Simple and Accessible.** Procedures to file complaints and seek redress are kept simple and easy to understand by the affected people, most especially the non-literate and their communities. Affected persons will have the flexibility of conveying grievances/suggestions through verbal narration from walk-in affected person, by dropping grievance redress/suggestion forms in complaints/suggestion boxes put up at accessible locations, through telephone hotlines, by e-mail, by post, or by writing in a complaint register at project site, SMC (Subproject Management Committee), and CPMO offices.

(iv). **Anonymity and Security**. To remain accessible, open, and trusted, the GRM ensures that the identities of those complaining are kept confidential. This encourages people to participate and file grievances openly. The project will maintain careful documentation of the name of the complainant, date of receipt of the complaint, address/contact details of the person, location of the problem area, and grievance details. The project will ensure a grievance tracking and monitoring system, response accorded, resolution status, and closure. SMC and CPMO's Social Development Specialists will be responsible for timely grievance redressal on safeguards and gender issues and registration of grievances, related disclosure, and communication with the aggrieved party.

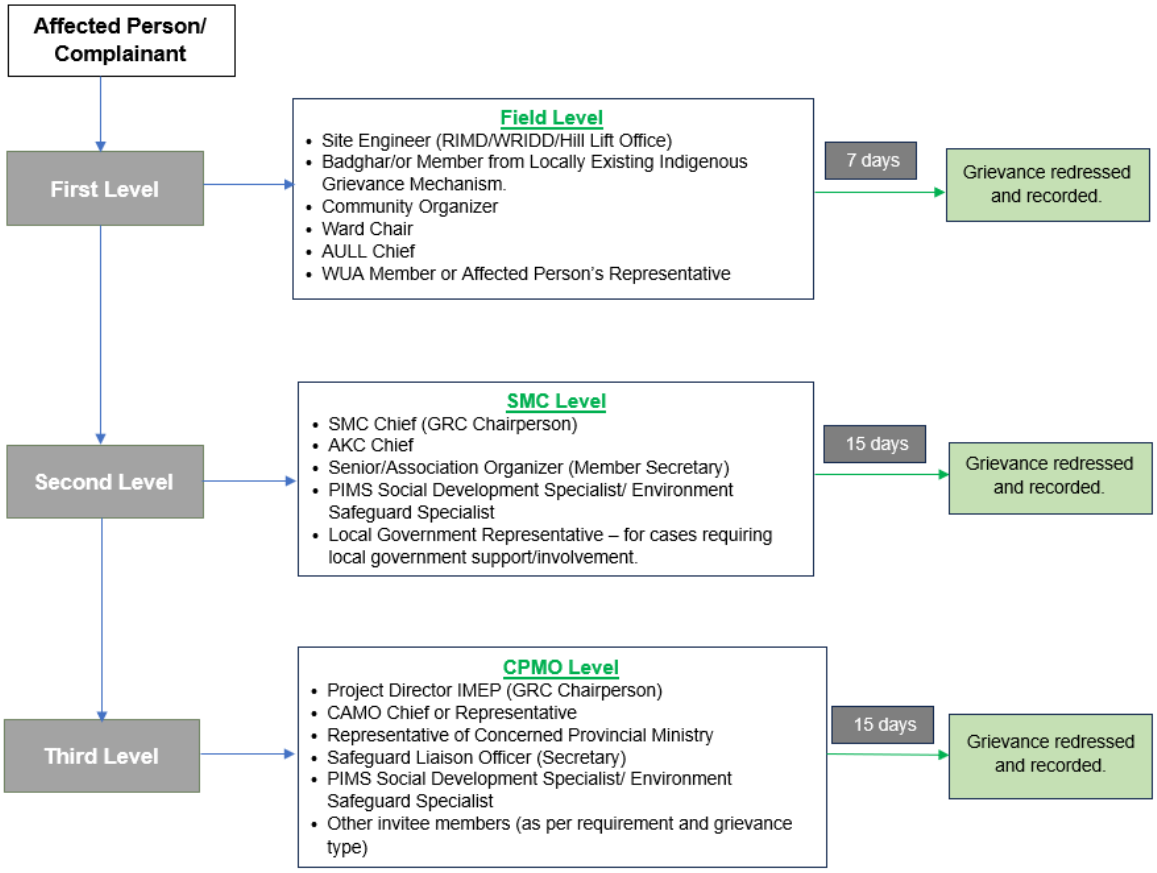
(v). **Institutional Capacity Building.** Through the GRM, the SMC and CPMO will strengthen communication channels and mechanisms for grievance redress at the community/project area level.

B. Grievance Redress Arrangements and Role Functions

283. The GRM is a three-tier arrangement that facilitates time-bound grievance resolution at each level. Responsible persons and agencies/offices are identified to address grievances and seek appropriate advice at each stage, as required. Institutional arrangements, including the

constitution of grievance redress committees (GRC) at various levels, will be ensured to function throughout the project duration. The CPMO shall ensure the constitution of these committees and oversee the implementation of grievance redress processes, including adherence to time limits, record keeping, and documentation at each level.

Figure 24: Grievance Redress Mechanism



Field Level: The first level of the GRM will function at the project location/site. The field-level arrangement will consist of ground implementation staff led by the project's Site Engineer, a Community Organizer, a Badghar or a member from a locally existing Indigenous grievance settlement mechanism, and a representative of the affected persons. All minor issues and those perceived as immediate and urgent by the complainant will be resolved at the field level itself (within 7 days). For cases requiring input and involvement of local bodies, the field-level grievance cell will be strengthened by including a Ward Chair (at least one female member and one representative from the local Indigenous community. In cases of larger issues that cannot be resolved at the field level, the matter will be escalated to the district/subproject level GRC, the second level arrangement. The Community Organizer will be responsible for documentation and record-keeping. A summary of grievance records will be submitted to the CPMO monthly. The province-based PIMS Social Development Specialist will both monitor and provide guidance and support to the field staff in grievance redress and record-keeping.

284. **SMC Level:** A GRC will be established at the SMC level and headed by the SMC chief**.**

The Senior/Association Organizer of the Institutional Development section of WRIDD/SD/RIMD will function as the member secretary of the GRC, supported by the PIMS Social Development Specialist/Environmental Safeguard Specialist. The committee will include a representative from the local body, the AKC Chief, as per the nature of the grievance. All grievances that cannot be resolved at the field level and those directly registered at this level will be addressed by this body within 15 days of complaint receipt. Proper documentation of grievances (including records of grievances redressed at the field level) will be maintained by the Institutional Development unit of WRIDD/RIMO and offices responsible for hill lift schemes. In cases where the GRC at this level cannot resolve a grievance within the stipulated period, the case will be escalated to a higher level for resolution. The SMC level will also maintain follow-up for each grievance, periodically disseminate information to complainants on the status of their grievance and record their feedback (satisfaction/dissatisfaction and suggestions).

285. **CPMO Level**: The arrangement at the highest level will involve the constitution of a project-level committee headed by the CPMO PD as the chairperson. The committee will receive support from the Social Development Specialist/Environmental Safeguard Specialist or technical experts relevant to grievances, the CAMO Chief or representative, the representative or senior officer from the concerned provincial ministry, and other members as required based on the type of grievance. All grievances that cannot be resolved by the SMC level GRC will be brought to the attention of this body, seeking its advice or referral for resolution at this level. Grievances received or referred to this committee will be resolved within 15 days. Periodic information will be provided to complainants on the status of their grievance resolution. The Safeguard Liaison Officer will act as the secretary for the CPMO-level committee and will also be responsible for compiling grievance redress records, including project-level documentation and reporting.

286. The affected person/complainant shall have access to the country's legal system at any stage. Further, accessing the country's legal system can run parallel to accessing the GRM and is not dependent on the negative outcome of the GRM.

287. **ADB Accountability Mechanism.** If the established GRM is not able to resolve a grievance, the affected person can also use the ADB Accountability Mechanism by directly contacting (in writing) the Complaint Receiving Officer at ADB headquarters or the ADB Nepal Resident Mission (NRM). Before submitting a complaint to the Accountability Mechanism, the affected/aggrieved person/s should make a good-faith effort to solve the problem by working with the concerned ADB operations department and/or NRM. Only after doing so, and if they are still dissatisfied, will the Accountability Mechanism consider the complaint eligible for review.[20] The complaint can be submitted in any of the official languages of ADB's developing member countries. The ADB Accountability Mechanism information will be included in the project-relevant information to be distributed to the affected communities as part of the project GRM.

288. **Consultation arrangements and information dissemination**. The GRM will adopt a consultative and participatory approach to grievance resolution, which may sometimes require one-to-one consultation with individual complainants or the aggrieved community. Furthermore, the CPMO and the PIMS Social Development Specialist/Environmental Safeguard Specialist will be responsible for disseminating information to affected persons on the grievance redressal procedure, ensuring that the host community understands the grievance redress process, and encouraging them to register complaints. Adequate consultations, meetings, and public awareness campaigns will be conducted to achieve this objective. Information on grievances received and responses provided will be documented and reported back to the affected persons. All grievances will be treated with utmost confidentiality, and the complainant's identity will not

[20] Accountability Mechanism. http://www.adb.org/Accountability-Mechanism/default.asp.

be disclosed. A sample grievance registration form is provided in **Appendix 7.**

289. **Record Keeping.** Records of all grievances received, including contact details of the complainant, date the complaint was received, nature of the grievance, agreed corrective actions and the date these were taken, and the outcome will be maintained by the CPMO (with the support of PIMS Social Development Specialist/Environmental Safeguard Specialist). As part of record-keeping and reporting practices, information on grievance tracking will also be maintained. Grievance reporting by SMC and CPMO at their respective levels will include information for the reporting period and the cumulative data on select parameters such as total grievances received, redressed, pending, etc., since the project's inception. Summarized information will be included in the CPMO's periodic reporting, with support from PIMS and ADB.

290. **Periodic review and documentation of lessons learned**. The CPMO will periodically review the functioning of the GRM and record information on the mechanism's effectiveness, particularly in preventing and addressing grievances within the project.

291. **Costs**. The project will bear all costs involved in resolving the complaints (meetings, consultations, communication, and reporting/information dissemination).

IX. CONCLUSIONS AND RECOMMENDATIONS

292. The preparation of the Irrigation Project funded by the Asian Development Bank (ADB) and implemented by the Ministry of Energy, Water Resources, and Irrigation, aims to increase agricultural production and productivity in the land areas of the proposed Subproject area. Department of Water Resources and Irrigation is promoting irrigation in the hilly and terai areas considering the demand of the medium to marginal farmers of the project area.

293. Farmers cannot divert sufficient irrigation water for crops in the cropping seasons due to the absence of permanent intake and other infrastructure in the canal system. Besides these, the high seepage losses from the canal system also aggravate the sufficiency of water in the canal. In addition, the farmers have limited access to appropriate seeds of good quality, chemical fertilizer, and other agrochemicals. Other problems are associated with a lack of appropriate equipment for applying insecticides/ fungicides and inadequate market information.

294. The proposed rehabilitation work of FMIS Irrigation subprojects in the three provinces' districts will benefit the local farmers and people. The magnitude of potential impacts and the presence of environmentally sensitive areas in the subproject influence areas are less significant. Considering this under ADB's Safeguard Policy Statement (2009), the project is categorized as category B for an environment requiring the preparation of an IEE. As per GoN, EPR 2020 rules have defined thresholds and equivalent environmental assessments (i.e., BES, IEE, and EIA). The proposed FMIS rehabilitation works are limited to the existing canal systems. There are no construction of new head works and changes in the main canal systems but limited to strengthening the existing canal structures. Thus, as per EPR 2020, the project component scope does not trigger BES/IEE/EIA.

295. According to the ADB Safeguard Policy Statement (SPS 2009), the proposed Irrigation Subprojects are categorized as B, and this IEE report is prepared to comply with ADB's requirement. The environmental impacts during construction are short-duration, temporary, reversible, and can be easily mitigated by good and best practices in engineering construction. Post-construction impacts will be mainly beneficial to affected people. The IEE prepared includes an EMP outlining the impacts, mitigation measures, implementation arrangements, and monitoring. The proponent should implement the environmental mitigation measures proposed in this IEE study to promote good practices in environmental management in the subproject area during the construction and operations stages of the project. The PIMS environmental safeguard consultant will support the CPMO, while DWRI will designate an Environmental Liaison Officer to ensure technical support in complying with the requirements of ADB and Nepal.

296. In the subproject implementation, there are no significant impacts during construction and operation and will be low to moderate, temporary, and short-term (i.e., most likely to occur only during peak construction periods). With the EMP in place, the potential impacts will either be eliminated or minimized to insignificant levels. IEE will be updated when unanticipated impacts occur during the project implementation. EMPs will also be updated based on the specific conditions of areas when beneficiaries and actual sites are defined. Throughout the implementation, the project will comply with the project's environmental safeguard requirements of ADB SPS (2009) and relevant government policies through the CPMO and PIU with support from PIMS.

Recommendations to update IEE

297. For any unanticipated environmental impacts and/or changes in the selection of FMIS

subprojects or IPS under Priority 1a and 1b, IEE and EMP should be updated through the approach below:

298. Firstly, the CPMO and its consultants should conduct an environmental assessment when any unanticipated impacts are observed or new FMIS subprojects arise. This process involves thorough field inspections, stakeholder consultations, and a review of relevant environmental indicators to determine the impacts' nature, scale, and significance. Should the assessment indicate significant impacts, a more detailed analysis must be undertaken to fully understand the potential consequences on the environment and the affected communities. This detailed analysis should elucidate the specific causes of environmental impacts and propose appropriate mitigation measures.

299. Developing specific mitigation plans based on detailed impact analysis is imperative. These new mitigation strategies should then be integrated into the EMP by the CPMO, clearly outlining the responsibilities assigned to specific parties, including contractors and environmental monitors. The CPMO and field offices ensure regulatory compliance is achieved. Any feedback or conditions from regulatory authorities should be incorporated into the updated plans and fully implemented.

300. Effective stakeholder engagement is necessary to address unanticipated impacts and/or assessment of new FMIS sites. This involves informing and consulting affected communities and stakeholders about the impacts and the measures being taken to mitigate them. Public consultations may be necessary to gather feedback and ensure transparency. All consultations and feedback should be documented, and the updated IEE and EMP should be disclosed to the public and stakeholders to keep them informed about the changes and the steps being taken to mitigate new impacts.

301. WRIDD must approach the national park administration offices of Chitwan National Park and Langtang National Park due to the proposed FMIS within their buffer zones. It is essential for WRIDD to consult with the respective officers and seek their No Objection Certificate (NOC) for the planned rehabilitation activities. This ensures compliance with park regulations and minimizes environmental impacts on these protected areas. The consultation process should involve detailed discussions on the scope of work, potential impacts, and mitigation measures to align the project with conservation goals and legal requirements. This collaborative approach helps safeguard biodiversity while facilitating necessary infrastructure improvements.

Appendix 1: List of Subproject Proposed under FMIS Component with Ecological belt, Province, District, and Municipality

S.N.	Province	Ecological Belt	District	Rural/Municipality	Wards	Name of ISP	Implementation priority	CCA
1	Madhesh	Terai	Bara	Mahagadhimai Municipality	5	Jokaha Dora ISP	Priority 1a:	300
2	Madhesh	Terai	Bara	Karaiyamai RM	1	Bhaluhi Suklaiya Patti	Priority 1a:	360
3	Madhesh	Terai	Mahottari	Balawa Municipality	11	Rato Bhagwatipur ISP	Priority 1b	515
4	Madhesh	Terai	Mahottari	Bhangaha	7	Ladakawa ISP	Priority 1a:	345
5	Madhesh	Terai	Mahottari	Balawa Municipality	8	Chakkarghatta ISP	Priority 1a:	670
6	Madhesh	Terai	Mahottari	Loharpattei and Jaleshwor NP	9	Rato Kokila ISP	Priority 1b	1120
7	Madhesh	Terai	Sirha	Sukhipur-8,10, 6 & 4	8,10, 6 & 4	Gagan ISP	Priority 1a:	835
8	Madhesh	Terai	Sirha	Laxmipur patari	4	Baburam	Priority 1b	400
9	Madhesh	Terai	Sirha	Laxmipur patari	2	Saraswati	Priority 1b	276
10	Madhesh	Terai	Sarlahi	Haripurwa	6	Haripurwa ISP	Priority 1a:	414
11	Madhesh	Terai	Sarlahi	Bansbariya RM	4 & 5	Laukat Dhangada ISP	Priority 1a:	375
12	Madhesh	Terai	Rauthat	Garuda	9	Dorapaini Raghunathpur ISP	Priority 1a:	255
13	Madhesh	Terai	Rauthat	Phatuwa, Bijayapur	11	Aruwa Khola ISP	Priority 1a:	430
14	Madhesh	Terai	Rauthat	Fatuwa Bijaypur	11	Aruwa Aknowa ISP	Priority 1b	264
15	Madhesh	Terai	Dhanusha	Bideha	2	Soharna ISP	Priority 1a:	430
16	Madhesh	Terai	Dhanusha	Bideha	1 & 4	Bachharaja ISP	Priority 1a:	325
17	Madhesh	Terai	Dhanusha	Kamla	2	Let ISP	Priority 1b	250
18	Madhesh	Terai	Parsa	Jagarnathpur RM	4	Hadahi ISP	Priority 1a:	275
19	Madhesh	Terai	Parsa	Paterwa sugauli RM	2	Gadi ISP	Priority 1a:	280
20	Madhesh	Terai	Parsa	Jagarnathpur	1	Oriya	Priority 1b	145
21	Madhesh	Terai	Parsa	Parsagadhi	6	Megha	Priority 1b	200
22	Madhesh	Terai	Saptari	Dakneswari	9	Kajra ISP	Priority 1a:	400
23	Madhesh	Terai	Saptari	Mahadeva RM	2	Jita Khola ISP	Priority 1a:	227
24	Bagmati	Mountain	Dhading	Thakre RM	8	Sopyang Khola Gatta Ko Kulo ISP	Priority 1a:	50
25	Bagmati	Mountain	Dhading	Dhunibesi Municipality	9	Jhagadiya Sikre ISP	Priority 1a:	45
26	Bagmati	Mountain	Dhading	Gajuri Rural Municipality	8	Parbang ISP	Priority 1b	100
27	Bagmati	Mountain	Dhading	Thakre RM	4&5	Liti ISP	Priority 1b	110
28	Bagmati	Mountain	Dhading	Gajuri Rural Municipality	3	Dharmasala ISP	Priority 1b	120
29	Bagmati	Mountain	Dolkha	Baiteshwor	5&6	Nimkot Besi ISP	Priority 1a:	50
30	Bagmati	Mountain	Dolkha	Melung RM	4&5	Nause Besi	Priority 1a:	72

S.N.	Province	Ecological Belt	District	Rural/Municipality	Wards	Name of ISP	Implementation priority	CCA
						Kulo ISP		
31	Bagmati	Mountain	Dolkha	Melung Rural Municipality	1	Ghyang Khola ISP	Priority 1b	301
32	Bagmati	Hill	Kavre	Panchkhal	6	Barasai Saathi ISP	Priority 1a:	58
33	Bagmati	Hill	Kavre	Bhumlu RM	2	Salleni Khola Pahari Basti ISP	Priority 1b	50
34	Bagmati	Hill	Kavre	Mandan Deupur	6	Muhane Mul Kulo ISP	Priority 1a:	65
35	Bagmati	Hill	Kavre	Panchkhal Municipality	3,5	Kumaitaar ISP	Priority 1b	25
36	Bagmati	Hill	Sindhuli	Dudhauli Municipality	5	Purwari Pachiyari ISP	Priority 1a:	170
37	Bagmati	Hill	Sindhuli	Tinpatan	2	Sakhamadi Chadaha ISP	Priority 1a:	90
38	Bagmati	Mountain	Sindhupalchowk	Chautara Sangachowgadi	4	Pokhre Tipling Khola Siran Kulo ISP	Priority 1a:	65
39	Bagmati	Mountain	Sindhupalchowk	Paanchpokhari Thaangpal	6	Mahadev Khola Sisneghari Dittiya ISP	Priority 1a:	76
40	Bagmati	Mountain	Sindhupalchowk	Melamchi	3	Bimreni Dhunge ISP	Priority 1b	66
41	Bagmati	Hill	Lalitpur	Godawari	1 & 2	Godavari (Right) Rajkulo ISP	Priority 1a:	80
42	Bagmati	Hill	Lalitpur	Paanchpokhari Thaangpal	4	Chimti	Priority 1b	105
43	Bagmati	Hill	Makwanpur	Bakaiya RM	6	Chyau Chyau ISP	Priority 1a:	80
44	Bagmati	Hill	Makwanpur	Bagmati RM	4	Bagmati ISP	Priority 1a:	75
45	Bagmati	Terai	Chitwan	Kalika Municipality	8	Majuwa ISP	Priority 1a:	45
46	Bagmati	Terai	Chitwan	Ratnanagar	5	Tarauli ISP	Priority 1b	80
47	Bagmati	Mountain	Rasuwa	Naukunda RM	1	Dhuple Khola ISP	Priority 1a:	35
48	Bagmati	Hill	Nuwakot	Bidur	8	Samari ISP	Priority 1a:	25
49	Bagmati	Hill	Nuwakot	Tadi RM	5	Dorkhu Khola ISP	Priority 1a:	40
50	Bagmati	Hill	Kathmandu	Dakshinkali	8	Phaku Khola	Priority 1b	30
51	Bagmati	Hill	Kathmandu	Shankharapur	5	Bishombhar	Priority 1a:	90
52	Bagmati	Hill	Kathmandu	Sankharapur	1	Chisapani Laharedevi ISP	Priority 1a:	30
53	Koshi	Hill	Bhojpur	Bhojpur Municipality	12	Simle Ghatte ISP	Priority 1a:	25
54	Koshi	Hill	Bhojpur	Temkemaiyung RM	2	Yangtang Khola Mailung Kulo ISP	Priority 1a:	45
55	Koshi	Hill	Bhojpur	Temkemaiyung	2	Hinkuwa Khola ISP	Priority 1b	30
56	Koshi	Hill	Dhankuta	Mahalaxmi Municipality	3 & 4	Birendra ISP	Priority 1a:	106
57	Koshi	Hill	Dhankut	Dhankuta	2	Tin Dovane	Priority 1a:	98

S.N.	Province	Ecological Belt	District	Rural/Municipality	Wards	Name of ISP	Implementation priority	CCA
			a	Muncipality		Kerabari ISP		
58	Koshi	Hill	Dhankuta	Mahalaxmi Municipality	2	Chayalu Laktang ISP	Priority 1b	188
59	Koshi	Hill	Dhankuta	Mahalaxmi Municipality	3	Leguwa Khola ISP	Priority 1b	250
60	Koshi	Hill	Ilam	Rong Rural Municipality	2	Mangaltar Dhansar ISP	Priority 1a:	95
61	Koshi	Hill	Ilam	Fakfokathum RM	1	Satake ISP	Priority 1b	121
62	Koshi	Hill	Ilam	Chulachuli RM	6	Nunsari ISP	Priority 1a:	91
63	Koshi	Hill	Ilam	Deumai Municipality	8	Lewa Khola ISP	Priority 1a:	70
64	Koshi	Hill	Ilam	Suryodaya Municipality	3	Runsung ISP	Priority 1b	70
65	Koshi	Terai	Morang	Sunbarshi Municipality	1	Sita Dans Kerkha ISP	Priority 1a:	370
66	Koshi	Terai	Morang	Kerabari RM	6&7	Sira Jimdari ISP	Priority 1b	300
67	Koshi	Terai	Morang	Pathri Sanischare	5,6&7	Adarsa Paini ISP	Priority 1a:	230
68	Koshi	Terai	Morang	Letang Municipality	5,6	Bhuwa ISP	Priority 1b	225
69	Koshi	Terai	Morang	Pathari Sanischare Municipality	2,3 & 7	Indreni ISP	Priority 1b	200
70	Koshi	Hill	Okhaldhunga	Champadevi RM	7	Dhuseni Khola Kangrange Kolchaur Besi ISP	Priority 1a:	53
71	Koshi	Hill	Okhaldhunga	Molung RM	4	Kul Khola ISP	Priority 1a:	50
72	Koshi	Hill	Okhaldhunga	Champadevi RM	9	Thotneri ISP	Priority 1b	54
73	Koshi	Hill	Panchthar	Phidim	11	Khang Khola Tetire Bibire Falate Kulo ISP	Priority 1a:	110
74	Koshi	Hill	Panchthar	Miklajung RM	2	Naya Kulo ISP (3.86)	Priority 1a:	115
75	Koshi	Mountain	Sankhuwasabha	Khandbari Municipality	7&8	Pangma Khola Badreni ISP	Priority 1a:	41
76	Koshi	Mountain	Sankhuwasabha	Dharmadevi Municipality	9	Kenwa Khola Fituwa Malibheg ISP	Priority 1a:	55
77	Koshi	Mountain	Sankhuwasabha	Panchakhapan Municipality	2	Thado Khola	Priority 1b	44
78	Koshi	Mountain	Sankhuwasabha	Savapokhari RM	6	Sang Khola	Priority 1b	38
79	Koshi	Mountain	Taplejung	Sirijangha RM	1	Nebu Khola ISP	Priority 1a:	87
80	Koshi	Mountain	Taplejung	Pathibhara Yangbarak RM	1	Khokse Nangkholyang ISP	Priority 1a:	63
81	Koshi	Mountain	Taplejung	Sirijangha RM	1	Major Singh ISP	Priority 1b	67
82	Koshi	Mountain	Taplejung	Aatharai Tribeni Gaunpalika	3	Chuwa ISP	Priority 1b	90
83	Koshi	Hill	Terhathum	Laliguras RM	6&7	Lambu Kulo ISP	Priority 1a:	300

S.N.	Province	Ecological Belt	District	Rural/Municipality	Wards	Name of ISP	Implementation priority	CCA
84	Koshi	Hill	Terhathum	Menchhayayem RM	5&6	Maynkhuwa Khola ISP	Priority 1b	135
85	Koshi	Hill	Terhathum	Chhathar RM	1	Teliya Khola ISP	Priority 1b	150
86	Koshi	Hill	Terhathum	Menchhayayem RM	3&4	Guranse ISP	Priority 1b	85
87	Koshi	Hill	Terhathum	Myanglung Municipality	4	Karange ISP	Priority 1a:	85
88	Koshi	Hill	Khotang	Sakela Rural Municipality	1	Sabju Khola Bhalu Khola ISP (4.19)	Priority 1a:	86
89	Koshi	Hill	Khotang	Diprung Chuichumma RM	3	Kharuwa Khola Aek Chhahe ISP (4.69)	Priority 1a:	234
90	Koshi	Hill	Khotang	Diktel Rupakot Majhuwagadi	10	ChimChima Khola ISP	Priority 1b	53
91	Koshi	Hill	Khotang	BarahaPokhari RM	4	Lapuwa Khola ISP	Priority 1b	85
92	Koshi	Terai	Sunsari	Ramdhuni	6 & 7	Kajara Khola Kataghara Bandh ISP	Priority 1a:	131
93	Koshi	Terai	Sunsari	Ramdhuni	7	Shankar Beli	Priority 1b	72
94	Koshi	Terai	Sunsari	Itahari	10 & 11	Tengra Khola Sera Bandh ISP	Priority 1a:	220
95	Koshi	Hill	Udaypur	Katari	5	Beladaha ISP	Priority 1a:	105
96	Koshi	Hill	Udaypur	Triyuga N.P.	10	Upper Baruwa ISP	Priority 1a:	215
97	Koshi	Hill	Udaypur	Triyuga N.P	2	Bablya Khola ISP	Priority 1b	116
98	Koshi	Terai	Jhapa	Arjundhara Municipality	2 & 3	Haldar Paini ISP	Priority 1a:	250
99	Koshi	Terai	Jhapa	Mechinagar Municipality	11,12	Hadiya Khola Abi Nahar ISP	Priority 1a:	265
100	Koshi	Terai	Jhapa	Mechinagar Municipality	13 & 14	Pathivara Krishi Kulo (NOT IN SPPR)	Priority 1b	165

Appendix 2. Sample Water Balance in Tarauli ISP

Table D.1: Mean Monthly Flows

Month	First Half Month Discharge (l/s)	Second Half Month Discharge (l/s)
January	1149.12	1044.24
February	934.80	857.28
March	816.24	775.20
April	747.84	766.08
May	843.60	2006.40
June	4259.04	7008.72
July	10246.32	12275.52
August	13100.88	12973.20
September	11906.16	9553.20
October	5918.88	3565.92
November	2489.76	1787.52
December	1459.20	1249.44

Table D.2: ETo Calculation

Months	Precipitation (mm)	Minimum Temperature (C)	Maximum Temperature (C)	Mean Relative Humidity (%)	Wind Speed (km/day)	Sun Shine (Hours)	ETo (mm/day)
Jan	7	5.80	18.7	61.44	86.4	6.4	1.87
Feb	14	7.30	21	58.14	103.68	6.6	2.55
Mar	24	11.10	25.7	52.23	112.32	6.5	3.55
Apr	72	16.10	30.1	47.72	146.88	6.5	4.84
May	162	19.00	29.6	57.52	146.88	5.8	4.67
Jun	386	20.70	28.3	76.44	129.6	4.1	3.69
Jul	768	21.00	27.6	86.02	112.32	3.6	3.24
Aug	572	20.60	28	86.06	103.68	3.7	3.13
Sep	431	19.70	27	84.62	95.04	4.3	2.91
Oct	104	17.00	26.7	66.39	86.4	6.1	2.93
Nov	6	10.60	23.8	59.98	69.12	6.6	2.18
Dec	13	6.40	20.1	60.33	69.12	6.6	1.75

Table D.3: Crop Water Requirement Calculation

S.N.	Items	Jan-1	Jan-2	Feb-1	Feb-2	Mar-1	Mar-2	Apr-1	Apr-2	May-1	May-2	Jun-1	Jun-2	Jul-1	Jul-2	Aug-1	Aug-2	Sep-1	Sep-2	Oct-1	Oct-2	Nov-1	Nov-2	Dec-1	Dec-2
1	**Eto Value mm/day**	1.84	2.04	2.38	2.8	3.3	3.87	4.52	4.8	4.71	4.42	3.94	3.58	3.35	3.21	3.16	3.08	2.96	2.92	2.92	2.74	2.37	2.07	1.86	1.78
2	**Crop Coefficients**																								
	Paddy Monsoon 2														1.1	1.1	1.1	1.1	1.05	0.95	0.95				
	Vegetable Monsoon													0.34	0.54	0.93	1.05	1.05	1.04	0.91					
	Wheat 1	1.15	1.15	1.15	0.9	0.4																	0.43	0.65	1.05
	Pulses (Lintel)	0.5	0.75	0.95	1.05	1.05	0.96																		0.4
	Oilseeds (Mustard)	0.46	0.82	1	1	0.72																			0.4
	Potato Winter 1	1.01	1.13	1.13	1.08	0.94	0.77																0.42	0.55	0.79
	Vegetable Winter	0.86	0.95	0.95	0.89																		0.28	0.34	0.54
	Paddy Early 1							1.1	1.1	1.1	1.1	1	1												
	Maize Spring 2							0.45	0.6	0.8	1.05	1.05	0.8												
	Banana	1	1	1	1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.1
3	**Eto Crop mm/half month**																								
	Paddy Monsoon 2	0	0	0	0	0	0	0	0	0	0	0	0	0	53	52.1	50.8	48.8	46	41.6	39	0	0	0	0
	Vegetable Monsoon	0	0	0	0	0	0	0	0	0	0	0	0	17.1	26	44.1	48.5	46.6	45.6	39.9	0	0	0	0	0
	Wheat 1	31.7	35.2	41.1	37.8	19.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13.4	18.1	28
	Pulses (Lintel)	13.8	23	33.9	44.1	52	55.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7
	Oilseeds (Mustard)	12.7	25.1	35.7	42	35.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7
	Potato Winter 1	27.9	34.6	40.3	45.4	46.5	44.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	15.3	21.1
	Vegetable Winter	23.7	29.1	33.9	37.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.7	9.5	14.4
	Paddy Early 1	0	0	0	0	0	0	74.6	79.2	77.7	72.9	59.1	53.7	0	0	0	0	0	0	0	0	0	0	0	0
	Maize Spring 2	0	0	0	0	0	0	30.5	43.2	56.5	69.6	62.1	43	0	0	0	0	0	0	0	0	0	0	0	0
	Banana	27.6	30.6	35.7	42	59.4	69.7	81.4	86.4	84.8	79.6	70.9	64.4	60.3	57.8	56.9	55.4	53.3	52.6	52.6	49.3	42.7	37.3	30.7	29.4
4	**Land Preparation (mm)**																								
	Paddy Monsoon 2												55	55	50	50									
	Wheat 1																						60		
	Paddy Early 1					75	75	50	50																
5	**Deep**																								

S.N.	Items	Jan-1	Jan-2	Feb-1	Feb-2	Mar-1	Mar-2	Apr-1	Apr-2	May-1	May-2	Jun-1	Jun-2	Jul-1	Jul-2	Aug-1	Aug-2	Sep-1	Sep-2	Oct-1	Oct-2	Nov-1	Nov-2	Dec-1	Dec-2
	Percolation (mm)																								
	Paddy Monsoon 2												75	75	75	75	75	75	75	75					
	Paddy Early 1					75	75	75	75	75	75	75													
6	**Evaporation during Land Preparation(mm)**																								
	Paddy Monsoon 2												67.1	62.8											
	Paddy Early 1					61.9	72.6																		
7	**Total CWR for Half Month (mm)**																								
	Paddy Monsoon 2	0	0	0	0	0	0	0	0	0	0	0	197.1	192.8	178	177.1	125.8	123.8	121	116.6	39	0	0	0	0
	Vegetable Monsoon	0	0	0	0	0	0	0	0	0	0	0	0	17.1	26	44.1	48.5	46.6	45.6	39.9	0	0	0	0	0
	Wheat 1	31.7	35.2	41.1	37.8	19.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73.4	18.1	28
	Pulses (Lintel)	13.8	23	33.9	44.1	52	55.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7
	Oilseeds (Mustard)	12.7	25.1	35.7	42	35.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7
	Potato Winter 1	27.9	34.6	40.3	45.4	46.5	44.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	15.3	21.1
	Vegetable Winter	23.7	29.1	33.9	37.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.7	9.5	14.4
	Paddy Early 1	0	0	0	0	211.9	222.6	199.6	204.2	152.7	147.9	134.1	53.7	0	0	0	0	0	0	0	0	0	0	0	0
	Maize Spring 2	0	0	0	0	0	0	30.5	43.2	56.5	69.6	62.1	43	0	0	0	0	0	0	0	0	0	0	0	0
	Banana	28.6	31.6	36.7	43	60.6	70.9	82.6	87.6	86	80.8	72.1	65.6	61.5	59	58.1	56.6	54.5	53.8	53.8	50.5	43.9	38.5	31.8	30.5
8	**80% Reliable Rainfall**	0	0	0	0	0	4.4	10.7	22.9	36.6	69	113.1	171.7	286.5	303.9	233	200.6	183	137.8	50.3	8.9	0	0	0	0
9	**Effective Rainfall(mm)**	0	0	0	0	0	0	9.1	19.5	31.1	58.6	79.2	120.2	200.6	212.7	163.1	140.4	128.1	96.5	42.8	7.6	0	0	0	0
10	**Net CWR for Half Month (mm)**																								
	Paddy Monsoon 2	0	0	0	0	0	0	0	0	0	0	0	76.9	0	0	14	0	0	24.5	73.8	31.4	0	0	0	0
	Vegetable Monsoon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Wheat 1	31.7	35.2	41.1	37.8	19.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73.4	18.1	28
	Pulses (Lintel)	13.8	23	33.9	44.1	52	55.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7
	Oilseeds (Mustard)	12.7	25.1	35.7	42	35.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.7
	Potato Winter 1	27.9	34.6	40.3	45.4	46.5	44.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	15.3	21.1
	Vegetable Winter	23.7	29.1	33.9	37.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8.7	9.5	14.4

S.N.	Items	Jan-1	Jan-2	Feb-1	Feb-2	Mar-1	Mar-2	Apr-1	Apr-2	May-1	May-2	Jun-1	Jun-2	Jul-1	Jul-2	Aug-1	Aug-2	Sep-1	Sep-2	Oct-1	Oct-2	Nov-1	Nov-2	Dec-1	Dec-2
	Paddy Early 1	0	0	0	0	211.9	222.6	190.5	184.7	121.6	89.2	54.9	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maize Spring 2	0	0	0	0	0	0	21.4	23.7	25.4	10.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Banana	28.6	31.6	36.7	43	60.6	70.9	73.5	68.1	54.9	22.2	0	0	0	0	0	0	0	0	11	42.9	43.9	38.5	31.8	30.5
11	**Net CWR l/s/ha per half month**																								
	Paddy Monsoon 2	0	0	0	0	0	0	0	0	0	0	0	0.59	0	0	0.11	0	0	0.19	0.57	0.24	0	0	0	0
	Vegetable Monsoon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Wheat 1	0.24	0.27	0.32	0.29	0.15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.57	0.14	0.22
	Pulses (Lintel)	0.11	0.18	0.26	0.34	0.4	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08
	Oilseeds (Mustard)	0.1	0.19	0.28	0.32	0.27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08
	Potato Winter 1	0.22	0.27	0.31	0.35	0.36	0.34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1	0.12	0.16
	Vegetable Winter	0.18	0.22	0.26	0.29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.07	0.07	0.11
	Paddy Early 1	0	0	0	0	1.64	1.72	1.47	1.43	0.94	0.69	0.42	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maize Spring 2	0	0	0	0	0	0	0.17	0.18	0.2	0.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Banana	0.22	0.24	0.28	0.33	0.47	0.55	0.57	0.53	0.42	0.17	0	0	0	0	0	0	0	0	0.08	0.33	0.34	0.3	0.25	0.24

Table D.4: Water Balance Calculation

Items	Coverage (%)	Area (ha)	Jan-1	Jan-2	Feb-1	Feb-2	Mar-1	Mar-2	Apr-1	Apr-2	May-1	May-2	Jun-1	Jun-2	Jul-1	Jul-2	Aug-1	Aug-2	Sep-1	Sep-2	Oct-1	Oct-2	Nov-1	Nov-2	Dec-1	Dec-2
Net CWR (l/s)																										
Paddy Monsoon 2	93.75	75	0	0	0	0	0	0	0	0	0	0	0	45	0	0	7.5	0	0	15	45	15	0	0	0	0
Vegetable Monsoon	2.5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wheat 1	50	40	8	12	12	12	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	24	4	8
Pulses (Lintel)	2.5	2	0.2	0.4	0.6	0.6	0.8	0.8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2
Oilseeds (Mustard)	27.5	22	2.2	4.4	6.6	6.6	6.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.2
Potato Winter 1	5	4	0.8	1.2	1.2	1.6	1.6	1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0.4	0.8
Vegetable Winter	2.5	2	0.4	0.4	0.6	0.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.2	0.2	0.2
Paddy Early 1	46.25	37	0	0	0	0	59.2	62.9	55.5	51.8	33.3	25.9	14.8	0	0	0	0	0	0	0	0	0	0	0	0	0
Maize	36.25	29	0	0	0	0	0	0	5.8	5.8	5.8	2.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Items	Coverage (%)	Area (ha)	Jan -1	Jan -2	Feb -1	Feb -2	Mar -1	Mar -2	Apr -1	Apr -2	May -1	May -2	Jun -1	Jun -2	Jul-1	Jul-2	Aug-1	Aug-2	Sep-1	Sep -2	Oct -1	Oct -2	Nov -1	Nov -2	Dec -1	Dec -2
Spring 2																										
Banana	3.75	3	0.6	0.6	0.9	0.9	1.5	1.5	1.8	1.5	1.2	0.6	0	0	0	0	0	0	0	0	0.3	0.9	0.9	0.9	0.6	0.6
Water Balance Calculation																										
Total Water Requirement (l/s)	270	216	12.2	19	21.9	22.3	77.7	66.4	63.1	59.1	40.3	29.4	14.8	45	0	0	7.5	0	0	15	45.3	15.9	0.9	25.5	5.2	12
Farm Application Efficiency (%)			60	60	60	60	60	60	60	60	60	60	60	80	80	80	80	80	80	60	60	60	60	60	60	60
Field Crop Water Requirement (l/s)			20.3	31.7	36.5	37.2	129.5	110.7	105.2	98.5	67.2	49	24.7	56.2	0	0	9.4	0	0	25	75.5	26.5	1.5	42.5	8.7	20
Distribution Canal Efficiency (%)			80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Terriary Head Water Requirement (l/s)			25.4	39.6	45.6	46.5	161.9	138.4	131.5	123.1	84	61.3	30.9	70.2	0	0	11.8	0	0	31.2	94.4	33.1	1.9	53.1	10.9	25
Main Canal Efficiency (%)			70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
Total Diversion Requirement (l/s)			36.3	56.6	65.1	66.4	231.3	197.7	187.9	175.9	120	87.6	44.1	100.3	0	0	16.9	0	0	44.6	134.9	47.3	2.7	75.9	15.6	35.7
Mean Monthly Flow (l/s)			1149.1	1044.2	934.8	857.3	816.2	775.2	747.8	766.1	843.6	2006.4	4259	7008.7	10246.3	12275.5	13100.9	12973.2	11906.2	9553.2	5918.9	3565.9	2489.8	1787.5	1459.2	1249.4
Water Balance (l/s)			1112.8	987.6	869.7	790.9	584.9	577.5	559.9	590.2	723.6	1918.8	4214.9	6908.4	10246.3	12275.5	13084	12973.2	11906.2	9508.6	5784	3518.6	2487.1	1711.6	1443.6	1213.7

Appendix 3: List of FMIS subprojects with Scope of Works

Hill - Bhojpur - Bhojpur Municipality
Simle Ghatte ISP (Priority 1a: Early Implementation)
CCA: 25.0 ha
Total Canal Length: 3000 m (Main), - (Branch)
Headworks/ Diversion Structures: Concrete weir
Canal Lining: 900.0 m
Outlets: 7.0
Super passage: 9.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 1.0
Culvert: 3.0

Hill - Bhojpur - Temkemaiyung
Hinkuwa Khola ISP (Priority 1b: Detail design phase)
CCA: 30.0 ha
Total Canal Length: 3050 m (Main), - (Branch)
Headworks/ Diversion Structures: RCC core wall
Canal Lining: 1700.0 m
Outlets: 13.0
Super passage: 11.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 1.0
VRB: 0.0
Culvert: 3.0

Hill - Bhojpur - Temkemaiyung Rural Municipality
Yangtang Khola Mailung Kulo ISP (Priority 1a: Early Implementation)
CCA: 45.0 ha
Total Canal Length: 3050 m (Main), - (Branch)
Headworks/ Diversion Structures: RCC cutoff wall
Canal Lining: 1500.0 m
Outlets: 21.0
Super passage: 8.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 10.0
VRB: 1.0
Culvert: 3.0

Hill - Dhankuta - Dhankuta Muncipality
Tin Dovane Kerabari ISP (Priority 1a: Early Implementation)
CCA: 98.0 ha
Total Canal Length: 3050 m (Main), - (Branch)
Headworks/ Diversion Structures: Bed Bar/Gabion protection Diversion
Canal Lining: 2722.0 m
Outlets: 7.0
Super passage: 14.0
Aqueduct: 1.0
HDPE Pipe Canal: 420.0 m
Drop Structure: 0.0
VRB: 3.0

Culvert: 3.0

Hill - Dhankuta - Mahalaxmi Municipality
Chayalu Laktang ISP (Priority 1b: Detail design phase)
CCA: 188.0 ha
Total Canal Length: - (Main), - (Branch)

Leguwa Khola ISP (Priority 1b: Detail design phase)
CCA: 250.0 ha

Hill - Dhankuta - Mahalaxmi Municipality
Birendra ISP (Priority 1a: Early Implementation)
CCA: 106.0 ha
Total Canal Length: 3050 m (Main), - (Branch)
Headworks/ Diversion Structures: Core wall with gabion protection
Canal Lining: 1550.0 m
Outlets: 11.0
Super passage: 10.0
Division Box: 1.0
HDPE Pipe Canal: 1695.0 m
VRB: 3.0
Culvert: 6.0

Hill - Ilam - Chulachuli RM
Nunsari ISP (Priority 1a: Early Implementation)
CCA: 91.0 ha
Total Canal Length: 3050 m (Main), 1900 m (Branch)
Headworks/ Diversion Structures: permanent
Canal Lining: 1600.0 m
Outlets: 6.0
Super passage: 3.0
Aqueduct: 3.0
Desilting Basin: 1.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 0.0
VRB: 4.0
Culvert: 15.0

Hill - Ilam - Deumai Municipality
Lewa Khola ISP (Priority 1a: Early Implementation)
CCA: 70.0 ha

Hill - Ilam - Fakfokathum Gaunpalika
Satake ISP (Priority 1b: Detail design phase)
CCA: 121.0 ha
Total Canal Length: 3050 m (Main), - (Branch)
Headworks/ Diversion Structures: No data
Canal Lining: 1390.0 m
Outlets: 7.0
Super passage: 10.0
Aqueduct: 1.0
Desilting Basin: 2.0
HDPE Pipe Canal: 0.0 m

Drop Structure: 5.0
VRB: 3.0
Culvert: 5.0

Hill - Ilam - Rong Rural Municipality
Mangaltar Dhansar ISP (Priority 1a: Early Implementation)
CCA: 95.0 ha
Total Canal Length: 3050 m (Main), - (Branch)
Headworks/ Diversion Structures: permanent
Canal Lining: 1387.0 m
Outlets: 7.0
Super passage: 3.0
Aqueduct: 5.0
Desilting Basin: 1.0
HDPE Pipe Canal: 4180.0 m
Drop Structure: 2.0
VRB: 1.0

Hill - Ilam - Suryodaya Municipality
Runsung ISP (Priority 1b: Detail design phase)
CCA: 70.0 ha

Hill - Kathmandu - Dakshinkali
Phaku Khola (Priority 1b: Detail design phase)
CCA: 30.0 ha
Total Canal Length: 1540 m (Main), - (Branch)
Headworks/ Diversion Structures: RCC Cutoff
Canal Lining: 840.0 m
Outlets: 7.0
Super passage: 4.0
Aqueduct: 30.0
Culvert: 1.0

Hill - Kathmandu - Sankharapur
Chisapani Laharedevi ISP (Priority 1a: Early Implementation)
CCA: 30.0 ha
Total Canal Length: 2700 m (Main), - (Branch)
Headworks/ Diversion Structures: Permanent diversion by construction RCC core wall
Canal Lining: 500.0 m
Outlets: 8.0
Super passage: 8.0
VRB: 1.0
Culvert: 0.0

Hill - Kathmandu - Shankharapur
Bishombhar (Priority 1a: Early Implementation)
CCA: 90.0 ha
Total Canal Length: 3700 m (Main), - (Branch)
Headworks/ Diversion Structures: -
Canal Lining: 1660.0 m
Outlets: 8.0
Super passage: 7.0
Aqueduct: 1.0
Culvert: 1.0

Hill - Kavre - Bhumlu RM
Salleni Khola Pahari Basti ISP (Priority 1b: Detail design phase)
CCA: 50.0 ha
Total Canal Length: 7200 m (Main), 3245 m (Branch)
Headworks/ Diversion Structures: Repair and Maintenance of existing diversion
Canal Lining: 1800.0 m
Outlets: 10.0
Super passage: 4.0
Desilting Basin: 1.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 1.0
VRB: 1.0
Culvert: 5.0

Hill - Kavre - Mandan Deupur
Muhane Mul Kulo ISP (Priority 1a: Early Implementation)
CCA: 65.0 ha
Total Canal Length: 7200 m (Main), 323 m (Branch)
Headworks/ Diversion Structures: Concrete core wall
Canal Lining: 2300.0 m
Outlets: 11.0
Super passage: 1.0
Aqueduct: 1.0
Desilting Basin: 1.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 1.0
VRB: 3.0
Culvert: 8.0

Hill - Kavre - Panchkhal
Barasai Saathi ISP (Priority 1a: Early Implementation)
CCA: 58.0 ha
Total Canal Length: 7200 m (Main), 3245 m (Branch)
Headworks/ Diversion Structures: RCC core wall
Canal Lining: 2475.0 m
Outlets: 14.0
Aqueduct: 3.0
Desilting Basin: 1.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 1.0
VRB: 5.0
Culvert: 5.0

Hill - Kavre - Panchkhal Municipality
Kumaitaar ISP (Priority 1b: Detail design phase)
CCA: 25.0 ha

Hill - Khotang - BarahaPokhari Rural Municipality
Lapuwa Khola ISP (Priority 1b: Detail design phase)
CCA: 85.0 ha
Total Canal Length: 2500 m (Main), - (Branch)

Headworks/ Diversion Structures: construction of core wall and side intake
Canal Lining: 3000.0 m
Outlets: 20.0
Super passage: 2.0
Aqueduct: 1.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 7.0
VRB: 5.0
Culvert: 6.0

Hill - Khotang - Diktel Rupakot Majhuwagadi
ChimChima Khola ISP (Priority 1b: Detail design phase)
CCA: 53.0 ha
Total Canal Length: 2500 m (Main), - (Branch)
Headworks/ Diversion Structures: Core wall and gabion
Canal Lining: 3000.0 m
Outlets: 20.0
Super passage: 2.0
Aqueduct: 1.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 7.0
VRB: 5.0
Culvert: 6.0

Hill - Khotang - Diprung Chuichumma RM
Kharuwa Khola Aek Chhahe ISP (4.69) (Priority 1a: Early Implementation)
CCA: 234.0 ha
Total Canal Length: 2500 m (Main), - (Branch)
Headworks/ Diversion Structures: A RCC Structure is required for the permanent diversion
Canal Lining: 4000.0 m
Outlets: 18.0
Super passage: 2.0
Aqueduct: 1.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 7.0
VRB and Culvert: 5.0 and 5.0

Hill - Khotang - Sakela Rural Municipality
Sabju Khola Bhalu Khola ISP (4.19) (Priority 1a: Early Implementation)
CCA: 86.0 ha
Total Canal Length: 2500 m (Main), - (Branch)
Headworks/ Diversion Structures: Core wall with gabion protection banks
Canal Lining: 2450.0 m
Outlets: 18.0
Super passage: 2.0
Aqueduct: 1.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 7.0
VRB: 5.0
Culvert: 5.0
Hill - Lalitpur - Godawari
Godavari (Right) Rajkulo ISP (Priority 1a: Early Implementation)
CCA: 80.0 ha

Total Canal Length: 3500 m (Main), - (Branch)
Headworks/ Diversion Structures: No data
Canal Lining: 1279.0 m
Outlets: 0.0
Desilting Basin: 1.0
Drop Structure: 5.0

Hill - Lalitpur - Paanchpokhari Thaangpal
Chimti (Priority 1b: Detail design phase)
CCA: 105.0 ha

Hill - Makwanpur - Bagmati RM
Bagmati ISP (Priority 1a: Early Implementation)
CCA: 75.0 ha
Total Canal Length: 4000 m (Main), - (Branch)
Headworks/ Diversion Structures: Temporary
Canal Lining: 2700.0 m
Outlets: 20.0
Super passage: 5.0
Drop Structure: 5.0
VRB: 4.0
Culvert: 12.0

Hill - Makwanpur - Bakaiya RM
Chyau Chyau ISP (Priority 1a: Early Implementation)
CCA: 80.0 ha
Total Canal Length: 4400 m (Main), - (Branch)
Headworks/ Diversion Structures: None
Canal Lining: 3098.0 m
Outlets: 20.0
Super passage: 4.0
Aqueduct: 2.0
Drop Structure: 5.0
Culvert: 12.0

Hill - Nuwakot - Bidur
Samari ISP (Priority 1a: Early Implementation)
CCA: 25.0 ha
Total Canal Length: 2051 m (Main), - (Branch)
Headworks/ Diversion Structures: concrete bed bar
Canal Lining: 364.0 m
Outlets: 6.0
Super passage: 1.0
VRB: 1.0

Hill - Nuwakot - Tadi RM
Dorkhu Khola ISP (Priority 1a: Early Implementation)
CCA: 40.0 ha
Total Canal Length: 1560 m (Main), 1148 m (Branch)
Headworks/ Diversion Structures: RCC Core Wall
Canal Lining: 945.0 m
Outlets: 3.0
Super passage: 2.0

Aqueduct: -
Desilting Basin: 1.0
VRB: 2.0
Culvert: 5.0

Hill - Okhaldhunga - Champadevi RM
Dhuseni Khola Kangrange Kolchaur Besi ISP (Priority 1a: Early Implementation)
CCA: 53.0 ha
Total Canal Length: 2500 m (Main), 1700 m (Branch)
Headworks/ Diversion Structures: Gabion Diversion
Canal Lining: 1100.0 m
Outlets: 16.0
Super passage: 6.0
Division Box: 1.0
HDPE Pipe Canal: 0.0 m
VRB: 3.0

Thotneri ISP (Priority 1b: Detail design phase)
CCA: 54.0 ha
Total Canal Length: 2500 m (Main), 1460 m (Branch)
Headworks/ Diversion Structures: Gabion work
Canal Lining: 1060.0 m
Outlets: 26.0
Super passage: 4.0
Desilting Basin: 1.0
Division Box: 4.0
VRB: 7.0

Hill - Okhaldhunga - Molung RM
Kul Khola ISP (Priority 1a: Early Implementation)
CCA: 50.0 ha
Total Canal Length: 3500 m (Main), 1225 m (Branch)
Headworks/ Diversion Structures: No
Canal Lining: 1300.0 m
Outlets: 15.0
Super passage: 4.0
Division Box: 2.0
HDPE Pipe Canal: 0.0 m
VRB: 3.0

Hill - Panchthar - Miklajung RM
Naya Kulo ISP (3.86) (Priority 1a: Early Implementation)
CCA: 115.0 ha
Total Canal Length: 4000 m (Main), - (Branch)
Headworks/ Diversion Structures: Weir Type
Canal Lining: 4000.0 m
Super passage: 8.0
Desilting Basin: 1.0
VRB: 2.0
Culvert: 11.0

Hill - Panchthar - Phidim
Khang Khola Tetire Bibire Falate Kulo ISP (Priority 1a: Early Implementation)

CCA: 110.0 ha
Total Canal Length: 4850 m (Main), - (Branch)
Headworks/ Diversion Structures: Gabion Weir
Canal Lining: 3200.0 m
Outlets: 7.0
Super passage: 9.0
VRB: 3.0
Culvert: 6.0

Hill - Sindhuli - Dudhauli Municipality
Purwari Pachiyari ISP (Priority 1a: Early Implementation)
CCA: 170.0 ha
Total Canal Length: 3108 m (Main), 5300 m (Branch)
Headworks/ Diversion Structures: RCC core wall
Canal Lining: 386.0 m
Outlets: 7.0
Desilting Basin: 1.0
Division Box: 9.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 3.0
VRB: 2.0
Culvert: 10.0

Hill - Sindhuli - Tinpatan
Sakhamadi Chadaha ISP (Priority 1a: Early Implementation)
CCA: 90.0 ha
Total Canal Length: 2800 m (Main), 2675 m (Branch)
Headworks/ Diversion Structures: RCC core wall
Canal Lining: 2580.0 m
Outlets: 10.0
Super passage: 1.0
Desilting Basin: 1.0
Division Box: 6.0
Drop Structure: 4.0
Culvert: 4.0

Hill - Terhathum - Chhathar RM
Teliya Khola ISP (Priority 1b: Detail design phase)
CCA: 150.0 ha
Total Canal Length: 4200 m (Main), - (Branch)
Headworks/ Diversion Structures: RCC core wall
Canal Lining: 1414.17 m
Outlets: 17.0
Super passage: 2.0
Aqueduct: -
Desilting Basin: 1.0
Division Box: -
HDPE Pipe Canal: 1471.0 m
Drop Structure: 12.0
VRB: 2.0
Culvert: 10.0

Hill - Terhathum - Laliguras RM

Lambu Kulo ISP (Priority 1a: Early Implementation)
CCA: 300.0 ha
Total Canal Length: 2500 m (Main), - (Branch)
Headworks/ Diversion Structures: No
Canal Lining: 3068.0 m
Outlets: 16.0
Super passage: 26.0
Aqueduct: 2.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 2.0
VRB: 5.0
Culvert: 12.0

Hill - Terhathum - Menchhayayem RM
Maynkhuwa Khola ISP (Priority 1b: Detail design phase)
CCA: 135.0 ha
Total Canal Length: 2500 m (Main), - (Branch)
Headworks/ Diversion Structures: RCC core wall
Canal Lining: 1057.62 m
Outlets: 13.0
HDPE Pipe Canal: 1381.0 m
Drop Structure: 37.0
VRB: 5.0
Culvert: 10.0

Guranse ISP (Priority 1b: Detail design phase)
CCA: 85.0 ha
Total Canal Length: 2500 m (Main), - (Branch)
Headworks/ Diversion Structures: Core wall
Canal Lining: 981.8 m
Outlets: 11.0
Super passage: 2.0
HDPE Pipe Canal: 2046.0 m
Drop Structure: 10.0
VRB: 2.0
Culvert: 8.0

Hill - Terhathum - Myanglung Municipality
Karange ISP (Priority 1a: Early Implementation)
CCA: 85.0 ha
Total Canal Length: 2500 m (Main), - (Branch)
Headworks/ Diversion Structures: RCC core wall
Canal Lining: 1680.45 m
Outlets: 13.0
Super passage: 5.0
HDPE Pipe Canal: 1136.3 m
Drop Structure: 25.0
VRB: 5.0
Culvert: 8.0

Hill - Udaypur - Katari
Beladaha ISP (Priority 1a: Early Implementation)
CCA: 105.0 ha

Total Canal Length: 2800 m (Main), 4445 m (Branch)
Headworks/ Diversion Structures: Double core wall with gabion protection
Canal Lining: 750.0 m
Outlets: 27.0
Aqueduct: 1.0
Division Box: 4.0
HDPE Pipe Canal: 0.0 m
VRB: 7.0

Hill - Udaypur - Triyuga N.P
Bablya Khola ISP (Priority 1b: Detail design phase)
CCA: 116.0 ha
Total Canal Length: 2800 m (Main), 4915 m (Branch)
Headworks/ Diversion Structures: double core wall with gabion protection
Canal Lining: 750.0 m
Outlets: 22.0
Division Box: 6.0
VRB: 12.0

Hill - Udaypur - Triyuga N.P.
Upper Baruwa ISP (Priority 1a: Early Implementation)
CCA: 215.0 ha
Total Canal Length: 2800 m (Main), 6350 m (Branch)
Headworks/ Diversion Structures: double core wall with gabion protection
Canal Lining: 2344.0 m
Outlets: 27.0
Super passage: 6.0
Division Box: 5.0
VRB: 22.0
Culvert: 1.0
Mountain - Dhading - Dhunibesi Municipality
Jhagadiya Sikre ISP (Priority 1a: Early Implementation)
CCA: 45.0 ha
Total Canal Length: 2800 m (Main), 390 m (Branch)
Headworks/ Diversion Structures: RCC Core Wall
Canal Lining: 1633.0 m
Super passage: 3.0
HDPE Pipe Canal: 50.0 m

Mountain - Dhading - Gajuri Rural Municipality
Parbang ISP (Priority 1b: Detail design phase)
CCA: 100.0 ha
Total Canal Length: 7200 m (Main), - (Branch)
Headworks/ Diversion Structures: Temporary
Canal Lining: 4030.0 m
Super passage: 10.0
Aqueduct: 2.0
VRB: 1.0

Dharmasala ISP (Priority 1b: Detail design phase)
CCA: 120.0 ha
Total Canal Length: 4800 m (Main), - (Branch)
Headworks/ Diversion Structures: RCC Core Wall

Canal Lining: 2479.0 m
Outlets: 3.0
Super passage: 11.0
Aqueduct: 2.0
HDPE Pipe Canal: 920.0 m
VRB: 8.0

Mountain - Dhading - Thakre RM
Sopyang Khola Gatta Ko Kulo ISP (Priority 1a: Early Implementation)
CCA: 50.0 ha
Total Canal Length: 2204 m (Main), - (Branch)
Headworks/ Diversion Structures: Single orifice side intake with corewall
Canal Lining: 1347.0 m
Super passage: 5.0
VRB: 2.0

Liti ISP (Priority 1b: Detail design phase)
CCA: 110.0 ha
Total Canal Length: 5700 m (Main), - (Branch)
Headworks/ Diversion Structures: Core wall
Canal Lining: 2380.0 m
Outlets: 12.0
Super passage: 9.0
Aqueduct: 1.0
VRB: 2.0

Mountain - Dolkha - Baiteshwor
Nimkot Besi ISP (Priority 1a: Early Implementation)
CCA: 50.0 ha
Total Canal Length: 2347 m (Main), 1500 m (Branch)
Headworks/ Diversion Structures: Core wall with side intake
Canal Lining: 1200.0 m
Outlets: 11.0
Super passage: 2.0
Desilting Basin: 1.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 11.0

Mountain - Dolkha - Melung RM
Nause Besi Kulo ISP (Priority 1a: Early Implementation)
CCA: 72.0 ha
Total Canal Length: 3212 m (Main), 1570 m (Branch)
Headworks/ Diversion Structures: Maintainance of existing gabion head wall orifice type side intake
Canal Lining: 1718.0 m
Outlets: 18.0
Super passage: 3.0
Desilting Basin: 1.0
HDPE Pipe Canal: 927.0 m
Drop Structure: 6.0

Mountain - Dolkha - Melung Rural Municipality
Ghyang Khola ISP (Priority 1b: Detail design phase)
CCA: 301.0 ha

Mountain - Rasuwa - Naukunda RM
Dhuple Khola ISP (Priority 1a: Early Implementation)
CCA: 35.0 ha
Total Canal Length: 1950 m (Main), 1250 m (Branch)
Canal Lining: 1132.0 m
Outlets: 6.0
Super passage: 4.0
HDPE Pipe Canal: 704.0 m
VRB: 1.0

Mountain - Sankhuwasabha - Dharmadevi Municipality
Kenwa Khola Fituwa Malibheg ISP (Priority 1a: Early Implementation)
CCA: 55.0 ha
Total Canal Length: 3300 m (Main), - (Branch)
Headworks/ Diversion Structures: -
Canal Lining: 1200.0 m
Outlets: 10.0
Super passage: 6.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 12.0
VRB: 1.0
Mountain - Sankhuwasabha - Khandbari Municipality
Pangma Khola Badreni ISP (Priority 1a: Early Implementation)
CCA: 41.0 ha
Total Canal Length: 5300 m (Main), - (Branch)
Headworks/ Diversion Structures: Gabion
Canal Lining: 1125.0 m
Desilting Basin: 1.0
VRB: 3.0

Mountain - Sankhuwasabha - Panchakhapan Municipality
Thado Khola (Priority 1b: Detail design phase)
CCA: 44.0 ha

Mountain - Sankhuwasabha - Savapokhari RM
Sang Khola (Priority 1b: Detail design phase)
CCA: 38.0 ha

Mountain - Sindhupalchowk - Chautara Sangachowgadi
Pokhre Tipling Khola Siran Kulo ISP (Priority 1a: Early Implementation)
CCA: 65.0 ha
Total Canal Length: 3065 m (Main), - (Branch)
Headworks/ Diversion Structures: Core wall
Canal Lining: 1750.0 m
Super passage: 2.0
Aqueduct: 1.0
HDPE Pipe Canal: 1219.0 m
VRB: 2.0

Mountain - Sindhupalchowk - Melamchi
Bimreni Dhunge ISP (Priority 1b: Detail design phase)
CCA: 66.0 ha

Total Canal Length: 2800 m (Main), - (Branch)
Headworks/ Diversion Structures: Corewall with Side Intake
Canal Lining: 1450.0 m
Super passage: 8.0
HDPE Pipe Canal: 52.0 m

Mountain - Sindhupalchowk - Paanchpokhari Thaangpal
Mahadev Khola Sisneghari Dittiya ISP (Priority 1a: Early Implementation)
CCA: 76.0 ha
Total Canal Length: 2250 m (Main), - (Branch)
Headworks/ Diversion Structures: None
Canal Lining: 1885.0 m
Super passage: 5.0
HDPE Pipe Canal: 184.0 m

Mountain - Taplejung - Aatharai Tribeni Gaunpalika
Chuwa ISP (Priority 1b: Detail design phase)
CCA: 90.0 ha
Total Canal Length: - (Main), - (Branch)
Headworks/ Diversion Structures: -
Canal Lining: 3435.0 m
Outlets: 25.0
Super passage: 4.0, VRB: 1.0, Culvert: 1.0

Mountain - Taplejung - Pathibhara Yangbarak RM
Khokse -gkholyang ISP (Priority 1a: Early Implementation)
CCA: 63.0 ha
Total Canal Length: 2421 m (Main), - (Branch)
Headworks/ Diversion Structures: Corewall
Canal Lining: 1496.0 m
Outlets: 6.0
Pipe Canal: 655.0 m

Mountain - Taplejung - Sirijangha RM
Nebu Khola ISP (Priority 1a: Early Implementation)
CCA: 87.0 ha
Total Canal Length: - (Main), - (Branch)
Headworks/ Diversion Structures: Corewall including gabion
Canal Lining: 1296.0 m
Outlets: 12.0
Desilting Basin: 1.0
VRB: 1.0
Pipe Canal: 2330.0 m

Major Singh ISP (Priority 1b: Detail design phase)
CCA: 66.7 ha
Total Canal Length: - (Main), - (Branch)
Headworks/ Diversion Structures: Core wall
Canal Lining: 1200.0 m
Outlets: 5.0
Super passage: 3.0
VRB: 2.0
Culvert: 4.0

Pipe Canal: 1250.0 m

Terai - Bara - Karaiyamai RM
Bhaluhi Suklaiya Patti (Priority 1a: Early Implementation)
CCA: 360.0 ha
Total Canal Length: 8600 m (Main), 3600 m (Branch)
Headworks/ Diversion Structures: RCC diversion weir with gated type undersluice
Canal Lining: 300.0 m

Terai - Bara - Mahagadhimai Municipality
Jokaha Dora ISP (Priority 1a: Early Implementation)
CCA: 300.0 ha
Total Canal Length: 5400 m (Main), 4450 m (Branch)
Headworks/ Diversion Structures: RCC diversion weir with gated type undersluice
Canal Lining: 300.0 m
Outlets: 10.0
Drop Structure: 3.0
VRB: 7.0

Terai - Chitwan - Kalika Municipality
Majuwa ISP (Priority 1a: Early Implementation)
CCA: 45.0 ha
Total Canal Length: 4000 m (Main), 1135 m (Branch)
Headworks/ Diversion Structures: Concrete core wall
Canal Lining: 550.0 m
Outlets: 8.0
Desilting Basin: 1.0
VRB: 3.0
Culvert: 4.0

Terai - Chitwan - Ratnanagar
Tarauli ISP (Priority 1b: Detail design phase)
CCA: 80.0 ha
Total Canal Length: 3550 m (Main), 2850 m (Branch)
Headworks/ Diversion Structures: Intake core wall (permanent structure)
Canal Lining: 1250.0 m
Outlets: 12.0
Desilting Basin: 1.0
VRB: 4.0
Culvert: 4.0

Terai - Dhanusha - Bideha
Soharna ISP (Priority 1a: Early Implementation)
CCA: 430.0 ha
Total Canal Length: 5850 m (Main), 1900 m (Branch)
Headworks/ Diversion Structures: Weir
Canal Lining: 600.0 m
Outlets: 0.0
Division Box: 3.0
VRB: 4.0

Bachharaja ISP (Priority 1a: Early Implementation)
CCA: 325.0 ha

Total Canal Length: 2808 m (Main), 967 m (Branch)
Headworks/ Diversion Structures: Weir
Canal Lining: 100.0 m
Outlets: 4.0
Division Box: 1.0
HDPE Pipe Canal: 0.0 m
VRB: 3.0

Terai - Dhanusha - Kamla
Let ISP (Priority 1b: Detail design phase)
CCA: 250.0 ha
Total Canal Length: 3521 m (Main), 4310 m (Branch)
Headworks/ Diversion Structures: Weir
Canal Lining: 400.0 m, Outlets: 0.0. , Division Box: 4.0, VRB: 2.0, Culvert: 0.0
Terai - Jhapa - Arjundhara Municipality
Haldar Paini ISP (Priority 1a: Early Implementation)
CCA: 250.0 ha
Total Canal Length: 2800 m (Main), 2051 m (Branch)
Headworks/ Diversion Structures: Weir
Canal Lining: 1050.0 m, Outlets: 6.0, Division Box: 9.0, HDPE Pipe Canal: 0.0 m, VRB: 21.0, Culvert: 5.0

Terai - Jhapa - Mechinagar Municipality
Hadiya Khola Abi Nahar ISP (Priority 1a: Early Implementation)
CCA: 265.0 ha
Total Canal Length: 2800 m (Main), 1500 m (Branch)
Headworks/ Diversion Structures: Low height weir
Canal Lining: 1800.0 m
Outlets: 10.0, Super passage: 1.0. Division Box: 5.0, VRB: 10.0, Culvert: 20.0
Pathivara Krishi (Priority 1b: Detail design phase)
CCA: 165.0 ha
Total Canal Length: 3370 m (Main), 2650 m (Branch)
Headworks/ Diversion Structures: Weir cum Undersluice
Canal Lining: 75.0 m
Outlets: 12.0
VRB: 5.0

Terai - Mahottari - Balawa Municipality
Chakkarghatta ISP (Priority 1a: Early Implementation)
CCA: 670.0 ha
Total Canal Length: 4300 m (Main), 2600 m (Branch)
Headworks/ Diversion Structures: Weir structure
Canal Lining: 100.0 m
Outlets: 4.0
Division Box: 2.0
VRB: 6.0

Rato Bhagwatipur ISP (Priority 1b: Detail design phase)
CCA: 515.0 ha
Total Canal Length: 7900 m (Main), 0 m (Branch)
Headworks/ Diversion Structures: Permanent Concrete Weir
Canal Lining: 1000.0 m
Outlets: 10.0

Aqueduct: 3.0
Division Box: 1.0
VRB: 5.0

Terai - Mahottari - Bhangaha
Ladakawa ISP (Priority 1a: Early Implementation)
CCA: 345.0 ha
Total Canal Length: 2800 m (Main), 3200 m (Branch)
Headworks/ Diversion Structures: Need headwork structure
Canal Lining: 400.0 m
Outlets: 10.0
Division Box: 3.0
VRB: 8.0

Terai - Mahottari - Loharpattei and Jaleshwor NP
Rato Kokila ISP (Priority 1b: Detail design phase)
CCA: 1120.0 ha
Total Canal Length: 4270 m (Main), 550 m (Branch)
Headworks/ Diversion Structures: -
Canal Lining: 100.0 m
Outlets: 6.0
Division Box: 1.0
VRB: 4.0

Terai - Morang - Kerabari RM
Sira Jimdari ISP (Priority 1b: Detail design phase)
CCA: 300.0 ha
Total Canal Length: 4100 m (Main), 10200 m (Branch)
Headworks/ Diversion Structures: None
Canal Lining: 4025.0 m
Super passage: 1.0
Division Box: 3.0
Drop Structure: 18.0
VRB: 6.0

Terai - Morang - Letang Municipality
Bhuwa ISP (Priority 1b: Detail design phase)
CCA: 225.0 ha

Terai - Morang - Pathari Sanischare Municipality
Indreni ISP (Priority 1b: Detail design phase)
CCA: 200.0 ha

Terai - Morang - Pathri Sanischare
Adarsa Paini ISP (Priority 1a: Early Implementation)
CCA: 230.0 ha
Total Canal Length: 2300 m (Main), 6100 m (Branch)
Headworks/ Diversion Structures: Major rehab of concrete weir
Canal Lining: 1830.0 m
Division Box: 5.0
VRB: 2.0

Terai - Morang - Sunbarshi Municipality

Sita Dans Kerkha ISP (Priority 1a: Early Implementation)
CCA: 370.0 ha
Total Canal Length: 7300 m (Main), 4850 m (Branch)
Headworks/ Diversion Structures: Headwork
Canal Lining: 700.0 m, Division Box: 3.0, Drop Structure: 3.0, VRB: 4.0
Terai - Parsa - Jagarnathpur
Oriya (Priority 1b: Detail design phase)
CCA: 145.0 ha

Terai - Parsa - Jagarnathpur RM
Hadahi ISP (Priority 1a: Early Implementation)
CCA: 275.0 ha
Total Canal Length: 5000 m (Main), 3130 m (Branch)
Headworks/ Diversion Structures: Weir
Canal Lining: 300.0 m, Outlets: 20.0, Division Box: 2.0, Culvert: 8.0
Terai - Parsa - Parsagadhi
Megha (Priority 1b: Detail design phase)
CCA: 200.0 ha

Terai - Parsa - Paterwa sugauli RM
Gadi ISP (Priority 1a: Early Implementation)
CCA: 280.0 ha
Total Canal Length: 4230 m (Main), 3245 m (Branch)
Headworks/ Diversion Structures: Headworks
Canal Lining: 300.0 m
Drop Structure: 4.0
VRB: 5.0

Terai - Rauthat - Fatuwa Bijaypur
Aruwa Aknowa ISP (Priority 1b: Detail design phase)
CCA: 264.0 ha

Terai - Rauthat - Garuda
Dorapaini Raghunathpur ISP (Priority 1a: Early Implementation)
CCA: 255.0 ha
Total Canal Length: 4060 m (Main), 1270 m (Branch)
Headworks/ Diversion Structures: Yes
Canal Lining: 500.0 m
Outlets: 7.0, Division Box: 1.0, VRB: 7.0

Terai - Rauthat - Phatuwa, Bijayapur
Aruwa Khola ISP (Priority 1a: Early Implementation)
CCA: 430.0 ha
Total Canal Length: 2870 m (Main), 1240 m (Branch)
Canal Lining: 362.0 m
Outlets: 0.0
VRB: 10.0

Terai - Saptari - Dakneswari
Kajra ISP (Priority 1a: Early Implementation)
CCA: 400.0 ha
Total Canal Length: 3950 m (Main), - (Branch)
Headworks/ Diversion Structures: New RCC Weir

Canal Lining: 200.0 m
Outlets: 10.0
HDPE Pipe Canal: 0.0 m
Drop Structure: 1.0
Culvert: 1.0

Terai - Saptari - Mahadeva RM
Jita Khola ISP (Priority 1a: Early Implementation)
CCA: 227.0 ha
Total Canal Length: 4000 m (Main), 3245 m (Branch)
Headworks/ Diversion Structures: Weir
Canal Lining: 300.0 m
Outlets: 2.0
Division Box: 1.0, VRB: 1.0
Terai - Sarlahi - Bansbariya RM
Laukat Dhangada ISP (Priority 1a: Early Implementation)
CCA: 375.0 ha
Total Canal Length: 5227 m (Main), 7500 m (Branch)
Headworks/ Diversion Structures: Leakage through masonry abutment, retrofitting of headwork
Canal Lining: 1635.0 m
Outlets: 12.0

Terai - Sarlahi - Haripurwa
Haripurwa ISP (Priority 1a: Early Implementation)
CCA: 414.0 ha
Total Canal Length: 3650 m (Main), 800 m (Branch)
Headworks/ Diversion Structures: -
Canal Lining: 1595.0 m
Outlets: 38.0

Terai - Sirha - Laxmipur patari
Baburam (Priority 1b: Detail design phase)
CCA: 400.0 ha

Saraswati (Priority 1b: Detail design phase)
CCA: 276.0 ha

Terai - Sirha - Sukhipur-8,10, 6 & 4
Gagan ISP (Priority 1a: Early Implementation)
CCA: 835.0 ha
Total Canal Length: 6000 m (Main), 9950 m (Branch)
Headworks/ Diversion Structures: Weir system
Canal Lining: 655.0 m
Outlets: 39.0, Aqueduct: 1.0, Division Box: 4.0, Culvert: 35.0

Terai - Sunsari - Itahari
Tengra Khola Sera Bandh ISP (Priority 1a: Early Implementation)
CCA: 220.0 ha
Total Canal Length: 2500 m (Main), - (Branch)
Headworks/ Diversion Structures: -
Canal Lining: 2300.0 m
Outlets: 6.0
Drop Structure: 1.0

VRB: 0.0
Culvert: 4.0

Terai - Sunsari - Ramdhuni
Kajara Khola Kataghara Bandh ISP (Priority 1a: Early Implementation)
CCA: 131.0 ha
Total Canal Length: 1950 m (Main), 1200 m (Branch)
Headworks/ Diversion Structures: Weir construction
Canal Lining: 2450.0 m
Outlets: 6.0
Desilting Basin: 2.0
Division Box: 5.0, VRB: 3.0, Culvert: 15.0

Shankar Beli (Priority 1b: Detail design phase)
CCA: 72.0 ha
Total Canal Length: 2800 m (Main), 2255 m (Branch)
Headworks/ Diversion Structures: Concrete Core wall with Guide Bund
Canal Lining: 2070.0 m
Outlets: 3.0
Super passage: 2.0
Desilting Basin: 1.0
Division Box: 3.0
VRB: 8.0
Culvert: 5.0

Appendix 4: Population in FMIS Sites

S.N.	District	Name of ISP	Households	Male population	Female population	Total population
1	Bara	Jokaha Dora ISP	600	1600	1900	3500
2	Bara	Bhaluhi Suklaiya Patti	700	1440	1560	3000
3	Mahottari	Rato Bhagwatipur ISP	560	1450	1650	3100
4	Mahottari	Ladakawa ISP	290	1015	1085	2100
5	Mahottari	Chakkarghatta ISP	750	3050	3150	6200
6	Mahottari	Rato Kokila ISP	2500	5800	6200	12000
7	Sirha	Gagan ISP	415	1050	1150	2200
8	Sirha	Baburam ISP	380	854	1155	2009
9	Sirha	Saraswati ISP	240	726	774	1500
10	Sarlahi	Haripurwa ISP	400	1050	1000	2050
11	Sarlahi	Laukat Dhangada ISP	450	1542	1608	3150
12	Rauthat	Dorapaini Raghunathpur ISP	350	900	850	1750
13	Rauthat	Aruwa Khola ISP	300	520	580	1100
14	Rauthat	Aruwa Aknowa ISP	138	497	503	1000
15	Dhanusha	Soharna ISP	400	1180	820	2000
16	Dhanusha	Bachharaja ISP	350	900	850	1750
17	Dhanusha	Let ISP	300	815	685	1500
18	Parsa	Hadahi ISP	180	555	469	1024
19	Parsa	Gadi ISP	114	315	323	638
20	Parsa	Oriya ISP	292	876	832	1708
21	Parsa	Megha ISP	150	505	495	1000
22	Saptari	Kajra ISP	450	1130	1120	2250
23	Saptari	Jita Khola ISP	900	2220	2180	4400
24	Dhading	Sopyang Khola Gatta Ko Kulo ISP	123	538	578	1116
25	Dhading	Jhagadiya Sikre ISP	245	723	747	1470
26	Dhading	Parbang ISP	236	493	495	988
27	Dhading	Liti ISP	130	451	450	901
28	Dhading	Dharmasala ISP	243	1032	1118	2150
29	Dolkha	Nimkot Besi ISP	300	950	1050	2000
30	Dolkha	Nause Besi Kulo ISP	310	690	810	1500
31	Dolkha	Ghyang Khola ISP	310	710	791	1500
32	Kavre	Barasai Saathi ISP	315	850	950	1800
33	Kavre	Salleni Khola Pahari Basti ISP	180	802	818	1620
34	Kavre	Muhane Mul Kulo ISP	200	396	404	800
35	Kavre	Kumaitaar ISP	200	391	405	796
36	Sindhuli	Purwari Pachiyari ISP	265	775	895	1670
37	Sindhuli	Sakhamadi Chadaha ISP	288	790	1027	1817
38	Sindhupalchowk	Pokhre Tipling Khola Siran Kulo ISP	147	335	394	729
39	Sindhupalchowk	Mahadev Khola Sisneghari Dittiya ISP	162	437	481	918
40	Sindhupalchowk	Bimreni Dhunge ISP	320	753	797	1550
41	Lalitpur	Godawari Rajkulo ISP	300	689	711	1400
42	Sindhupalchowk	Chimti ISP	287	559	546	1105
43	Makwanpur	Chyau Chyau ISP	130	426	434	860
44	Makwanpur	Bagmati ISP	263	656	659	1315
45	Chitwan	Majuwa ISP	132	431	472	903
46	Chitwan	Tarauli ISP	170	473	492	965
47	Rasuwa	Dhuple Khola ISP	115	345	330	675
48	Nuwakot	Samari ISP	141	339	366	705
49	Nuwakot	Dorkhu Khola ISP	45	151	164	315
50	Kathmandu	Phaku Khola ISP	160	240	260	500

51	Kathmandu	Bishombhar	425	925	1200	2125
52	Kathmandu	Chisapani Laharedevi ISP	170	414	436	850
53	Bhojpur	Simle Ghatte ISP	69	215	185	400
54	Bhojpur	Yangtang Khola Mailung Kulo ISP	72	170	184	354
55	Bhojpur	Hinkuwa Khola ISP	57	144	144	288
56	Dhankuta	Birendra ISP	93	275	294	569
57	Dhankuta	Tin Dovane Kerabari ISP	75	271	240	511
58	Dhankuta	Chayalu Laktang ISP	144	289	301	590
59	Dhankuta	Leguwa Khola ISP	362	887	923	1810
60	Ilam	Mangaltar Dhansar ISP	100	216	263	479
61	Ilam	Satake ISP	185	714	796	1510
62	Ilam	Nunsari ISP	204	613	465	1078
63	Ilam	Lewa Khola ISP	52	135	163	298
64	Ilam	Runsung ISP	92	220	258	478
65	Morang	Sita Dans Kerkha ISP	406	920	1181	2101
66	Morang	Sira Jimdari ISP	810	1778	2135	3913
67	Morang	Adarsa Paini ISP	355	1164	1131	2295
68	Morang	Bhuwa ISP	851	1898	2114	4012
69	Morang	Indreni ISP	253	714	808	1522
70	Okhaldhunga	Dhuseni Khola Kangrange Kolchaur Besi ISP	85	259	239	498
71	Okhaldhunga	Kul Khola ISP	147	354	330	684
72	Okhaldhunga	Thotneri ISP	113	252	242	494
73	Panchthar	Khang Khola Tetire Bibire Falate Kulo ISP	147	512	500	1012
74	Panchthar	Naya Kulo ISP	130	207	218	425
75	Sankhuwasabha	Pangma Khola Badreni ISP	46	145	155	300
76	Sankhuwasabha	Kenwa Khola Fituwa Malibheg ISP	67	133	142	275
77	Sankhuwasabha	Thado Khola ISP	44	115	120	235
78	Sankhuwasabha	Sang Khola ISP	47	63	125	188
79	Taplejung	Nebu Khola ISP	95	252	242	494
80	Taplejung	Khokse Nangkholyang ISP	40	88	87	174
81	Taplejung	Major Singh ISP	46	100	103	204
82	Taplejung	Chuwa ISP	57	175	172	347
83	Terhathum	Lambu Kulo ISP	294	641	741	1382
84	Terhathum	Maynkhuwa Khola ISP	102	249	287	536
85	Terhathum	Teliya Khola ISP	217	531	597	1128
86	Terhathum	Guranse ISP	77	219	247	466
87	Terhathum	Karange ISP	130	325	343	668
88	Khotang	Sabju Khola Bhalu Khola ISP	157	200	250	450
89	Khotang	Kharuwa Khola Aek Chhahe ISP	200	471	469	940
90	Khotang	ChimChima Khola ISP	200	500	500	1000
91	Khotang	Lapuwa Khola ISP	60	140	160	300
92	Sunsari	Kajara Khola Kataghara Bandh ISP	157	245	265	510
93	Sunsari	Shankar Beli	101	305	314	619
94	Sunsari	Tengra Khola Sera Bandh ISP	327	801	840	1641
95	Udaypur	Beladaha ISP	250	550	700	1250
96	Udaypur	Upper Baruwa ISP	321	1253	452	1705
97	Udaypur	Bablya Khola ISP	199	470	525	995
98	Jhapa	Haldar Paini ISP	389	1046	1098	2144
99	Jhapa	Hadiya Khola Abi Nahar ISP	238	561	530	1091
100	Jhapa	Pathivara Krishi Kulo	222	504	549	1053
		Total	26,406	69,044	72,346	141,390

Source: SPPR/DDR and project reports: 2022-2023

Appendix 5: Sample Environmental Site Inspection Report

Project Name
Contract Number

NAME: _____ DATE: _____

TITLE: _____ DMA: _____
LOCATION: _____ GROUP: _____

WEATHER:

Project Activity Stage	Survey	
	Design	
	Implementation	
	Pre-Commissioning	
	Guarantee Period	

MONITORING ITEMS	COMPLIANCE
Compliance marked as Yes / No / Not applicable (NA) / Partially Implemented (PI)	
EHS officers/supervisors appointed by the contractor and available on-site	
Construction site management plan (spoils, safety, schedule, equipment etc.,) prepared	
Traffic management plan prepared	
Dust is under control	
Excavated soil properly placed within minimum space	
Construction area is confined; no traffic/pedestrian entry observed	
Surplus soil/debris/waste is disposed of without delay	
Construction material (sand/gravel/aggregate) brought to site as & when required only	
Tarpaulins used to cover sand & other loose material when transported by vehicles	
After unloading, wheels & undercarriage of vehicles cleaned prior to leaving the site	
No chance finds encountered during excavation	
Work is planned in consultation with traffic police	
Work is not being conducted during heavy traffic	
Work at a stretch is completed within a day (excavation, pipe laying & backfilling)	
Pipe trenches are not kept open unduly	
Road is not completely closed; work is conducted on edge; at least one line is kept open	
Road is closed; alternative route provided & public informed, information board provided	
Pedestrian access to houses is not blocked due to pipe laying	
Spaces left in between trenches for access	
Wooden planks/metal sheets provided across trench for pedestrian	
No public/unauthorized entry observed in work site	

MONITORING ITEMS	COMPLIANCE
Children safety measures (barricades, security) in place at works in residential areas	
Prior public information provided about the work, schedule and disturbances	
Caution/warning board provided on site	
Guards with red flag provided during work at busy roads	
Workers using appropriate PPE (boots, gloves, helmets, earmuffs etc.)	
Workers conducting or near heavy noise work is provided with earmuffs	
Contractor is following standard & safe construction practices	
Deep excavation is conducted with land slip/protection measures	
First aid facilities are available on site and workers informed	
Drinking water provided at the site	
Toilet facility provided at the site	
Separate toilet facility is provided for women workers	
Workers camps are maintained cleanly	
Adequate toilet & bath facilities provided	
Contractor employed local workers as far as possible	
Worker's camp set up with the permission of PMU	
Adequate housing provided	
Sufficient water provided for drinking/washing/bath	
No noisy work is conducted in the nights	
Local people informed of noisy work	
No blasting activity conducted	
Pneumatic drills or other equipment creating vibration is not used near old/risky	

Signature

_____

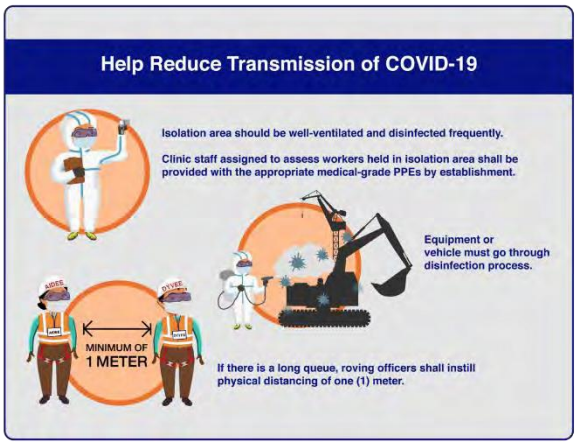
Sign off

_____ _____

Name **Name**
Position **Position**

Appendix 6: COVID-19 Guideline

A. PREPARATION BEFORE WORK



- The worksite and camp will be secured with a gated fence
- A Photo Identity Card will be issued to all workers with a unique identification number
- Preparation will be made for daily medical screening (thermal check and symptoms assessment) of all workers and report to H&SO
- COVID Marshal will measure temperature by wearing a facemask and gloves for their gang of workers before leaving the camp
- Workers with high fever and frequent cough will not be allowed to work. The worker will be asked to stay in quarantine (for residential workers) or sent back home (for non-residential workers).

COVID-19 लक्षणहरू		
सबैभन्दासामान्यलक्षणहरू: – ज्वरोआउने – सुक्खाखोकीलाग्ने – थकाइलाग्ने	**सामान्यतयाकमैदेखिनेलक्षणहरू:** – पीडाहुनेवादुख्ने – घाँटीदुख्ने – पखालालाग्ने – आँखापोल्ने – टाउकोदुख्ने – स्वादवागन्धथाहानहुने – छालामादागहुनेवाहातवाखुट्टाकाऔँलाकोरङउड्ने	**गम्भीरलक्षणहरू:** – सासफेर्नगाह्रोहुनेवापटकपटकसासफेर्नुपर्ने – छातीदुख्नेवाछातीमादबाबपर्ने – बोल्नवाहिँडडुलगर्ननसक्ने –
तपाईंमागम्भीरलक्षणहरुदेखिएमातुरुन्तैचिकित्साजाँचगराउनुहोस्। जहिलेपनिआफ्नोडाक्टरवास्वास्थ्यसुविधाप्रदायककहाँजानुअघिकलगर्नुहोस्		

- COVID Test (PCR Test) will be conducted for the staff and workers who have the symptoms related to COVID-19 (if required)
- Register records will be maintained
- Quarantine and isolation tents will be established at sufficient distance in the camp from regular shelters
- Specific and separate worksites will be assigned to the new group of workers away from regular workers for a minimum of 14 days to minimize risk
- Work will be arranged in shifts to avoid crowding of workers. Teams will be divided based on (i) workers residing in the same camp (ii) workers residing outside the camp (iii) a new group of workers, etc.
- Consumption of liquor and chewable like Khaini, Surti, Paan,

etc. (those generating the urge for frequent spitting) will be strictly restricted inside office and work areas

B. PROCEDURE AT ENTRY

- Guards will be oriented by the H&SO on (i) checking temperature, (ii) observing health symptoms, (iii) recording personal details and travel history, and (iv) taking emergency procedures, if required
- Unauthorized persons and visitors will not be allowed to enter
- All new groups of workers will be allowed to enter the site only after showing a COVID Test certificate from an authorized government hospital issued within the last 7 days, which the Assistant Health Worker will check at the Medical Center
- Guards will wear prescribed PPEs at all times and regularly disinfect their hand
- Visitors having COVID symptoms will be sent back, and immediately call HW from the Medical Center for staff and workers showing symptoms
- Personnel should maintain a distance of 1 meter at all times following the floor-marking wherever queue is required
- Guard will direct vehicles supplying materials to the delivery zone
- The guard will inform the visitors about fulltime use of masks and hand washing/sanitizing

C. MINIMIZEWORKER AND COMMUNITY CONTACT

The Contractor will be fully responsible for ensuring taking all preventive measures and safety precautions for COVID-19 risks such as the following:

- The Project Manager will work closely with the Site in-Charge and Resident Engineer to plan special measures and expedite work implementation at high-risk areas and areas requiring work in close proximity to the communities
- Physical barricades will be made mandatory to separate and minimize contact between workers and local people
- Arrangements will be made to minimize movement of workers from barricaded work areas and camps and visiting settlement areas
- Work sites will be separated into working zones to keep the groups of workers physically separated. Not more than 20 workers will be allowed to work in one group. A group leader will be identified as a COVID Marshal and given orientation to keep close watch on workers and trigger emergency protocol in emergency case
- Emphasis will be given to establishing a sufficient size of labor camp to keep all workers inside the camp to minimize contact with the community.

D. TRAVEL TO WORK SITE

The workers will observe precautions and the contractor will arrange the following measures for arranging transport for workers to the worksite:

- Travel between sites and labor camps will be arranged through the official vehicle
- All workers will wear facemasks when travelling in a shared vehicle, including the driver,

who will wear a mask and glove

- Driver will sanitize had regularly and before & after every trip
- Only 40% capacity of the vehicle will be used, and a seat will be kept empty between passengers
- Windows will be opened for natural ventilation
- Workers will stay facing away from each other while in the vehicle
- Vehicle will be cleaned and disinfected thoroughly after every shift- with emphasis on handles, steering wheel, gear, etc.
- All workers, prior to entering the vehicle and exiting, will sanitize their hands
- Prior to entering the vehicles, all nonresidential staff and workers must self-certify that they do not have any COVID-19 symptoms.

Appendix 7: Sample Grievance Registration Form

(To be available in Nepali and English)

The _____Project welcomes complaints, suggestions, queries, and comments regarding project implementation. We encourage persons with grievance to provide their name and contact information to enable us to get in touch with you for clarification and feedback.
Should you choose to include your personal details but want that information to remain confidential, please inform us by writing/typing *(CONFIDENTIAL)* above your name. Thank you.

Date	Place of registration	Project Town Project:			
Contact information/personal details					
Name		Gender	* Male * Female	Age	
Home address					
Place					
Phone no.					
E-mail					
Complaint/suggestion/comment/question Please provide the details (who, what, where, and how) of your grievance below: If included as attachment/note/letter, please tick here:					
How do you want us to reach you for feedback or update on your comment/grievance?					

FOR OFFICIAL USE ONLY

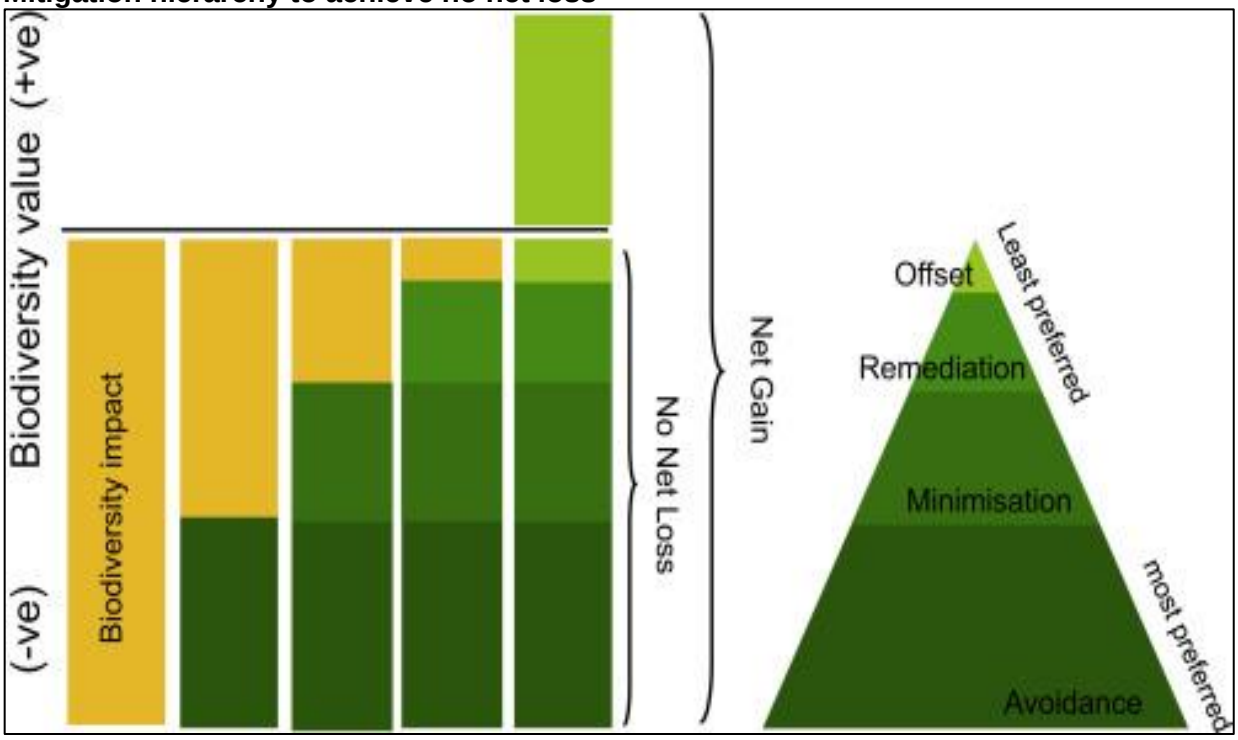
Registered by: (Name of official registering grievance)		
Mode of communication: Note/letter E-mail Verbal/telephonic		
Reviewed by: (Names/positions of officials reviewing grievance)		
Action taken:		
Whether action taken disclosed:	Yes	No
Means of disclosure:		

Appendix 8: Biodiversity Action Plan (BAP)

This section presents the BAP, which outlines the mitigation measures/actions to ensure that the FMIS components have no significant adverse impact on wildlife and no net loss in biodiversity and comply with requirements in accordance with government rules and ADB's Safeguards Policy Statement 2009.

Conservation measures (i.e., prevent, minimize, mitigate/remediate, and compensate/offset) are created to guarantee the application of the mitigation hierarchy and address concerns about biodiversity characteristics as a consequence of the proposed works and operations. Below is an outline of the mitigation hierarchy concept. This will protect the integrity, health, and function of the ecological system and biodiversity characteristics while enabling rigorous risk management and the best potential results for the subproject.

Mitigation hierarchy to achieve no net loss[21]



Following are the action plans proposed for FMIS inside KBAs and Buffer Zones:

1. **Actions to avoid, minimize and/or remediate loss/degradation of habitats during construction**
    - WRIDD and community organizers, with guidance from PIMs, will gather data on wildlife populations, habitat conditions, and biodiversity in the construction sites prior to works. (minimization)

[21] Figure is sourced from "Net Gain: Seeking Better Outcomes for Local People when Mitigating Biodiversity Loss from Development. One Earth,Volume 1, Issue 2. 195-20" by Jones, J. P. G. and et. al. (2019).

- Community contractors will reach out to local communities and stakeholders and incorporate feedback in preparing the CEMP. (minimization)
- Community contractors will employ local wildlife spotters to monitor and guide construction activities to protect animals in the KBAs and buffer zone. (minimization)
- Community contractors will mark the construction site's boundaries and disseminate information about civil work areas to construction staff and laborers. (avoidance)
- WRIDD will instruct contractors that they are only authorized to cut or clear any vegetation within the designated clearing limits with permission from government authority. (minimization)
- Tree cutting shall be avoided for the establishment of a labor camp, material storage site, and transferring of any machinery, equipment, and vehicles at the subproject site. (avoidance)
- No objection clearance (NOC) for tree cutting to be obtained by the WRIDD before construction. (minimization)
- Community contractors will prohibit collection of firewood, plants, etc., to minimize the impact on natural habitats. (minimization)
- Community contractors will select suitable areas for material storage, quarries, borrow areas spoil/muck disposal areas, construction laydown areas, access roads, and other facilities to minimize forest clearing and environmental impacts. The locations for material storage, quarrying areas, spoil deposits, muck disposal, construction laydown areas, roads, and others have all been selected based on the minimum likely ecological and environmental impacts. (minimization)
- The movement of contractor vehicles across the subproject areas will be strictly monitored, and drivers will be required to use designated roads only. (avoidance)
- All construction staff should be informed about the importance of stream/river habitat and the importance of wildlife. WRIDD and community organizers will prepare and give information as part of the staff inductions. (minimization)
- The contractor will ensure complete prohibition of fishing and hunting activities. (avoidance)
- Speed limits will be imposed, which should also minimize the dust levels. Off-road vehicle movements can cause habitat degradation and loss. Limit speeds for construction vehicles to 30 km/hr to minimize the generation of fugitive dust and to minimize the risk of wildlife strikes. All construction vehicles will be limited to designated access roads, and construction sites with no off-road vehicle use will be permitted. (minimization)
- When there are trees removed, contractor will replace enough trees and species as per the rule of Nepal. (remediation)

2. Additional mitigation measures for the protection of species

- This will involve an awareness program for community contractors from WRIDD and community organizers on the conservation importance of protected animals and the national legislation protecting them, including the fines and imprisonment that are imposed on those who violate the law. Appropriate information will be given to all staff as part of their site induction, and leaflets will be displayed in site offices.
- Avoid tree clearance in the breeding season for priority species (if any) reported and undertake mitigation
- Night work shall be prohibited.

- All the equipment likely to generate high noise shall be appropriately enclosed or inbuilt noise enclosures be provided to meet the ambient noise standards
- Maintain the equipment, as simple maintenance can reduce noise levels.
- Movement of vehicles should be restricted to working hours only.
- Use sediment barriers and silt screens to prevent construction runoff from increasing sedimentation in rivers, which can affect dolphin habitats.
- WRIDD, with support from wildlife agencies, will monitor nesting sites at the proposed locations of FMIS.

3. Reporting and Communication.

- WRIDD will document all activities, observations, and mitigation measures in detail.
- Submit regular reports to wildlife authorities and other stakeholders, including ADB.
- Secure necessary permits and approvals (if any) from relevant authorities before implementing any actions.

4. Institutional Implementation of BAP

Community Contractor: The community contractor will be responsible for the ground-level implementation of BAP measures. This includes executing specific actions to protect and restore habitats, ensuring that construction activities align with the conservation goals outlined in the BAP, and managing on-site activities to minimize environmental impact.
WRIDD: The assigned department will monitor the contractor's compliance with the BAP. WRIDD will conduct regular inspections and audits to ensure that all BAP measures are correctly implemented and adhered to, providing guidance and corrective actions when necessary.

Community Organizers: They will assist WRIDD by supporting monitoring efforts, disseminating information to local communities, and conducting capacity-building activities (with support from PIMS). They will help raise awareness about the importance of habitat conservation and ensure that local knowledge and feedback are incorporated into the implementation process.
CPMO: The CPMO and its consultants will offer additional support to WRIDD by providing technical expertise to characterize the KBA and its buffer zones. This includes conducting ecological assessments, mapping sensitive areas, and identifying key species and habitats requiring protection. They will facilitate connections with appropriate government authorities to ensure compliance with environmental regulations and may allocate budgetary resources to ensure the effective implementation of BAP actions.

5. Offsetting strategy

Tree planting in KBAs and buffer zones is a critical conservation activity that involves several important steps. The first step is conducting a thorough site assessment to understand soil conditions, existing vegetation, and local climate, facilitated by WRIDD and government authorities. This assessment helps in selecting the right tree species, which is crucial for the success of tree planting. Native species are preferred because they are well-adapted to the local environment and support local wildlife, thereby maintaining ecological balance.
Engaging local communities or beneficiaries of FMIS in the tree planting process is also crucial. Local communities are invaluable in identifying areas that need land cover improvements. Their involvement ensures that reforestation efforts are tailored to local needs and conditions. Additionally, these communities can carry out regular maintenance activities such as watering, weeding, and replacing dead seedlings. These activities are essential for the long-term success

of reforestation efforts.

The WRIDD plays a pivotal role in tree planting efforts. WRIDD is responsible for coordinating these activities, ensuring that all steps are meticulously followed. They provide the technical expertise and resources needed for successful tree planting. WRIDD's oversight ensures compliance with environmental regulations and promotes long-term environmental health and biodiversity conservation. By working closely with local communities and government authorities, WRIDD helps create sustainable reforestation projects that enhance biodiversity and ecological resilience.