ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
of
BIOGAS TO BIO CNG
of
Jakhera Urja Tatha Mal Bikas Company Pvt
Badhaiyatal Rural Municipality-8, Bardiya

Submitted To:

Private Sector Led Mini Grid Energy Access Project (MGEAP)
Biogas Sub-component
Alternative Energy Promotion Centre (AEPC)
Tahachal, Kathmandu

Submitted By:

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January, 2025

ACRONYMS AND ABBREVIATIONS

AEPC	Alternative Energy Promotion Centre
BOD	Biological Oxygen Demand
CBS	Central Bureau of Statistics
CH_4	Methane
CITES	Convention on International Trades of Endangered Species
CNG	Compressed Natural Gas
CO_2	Carbon dioxide
DIA	Direct Impact Area
EMF	Environmental Management Framework
EPA	Environment Protection Act
EPR	Environment Protection Rules
ESIA	Environmental and Social Impact Assessment
FGD	Focus Group Discussion
GoN	Government of Nepal
H_2S	Hydrogen Sulfide
IEE	Initial Environmental Examination
IIA	Indirect Impact Area
IUCN	International Union for Conservation of Nature
MT	Metric ton
MoFE	Ministry of Forest and Environment
NOx	Oxides of Nitrogen
PSA	Pressure Swing Adsorption
RM	Rural Municipality
SMF	Social Management Framework
SO_2	Sulfur dioxide
SREP	Scaling -Up Renewable Energy Program
TPD	Tons per day
ZoI	Zone of Influence

TABLE OF CONTENT

List of Tables

List of Figures

EXECUTIVE SUMMARY

The objective of this sub-project is to construct a 65 TPD large-scale biogas plant that will make use of about 65 tonnes of organic waste per day and produce 1,092 kg of clean natural gas (Bio-CNG) and 8.45 MT of fertilizer daily.

The proposed biogas plant will be constructed in Badhaiyatal Rural Municipality-08, Bardiya District, Lumbini Province. The proposed biogas plant will utilize cow dung and press mud as its feedstock. Based on the assessment, the substrate available for the commencement of the sub-project is 65 tons/day yielding 2600 m^3 of raw biogas daily which is also the target gas generation as proposed by the developer. The produced 1,092 kg/day of compressed biogas will be bottled as Bio-CNG and will be supplied to the nearby industries and hotels. A total of 8.45 MT of compost (80% DS) will be produced as a valuable by-product.

The potential pollutants resulting from the construction activities for the implementation of the sub-project are construction spoils, mucks, washout liquid wastes, gaseous emission from vehicles carrying construction materials, dust, and suspended particles. Similarly, during the operation phase, processed wastewater after dewatering of post-digestate slurry, leaching of raw feedstock into groundwater during rainy season, issues related with collection and transportation of waste, post-digestate slurry management, odor, noise, drainage management and matter concerning with health of operational staffs are provisioned. There are positive impacts with the implementation of the sub-project as well, despite the associated adverse impacts. Employment opportunity to locals, skill development of locals, and increase in local economy are some of the beneficial impacts during construction phase. Similarly, promotion of renewable energy, employment opportunity to locals, skill development of locals is few of the beneficial impacts during the operation phase of the sub-project.

However, the above predicted potential impacts can be mitigated by strictly following the mitigation measures proposed in this ESIA report. All vehicles and machineries used in the construction as well as operation phase should be in compliance with emission standards set by Ministry of Forest and Environment (MoFE), stockpiles should be covered to avoid washout during rainy season, mixing and washing of aggregates should be done in designated area, direct discharge of slurry and decanted waste should be avoided. Along with this, all the workers should wear Personnel Protective Equipment like helmets, safety jacket, gloves, boots, etc. in both construction and operation phase. Adequate safety training should be provided to all staff to minimize the risk of accidents and occupational illnesses. From an environmental and social perspective, if the mitigation measures outlined in this report are implemented effectively, the sub-project is not expected to result in any significant adverse impacts.

कार्यकारी सारांश

यस जाखेरा ऊर्जा तथा मल विकास कम्पनि प्रा. लि. द्वारा प्रस्तावित परियोजनाको उद्देश्य ६५ टन प्रतिदिन क्षमताको ठूलो आकारको बायोग्यास प्लान्ट निर्माण गर्नु हो, जसले दैनिक करिब ६५ टन जैविक फोहोरको प्रयोग गरी दैनिक १०९२ केजी स्वच्छ प्राकृतिक ग्यास (बायो सीएनजी) र ८.४५ मेट्रिक टन जैविक मल उत्पादन गर्नेछ ।

प्रस्तावित परियोजना लुम्बिनी प्रदेश, बर्दिया जिल्ला अन्तर्गत बढैयाताल गाउँपालिका वडा नं. ८ मा निर्माण गरिनेछ । यस बायोग्यास प्लान्टमा गाई भैँसीको गोबर र चिनि उद्योगबाट निष्काशित हुने प्रेस मडको भरण गरी ग्यास उत्पादन गरिनेछ । यस परियोजनामा दैनिक ६५ टन फोहोर (फिडस्टक) को भरण गरिनेछ, जसबाट २६०० घनमिटर प्रतिदिन कच्चा बायोग्यास उत्पादन हुने लक्ष्य रहेको छ । उक्त कच्चा ग्यासलाई प्रशोधन गरी उत्पादन हुने १०९२ केजी बायो सिएनजीलाई बायोग्यास सिलिन्डरमा भरण गरी नजिकैका उद्योग तथा होटलहरुमा आपुर्ति गरिनेछ । सह-उत्पादनको रुपमा दैनिक ८.४५ मेट्रिक टन जैविक मल उत्पादन गरी विक्रि वितरण गरिनेछ ।

परियोजनाको कार्यान्वयनका क्रममा, निर्माणकार्य बाट हुन सक्ने सम्भावित प्रदुषणहरुमा हिलो, तरल पदार्थको निष्काशन, निर्माण सामग्रिहरु बोक्ने सवारी साधनबाट उत्सर्जन हुने धुवाँ, धुलो तथा कणहरु रहेका छन् । त्यसैगरी प्लान्ट संचालनको क्रममा, भरण गरिएको फोहोरलाई प्रशोधन पश्चात् मल बनाउने क्रममा निष्काशन हुने फोहोर पानी, वर्षायाममा कच्चा फोहोरबाट जमिनमुनीको पानी प्रदुषित हुने जोखिम, फोहोर संकलन र ढुवानीसंग सम्बन्धित समस्या, फोहोर प्रशोधन पश्चात् निष्काशन हुने बाक्लो घोल (स्लरी) को व्यवस्थापन, गन्ध, आवाज, ढल व्यवस्थापन तथा प्लान्ट संचालनका गर्ने कर्मचारीहरुको स्वास्थ्यमा हुने जोखिम हरुको व्यवस्थापन हुन आवश्यक देखिएको छ । यी सम्भावित प्रतिकुल असरहरुका बावजुद परियोजना कार्यान्वयनबाट सकारात्मक प्रभावहरु समेत पर्नेछन् । यसमा स्थानिय समुदायलाई रोजगारीको अवसर, सीप विकास र स्थानिय अर्थतन्त्रको वृद्धि हुनु निर्माण चरणका लाभदायक प्रभावहरु मध्ये पर्दछन् । त्यसैगरी परियोजना संचालनको क्रममा स्थानीयलाई दिगो रोजगारीको अवसर प्राप्त हुनु, स्थानियको सिप विकास हुनु र नविकरणीय ऊर्जाको प्रवर्द्धन हुनुले दिर्घकालिन रुपमा समुदायमा सकारात्मक प्रभाव पार्नेछन् ।

माथी उल्लेख गरिएका प्रतिकुल असरहरु न्युनिकरण एवं निराकरण गर्नका लागि यो वातावरणीय एवं सामाजिक प्रभाव मुल्यांकन (ESIA) प्रतिवेदन तयार गरिएको छ । यस प्रतिवेदनमा प्रस्तावित न्यूनिकरणका उपायहरुलाई कडाईका साथ पालना गरेर माथीका अनुमानित संभावित प्रभावहरुलाई धेरै हदसम्म कम गर्न सकिन्छ । मुख्यतया प्लान्ट निर्माण एवं संचालनका चरणमा प्रयोग हुने सबै सवारी साधन र मेसिनरीहरु वन तथा वातावरण मन्त्रालयले तोकेको उत्सर्जन मापदण्ड अनुरुप हुनुपर्दछ । वर्षायाममा चुहावटबाट रोक्न कच्चा फोहोरको ढेरलाई छोपेर राख्नुपर्छ । गिट्टि, बालुवा, सिमेन्टहरु मिसाउने र धुने कार्य तोकिएको क्षेत्रमा मात्र गर्नुपर्छ भने हिलो घोल र निष्काशित फोहोर पानीलाई समेत परियोजना स्थलबाट सिधा निकास नगरी व्यवस्थित गर्नुपर्छ । यसका साथै निर्माण र संचालन दुवै चरणमा सबै कामदारले हेल्मेट, सेफ्टि ज्याकेट, पंजा,

जुत्ता जस्ता व्यक्तिगत सुरक्षात्मक उपकरणहरु अनिवार्य लगाउनुपर्छ । दुर्घटना र पेशागत रोगबाट बच्नका लागि कर्मचारीहरुलाई उचित तालिम दिनुपर्छ ।

वातावरणीय तथा सामाजिक दृष्टिकोणबाट यस प्रतिवेदनमा उल्लेख गरिएका न्युनिकरणका उपायहरुलाई सही एवं प्रभावकारी रुपमा अनुसरण गरिएमा यस प्रस्तावित परियोजनाबाट कुनै उल्लेखनिय प्रतिकुल प्रभाव पर्ने देखिँदैन ।

CHAPTER I: INTRODUCTION

1.1. Project Description

Jakhera Urja Tatha Mal Bikas Company Pvt. has proposed the establishment of a large-scale biogas plant in Ward No. 8 of **Badhaiyatal Rural Municipality**, Bardiya District, Lumbini Province, using cow dung and press mud grass as the primary substrates for biogas production.

The main objective of the project is to set up a commercial biogas plant using a Continuous Stirred-Tank Reactor (CSTR) system that processes cattle dung and press mud to produce about 2,600 m^3 of raw biogas per day. The biogas will be purified into Bio-CNG, and the remaining digestate will be converted into organic fertilizer.

The project incorporates a CSTR based mesophilic anaerobic digestion system equipped with a double-membrane gas holder and safety pressure-relief mechanisms. The plant is designed to utilize approximately 65 tons of organic feedstock per day, comprising about 60 tons of cow/buffalo manure and 5 tons of press mud. Based on the waste characterization and the assessed availability of these substrates, the proposed system is considered technically feasible. The digester, with a required capacity of 5,500 m^3, is projected to produce approximately 2,600 m^3 of biogas per day, which will be upgraded to an estimated 1,092 kg of Bio-CNG. Furthermore, the process will generate around 8,450 kg of high-grade fertilizer per day, supporting circular resource utilization and contributing to improved soil health.

The developer has selected **Green Planet Energy Pvt. Ltd**., Bhairahawa, Nepal as a technology provider having experience in large, scaled biogas sector including biogas purification process. Green Planet Energy Pvt. Ltd. has extensive experience in the feasibility assessment, installation, and technological advancement of biogas systems in Nepal. The company has successfully implemented biogas plants of various capacities for several institutions, including Kalash Cattle Farming, Kamdhenu Gas tatha Mal Udhyog, Jeevan Bikash Samaj, Dev Training & Management Center, Waste & Enviro Management Pvt. Ltd., KP Services, Emerald Energy Pvt. Ltd., and Fossil Solutions Pvt. Ltd. All biogas plants developed by the firm are currently in commercial operation, demonstrating the company's technical capability and reliability in executing large-scale biogas projects. The technology provider will be bound to produce desired output as per provision and policy of AEPC for assurance of successful project delivery to the developer.

1.2. Rationality of ESIA Study

The Environmental and Social Impact Assessment (ESIA) has been conducted with reference to the criteria cited in Schedule 2 of EPR 2077, and as per the requirement of Environmental Management Framework (EMF) of Mini Grid Energy Access Project (MGEAP).

According to Schedule 2 of the Environment Protection Regulations (EPR) 2077, in the section '**Energy, Water Resources, and Irrigation Sector**' and the sub-section 'Renewable Energy Sector', under heading Biogas Plants, any biogas plant with a production capacity of 1,500 to 10,000 m^3/day is required to undergo an Initial Environmental Examination (IEE) prior to operation. The proposed project plans to construct a biogas plant with the production of approximately 2,600 m^3/day of raw biogas from organic waste. Since this capacity falls within the regulatory threshold, the project requires an IEE to assess potential environmental impacts and propose appropriate mitigation measures.

The study team effectively assessed the screening of the environmental and social aspects of the proposed sub-project and prepared this ESIA report to minimize/mitigate the identified impacts. The sub-project will be implemented and will be supported with subsidy after the approval from AEPC/MGEAP.

1.3. Objective of ESIA Study

The objectives of ESIA are as follows:

- Identify the environmental and social issues/impacts related to construction and operation of large biogas plant.
- Access potential impacts on physical, biological, and socio-economic environment (based on both field inspection and desk review).
- Propose pragmatic measures aimed at avoiding, minimizing, mitigating or compensating the impacts
- Define monitoring and management systems which are applicable and suitable in the sub-project area. The monitoring plan will be prescribed as provided in EMF and SMF provisions.
- Define the institutional framework required for the execution of monitoring and management programs.
- Integrate environmental and social considerations into sub-project planning, design and costing. Allow proponent, designers, implementing agencies and funding agencies to address environmental and social issues in a timely and cost-effective manner during the pre-feasibility stage.
- Involve stakeholders, including project affected people and other parties who have interests and influence on the project during planning, designing and implementation stages.

1.4. The Proponent

The Proponent of this sub-project is Jakhera Urja Tatha Mal Bikas Company Pvt., which has been registered in company Registrar office under Registration No. 367823/81/82 on 2025/06/02 as private limited company. Main aim of the company is to promote and develop renewable energy, especially large-scale Biogas Plant, in Nepal.

The Name and Address of the Proponent of this Biogas sub-project is:

Jakhera Urja Tatha Mal Bikas Company Pvt Ltd
Tel: +977-9817414297

Report Preparing Institution:

Urja Consult Pvt. Ltd. has been assigned for conduction of ESIA of this sub-project. This ESIA has been prepared by multi-disciplinary team specialist on environmental and social aspects. The list of the study team has been mentioned in **Annex 6**.

Urja Consult Pvt. Ltd.
Kathmandu-32, Koteshwor
Email: consulturja@gmail.com

1.5. Project Location and Accessibility

The project site is situated at the coordinate of 28°10'8.93"N and 81°26'5.70"L with the average elevation of about 112 meters from sea-level. The nearest main road is Hulaki Rajmarga (NH05) which is at distance of 3.5 km from the project site. The nearest major road is East-West Highway which is at distance of about 12 km form the sub-project site.

The nearest settlement (market) from the project site is Guleriya, located at a distance of about 4.5 km. The nearest dense settlement to the project site is Mainapokhari. The aerial distance from sub-project site to Mainapokhari village is 3.6 km. The nearest other settlement areas are Dasipur, Phutaha, and Padariya. **Figure 1** and **Figure 2** depicts the topographic map and google earth image of the sub-project location respectively.

The proposed project site is located completely on **privately owned agricultural land** with no existing buildings or infrastructure on the site. The area is easily reachable by local road, which is 500 m far from the sub-project area, which provide convenient access for vehicles and construction activities. The surrounding area consists of scattered residential settlements, reflecting a low-density population of 5,818 of ward No. 8 of Badhaiyatal Rural Municipality. The sub-project area is just 1 km far from the Indo-Nepal Boarder Trail, close to the boarder to India

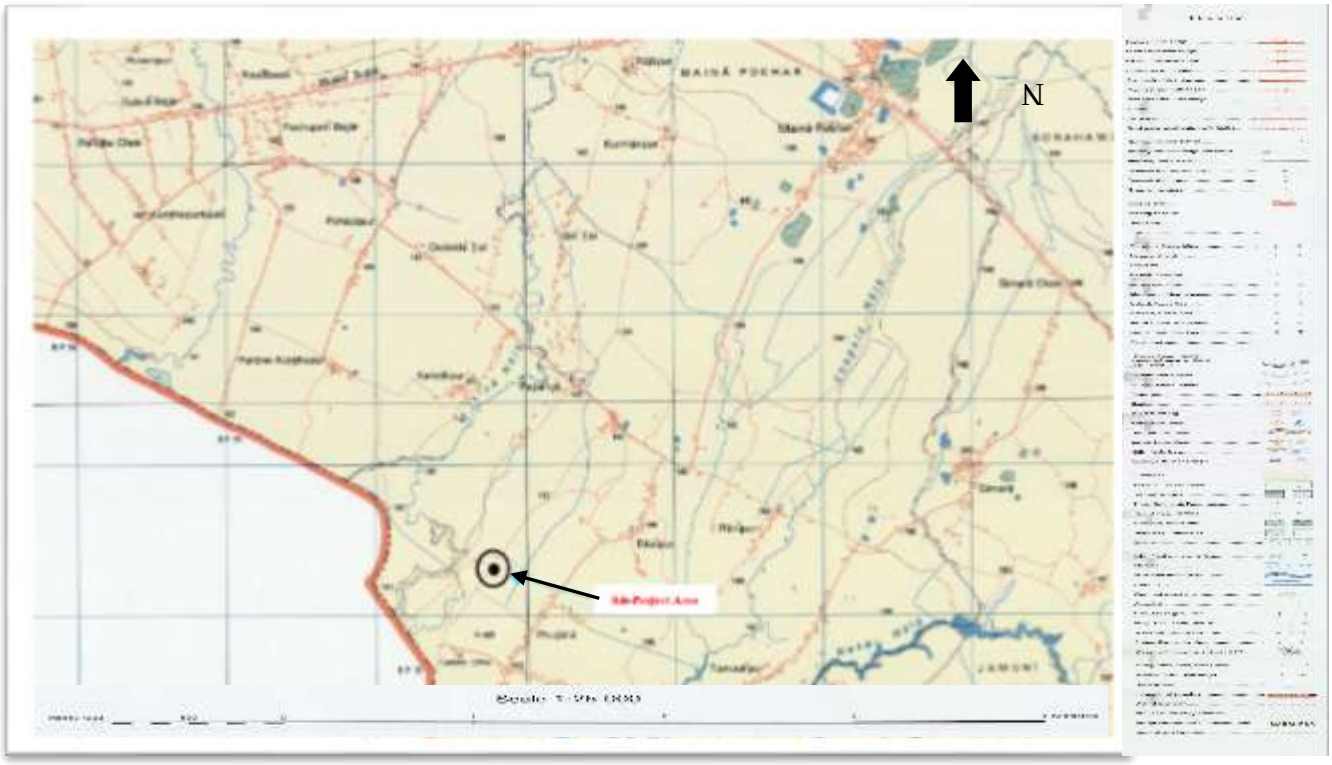


Figure 1: Topographic Map of Proposed Sub-Project Location

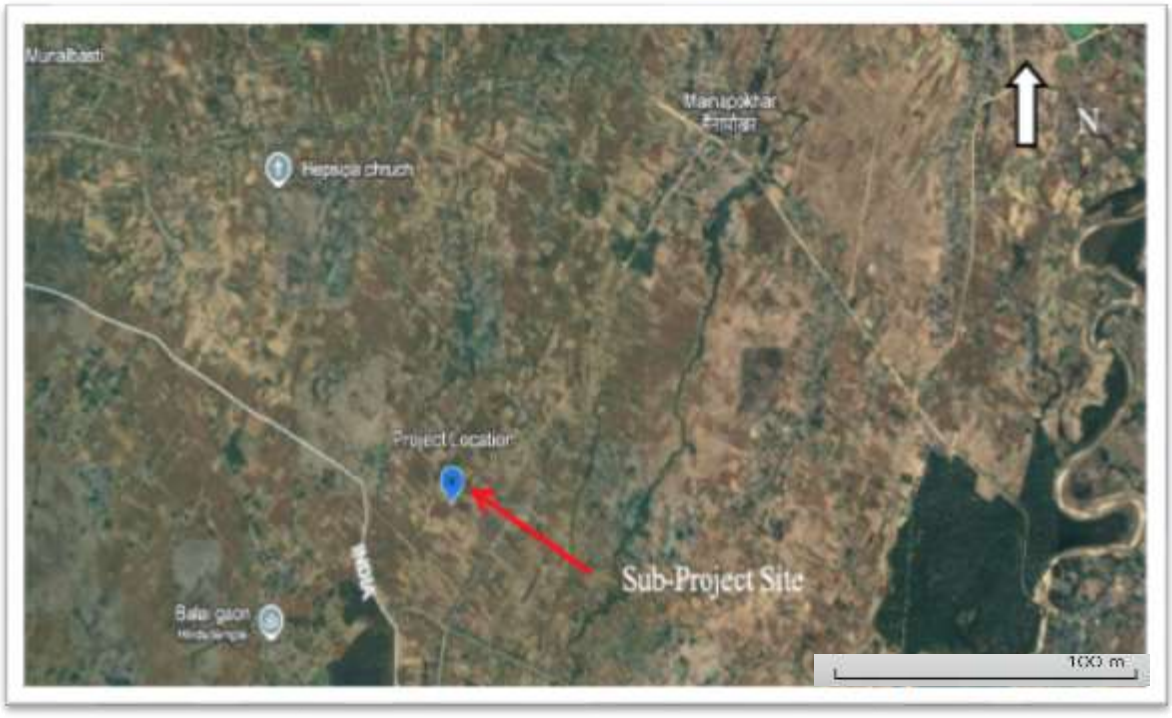


Figure 2: Google Earth Image of the Proposed Sub-Project Location

1.6. Salient Feature of the Sub-Project

The main objective of the sub-project is to install a biogas plant using anaerobically digestible organic waste from the commercial entities. The produced Biogas will be bottled and distributed to nearby industries for thermal purpose. The salient features of the sub-project are presented in **Table 1.**

The estimated cost of the installation of biogas plant including cost of land and civil construction is estimated to be NRs. 205,895,720.30 (With VAT) and NPR 196,512,632.10 (Without VAT), of which 40% (NPR 78,605,052.82) will be provided by AEPC as subsidy.

Table 1: Salient Features of the Sub-Project

Name of Commercial Entity:		Jakhera Urja Tatha Mal Bikas Company Pvt Ltd
Address of Commercial Entity:		Badhaiyatal RM-08, Bardiya district
Name of Contact Person (Developer):		Mr. Sandip Kandu
Contact Number of Contact Person (Developer):		9817414297
Biogas Project Location		Badhaiyatal RM-08, Bardiya District
Recommended Technology:		Continuously Stirred Tank Reactor (CSTR) based biogas plant
Digester Volume (m^3)		5500 m^3
Biogas Production		2600 m^3/day
Saleable Bio-CNG Production		1092 kg/day
Compost Production		8,450 kg/day
Slurry Volume		97.8 TPD
End Use:		Thermal (Bio-CNG) Captive use and Selling
Tentative Total Project Cost		NPR 213,856,682.73 (With VAT and ESIA implementation cost)
		NPR 196,512,632.10 (Cost eligible for AEPC subsidy)
Safeguard Document to be prepared during DFS	Environmental and Social Safeguard	ESIA (IEE) – Category B project
Legal Clearance Required		IEE approval from GoN

Source: DFS of Jakhera Urja Tatha Mal Bikas Company Pvt Ltd

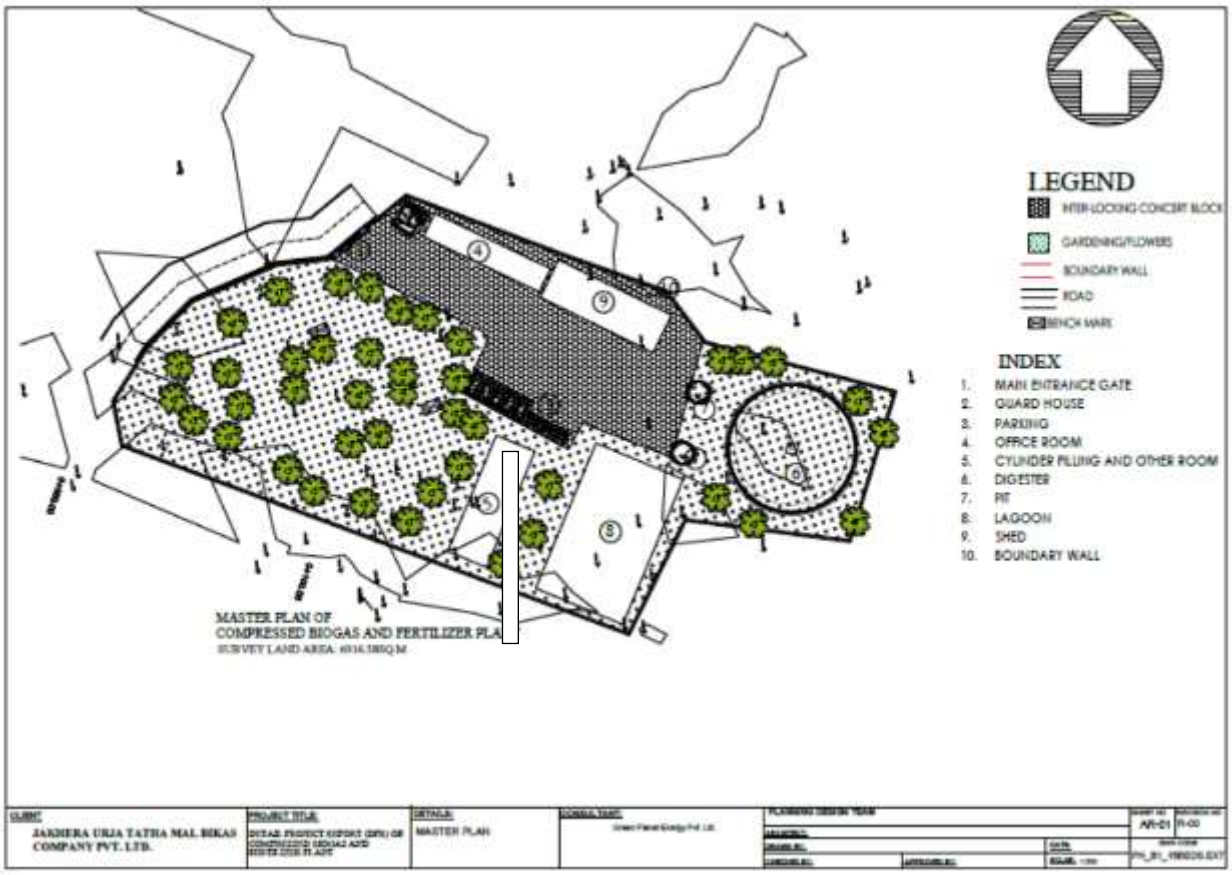


Figure 3: Typical layout of the plant

1.7. Study Methodology

The ESIA study has been carried out in accordance with the Environment Protection Act, 2076 and Environment Protection Rules, 2077, Environment Management Framework (EMF) and Social Management Framework (SMF) of MGEAP and National Environmental Impact Assessment (EIA) Guidelines 1993. These instruments guided the overall assessment process, including data collection, impact identification, and analysis of environmental and social risks

1.7.1. Desk Review

The secondary data were collected from various sources such as published reports, topographic maps, land use maps, aerial photographs (Google Earth), etc. Furthermore, Detailed Feasibility Study report of the project, environmental standards, Acts and Regulations, etc. were reviewed as necessary. The district profile of Bardiya District and Badhaiyatal RM were also reviewed for acquiring demographic information of the sub-project location.

1.7.2. Field Based Study

A field visit was conducted on 9th, 10th and 11th Mangshir, 2082 B.S. (25th, 26th and 27th November, 2025) for survey, public consultation by multidisciplinary team of environmentalists and socio-economist for collecting information on physical, biological and socio-economic and cultural environment of the sub-project site. The details discussed in public consultation are explained in **Chapter VII** of this ESIA report. The team of expert generated data regarding the physical, biological and socio-economic environment of direct and indirect zone of influence (ZoI) with the methodological approaches as given below:

Physical Environment and Cultural Environment: The field visit team collected the site- specific information using checklist and matrix on following areas:

- Physiography, topography and land-use
- Climate and hydrology
- Geology and soil
- Drainage pattern

The checklist used for the survey during field visit is attached in ***Annex 7*** of this ESIA report.

Biological Environment: The information on composition, distribution patterns and characteristics of vegetation and any sensitive habitat in the sub-project area were assessed from direct field observations, transect walk survey, maps, and collection of information from relevant literatures. Based on expert observations and consultations with local residents, no protected vegetation (such as rare, endangered, or indigenous species) has been identified within the sub-project's area of influence.

Socio-economic Environment: The information on socio-economic condition of the people of sub-project affected area was collected through;

- Public consultations with nearby residents.
- Key Informant Interviews (KIIs) using a standardized checklist (Annex 7).
- Meetings with officials from Badhaiyatal Rural Municipality.
- Field observations and data from the ward office.

The key informants were selected based on their knowledge of the local area, their role within the community, and their understanding of the potential impacts of the sub-project. The selection process included:

- **Local Leaders:** Individuals holding positions of leadership within the community of ward 8 of Badhaiyatal RM, such as ward representatives, village elders, and heads of local community-based organizations.

- **Officials from Badhaiyatal Rural Municipality:** Officials with insights into local governance, infrastructure, and development plans were included to provide a governmental perspective.
- **Community Representatives:** Individuals who represented specific interest groups within the community, such as women's groups, farmers, and youth organizations, were also interviewed.

The key informants have raised the issues of possible impacts during sub-project construction and operation phase. The mitigation measures of the possible impacts were delivered by the expert team. The issues that were raised are adequately addressed in the impact mitigation measures. Most of the participants of the key informant survey have queried about the employment opportunities to locals after the commencement of the sub-project. The people around the sub-project vicinity are positive about the project.

Other relevant information on public institution and social infrastructure such as school, health post, and drinking water structure was collected from ward office and public consultation. Religious and cultural sites were also observed at the vicinity of the sub-project site. The sub- project is located within private land and no settlements or residential structures exist within the area of influence**;** no households were identified as being affected by the project**.** Therefore, affected household survey was not conducted.

The following data of socio-economic and cultural environment of the sub-project vicinity were collected.

- Population, ethnicity, settlement pattern, and major occupations.
- Access to social services and community facilities.
- Local resources such as schools, health posts, and temples.
- Key economic activities practiced by households.
- Cultural and religious values present in the community.
- Educational status of residents.
- Health and sanitation conditions in surrounding settlements.

1.7.3. Impact Assessment

After the complete documentation of baseline environmental data of the sub-project area, each of the environmental parameters were examined against the sub-project activities in the different stages of sub-project development using various methods and tools. A logical, simple and systematic approach has been adopted for impact identification, evaluation and prediction. The impact has been identified for physical, biological, socio-economic, and cultural environment of the sub-project area. The expert's judgment using past experiences of similar type of projects have been used to predict impacts.

The assessment of impacts is based on the baseline environmental conditions of the affected area with the project activities in relation to spatial and temporal aspects in terms of magnitude, extent and duration using various environmental prediction methods. The impact has been predicted over a

specified period and within defined area. Consequences of environmental impacts were interpreted in terms of local, regional and national contexts. The significant positive and adverse environmental impacts associated with the project components have been identified considering the impact zone. The magnitude, extent and duration of the impacts which were categorized according to the National EIA Guidelines, 1993 are given below:

Magnitude of impacts

- Low Impact (L): If the value of the resources could be used with no or minimum inconvenience to the public
- Medium/Moderate Impact (M): If the value of the resources could be used with inconvenience to the public
- High Impact(H): If the value of the resources reduced far below publicly acceptable level

Extent Impacts

- Site Specific (S): Impacts confined strictly within the project boundary or immediate work area (e.g., within the proposed plant premises).
- Local (L): Impacts extending to the nearby surrounding area, such as adjoining wards, nearby settlements, or within approximately 100 m to 300 m from the project boundary.
- Regional (R): If the impact of the work extends to the entire district or further then it is termed regional. Impacts stretching beyond the local area, influencing larger administrative regions such as the entire municipality, district, or further.

Duration of the Impacts

- Short Term (ST): If the impacts last for 3 years after project initiation it is classified as short term. Construction phase impacts are mostly categorized under this category.
- Medium Term (MT): An impact that continues for more than 3 years but less than 20 years is considered as medium-term. The construction phase impacts which carry over for few years of operation falls under this category.
- Long Term (LT): An impact that lasts beyond 20 years is considered to be long term. The operation phase impacts are mostly categorized under this category.

1.7.4. Public Consultation

In order to ensure public involvement, the team carried out interaction with local communities and related stakeholders during field survey to collect their views and suggestions on the sub-project. The consultation was held on 2082 Mangshir 10 (November 26, 2025). The issues raised by the public during consultation meeting have been incorporated in the report ***(Annex 1)***.

1.7.5. Project Impact area Delineation

The project affected areas are classified into direct and indirect impact area based on scale, nature and location of the project. The zone of influence shall be considered within Badhaiyatal Rural Municipality.

Direct Impact Area (DIA): The Direct Impact Area includes the area from 100 m radius from the sub-project site where direct activity during construction and operation occurs. It includes areas where the construction work will be done. The residents may be affected by short-term disturbances such as dust generation, noise from machinery, increased movement of construction vehicles, temporary access obstruction, vibration, and visual disturbance. During the operational phase, nearby households may also experience odour, increased traffic, and minor risks related to waste handling depending on the nature of the biogas facility. Although these impacts cannot be fully avoided within the DIA, they can be minimized or compensated through dust suppression, noise control measures, proper waste handling, traffic management, and continuous community communication. It includes the nearby scattered settlement area of Badhaiyatal Rural Municipality - Dasipur, Phutaha and Padariya.

Indirect Impact Area (IIA): Indirect impact area includes all the areas that will have indirect impacts by construction and operation activities which can be mitigated or minimized and mostly the activities of construction workers. The Indirect Impact Area (IIA) for the sub-project includes both the 500 m periphery surrounding the project site and the entire transportation route used for transporting substrates and materials from the collection points to the sub-project location. In addition, since the transportation route and surrounding influence area lie within Ward No. 8 of Badhaiyatal Rural Municipality**,** this ward is also considered part of the IIA. Therefore, the IIA consists of the 500 m radius around the project site, the full stretch of the transportation route, and the areas of Ward 8 that may experience indirect impacts such as noise, dust, increased vehicle movement, worker activities, and temporary disturbances during construction and operation**.** **Figure 4** depicts the Direct and Indirect Impact area delineated in top

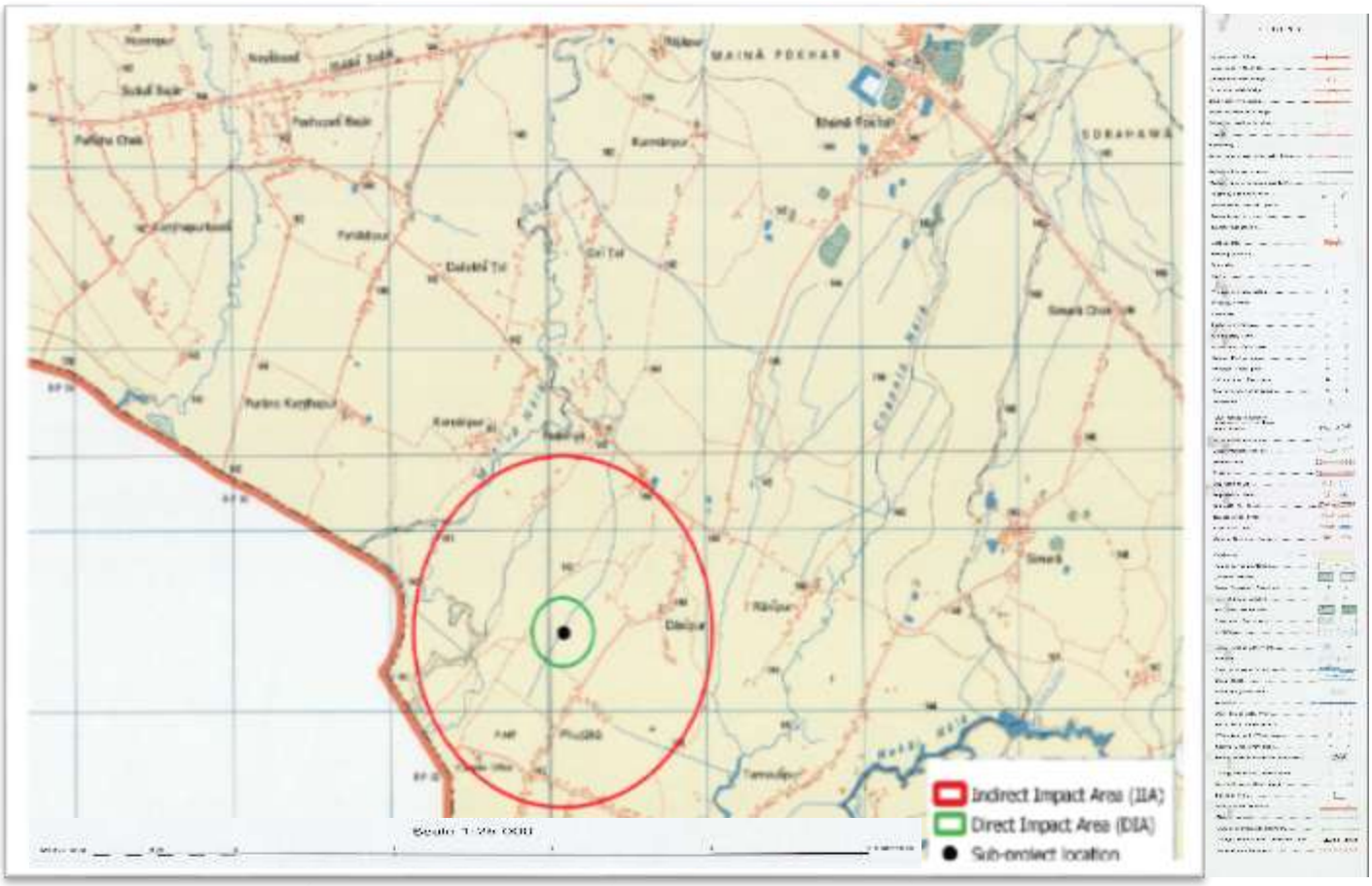


Figure 4: **Topographic Map Showing Direct and Indirect Impact Zone**

CHAPTER II: PLANT DESIGN AND TECHNOLOGY

2.1 Description of the Technology

Biogas is produced through the biological breakdown of organic matter in the absence of oxygen (anaerobic conditions). The resulting gas primarily consists of methane (CH_4) and carbon dioxide (CO_2), along with trace gases such as hydrogen sulfide (H_2S). The feedstock for biogas production includes a variety of degradable organic materials, such as agricultural residues, food waste, vegetable and horticultural waste, animal manure, and kitchen waste. The decomposition is carried out by a diverse population of anaerobic bacteria.

The proposed sub-project adopts anaerobic digestion (AD) technology, which converts organic matter into biogas and digestate. Biogas can be utilized for thermal applications or further processed into Bio-CNG, while the digestate can be used as organic fertilizer. Anaerobic digestion not only manages organic waste efficiently but also contributes to greenhouse gas reduction by replacing fossil fuels such as LPG and kerosene.

2.2 Anaerobic Digestion Process

Anaerobic digestion occurs in the absence of oxygen and involves a series of biological processes where bacteria convert organic substrates into biogas and digestate. The process produces:

- **Biogas**: Typically contains 60–70% methane (CH_4) and 30–40% carbon dioxide (CO_2), with trace amounts of H_2S and other gases. Biogas can be combusted for heat or electricity or upgraded to Bio-CNG. (Source: *Biogas: Anaerobic Digestion.* (2025). *Biogas-Info.*)
- **Digestate**: A nutrient-rich slurry and solid fraction, which can be used as organic fertilizer, applied to croplands, or processed into products like potting soil.

Feedstock sources include cow/buffalo manure, press mud from sugar mills, food processing waste, and other biodegradable organic wastes. The process reduces odors, pathogens, and greenhouse gas emissions.

2.3 Important Operating Factors

2.3.1 Temperature

Mesophilic digestion operates optimally at 35–40°C, while thermophilic digestion functions at 55–60°C. Mesophilic digestion is preferred due to lower operating costs and stable performance. Temperature fluctuations significantly affect biogas yield; a decrease of 6–8°C can reduce gas production by approximately 50%.

2.3.2 Hydraulic Retention Time (HRT) and Loading Rate

- HRT: The average time that feedstock remains in the digester, typically 25–30 days for optimal methane production.
- Loading Rate: Number of volatile solids fed daily. Uniform daily feeding ensures consistent biogas production and minimizes emissions.

2.4 Technology Selected

The proposed plant will utilize a **CSTR-based mesophilic biogas digester** with continuous substrate feeding and pressure swing adsorption (PSA) technology for biogas upgrading. Key features include:

- Continuous anaerobic digestion with constant temperature and pH control.
- Continuous agitation of the slurry to ensure homogenization.
- Biogas scrubbing to remove H_2S and CO_2 before compression into Bio-CNG.
- Conversion of digestate into high-quality organic fertilizer (TS ~70%).

2.5 Components of Proposed Biogas Plant

The types of units and equipment that are required in the proposed CSTR based biogas system are described below:

i. Substrate Storage and Preparation Area: The biomass substrates proposed for the sub-project are cattle dung (cow/buffalo) and press mud. The substrate will be continuously fed into the digester in daily basis or need only one or two days of storage.

ii. Feed Mixer Tank and Substrate Feeding: The feeding of the BMP (Bio Methane Plant) will work as a semi-automatic storage – flow- process, by which the bio mass is guided into the digester per day. Additionally, Digestate can be pumped from digester outlet to inlet in case of demand. Any process of pumping from and to any containment will be monitored by level switches, which are connected to the PLC - system, and will supervise the pumping system. The digesters are fully mixed by high quality submersible agitators and will be operated in a mesophilic (38˚C ± 1˚C) temperature range. This leads to a stable process and an economical optimized demand for process heat, so a maximum gas yield which results in maximum greenhouse gas reduction will be guaranteed.

iii. Concrete Biogas Digester: Digester is comprised of a standing cylindrical tank of reinforced concrete – 24 meters in diameter and 8 meters high including a free board head space for gas release. The solid that are fed into the digestion system for decomposition or degradation of the Volatile Solids (VS) (Organic Dry Matter) present inside the feed substrate (bio-mass). The Degradation is done in the digester. The proposed plant works on a storage –flow-process. Biomass is guided into the single digester by a solid feeder several times per day. Additionally, re-circulated slurry will be pumped into

the digester. The digester is fully mixed by high quality lateral mixers and will be operated in a mesophilic (38°C) temperature range. This combination leads to a stable process with good homogenization of waste and minimized efforts as far as areas requirement and digester volume are concerned. On the other hand, it aims at maximum gas yield which results in maximum greenhouse gas reduction. The digester is standing cylindrical tanks made of reinforced concrete and is equipped with a wall heating system. The digester is covered with a double membrane dome type gasholder.

iv. Biogas Flare and Flame Arrester: Biogas flares are used to safely burn biogas that is surplus to the demand of the biogas plant or where the plant fails. The flow rate of the biogas flares to be used is 100 m^3/hr and will be installed at 7 meters height from the ground. It is equipped with moisture trap and flame arrestor.

v. Biogas Up-gradation: The biogas collected in the gasholder will be fed to a Roots compressor where pressure of gas is raised to 0.5 kg/cm²g. This gas is then fed to a Proprietary Chemical based purification unit, which has a twin tower arrangement filled with special grade of Chemical; adsorb H_2S and CO_2 from the inlet gas. The outgoing gas will be free from H_2S and will have approximately 7-10% CO_2. While one tower is purifying the gas, the other tower is taken for regeneration, which is achieved by:

a) Depressurization of the tower
b) Creating partial vacuum in the tower

The changeover from one tower to another is fully automatic and accordingly continuous supply of purified gas is available at the outlet of the system. The outgoing purified gas can be bottled in CNG cylinders and be used for Heating/Energy purpose. In order to fill gas in the CNG cylinders at a pressure of 200 Kg/cm^2g, a methane compressor will be installed. The gas is perfect replacement of LPG for heating application.

vi. Biogas Compression and Filling Station: The biogas compressor is used to increase the pressure of the bio-methane to a pressure (200 bar) suitable for it to be injected into the cylinder filling manifold. The capacity of each cylinder will be 14.2 kg of CNG. The working pressure of Cylinder will be 200 bar and its burst pressure will be 300 bars as a safety margin. Normal cascade consists of 6 cylinders; however it can be customized based on end use gas requirement. Safety standards of Petroleum and Explosives Safety Organizations (PESO), Government of India, will be adopted for the activities related to compression and filling of cylinders, as well as other activities related to Bio-CNG such as manufacture, possession, use, sale, import, export, transport & handling.

vii. Post Digested Slurry Handling and Compost Production

Solid Liquid Separator (Screw Press): The Screw Press unit will be fitted in line of the spent slurry disposal system. Spent slurry that is coming out of the digester will have around 8-10 % dissolved

solids, which are pathogen-free bio-fertilizer. The solids in the spent slurry will be separated out in the Screw Press unit. In addition, the dried cake will be sold to farmers as organic fertilizer; the effluent from the Screw Press is further stored and reused. Hence, the plant ensures zero discharge.

Slurry Storage Lagoon: The Digester (liquid fertilizer) storage lagoon will be designed for around 4 week's storage. Solid liquid separating decanters will be connected to outlet of storage lagoon. The lagoon side walls/bottom & solid manure collecting yard would be treated to prevent any leaching. The lagoon / yard would have facility to enable periodic cleaning of the lagoon & yard. The Substrate Handling and Slurry Management plan is provided in the **Section 11.5**.

viii. Compost Production and Packaging Unit: The compost manure separated from the slurry solid separator will be stored in fertilizer yard of area spread to 120 m^2 where the collected manure will be stored and dried to achieve desired TS (70%). Workers manually fill the final compost product in the bag and seal with hand stitching gun.

ix. Monitoring: Process temperature and pH value monitoring will be done in digester or slurry taken from digester. Similarly, the system will have Volatile fatty acids (VFA) monitoring, dew point meter, biogas quantity monitoring through flow meter and quality monitoring through gas analyzer which will indicate the composition of biogas. All of these monitoring indicators can be accessed through computer/control panel in remote location.

2.6 Testing, Commissioning, Operation, and Sustainability

The biogas plant will undergo thorough testing and commissioning, where AEPC officials will verify the performance of the plant, including biogas output and methane content. Green Planet Energy Pvt. Ltd., the technology provider, will offer operational support and train the plant staff.

Operation and maintenance will be carried out by a team consisting of one supervisor, two operators, and supporting personnel. Scheduled maintenance and equipment replacement will be implemented as required, with ongoing technical guidance from the installer.

Sustainability measures include selecting proven technology and an experienced provider, contractual performance guarantees, staff training and capacity building, marketing of plant products, continuous performance monitoring, and regular maintenance and equipment replacement to ensure long-term plant viability.

2.7 Sub-project Process Cycle

The proponent has considered anaerobic digestion technology for generation of biogas from organic wastes collected. The digester of proposed biogas plant is based on Continuously Stirred Tank Reactor (CSTR) with additional facility of heating and stirring. After generation of biogas in the digester, the biogas will be refined by removing H_2S gas followed by gas up gradation. After this stage, the biogas will be upgraded to methane with 96% purity.

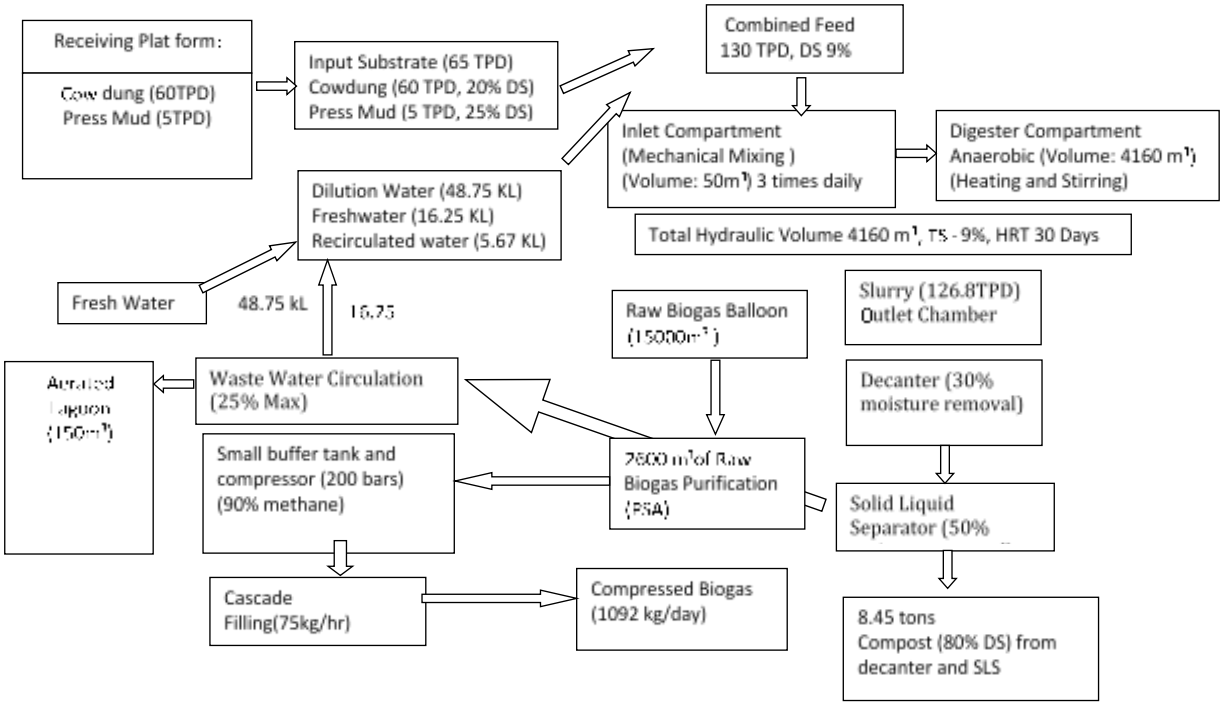


Figure 5: Process Flow Diagram and Mass Balance

2.7.1 Waste Characterization and biogas production potential

The characterizations of various wastes are known and presented in **Table 2**. While designing the biogas plant, sizing and biogas production calculation, following data is used.

Table 2: Waste Characterization

Substrate	Biogas Yield (m^3/kg day)	C: N ratio	TS%	VS (% of TS)
Cow Dung	0.040	20	20	80
Press Mud	0.040	25	25	75

Source: DFS of Jakhera Urja Tatha Mal Bikas Company Pvt. Ltd.

From the above characteristics and available substrate, the biogas production potential is calculated as:

Table 3: Biogas Production Potential from Available Substrate

Substrate	Available Quantity (tons/day)	Biogas Yield (m^3/kg day)	Daily biogas production (m^3/day)	Density of Methane (kg/m^3)	Probable Bio-CNG (Methane) Production (Kg/day)
Cow/Buffalo Dung	60	0.040	2400	0.400	1012
Press Mud	5	0.040	200	0.400	80
Total	**65**		**2600**		**1092**

Source: DFS of Jakhera Urja Tatha Mal Bikas Company Pvt. Ltd.

2.7.2 Biogas Plant Design

With above parametric conditions, a biogas plant was designed with estimated size of biogas digester volume, quantity of substrates for co-digestion and estimated biogas and compost production. The design of the biogas plant with its parametric conditions is presented in **Table 4**:

Table 4: Design Parameters of Proposed Biogas Plant

Substrates to be used	Cow dung and press mud
Total Substrate quantity	65,000 kg/day (65 tons/day)
Combined TS of substrate	20%
Dilution Water Requirement	**65,000 litres/day**
TS of feedstock after dilution	10-12%
Hydraulic Retention Time	**25-30 Days (Mesophilic)**
Volume of Digester	5500 m^3
Combined CN Ratio	**17**
Total Biogas Production	**2600 m^3**
Total slurry (liquid) from outlet	**126.8 tons per day**
TS of Slurry	12%
Total compost production	**8.45 tons per day (70% DS)**
Total Liquid slurry available after compost (Screw press)	**97.8 tons/day**

Source: DFS of Jakhera Urja Tatha Mal Bikas Company Pvt. Ltd.

The estimated compressed biogas (Bio-CNG) and compost produced from the proposed plant is calculated as approximately 1092 kg of Bio-CNG and 8.45 tons of compost fertilizer daily. The composition of raw biogas as claimed by technology provider is 55% to 60% of Methane (CH_4), 40%±5% Carbon dioxide (CO_2), 1000 ppm±400ppm Hydrogen sulphide (H_2S), saturated water (H_2O), less than 2% air and less than 0.5% Oxygen (O_2).

Table 5: Biogas and Compost Fertilizer Production

Total Biogas Generation		**2600 m^3/day**		
Composition	**Percent (%)**	**Volume (m^3/day)**	**Density (kg/m^3)**	**Quantity (kg/day)**
Methane	60%	1560	0.68	1092
Carbon dioxide	39%	936	1.98	
Others	1%	24	-	
Total Slurry Production		126.8 tons/day (10 % DS)		
Total Compost Production		8.45 tons/day (70% DS)		

Source: DFS of Jakhera Urja Tatha Mal Bikas Company Pvt. Ltd.

While, in the final product i.e. compressed biogas (Bio-CNG), the composition will be 96% CH4, less than 3% CO_2 and less than 5ppm H_2S.

2.7.3 Calorific Value and Conversion Equivalent

The net calorific value of pure methane is considered as 50 MJ/kg whereas calorific value of LPG (baseline energy source considered for thermal purpose) stands at 45.5 MJ/kg. The proposed sub-project will use Chemical H_2S Scrubbing from NaOH dosing and Pressure Swing Adsorption (PSA) technology for biogas purification and will produce about 96% of pure methane gas as final output. Hence, the calorific value is considered equal for LPG and Bio-CNG. With this assumption, the produced Bio-CNG will replace approx. 88 cylinders of LPG per day equivalent marketed in Nepal (14.2 kg of LPG in each cylinder).

2.8 Sub-Project Requirements

2.8.1 Water Requirement

During construction period, estimated water requirement is approx. 20,000 -25,000 litres per day which will be sourced from ground water extraction within the construction site. A permanent deep boring will be installed for meeting water demand for construction as well as in operation phase.

For the operation of the sub-project, water requirement is estimated to be 50000-60000 litres per day. The water demand will be fulfilled through deep boring, and recirculation of liquid slurry generated from digester.

2.8.2 Land Requirement

The proposed sub-project location is at Ward No. 8, Badhaiyatal Rural Municipality, Bardiya District. The site is about 3.5 km South from Hulaki Rajmarga. The required land for the sub-project is privately owned agricultural land, and the entire proposed project will be built completely on private land. Around 29 Kattha (138,510 sq. ft.) of private land is separated by the developer at the proposed location which is sufficient for the construction of the new plant. The land is completely owned by the developer itself. The biogas plant will be owned and operated by the developer - Jakhera Urja Tatha Mal Bikas Company Pvt. Ltd. The total land required for construction of the subproject is estimated at 20.43 Kattha (74,467.35 sq. ft.) as per the DFS prepared for the subproject.

2.8.3 Work Force Requirement

For the construction period of six months, work force required is approximately 20-25 skilled and 100 semi-skilled/unskilled human resources. During the operation phase, around 12 regular employees and 12 field employees will be employed for the operation and maintenance of the biogas plant. While employing the workers, preference will be given to the locals especially women and disadvantage groups according to their qualification, skills and interest. The sub-project shall ensure that child labor and forced labor are strictly prohibited during all phases of implementation, including construction and operation. Additionally, it will be ensured that contractors and subcontractors engaged in the sub-project comply with national labor laws.

2.8.4 Energy Requirement

Electricity will be used as a major source of energy for the construction and operation of the sub-project and diesel generator will be used as a backup. The total connected power of the system is **161** kW while the plant will consume 1383.95 kWh of energy on daily basis. The peak load is expected around 161 kW during 8-12 pm while the plant is expected to run at optimum. The sub-project shall strictly prohibit the illegal extraction of fuelwood and will discourage the excessive use of fossil fuel-based backup energy systems, promoting energy efficiency and sustainable practices.

2.9 Industrial Resource Availability and Market Assessment

2.9.1. Industries

Nearby cattle farms have agreed to supply about 65 tonnes of animal waste per day, which is enough to run the biogas plant. Sugar mills have also agreed to provide press mud as a backup source. Moreover, the sub-project area has good road access, bringing these materials from farms and industries to the plant will be easy. AEPC's biogas calculation tool shows a theoretical potential of 133.38 TPD of substrate, but the confirmed supply is 65.8 TPD. This is sufficient, as the plant requires only 60 TPD for daily operation. The cow/buffaloes dung availability in the sub-project area is presented in Table 6 whereas the agreement with the individual farms have been presented in the DFS. Few sample agreements have been made part of the Annex.

Table 6: Availability of Cow/buffaloes-dung in the Sub-project area

Name of Supplier	Type of Substrate	Number of cows / buffaloes	Location	Supply Capacity (Kg/day)
Lucky Bhaisi Paalan Farm	Cattle Manure	288	Guleriya-11, Bardiya	5730
Bagar Bhaisi Palan Farm	Cattle Manure	130	Guleriya-3, Bardiya	2600
Shahi Bhaisi Palan Farm	Cattle Manure	93	Guleriya-12, Bardiya	1860
Yadav Bhaisi Palan Farm	Cattle Manure	108	Guleriya-1, Bardiya	2160
Shriwastab Bhaisi Palan Farm	Cattle Manure	112	Guleriya-3, Bardiya	2240
Ambika Bhaisi Farm	Cattle Manure	103	Guleriya-4, Bardiya	2060
Siddhartha Bhaisi Palan Farm	Cattle Manure	116	Guleriya-9, Bardiya	2320
Om Prakash Bhaisi Palan Farm	Cattle Manure	118	Guleriya-3, Bardiya	2360
Maddewarti Pashu Palan Farm	Cattle Manure	274	Guleriya-4, Bardiya	5480
Ayush Bhaisi Farm	Cattle Manure	115	Guleriya-11, Bardiya	2300
Nawa Durga Bhaisi Palan Farm	Cattle Manure	121	Guleriya-4, Bardiya	2420

Name of Supplier	Type of Substrate	Number of cows / buffaloes	Location	Supply Capacity (Kg/day)
Manakamana Gai Breeder Farm	Cattle Manure	116	Guleriya-7, Bardiya	2320
Yadav Bhaisi Palan Farm	Cattle Manure	114	Guleriya-11, Bardiya	2280
Ma Gayatri Bhaisi Palan Farm	Cattle Manure	73	Guleriya-11, Bardiya	1460
Prema Bhaisi Palan Farm	Cattle Manure	102	Guleriya-11, Bardiya	2040
Ganesh Bhaisi Palan Farm	Cattle Manure	130	Guleriya-2, Bardiya	2600
Krishna Sar Bhaisi Palan Farm	Cattle Manure	148	Guleriya-3, Bardiya	2960
Jay Shree Kotahi Bhaisi Palan Farm	Cattle Manure	144	Guleriya-9, Bardiya	2880
Jay Shree Bhole Baba Bhaisi Palan Farm	Cattle Manure	95	Guleriya-9, Bardiya	1960
Bindawasini Bhaisi Palan Farm	Cattle Manure	103	Guleriya-4, Bardiya	2060
Chaurasiya Bhaisi Palan Farm	Cattle Manure	113	Guleriya-8, Bardiya	2260
Manakamana Bhaisi Palan Farm	Cattle Manure	157	Guleriya-4, Bardiya	3140
Banjara Bhaisi Palan Farm	Cattle Manure	107	Guleriya-4, Bardiya	2140
Laxmi Gai Farm	Cattle Manure	135	Guleriya-12, Bardiya	2700
Jay Shree Dharana Bhaisi Palan Farm	Cattle Manure	106	Guleriya-7, Bardiya	2120
Shree Krishna Gai Bhaisi Palan Farm	Cattle Manure	68	Guleriya-6, Bardiya	1360
			Total	**65,810**

Source: DFS of Jakhera Urja Tatha Mal Bikas Company Pvt. Ltd.

Addition to this, around 5500 tons per year of press mud will be sourced from two sugar mills, one in Bardiya itself and one located in Nanpara, India mentioned in **Table 7.** This ensures regular supply of the required quantity of substrate for the daily operation of the plant.

Table 7: Availability of Press Mud in the Sub-project area

Name of Supplier	Type of Substrate	Location	Supply Capacity (Tons/year)
Rajapur Sugar and Chemical Industries Pvt. Ltd	Press Mud	Rajapur Municipality, Bardiya, Nepal	2500
Shravasti Kisan Sahkari Sugar Mill	Press Mud	Nanpara Rd, Balha, Uttar Pradesh, India	3000
		Total	**5500**

The sub-project area is located close to major towns such as Gulariya and Nepalgunj, as well as several industries and commercial activities along the East–West Highway. This makes the market for Bio-CNG easily accessible. The surrounding area is also heavily agricultural, ensuring strong demand for organic fertilizer, as farmers prefer good-quality products at reasonable prices. Additionally, the Bardiya–Banke region is an industrial and tourism hub with many hotels and industries, providing further opportunities for the developer to sell Bio-CNG. The list of potential end users for this sub-project is presented in the **Table 8.**

Table 8: List of Potential End-Users in the Sub-project area

S.N	Name of Potential End-users	Distance From Project Site (km)	Daily Consumption Potential (kg)	Area of Use
1	Hotel Siddhartha	28.9	100	Restaurant and Casino Kitchen
2	Soaltee Westend Premier	30.3	100	Restaurant and Casino Kitchen
3	Star Polypipe Industries	33.3	170	Water Tank Roto Moulding
4	Jay Ambe Steels	34.4	100	Staff Mess
5	Ganapati Plasto Industries	28.7	240	Water Tank Roto Moulding
6	Ganapati Food Industries	30.9	200	Furnace Burner
7	Saurabh Oil and Agro Industries	26.1	350	Lentil Drier
8	VMI Group	28.2	500	Metal Melting
	Total	**1,270**	**1760**	

Source: DFS of Jakhera Urja Tatha Mal Bikas Company Pvt. Ltd.

2.9.2. Livestock

The list of farms in the Badhaiyatal Rural Municipality is given in the **Table 9.**

Table 9: Livestock Farm in the Badhaiyatal Rural Municipality

S.N.	Name of Farm	Ward No.	Type of Farm
1	Badhaiyatal Dairy Udhyog	1	Cow & Buffalo Dairy Farm
2	Shiva Ganga Cow Farm	1	Cow Dairy Farm
3	Janajyoti Buffalo Farm	2	Buffalo Milk Farm
4	Bhawani Dairy & Livestock Farm	2	Cow + Buffalo Mixed
5	Kamala Cow & Buffalo Rearing Center	3	Buffalo + Cow Rearing
6	Pragati Dairy Production Center	3	Cow Dairy Production
7	Naya Goreto Buffalo Farm	3	Buffalo Milk Farm
8	Adarsha Cow Farm	4	Cow Dairy Farm
9	Rara Fresh Milk Udhyog	4	Commercial Cow Dairy
10	Shrijana Buffalo Farm	4	Buffalo Milk Farm
11	Lumbini Dairy & Milk Collection Center	5	Cow & Buffalo Mixed
12	Samarpan Buffalo Rearing Farm	5	Buffalo Rearing
13	Bheri Kinara Livestock Farm	5	Cow Dairy Farm
14	Suryoday Cow & Buffalo Farm	6	Cow + Buffalo Mixed
15	Shanti Dairy Udhyog	6	Cow Dairy Farm

S.N.	Name of Farm	Ward No.	Type of Farm
16	Ram Janaki Buffalo Shed	6	Buffalo Farming
17	Sundar Nagar Dairy Farm	7	Cow Dairy Farm
18	Gautam Livestock Dairy	7	Buffalo + Cow Mixed
19	Krishik Dairy Milk Center	7	Cow Dairy Farm
20	Hariyali Buffalo Farming Center	8	Buffalo Milk Farm
21	Janahit Dairy Production Group	8	Cow Dairy Farm
22	Om Shree Cow & Buffalo Farm	8	Mixed Livestock
23	Gaun Sudhar Dairy Cooperative (Various Small Farms)	8	Cow/Buffalo Small-Scale
24	Paluwa Cow Farm	9	Cow Dairy Farm
25	Nepalgunj Corridor Milk Collection Route Farms	9	Small-Scale Dairy Farms
26	Saraswati Buffalo Farm	9	Buffalo Milk Farm
27	Kapil Dairy & Buffalo Rearing Center	9	Cow + Buffalo Rearing
28	Loktantrik Livestock Group Dairy	9	Cooperative Dairy Farm
29	Pashupati Cow & Buffalo Shed	2	Mixed Livestock
30	Deepjyoti Dairy Udhyog	6	Cow Dairy Farm

Source: District Agriculture Development Office (DADO), Bardiya, 2025.

2.10 Potential Pollutants/Emission Resulting from Implementation of the Proposal

Different types of wastes and pollutants are assumed to be produced during the construction and operation phase of the proposed sub-project. Different nature of wastes produced during the construction phase and operation phase are discussed in **Table 10.**

Table 10: Potential Pollutants/Emissions Resulting from Implementation of the Proposal

Pollutant Category	Pollutants/Emissions	Sources
Construction Phase		
Solid Waste	Muck/ Spoil	Excavation and civil construction work for foundation of digester, sump
	Food wastes, polythene, papers etc.	Construction Workforce
Liquid and Semi-Liquid Wastes	Wash out Liquid Wastes,	Aggregate Washing, Wash outs from concrete
	Spent grease, lubricants, spills and leaked petroleum	Vehicles and Generators
Gaseous Emission	Dust, CO_2, CO, NOx, SO_2 and suspended particulate matter	Various excavation processes, crushing and mixing activities, vehicles and diesel generator
Operation Phase		
Solid Waste	Solid slurry production and raw materials	During storage of raw materials and post digestate
Liquid and Semi-Liquid Wastes	Process wastewater after dewatering of post digestate slurry	Biogas production and post digestate management, washing and cleaning
Noise Pollution	Noise level from vehicle movements, pumps	Transportation vehicles, components of plant
Odor Pollution	Foul Odor	Pre-storage of biodegradable raw materials, transportation of feedstock from different locations

CHAPTER III: DESCRIPTION OF EXISTING ENVIRONMENTAL CONDITION

This section describes the existing environmental condition of the sub-project area based on the site-specific information gathered through primary and secondary sources of information. The district and municipality level information of the sub-project is gathered through secondary sources of information. The existing environment related to physical, biological, socio-economic and cultural environment are described below:

3.1 Physical and Cultural Environment

3.1.1 Physiography and Topography

Physiography wise, the sub-project is located in Badhaiyatal Rural Municipality-08, Bardiya District, Lumbini Province of Nepal. The sub-project area lies at an altitude about 112 m above mean sea level. The sub-project will be commissioned in 105,705 sq. ft. (29 Katthas) land which the proponent has owned. The Badhaiyatal Rural Municipality shares the eastern border with Banke District, western border with Gulariya Municipality, northern border with Bansgadhi Rural Municiaplaity and Barbardiya Municiaplaity and southern border with India. Geographically, the sub-project area is located at Latitude 28°10'8.93" N and 81°26'5.70" E Longitude.

3.1.2 Geology and Soil Type

Geologically, the sub-project area lies in the Terai region of western Nepal, which is part of the Indo-Gangetic Plain. The geology mainly consists of recent alluvial deposits brought by the Karnali and Babai river systems. The soil profile includes sandy loam, silt, and clay, with occasional gravel layers. The subsurface is relatively soft and unconsolidated, typical of floodplain and deltaic environments, making it suitable for agriculture but sensitive to erosion and flooding.

3.1.3 Climate

The climate of the sub-project area is sub-tropical and temperature fluctuation in summer and winter ranges from 30°C to 42°C and 6°C to 17°C respectively. The relative humidity ranges from 84 to 87% with estimated average annual rainfall of 2360 – 2375 mm. The maximum rainfall within 24 hours is noted to be 177-175 mm.

3.1.4 Drainage and Hydrology

The sub-project area has flat land with natural small drains and irrigation channels that carry rainwater away during the monsoon season. Most of the surface water flows slowly through fields and joins nearby streams that eventually connect to the Babai or Karnali river systems. During heavy rains, the

area can experience short-term flooding and waterlogging because the ground becomes saturated, and the water table rises. Overall, the drainage and hydrology of the area are shaped by monsoon rainfall, slow-moving surface runoff, and the use of local agricultural drains.

3.1.5 Land Use

The sub-project area consists entirely of **privately owned agricultural land**, and the proposed works will be built fully within this private farmland with crop fields around scattered rural settlements of typical Terai farming landscape.

3.1.6 Air Quality, Water Quality and Noise Levels

There are no instrumentally monitored baseline data on air quality. The sub-project vicinity (around 500 m) is devoid of any industrial activities and is surrounded by agricultural land. There is earthen road to reach the sub-project site and there is not much vehicular movements and industrial pollution in the project vicinity. Water quality in local ponds, wells, and irrigation channels is usually suitable for household and farming use, although it can become muddy during the monsoon season. Noise levels are low throughout the day, mainly coming from farming activities, local vehicles, and community movement, making the area generally quiet and peaceful. However, after the completion and operation of the sub-project, there is possibility of air pollution due to vehicular movement while transporting collected waste from at the proposed land.

3.2 Biological Environment

3.2.1 Vegetation and Forest

The sub-project area has common Terai vegetation with scattered trees, small green patches, and plants around farmland. Since it is completely situated on **private agricultural land** with no significant natural forest cover. The main tree species include Sal (*Shorea robusta*), Sissoo (*Dalbergia sissoo*), Khair (*Acacia catechu*), Neem (*Azadirachta indica*), Mango (*Mangifera indica*), Peepal (*Ficus religiosa*), and Bamboo (*Bambusoideae*). Most of the land is used for farming, so natural forest is limited, with only small patches and roadside trees providing greenery. Most of the land is used for farming, so only small patches of vegetation and local wildlife are present

Two community forests, Manjundi Community Forest and Gijara Community Forest, are present in the wider area, located approximately 4.5 km and 5 km from the sub-project site. They lie outside the project's direct influence zone and are separated by the Maan Khola River, so no impacts on these forest areas and river are anticipated.

3.2.2 Protected Areas.

No protected, rare, or endangered plant species have been reported or observed within the immediate project vicinity based on field observation and consultation with local stakeholders.

3.3 Socio-Economic and Cultural Environment

3.3.1 Demography and Households

The Bardiya district has a total population of 106,326, while Badhaiyatal Rural Municipality holds a population of 1,261. The average household size in Bardiya District is 4.33 compared to 4.08 Badhaiyatal Rural Municipality. The sex ratio shows that the number of females is higher than the number of males in district, rural municipality and ward no. 8. **Table 11** represents the demographic characteristics of Bardiya, Badhaiyatal Rural Municipality and Ward no. 8 of Badhaiyatal Rural Municipality.

Table 11: Demographic Information of Sub-Project District, Rural Municipality & Ward Level

Demographic Parameter	Bardiya District	Badhaiyatal RM	Ward No. 8
Area (sq.km.)	2025	115.19	9.98
Total households	106,326	1261	1535
Total Population	459,900	52,818	6,141
Male (%)	48.9	46.2	46.0
Female (%)	51.5	53.8	54.0
Sex ratio (M:F)	95.59	85.76	85.30
Average HH Size	4.33	4.08	4.0

(Source: CBS, 2021)

3.3.2 Population by Age Group in District and Rural Municipality

The population by age group in Bardiya District, Badhaiyatal Rural Municipality and Ward No. 8 are presented in the **Table 12.**

Table 12: Population by Age Group in District, Rural Municipality & Ward Level

SN	Age group	Bardiya District		Badhaiyatal RM		Ward No. 8	
		Both sex	%	Both sex	%	Both sex	%
1	0-14	120,994	26.2	14,895	28.2	1642	26.7
2	15 -64	309,183	67.4	33,962	64.3	3,519	57.3
3	65+	29,357	6.39	3,750	7.1	480	7.8
Total		**459,900**	**100**	**52,818**	**100**	**6,141**	**100**

(Source: CBS, 2021)

3.3.3 Caste and Ethnicity in District and Rural Municipality

The caste and ethnic composition of Bardiya District and Badhaiyatal Rural Municipality shows a diverse social structure, with Tharu being the largest group in both areas (50.7% in Bardiya and 36.2% in Badhaiyatal). Other major groups include Kshetri, Brahmin Hill, and Bishokarma, along with notable populations of Magar, Musalman, Yadav, Barhaman/Terai, Thakuri, and Pariyar is presented in **Table 13**.

Table 13: Ethnic Distribution of the Sub-Project District and Rural Municipality

SN	Caste	Population (%)	
		Bardiya District (%)	Badhaiyatal RM (%)
1	Tharu	50.7	36.2
2	Brahmin Hill	7.1	8.9
3	Magar	3	5.2
4	Musalman	2.9	3
5	Yadav	2	2.4
6	Kshetri	12.8	14.6
7	Bishokarma	6.3	12
8	Barhaman/Terai	1.06	1.8
9	Thakuri	2.3	2.6
10	Pariyar	1.9	2.8

(Source: CBS, 2021)

3.3.4 Languages

The language distribution in Bardiya District and Badhaiyatal Rural Municipality shows a multilingual community dominated by Nepali and Tharu speakers. In Bardiya, Tharu is the most spoken language (50.4%), followed by Nepali (36.3%) and Adavi. In contrast, Badhaiyatal RM has a higher proportion of Nepali speakers (50.7%), while Tharu and Adavi also form significant groups as shown in **Table 14.**

Table 14: Language Distribution in the Sub-Project District and Rural Municipality

SN	Languages	Population	
		Bardiya District (%)	Badhaiyatal RM (%)
1	Adavi	9.8	8.8
2	Nepali	36.3	50.7
3	Tharu	50.4	36.0
4	Magar Dutt	0.6	1.01
5	Achhami	0.3	-
6	Urdu	0.2	-
7	Hindi	0.6	1.8
8	Bhojpuri	0.4	
9	Newari	-	0.5
10	Gurung	0.2	
	Total	**100**	**100**

(Source: CBS, 2021)

3.3.5 Religious and Cultural Environment

The religious and cultural environment around the proposed sub-project area in Badhaiyatal, Bardiya District, is primarily influenced by the local traditions and practices of the rural Terai communities. The site itself does not contain any significant cultural or historical monuments. However, one notable site is the **Ranipur Durga Temple**, which serves as a place of worship and local gathering. The surrounding villages observe traditional festivals, predominantly **Hindu festivals** such as Dashain, Tihar, and Teej, reflecting the cultural practices of the majority population. These religious and cultural

practices contribute to the social cohesion of the local communities, although they are not directly impacted by the proposed sub-project location.

3.3.6 Literacy Status in District and Rural Municipality

The literacy status of Bardiya District and Badhaiyatal Rural Municipality shows a similar educational pattern, with the majority of the population being literate. In Bardiya District, 76.9% of people can read and write, closely matched by 76.7% in Badhaiyatal RM. A very small portion of the population in both areas can read only, accounting for 1.1% in the district and 1.4% in the rural municipality. Likewise, those who are unable to read and write make up 22.0% of Bardiya District and 21.8% of Badhaiyatal RM. **Table 15** indicates comparable literacy levels across the district and the rural municipality.

Table 15: Population of 5 Years of Age and Over by Literacy Status

Literacy Index	Bardiya District (%)	Badhaiyatal RM (%)
Can Read & Write	76.9	76.7
Can read only	1.1	1.4
Can't read and write	22.0	21.8
Total	**100**	**100**

(Source: CBS, 2021)

3.3.7 Drinking Water Facility in District and Rural Municipality

Groundwater-based systems, particularly tube wells and hand pumps, remain the dominant and most widely used drinking water sources in both the district and RM, accounting for 69.4% of households in Bardiya and 70.6% in Badhaiyatal RM. At the ward level (Ward No. 8), drinking water supply is predominantly groundwater-based, with tube wells and hand pumps used by 61.2% of households.
Only a limited percentage of households as shown in **Table 16** use jar or bottled water, wells (covered or uncovered), spout water, river/stream water, or other minor sources, each contributing less than 2% of total water use.

Table 16: Drinking Water Sources in Sub-Project District, Rural Municipality and Ward Level

Source of Drinking Water	Bardiya District (%)	Badhaiyatal RM (%)	Ward No. 8 (%)
Tap/piped (Inside compound)	18.9	17.2	6.5
Tube well/hand pump	69.4	70.6	61.2
Tap/Piper (outside compound)	9.3	10.5	27.5
Jar/Bottle	0.7	1.06	3.9
Under covered Well/Kuwa	0.5	0.4	0.2
Spout Water	0.5	0.4	0.1
Covered Well/Kuwa	0.2	0.03	-
River/Stream	0.00	0.02	0.2
Other	0.4	0.1	0.2
Total	**100**	**100**	**100**

(Source: CBS, 2021)

a. Sanitation Status in District and Rural Municipality

Most households in Bardiya District and Badhaiyatal Rural Municipality use pit toilets, accounting for 48.2% of households in Bardiya and a higher 57.0% in Badhaiyatal RM. Flush toilets connected to septic tanks are the second most common type. However, a small number of people, around 3–2% still do not have any toilet at all, showing that while most rely on on-site toilets, lacking proper sanitation.

At the ward level (Ward No. 8), most households use flush toilets with septic tanks (52.57%), followed by pit toilets (45.02%). Very few households lack toilet facilities, showing comparatively better sanitation conditions at the ward level. The types of toilets in the district, Rural Municipality and ward no. 8 are presented in **Table 17**.

Table 17: Sanitation Status in Sub-Project District, Rural Municipality and Ward Level

Types of Toilets	Bardiya District (%)	Badhaiyatal RM (%)	Ward No. 8 (%)
Without Toilet	3.5	2.4	0.59
Flush Toilet (Septic tank)	44.0	36.9	52.57
Pit Toilet	48.2	57.0	45.02
Flush Toilet (Public Sewerage)	3.8	3.5	1.56
Public Toilet	0.5	0.2	0.26
Total	**100**	**100**	**100**

(Source: CBS, 2021)

b. Energy for Cooking in District and Rural Municipality

Most households in Bardiya District and Badhaiyatal RM still use traditional fuels for cooking. Firewood is the most common cooking fuel, used by 63.5% of households in Bardiya and 53.2% in Badhaiyatal RM. LP gas is also widely used, especially in Badhaiyatal (40.1%) compared to Bardiya (30.6%).

At the ward level (Ward No. 8), most households use LPG for cooking (63.45%), followed by firewood (26.29%). A small but notable proportion of households (9.90%) use biogas, indicating growing adoption of renewable and cleaner energy sources in the area. The overall **Table 18** shows that although traditional fuels such as firewood are still widely used, cleaner energy sources like LP gas and biogas are gradually becoming more common, particularly at the local level.

Table 18: Energy Source for Cooking

Energy for Cooking	Bardiya District (%)	Badhaiyatal RM (%)	Ward no. 8 (%)
Firewood	63.5	53.2	26.29
Kerosene	-	0.01	0.07
LP Gas	30.6	40.1	63.45
Cow Dung	0.1	0.1	-
Biogas	4.8	5.8	9.90
Electricity	0.9	0.7	0.39

Energy for Cooking	Bardiya District (%)	Badhaiyatal RM (%)	Ward no. 8 (%)
Others	-	0.02	-
Total	**100**	**100**	**100**

(Source: CBS, 2021)

c. Energy for Lighting in District and Rural Municipality

The sources of lighting in Bardiya District and Badhaiyatal RM indicate that electricity is the primary source in almost in all households**,** used by 95.7% of households in Bardiya, 94.9% in Badhaiyatal RM and 98.9 in Ward no. 8. Other sources like kerosene, biogas, solar, and other sources account for a small portion of lighting needs as shown in **Table 19.**

Table 19: Energy Source for Lighting

Energy Source for Lighting	Bardiya District (%)	Badhaiyatal RM (%)	Ward no. 8 (%)
Electricity	95.7	94.9	98.9
Kerosene	1.3	2.0	0.3
Biogas	0.0	0.02	0.0
Solar	1.9	1.9	0.4
Other	1.2	1.1	0.26
Total	**100**	**100**	**100**

(Source: CBS, 2021)

CHAPTER IV: REVIEW OF PLANS/POLICES/LEGISLATIONS AND GUIDELINES

Government of Nepal (GoN) has adopted various policies, acts, regulations and guidelines to ensure the integration of development with the environmental conservation. In addition, for implementation of SREP large biogas sub-projects, EMF and SMF are prepared for guiding overall safeguard implementation. The ESIA will be guided by the requirements and provisions of the following acts, rules and guidelines as applicable. The descriptions of the legislations attracted by this project are provided in ***Annex 3***.

The Constitution

- **The Constitution of Nepal**: Establishes the legal framework for governance, fundamental rights, environmental protection, and sustainable development in Nepal.

Plans and Policies

- **Fifteenth Plan FY 2076/77–2080/81**: National development plan focusing on economic growth, social inclusion, and sustainable resource management.
- **Sixteenth Plan FY 2081/82–2085/86**: Upcoming national plan emphasizing renewable energy, environmental sustainability, and infrastructure development.
- **Fourteenth Plan 2013–2016**: Previous development plan targeting poverty reduction, energy access, and rural development.
- **Rural Energy Policy, 2006**: Promotes renewable energy solutions in rural areas to improve energy access and reduce reliance on traditional fuels.
- **Renewable Energy Subsidy Policy, 2016**: Provides financial incentives for adopting renewable energy technologies to encourage sustainable energy use.

Acts and Rules

- **Environment Protection Act, 2076 and Environment Protection Rule, 2077**: Legal provisions for environmental conservation, pollution control, and sustainable resource management.
- **Local Government Operation Act, 2074 (2017)**: Defines powers and responsibilities of local governments, including environmental governance.
- **Water Resource Act, 1992**: Regulates the use, management, and protection of water resources in Nepal.
- **Solid Waste Management Act, 2011 & Regulation, 2013**: Establishes rules for proper handling, collection, and disposal of solid waste.
- **Child Labor (Prohibition and Regulation) Act, 2000**: Prohibits hazardous child labor and promotes safe working conditions for minors.

- **Labor Act, 2074 (2017)**: Governs labor rights, workplace safety, and employment standards in Nepal.

Guidelines/Framework

- **National EIA Guidelines, 1993**: Provides procedures for conducting environmental impact assessments for projects in Nepal.
- **SREP Environment Management Framework (EMF), 2013**: Offers guidance for minimizing environmental risks in renewable energy projects.
- **SREP Social Management Framework (SMF), 2013**: Provides measures to address social impacts, including community engagement and benefits sharing.

Standards

- **National Ambient Air Quality Standards, 2003**: Sets permissible limits for air pollutants to protect public health.
- **Nepal Vehicle Mass Emission Standards, 1999**: Defines emission limits for vehicles to reduce air pollution.
- **National Ambient Sound Quality Standard, 2012:** Establishes acceptable noise levels in different areas to prevent noise pollution.
- **Generic Standard for Effluents to be Discharged in Inland Surface Water, 2003**: Regulates water pollution by controlling effluent quality.

International Policies and Conventions

- **World Bank Safeguard Policy (OP 4.01 Environment Assessment):** Requires environmental assessment for projects financed by the World Bank.
- **World Bank Safeguard Policy (OP 4.10 Indigenous Peoples):** Protects rights and interests of indigenous peoples affected by development projects.
- **World Bank Safeguard Policy (OP 4.11 Physical Cultural Resources):** Ensures conservation of cultural and historical resources during projects.
- **World Bank Safeguard Policy (OP 4.12 Involuntary Resettlement):** Provides guidance to mitigate social and economic impacts on displaced communities.
- **Convention on Biodiversity (CBD), 1993:** Promotes conservation of biodiversity and sustainable use of biological resources.
- **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973:** Regulates international trade of endangered species to prevent exploitation.
- **Convention (No. 169) Concerning Indigenous and Tribal Peoples, 1989:** Protects the rights and cultures of indigenous and tribal communities.

CHAPTER V: IMPACT ASSESSMENT

This section provides the predicted impact of the implementation of the proposal on environment and community. Every development project comes with some adverse impact along with its community benefit. The main purpose of conducting environmental and social assessment is to enhance the beneficial impacts and to reduce potential adverse impacts. This section distinctly categorizes the envisaged beneficial impacts as well as adverse impacts in the subsequent subsections.

The adverse impacts are broadly categorized into physical, biological and socio-economic environment and assessed with extent, magnitude and duration of the predicted impacts. Moreover, the impacts have been predicted in terms of their magnitude of significance (minor, moderate and high), extent (site specific, local and regional) and duration (short, medium and long term). Most of the identified impacts have been quantified to the extent possible. The possible impacts from the proposal during the construction and operation phases are presented in the succeeding sections.

5.1 Beneficial Impacts

5.1.1 Construction Phase

a. Employment Opportunity to Locals

The sub-project will provide a wide range of employment opportunity for unskilled, skilled and semi-skilled labors. These opportunities will enable local people to generate wage based income, thereby supporting livelihood at the community. Total 20-25 skilled labors and 100 unskilled labors will be required during construction and operational phase. Preference will be given more to women and disadvantaged groups, based on their skills and experience. The income earned by workers will contribute to the local economy and support small businesses and other activities in the area. *The impact will be direct, high in magnitude, local in extent and medium term in duration.*

b. Boost in the Local Economy

The flow of labors will increase in the sub-project area during the construction period. Increase in the number of people shall increase economic activities within the proposed sub-project area, as the labors require accommodation, foods and others from the nearby market. Thus, the construction activities can help open new stalls and develop new shops and lodges near the construction sites. Various farm-based enterprises including a wide range of agricultural and livestock products will gain momentum because of increased demand by labors during construction period. This will increase local trade and business in the area. *The impact will be direct, high in magnitude, local in extent and medium term in duration.*

a. Enhancement in Technical Skills

The biogas plant construction will not only provide employment opportunities but also helps in providing the skills and technical expertise to the local labors. Unskilled Labor will be trained which will enhance their skills and capability in working like construction of walls, fitting of iron frames, and other required items necessary for the Biogas Plant construction. These skills will not only benefit the local workers by providing employment opportunity but also contributes to local human resource development in the sub-project area. The skills will also help unskilled laborers for their self-dependence in the future. *The impact will be indirect, moderate in magnitude, local in extent and long term in duration.*

b. Enterprise Development and Commercialization

During the construction period, different types of commercial activities will emerge in order to meet the demand of labor groups, construction crew and project team. For meeting these needs, enterprises like food and tea shops, groceries, lodges and restaurants will be developed for serving large numbers of people. Demand on the local production like pulses, milk, meat, vegetables, fruits etc. will increase which may provide added impetus for local production and marketing. Such benefits may contribute to enterprise development which often continues to entrench beyond construction period. *The impact will be direct, high in magnitude, local in extent and medium term in duration.*

c. Increase/ Appreciation of land value

The construction of sub-project which will lead to appreciation of land values particularly near the market and settlement areas. The land price would increase due to the availability of reliable transportation facilities. There will be rapid increase in the commercial production of agricultural crops due to road accessibility which is also a major factor to raise the land value. This activity would likely uplift the economic condition of the local people. *This impact will be indirect, medium magnitude, local in extent and long term in nature.*

5.1.2 Operation Phase

a. Employment Opportunity to Locals

For smooth operation of the proposed biogas plant, about 10 skilled regular employees and 12 skilled field employees are required. The regular employees will work in the plant site and field employees will work for marketing of the Bio-CNG and organic fertilizer. For the daily operation of the biogas plant, biogas operators will be employed in different units of the plant. The project will employ the locals as possible, depending on their skills and qualification, at different sectors and also encourage the establishment of small businesses in the surrounding for selling dry fertilizers to the nearby community. This will ultimately help to uplift the economy of the sub-project area as well as the nearby community. *The impact will be direct, high in magnitude, local in extent and long term in duration.*

b. Promotion of Renewable Energy Technology and Availability of Cleaner Thermal Energy

At present, there are very few large-scale biogas plants operating in Nepal. The proposed project will utilize the organic waste from livestock farms to generate Bio-CNG and organic fertilizers and will serve as an example of renewable energy technology. During the biodegradation of the organic waste, Methane (CH_4) is released which has 28- 36 times higher global warming potential in comparison to CO_2 over 100 years-time period. The installation of biogas plant will directly reduce the emissions of methane gas such process. In addition, thus produced biogas is expected to replace fossil fuels (LPG). *The impact will be direct, high in magnitude, local in extent and long term in duration.*

c. Reduction in Pollution and availability of fertilizer to locals

As biogas becomes available as a clean cooking and lighting fuel, it replaces fossil fuels. This substitution reduces the carbon footprint and lowers the emission of harmful pollutants such as sulfur dioxide, nitrogen oxides, and particulate matter, leading to improved air quality and a healthier environment.

The byproduct of biogas production, known as digestate, is a nutrient-rich organic fertilizer. This digestate contains essential nutrients such as nitrogen, phosphorus, and potassium, which are vital for plant growth. Unlike synthetic fertilizers, digestate is environmentally friendly and improves soil health over time. *The impact will be direct, high in magnitude, local in extent and long term in duration.*

d. Skill Development of Locals

The locals involved during the operation phase will get to learn skills and techniques required to run and manage the biogas plant. The technology provider will provide complete technical skill training to staff for various aspects of running the plant during its operation period. This will help them to build their capacity and can even use these skills elsewhere in a near future. *The impact will be direct, high in magnitude, local in extent and long term in duration.*

e. Sustainable Waste Management

The proposed large biogas plant is designed to manage approximately 65 TPD of organic waste. About 60 TPD of waste from cow/buffalo farm and 5 TPD of press mud, waste from sugarcane industry will be utilized. The produced Bio-CNG will be distributed in industries which will reduce the dependency on LPG cylinders as well as also helps to minimize the degradation of forest products like firewood. *The impact will be direct, high in magnitude, local in extent e and long term in duration.*

5.2 Adverse Issues

5.2.1 Physical Environment

5.2.1.1 Construction Phase

a. Change in Land use

The land use pattern of sub-project area is agricultural land. The land intended for the sub-project is privately owned by the developer, encompassing approximately 29 Katthas. It is currently used for cultivating seasonal crops. The plant will be developed within the 20.43 Katthas. There will be minimal or no significant impact on the land use pattern with the implementation of the proposed biogas plant. Additionally, no trees will be cut during the construction and operational phase of the sub-project, therefore; adverse impact is not envisaged. *The impact direct, low in magnitude, site-specific in extent and short term in duration.*

b. Issues Related to Soil Pollution

Another impact that could result from construction activities is depletion of soil quality. The construction materials such as cement, contain certain level of chemicals which when mixed with soil can deplete its fertility over the time. Besides, haphazard disposal of construction debris can cause formation of muddy ditches during rainy season which would possibly hinder the staffs and local passers to walk comfortably. Other chemicals like grease and petroleum fuel if spilled will also reduce fertility of soil in the sub-project site. *The impact direct, low in magnitude, site specific in extent and short term in duration.*

c. Increase in Noise Level due to Construction Activities

The operation of various machineries during the construction period, such as excavators, loaders, and moving vehicles, will generate noise within the sub-project site and its surrounding vicinity. However, this noise pollution is limited mainly to the construction phase and occurs only during active work hours. While nearby communities are unlikely to be significantly affected, the increased noise levels are most likely to impact construction workers who remain within the work zone. *The impact direct, moderate in magnitude, site-specific in extent and short-term in duration*.

d. Issues related to Air Pollution

The construction activities such as operation of vehicles to transport the construction materials, excavation, mixing to aggregates generate dust, smoke, emission of CO_2 and other harmful gases. Such activities will be limited mainly to the construction phase and will occur only during active work hours. However, dust related impact are envisioned which can affect nearby scattered settlement due to the increased traffic during the transportation of construction materials to the subproject site. *The impact direct, low in magnitude, site-specific in extent and short term in duration.*

e. Issues Related to Water Pollution

Percolation of wastewater generated from washing of construction materials, spillage of lubricants, grease, petroleum fuels and percolation of black and grey water generated from construction camp could contaminate groundwater and nearby irrigation channel. The local people depending on groundwater source for running various domestic purposes and nearby irrigation channels for farming could be affected from such activities. However, there do not seem much construction activities as most of the construction components are prefabricated. *The impact on water sources will be considered as direct, low in magnitude, local in extent and short term in duration.*

f. Issues Related with Spoil Disposal and Stockpiling of Construction Materials

It is likely to have construction debris and stockpiles of construction materials in any construction activities. But haphazard disposal of such materials causes disturbance in aesthetic beauty of the surrounding area and besides, construction material such as cement contains certain level of chemical which when mixed with soil/agricultural field can reduce its fertility. In addition, such activities increase suspension of dust during windy season and formation of muddy surface during rainy season. However, the sub-project is small scale and most of the components are prefabricated. So, only small quantity of construction material is required, and only small quantity of construction debris will be generated which would not cause significant impact in the sub-project vicinity. The spoils will be generated from excavation of feeding pits and lagoons but will be consumed in the area for land labeling and land development. *The impact will be considered direct, low in magnitude, site-specific in extent and short term in duration.*

g. Road safety risks due to increased vehicle movement and construction activities

It is likely that construction activities and the associated movement of vehicles will increase road safety risks for workers, pedestrians, and local communities. Increased trips by trucks, heavy machinery, and construction vehicles may cause temporary congestion and elevate the risk of collisions. In addition, temporary road diversions, uneven surfaces, and construction zones may pose hazards, especially to pedestrians and cyclists. However, the sub-project is small in scale, and vehicle movement is limited. Traffic management measures such as proper signage, speed limits, designated vehicle routes, and flag persons will be implemented to reduce risks. *Therefore, the impact is considered direct, low in magnitude, site-specific in extent, and short term in duration.*

5.2.1.2 Operation Phase

a. Issues Related to Management of Raw Materials Storage and Post-digestate Slurry

The by-product generated from the anaerobic digestion to produce biogas is organic waste. They are mostly semi solid slurry and liquid slurry, generally known as digestate. These digestate has high BOD, nitrogen content and can contaminate land and water if not managed properly. Besides the digestate, the storage of raw substrate which is in large amount can also create nuisance. If these raw feeds are not stored in a proper roofed place with sealed ground, leaching of such substrate can possibly

contaminate groundwater especially during rainy season. *The impact will be direct, moderate in magnitude, local in extent and long-term in duration*.

b. Issues Related to Foul Odor during Storage of Raw Material and Post-digestate

The raw materials to be used for biogas production are organic waste. All of these wastes are stored for maximum of 1-2 days period before they are fed into biogas plant. Open storage of such large amount of substrate could cause foul odor in the sub-project area and would attract flies and vector diseases. Similarly, haphazard disposal of digestate and absence of proper composting system will also create foul smell. However, the foul odor might not possibly impact the surrounding vicinity as the nearest settlement is 4 km away. So, the receptors of impact are apparently the in-house staffs. *The impact will be direct, moderate in magnitude, site-specific in extent and long-term in duration*.

c. Issues Related to Extraction of Water for Meeting Demand

The water required to operate the sub-project is 50000-60000 liters per day which will be sourced from ground water. The sub-project site is mostly agricultural open land and has greater availability of groundwater recharge zone so the extraction of groundwater will not impact significantly on groundwater depletion. *The impact will be direct, low in magnitude, local in extent and long term in duration.*

d. Management of Wastewater from Digested Slurry

The digested slurry produced from anaerobic digestion is proposed to be used as compost. Solid Liquid separator will be used to separate the digested slurry into liquid slurry and solid manure. The semi-solid slurry will be further treated to make dry compost while liquid slurry will be re-circulated in the digester. The remaining liquid slurry, after the recirculation, is proposed to be sold to local farmers as per demand basis. The liquid effluent is treated in the lagoon pond which would decrease the BOD, total suspended solid and turbidity of the liquid effluent. *The impact due to this activity will be direct, low in magnitude, site specific in extent and long-term in duration.*

e. Impact Associated with Collection and Transportation of Waste from Source to Sub-Project Location

The collection and transport of feed to the sub-project location may create foul smell along the transport route. There is also a possibility of dropping down of waste throughout the route due to improper transportation activity and overloading of waste in the vehicle. In addition, the vehicle will also emit gaseous pollutants such as CO_2, SO_2 in the atmosphere. The collection and transportation of waste can lead to increased traffic and associated emissions from the vehicles used. This can contribute to air pollution and congestion in the areas surrounding the biogas plant. Frequent movement of heavy waste collection vehicles can cause wear and tear on local roads and infrastructure. *The impacts to such activities will be direct, moderate in magnitude, local in extent and short-term in duration.*

f. Increase in Noise Level from Plant Operation

The noise is generated from various components to operate the plant such as agitators, pumps, substrate feed loaders, etc. Such operational activity can increase surrounding noise level greater than 85 dB. According to occupational safety standards, exposure to noise at or above **85 dB (A)** over an 8-hour workday can affect hearing, and the maximum allowed limit is **90 dB (A)** (osha.gov). If workers are exposed for long periods without protection, it can cause temporary hearing loss, annoyance among working staffs if exposed for long time. If proper mitigation is followed such impacts can be minimized easily. *The impact will be direct, low in magnitude, site-specific in extent and long-term in duration.*

g. Gas Leakage and Associated Impacts including Fire Hazard

The biogas/methane is highly flammable and a naked flame can easily catch fire if leaked. This will ultimately cause loss of life and property. Moreover, methane emissions contribute significantly to greenhouse gas effects, as methane has a Global Warming Potential (GWP) about 28 times higher than that of carbon dioxide over a 100-year period. *The impact due to gas leakage will be direct, moderate in magnitude, site-specific in extent and long-term in duration*.

h. Flood Hazard

The sub-project area in Badhaiyatal is located on a flat alluvial plain, which makes it prone to seasonal flooding, especially during the monsoon months from June to September. Heavy rainfall can cause waterlogging in low-lying agricultural fields, and nearby rivers and drains, including tributaries of the Karnali river, may overflow. While the area generally drains through small channels and irrigation canals, sudden heavy rains or high river flows can temporarily flood farmland and affect local roads and settlements. Therefore, proper drainage planning is important to reduce flood risks. *The impact will be direct, low in magnitude, local in extent and short term in duration.*

i. Issues with Drainage Management

The sub-project area faces several drainage management issues due to its flat terrain and agricultural land use. During the monsoon, water tends to accumulate in low-lying fields, causing temporary waterlogging. Existing small drains and irrigation channels are often narrow, poorly maintained, or clogged, which reduces their capacity to carry runoff efficiently. Additionally, lack of proper stormwater management and sedimentation from farmland can block natural drainage paths. These issues can lead to mismanage surface water effectively during heavy rains. Similarly, drainage is necessary to manage wastewater generated from cleaning the plant units and to channelize the liquid effluent after decantation to avoid contamination of nearby water bodies and groundwater as these wastes are highly pathogenic. *The impact will be direct, moderate in magnitude, local in extent and long term in duration.*

5.2.2 Biological Environment

5.2.2.1 Construction Phase

a. Loss of Vegetation

The proposed biogas plant will be constructed on the designated agricultural land owned by the project proponents. The livelihoods of local farmers will remain unaffected, as they will have employment opportunities during both the construction and operational phases of the plant. The sub-project does not involve the felling of any trees; therefore, no significant impacts on the biological environment are anticipated. *The impact will be direct, low in magnitude, site-specific in extent and short term in duration*.

5.2.2.2 Operation Phase

a. Loss of Greenery in the Sub-Project Periphery

During operation, the biogas plant is not expected to cause major disturbance to the surrounding environment, as it will be built on a clearly defined land area. However, activities such as handling substrate, vehicle movement, accidental spills, or emissions of biogas and digestate may affect nearby plants. For example, nutrients like nitrogen, phosphorus, and other trace elements in the digestate may deposit on soil or plants, altering soil conditions and potentially harming sensitive vegetation. Dust and residue from operations may also settle on leaves and temporarily reduce plant growth. *The impact will be direct, moderate in magnitude, site-specific in extent and long term in duration*.

5.2.3 Socio-economic and Cultural Environment

5.2.3.1 Construction Phase

a. Occupational health and safety of workers

During the construction phase, the construction work force is expected to expose to a number of constructions related health hazards. The construction fugitive emissions, noise, and physical injury are some of the occupational health issues for construction workforce. Moreover, working in height, confined space and hazardous environment are other potential threats to workers. *The impact will be direct, high in magnitude, site-specific in extent and short term in duration*.

b. Pressure on Existing Infrastructure and Community Resources

The Construction activities generally cause pressure on community water supply system, increase in solid waste generation due to increase in construction workforce, etc. Since the project construction period is only few months long i.e. 8 months and construction workers are in limited numbers, there will be very negligible pressure in utilities in the community. Moreover, the sub-project is going to use deep boring water in its own boundary so there will be no any pressure on community for water supply. Hence, this impact is not envisaged.

The construction of a biogas plant typically involves a significant increase in the movement of construction vehicles, including heavy machinery, delivery trucks, and worker transport. This can lead to traffic congestion, particularly on narrow or previously low-traffic access roads. *The impact will be direct, low in magnitude, site-specific in extent and short term in duration.*

c. Health and Sanitation Related Issues

During the construction phase, the workers are exposed to various kind of machineries which if mishandled can cause injuries. In addition, nearby locals especially children can also get in accident around the sub-project area. *The impact will direct, moderate in magnitude, local in extent and short-term in duration.*

d. Labor Influx and Associated Impacts in the Local Community

During the development of the sub-project, a diverse workforce will be employed, potentially leading to social conflicts within the community. However, during the construction phase, the project will employ 20-25 skilled laborers and approximately 100 unskilled laborers, causing minimal community disturbances. Due to the limited number of workers and the short construction period, the impact of labor influx on the local community is expected to be negligible. *The impact will be direct, low in magnitude, site-specific in extent and short term in duration.*

e. Involuntary Land Acquisition and Displacement Issue

The proposed land for the construction and implementation of the biogas plant is owned by the developer. Hence the involuntary land acquisition and displacement issue is not applicable for this project.

f. Grievances Management

The grievances such as low agricultural yield and aesthetic degradation from haphazard disposal of construction debris and improper management of construction materials could be raised from the community. The mishandling of such grievances could invite social demonstration, opposition and conflict. *The impact will be direct, moderate in magnitude, site-specific in extent and long term in duration.*

g. Sexual Exploitation Abuse and Sexual Harassment

Construction workers and other concerned stakeholders may have complaints regarding sub-project activities and the behavior of sub-project staff and workers. Additionally, there may be incidents of gender-based violence (GBV), sexual exploitation, and harassment among workers, sub-project staff, and local people. The large influx of labor in the sub-project area during the construction phase poses a risk related to sexual exploitation and abuse/sexual harassment (SEA/SH). The interaction between workers and community members could lead to increased risks of GBV in the local communities. Therefore, effective and timely mitigation measures must be implemented to address and mitigate the potential risks of SEA/SH and abusive behaviors between sub-project-related staff and the local population. *The impact will be direct in nature, moderate in magnitude, local in extent and short term in duration.*

h. Gender discrimination and child labour

Male and female workers may be paid unequally for the same or similar works. Similarly, contractor may select male and female workers for selective works rather than the capacity of individual workers. Such gender discrimination on works and pay scale may create dispute at workplace and hindrance on progress of works. Similarly, there is probability of using children in the subproject as cheap construction labour. *The impact will be direct in nature, moderate in magnitude, site specific in extent and short term in duration.*

i. Stakeholder Engagement and information disclosure

Stakeholder engagement and information disclosure is very important for the successful implementation of the proposed subproject. Avoiding or evading the stakeholders on proposed subproject activities may hamper the progress and sustainability of the subproject. Likewise, if information regarding the subproject is not shared with concerned stakeholders and locals, it can also create problem in subproject implementation and sustainability. *The impact will be direct in nature, high in magnitude, local in extent and long term in duration.*

5.2.3.2 Operation Phase

a. Issues of road safety

Inadequate provisions of road safety measures such as road safety signals, lack of enforcement of traffic rules during operation period may invite accidents. *Impact is direct, high magnitude, local in extent, long-term in nature.*

b. Issues Related to Occupational Health and Safety

The workers are prone to get infected from various diseases as they are required to handle organic waste materials and slurry, during the operation phase. The most common injuries occur due to mishandling of machineries leading to fire hazard. The workers are also exposed to noise from operation of biogas plant. Working safety measures shall be executed by the developer to workers providing ample numbers but not limited to helmets, boots, gloves and masks while working with the biogas plant. Along with the PPEs, first aid facilities for the labors will also be provided. Awareness programs on the use of PPEs to labors shall also be conducted. Without proper safety measures, prolonged exposure to such activities can cause long term health hazard. *The impact will be direct, high in magnitude, site-specific in extent and long-term in duration*.

c. Issues Related with Health and Sanitation in and around project site

The operation of biogas plant consists of handling of organic waste like cow dung which might be pathogenic to some extent. Haphazard disposal and improper management can cause increase in vector borne diseases and can spread out to nearby communities that can create agitation among the locals and oppose the sub-project. *The impact will be direct, high in magnitude, site-specific in extent and long-term in duration*.

d. Inflow of people in the Sub-project area

The workers may hinder the local culture and traditional activities of local people which might create debate, quarrel and misunderstandings in some cases. Similarly, due to unique nature of renewable energy industry, different people from diverse society may also visit the sub-project site. *The impact will be direct, moderate in magnitude, site-specific in extent and long term in duration*.

e. Grievances from nearby Local Communities

The grievances such as foul odor, threat of disease, haphazard disposal of digestate are few grievances that could be raised from the community. The mishandling of such grievances could invite social demonstration, opposition and conflict. *The impact will be direct, moderate in magnitude, local in extent and long-term in duration*.

The summary of impact prediction and its evaluation is presented in **Table 20.**

Table 20: Summary of Impact Prediction

Impact	Direct/Indirect Impact	Magnitude	Extent	Duration	Significance
Beneficial Impact					
Construction Stage					
Employment Opportunities to locals	Direct	H (60)	L (20)	MT (10)	90 Very Significant
Boost in Local Economy	Direct	H (60)	L (20)	MT (10)	90 Very Significant
Enhancement in Technical Skills	Indirect	Mo (20)	L (20)	LT (20)	60 Significant
Enterprise Development and Commercialization	Direct	H (60)	L (20)	MT (10)	90 Very Significant
Increase/Appreciation of land Value	Indirect	Mo (20)	L (20)	LT (20)	60 Significant
Operation Stage					
Employment Opportunities to Locals	Direct	H (60)	L (20)	LT (20)	100 Very Significant
Promotion of Renewable Energy Technology and Availability of Cleaner Thermal Energy	Direct	H (60)	L (20)	LT (20)	100 Very Significant
Reduction in Pollution and availability of fertilizers	Direct	H (60)	L (20)	LT (20)	100 Very Significant
Skill Developments of locals	Direct	H (60)	L (20)	LT (20)	100 Very Significant
Sustainable waste management	Direct	H (60)	L (20)	LT (20)	100 Very Significant

Impact	Direct/Indirect Impact	Magnitude	Extent	Duration	Significance
Adverse Impacts					
Physical Environment					
Construction Phase					
Change in Land Use	Direct	Lo (10)	S (10)	ST (5)	25 Insignificant
Issues related to Soil Pollution	Direct	Lo (10)	S (10)	ST (5)	25 Insignificant
Issues due to increase in Noise level due to construction	Direct	Mo (20)	S (10)	ST (5)	35 Insignificant
Issues related to Air Pollution	Direct	Lo (10)	S (10)	ST (5)	25 Insignificant
Issues related to water pollution	Direct	Lo (10)	L (20)	ST (5)	35 Insignificant
Issues related to spoil disposal and stockpiling of construction materials	Direct	Lo (10)	S (10)	ST (5)	25 Insignificant
Road safety risks due to increased vehicle movement and construction activities	Direct	Mo (20)	L (20)	ST (20)	60 Significant
Operation Phase					
Issues Related to Management of Raw Materials Storage and Post-digestate Slurry	Direct	Mo (20)	L (20)	LT (20)	60 Significant
Issues Related to Foul Odor during Storage of Raw Material and Post-digestate	Direct	Mo (20)	S (10)	LT (20)	50 Significant
Issues Related to Extraction of Water for Meeting Demand	Direct	Lo (10)	L (20)	LT (20)	50 Significant
Management of Wastewater from Digested Slurry	Direct	Lo (10)	S (10)	LT (20)	40 Insignificant
Impact Associated with Collection and Transportation of Waste from Source to Sub-Project Location	Direct	Mo (20)	L (20)	ST (5)	45 Significant

Impact	Direct/Indirect Impact	Magnitude	Extent	Duration	Significance
Increase in Noise Level from Plant Operation	Direct	Lo (10)	S (10)	LT (20)	40 Insignificant
Gas Leakage and Associated Impacts including Fire Hazard	Direct	Mo (20)	S (10)	LT (20)	50 Significant
Flood Hazard	Direct	Lo (10)	L (20)	ST (5)	35 Insignificant
Issues with Drainage Management	Direct	Mo (20)	L (20)	LT (20)	60 Significant
Biological Environment					
Construction Phase					
Loss of Vegetation	Direct	Lo (10)	S (10)	ST (5)	25 Insignificant
Operation Phase					
Maintenance and Protection of Greenery in the Sub-Project Periphery	Direct	Mo (20)	S (10)	LT (20)	50 Significant
Socio-economic and Cultural Environment					
Construction Phase					
Occupational health and safety of workers	Direct	H (60)	S (10)	ST (5)	75 Very Significant
Pressure on Existing Infrastructure and Community Resources	Direct	Lo (10)	S (10)	ST (5)	25 Insignificant
Health and Sanitation Related Issues	Direct	Mo (20)	L (20)	ST (5)	45 Significant
Labor Influx and Associated Impacts in the Local Community	Direct	Lo (10)	S (10)	ST (5)	25 Insignificant
Involuntary Land Acquisition and Displacement Issue	-	-	-	-	Not Applicable
Grievances Management	Direct	Mo (20)	S (10)	LT (20)	50 Significant
Sexual Exploitation Abuse and Sexual Harassment	Direct	Mo (20)	L (20)	ST (5)	45 Significant
Gender discrimination and child labour	Direct	Mo (20)	S (10)	ST (5)	35 Insignificant
Stakeholder Engagement and information disclosure	Direct	H (60)	L (20)	LT (20)	100 Very Significant

Impact	Direct/Indirect Impact	Magnitude	Extent	Duration	Significance
Operation Phase					
Issue of road safety	Direct	H (60)	L (20)	LT (20)	100 Very Significant
Issues related to Occupational Health and Safety	Direct	H (60)	S (10)	LT (20)	90 Very Significant
Issues Related with Health and Sanitation in and around the Sub-Project Site	Direct	H (60)	S (10)	LT (20)	90 Very Significant
Inflow of people in the Sub-project area	Direct	Mo (20)	S (10)	LT (20)	50 Significant
Grievances from nearby Local Communities	Direct	Mo (20)	L (20)	LT (20)	60 Significant

Impact Weightage Criteria, National EIA Guidelines (1993)

Magnitude		Extent		Duration	
High (H)	60	Regional (R)	60	Long Term (LT)	20
Moderate (Mo)	20	Local (L)	20	Medium Term (MT)	10
Low (Lo)	10	Site Specific (S)	10	Short Term (ST)	5

Using this system, the maximum score is 140 points and the minimum score is 25

Significance of Impact

Total Score: *< 45: Insignificant 45-74: Significant ≥ 75: Very Significant*

CHAPTER VI: ENVIRONMENTAL AND SOCIAL IMPACT MITIGATION

Chapter VI has identified the impacts associated with the construction and operation phases of proposed sub-project and evaluated the impacts in without mitigation scenario. This section of the report has prescribed the practical and cost-effective mitigation measures to avoid, minimize and compensate the effects of adverse impacts to acceptable level. The sub-project proponent ensures to implement these measures during the construction and operation of the sub-project.

6.1 Mitigation Measures

In order to prevent the likely environmental impacts identified in previous section, **Table 21** presents prescribed environmental mitigation measures and their estimated mitigation costs.

Table 21: Environmental Matrix Showing Impacts, Mitigation Measures and Costs

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
Physical Environment					
A.1 During Construction Stage					
A.1.1	Change in Land Use • Modification on existing land patterns and vegetation.	• Minimum land disturbance will be made while project construction. Greenery will be maintained with plantation.	During Construction Phase	50,000	Developer
A.1.2	Issues Related to Soil Pollution • Decrease in soil fertility of nearby agricultural land from spillage of grease and petroleum fuel from generators and construction materials including vehicles • Formation of muddy ditches during rainy season	• Spent lubricants and greases, petroleum will be stored in designated vessels only. • Covering and storage of construction debris in specific place within the construction site	During Construction Phase	Not required	Developer and Construction Contractor
A.1.3	Increase in Noise Level due to Construction Activities • Noise disturbances from machinery and vehicle operations	• Provision of low sound emitting machineries • Regular maintenance of vehicles and machines • Prohibition of construction activities in night time and early morning	During Construction Phase	Not required	Developer and Construction Contractor
A.1.4	Issues related to Air Pollution • Dust, smoke, and emissions from vehicles and machinery can affect air quality.	• All vehicles and machineries used in construction work shall be in compliance with emission standard set for vehicles and machineries by MoFE • Regular maintenance of vehicles and machineries • Regular spray of water in the construction site and access road	During Construction Phase	400,000	Developer and Construction Contractor

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
A.16	Issues Related to Water Pollution • Wash water, concrete residues, and lubricant spills may seep into groundwater.	• Wastewater from aggregate washing and washout from concretes will be settled in a sedimentation tank before releasing into the receiving water bodies. • Storage of spent oil and greases in containers and its safe disposal • Provision of proper drainage system	During Construction Phase	50,000	Developer and Construction Contractor
A.16	Issues Related with Spoil Disposal and Stockpiling of Construction Materials • Visual impact, wastewater run-off, and soil erosion • Degradation in aesthetic beauty • Stockpile materials in designated areas, cover during rains, provide drainage, and reuse spoil.	• Stockpiling the materials in designated place within the construction site • Compaction of soil • Covering of stockpiles to avoid washout during rainy season • Provision of necessary drainage • Using construction spoils to fill up low land area, ditches and land development work	During Construction Phase	70,000 Part of Civil work	Developer and Construction Contractor
A.17	Road safety risks due to increased vehicle movement and construction activities	• Use of traffic diversions signboards, safety tapes at construction sites and settlement areas • Provision of footpath/ pedestrian crossing • Announcement through local media about the construction activities • Periodic Road maintenance • Speed limits for vehicles plying on the road • Disposal of construction spoil at approved disposal sites • Safety awareness programs	During Construction Phase	60,000 Part of Civil work	Developer and Construction Contractor
A.2 During Operation Stage					

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
A.2.1	Issues Related to Management of Raw Materials Storage and Post-digestate Slurry • Contamination of land and water due to leaching of raw materials and digestate • High BOD and nitrogen content affecting soil and water quality	• Avoid direct discharge of slurry and decanted liquid waste into nearby water bodies and agricultural fields • Store raw materials in enclosed roofed units with impermeable base • Provide compost preparation unit with sealed base for settling solid and liquid slurry • Ensure proper drainage system	Operation Phase	80,000	Developer
A.2.2	Issues Related to Foul Odor during Storage of Raw Material and Post-digestate • Foul smell from open storage • Attraction of flies and vector diseases • Impacts mainly to in-house staff	• Store raw materials in enclosed spaces with net system so that it would not attract any kind of harmful insects • Implement proper composting system • Ensure timely removal of slurry from storage	Operation Phase	60,000	Developer
A.2.3	Issues Related to Extraction of Water for Meeting Demand Groundwater depletion risk Reduced water availability for local use	• Extract water within sustainable limits (50000-60000 L) • Monitor groundwater levels periodically	Operation Phase	Not requires	Developer
A.2.4	Management of Wastewater from Digested Slurry • Contamination of land and water • High BOD, total suspended solids (TSS), and turbidity	• Use solid-liquid separator to separate solid and liquid fractions • Treat remaining liquid in lagoon pond • Sell treated liquid slurry to local farmers	Operation Phase	Not required	Developer
A.2.5	Impact Associated with Collection and Transportation of Waste • Foul smell along transport route • Dropping of waste on roads • Vehicle emissions (CO2, SO2)	• Cover waste during transport • Avoid overloading vehicles • Use designated routes and maintain vehicles	Operation Phase	Not required	Developer

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
	• Traffic congestion and road wear				
A.2.6	• Noise >85 dB from plant equipment (agitators, pumps, feed loaders) • Temporary hearing loss and annoyance among workers	• Provide PPE such as earplugs • Maintain equipment to reduce noise • Schedule noisy operations to minimize exposure	Operation Phase	60,000	Developer
A.2.7	Gas Leakage and Associated Fire Hazard • Fire hazard and explosions • Methane emissions contributing to GHG effect	• Install gas detectors • Ensure proper sealing of biogas system • Provide firefighting equipment and emergency response plan	Operation Phase	1,000,00	Developer
A.2.8	Flood Hazard • Temporary waterlogging • Damage to plant, roads, and low-lying farmland during heavy rains	• Design proper site drainage • Elevate key infrastructure • Monitor water levels during monsoon	Operation Phase	Not required	Developer
A.2.9	Issues with Drainage Management • Accumulation of water and wastewater • Risk of contamination of nearby water bodies and groundwater • Poor runoff management during heavy rains	• Construct and maintain drains and channels • Implement stormwater management • Ensure proper disposal and treatment of liquid effluent	Operation Phase	70,000	Developer
B. Biological Environment					
B.1 During Construction Stage					
B.1.1	Clearance of vegetation • Felling trees is not required for project development.	• Nevertheless, plantation shall be done after the construction activities to maintain the greenery and healthy ecosystem.	Both construction and operation phase	50,000	Developer
B.2 During Operation Stage					

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
B.2.1	Vegetation Maintenance and Protection • Maintenance and protection of greenery in the project periphery	• Haphazard disposal of waste to the vegetated land by the workers should be avoided • A strict rule for workforce to not degrade nearby area • Maintenance of garden in the sub-project area	During Operation Phase	70,000	Developer
C. Socio-economic and Cultural Environment					
C.1 During Construction Stage					
C.1.1	Occupational Health and Safety • Exposure to fugitive emission, noise and risk of physical injuries • Transmission of infectious diseases	• Provision of Personnel Protective Equipment (PPEs) like helmets, masks, safety jacket, gloves and boots, safety harness to construction workers and they will be educated in using the PEEs • Provision of first aid kits in the subproject premises • The workers, engineers and supervisors working at the active construction sites will be provided with air masks, helmets, safety goggles, earplugs, gloves and boots. The contractors will be made responsible to provide the PPE contractually. • The only authorized personnel will be allowed • Provision of fire-fighting gears and training to the involved workers on fire fighting. • Provision of immediate rescue, primary treatment in the site as well as provision of air ambulance and immediate treatment in case of an accident in the construction site	During Construction Phase	300,000	Construction Contractor

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
		• Provision of proper record of labor, well maintained registration sheet with personal details as well as emergency contact details (native and migrant worker) • Safety Signage shall be placed in construction site • Construction workers will be trained in job hazards, emergency procedures and in any other relevant safety measures. • Orientation to workers and staff possible spread of communicable disease • Provision of reporting mechanism if any incidents occurs • The feedstock storage chamber and by-product slurry chamber will be double fenced to protect workers from the fell down and accident.			
C.1.2	Pressure on Existing Infrastructure & Community Resources • Increased solid waste and water demand. • Potential stress on community water supply.	• Use own water sources (deep boring). • Manage and segregate solid waste properly. • Limit workforce within planned numbers.	Construction Phase	Not required	Contractor / Developer
C.1.3	Health and Sanitation Related Issues • Possibilities of accident in community which transporting the construction materials to the subproject site • Community children getting into accidents	• Transport management plan will be implanted. • Construction materials will be transported to day time • The subproject site will be barricaded to avoid the trespass of unauthorized person in subproject site	During Construction Phase (Plans will be prepared prior to construction phase)	250,000	Construction Contractor

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
		• Proper fencing of the each unit is required to prevent from direct entry into the particular unit. • Rehabilitation of existing infrastructures like road, if affected by subproject related activities • Emergency Preparedness Plan, Occupational Health and Safety Plan, Community Health and Safety Plan (a trained staff will be appointed by proponent to prepare these plans) • Sprinkle the water on the road that passes through community to control the dust while transporting material to the subproject site. • Provision of reporting mechanism if any incidents occurs			
C.1.4	Issues related Grievance Redress Mechanism • Grievances related with improper management of construction materials, aesthetic degradation, conflicts.	• Grievance redress Committee (GRC) at subproject level will be established • Management of record keeping system of the grievance received at field level • Appoint ESS focal person for handling grievances under Grievance Redress Mechanism • Suggestion box will be place at the entrance of subproject premises to receive the suggestions and complaints from community people. Instruct construction company to	During Construction and Operation Phase (Plans will be prepared prior to construction phase)	30,000	Developer

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
		proceed construction work in compliance to ESIA report • Conduct periodic meaningful consultation with locals and concerned stakeholders regarding the various scope of the project and organize awareness raising program throughout the project cycle.			
C.1.5	Impact associated with gender and SEA/SH • Contractors, project employee and the workforce could discriminate against women and vulnerable groups • The contractor could pay differently to the male and female worker for the same work • The exploitation of children in the construction work.	• Code of Conduct (CoC) including SEA/SH for subproject staff will be implemented • Orientation of SEA/SH and gender based violence to the staff and workers of sub-projects • The use of child labour in subproject construction will be strongly prohibited (Record keeping of labour with identity card showing age will be maintained) • Both women and men and people of excluded groups will be given equal opportunity for employment and no gender discrimination will be done in terms of wages for the same or similar works.	During Construction Phase	50,000	Developer and Construction Contractor
C.1.6	Stakeholder Engagement & Information Disclosure • Lack of engagement may hinder project progress. • Risk of misinformation or local opposition.	• Conduct regular stakeholder meetings. • Share project updates transparently. • Document and address concerns promptly.	Construction Phase	35,000	Developer
C.1.7	Labor Influx and Associated Impacts in the Local Community	• Prioritize hiring local workers where possible and orient	Construction Phase	Not required	Developer and Construction Contractor

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
		workers on local culture and norms			
C.1.8	Gender discrimination and child labour	• Ensure equal employment opportunities, fair wages, and non-discriminatory workplace policies	Construction Phase	Not required	Developer and Construction Contractor
C.2 During Operation stage					
C.2.1	Occupation Health and Safety • Physical injury to staffs • Prone to catch disease from organic waste handling	• Workers shall be provided with PPEs like helmet, safety boots, safety jacket, gloves and masks and they will be educated in using the PPEs • Provision of First aid kit • Staffs shall undergo a regular medical checkup • Proper orientation and training should be provided to the staff on safety so that accidents and disease can be avoided • Provision of necessary safety cautions, signposts and instructions at –project site as well as near moving machineries • Preparation of Emergency Preparedness Plan, Occupational Health and Safety Plan, Community Health and Safety Plan Provision of proper record of labor, well maintained registration sheet with personal details as well as emergency contact details (native and migrant worker) • Conduct periodic meaningful consultation with the local	During sub-project planning and Operation Phase	300,000	Construction Phase

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
		communities and implementation of stakeholder engagement activities throughout the project lifecycle. • The feedstock storage chamber and by-product slurry chamber will be double fenced to protect workers from the fell down and accident.			
C.2.2	Community Health and Safety • Spread of vector borne disease around the community and staffs due to improper management of organic waste • Opposition from the community against the project • Increase in quarrel and debates among workforce and community	• Management of Oder and waste of subproject so that it will not affect the community • Keeping the unit areas clean with disinfectants • Avoid haphazard disposal of digestate • Awareness and training to staffs regarding sanitation and operation of plant • Transportation of feedstocks will be done with covering to prevent spill on the roads • Formulation of code of conduct and dos and don'ts for staffs • Ensure the implementation of respective rules and regulation by staffs • Aware/motivate workers to respect nearby community and their respective cultures. • Provision of periodic consultation with the nearest community and concerned stakeholders	During Operation Phase	60,000	Developer

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)	Roles and Responsibility
C.2.3	GRM • Grievances with aesthetics, odor, noise, haphazard disposal of digestate from local residents resulting opposition and conflict	• Implement mitigation measures to avoid potential impacts mentioned in B.1, B.2 and B.3 • Establish Grievance Redress Mechanism (GRM) and manage a trained staff to ensure smooth operation of the mechanism • Appoint ESS focal person and ensure the grievance handling through Grievance Redress Committee • Arrangement of handling received grievances and proceeds immediate action through the GRM Periodic meeting with the locals and based on the meeting organize related programs to the nearby settlement regarding the project • Employment opportunities to the locals	During Operation Phase	30,000	Developer
C.2.4	Road Safety	• Schedule deliveries during non-peak hours to reduce congestion. • Cover all transport vehicles to prevent spillage • Maintain vehicles regularly to ensure safety and reduce emissions • Use designated routes and communicate schedules with local communities.	Operation Phase	50,000	Developer

6.2 Estimated Cost for Executing the Environmental Management Plan

The total summarized environmental and social mitigation costs from Table 21, including the costs for land acquisition are summarized in **Table 22.**

Table 22: Environmental Matrix Showing Impacts, Mitigation Measures and Costs

S.N.	Description	Brief Mitigation	Responsibility	Cost (Rs.)
1	Land use change during construction	Minimize land disturbance, maintain greenery with plantation	Developer	50,000
2	Air Pollution from dust, smoke, $C0_2$ and emission	Use compliant vehicles/machinery, regular maintenance, water spraying	Developer & Contractor	400,000
3	Groundwater contamination from construction materials and lubricants	Sedimentation tanks, safe storage of oil/grease, proper drainage	Developer & Contractor	50,000
4	Aesthetic degradation & wastewater impacts	Stockpile management, soil compaction, drainage, use of spoils for land development	Developer & Contractor	70,000
5	Road safety risks	Traffic signs, footpaths, speed limits, community awareness	Developer & Contractor	60,000
6	Land/water contamination during operation	Enclosed storage, compost unit, proper drainage	Developer	80,000
7	Increase in Noise Level from Plant Operation	PPE (earplugs), maintain equipment, schedule noisy operations	Developer	60,000
8	Foul smell & waste spillage during transport	Proper covering and compaction during transport, compliant vehicles	Developer	60,000
9	Fire hazard from methane	Fire safety measures, assembly points, leak checks	Developer	100,000
10	Issues with Drainage Management	Construct & maintain drains, storm water management, effluent disposal	Developer	70,000
11	Tree plantation during construction	Plantation after construction to maintain greenery	Developer	50,000
12	Vegetation Maintenance and Protection	Avoid haphazard disposal, maintain gardens	Developer	70,000
13	Occupational health & safety (construction)	PPE, first aid, training, fire safety, records	Contractor	300,000
14	Community health & safety (construction)	Transport management, site fencing, emergency preparedness	Contractor	250,000

15	Occupational health & safety (operation)	PPE, medical checkups, training, emergency preparedness	Developer	300,000
16	Community health & safety (operation)	Waste management, staff training, community consultation	Developer	60,000
17	GRM (Construction Phase)	Establish grievance mechanism, trained staff, periodic consultation, employment to locals	Developer	30,000
18	GRM (Operational Phase)	Establish grievance mechanism, trained staff, periodic consultation, employment to locals	Developer	30,000
19	Gender & SEA/SH	Code of Conduct, orientation, equal opportunity, no child labour	Developer	50,000
20	Stakeholder Engagement	Regular meetings, updates, document concerns	Developer	35,000
21	Road safety	Schedule deliveries, cover transport, maintain vehicles, designated routes	Developer	50,000
			Total	**2,255,000**

CHAPTER VII: STAKEHOLDER CONSULTATION, COMMUNITY PARTICIPATION AND DISCLOSURE

A public consultation meeting was conducted in the sub-project area with nearby residents on 2082 Mangshir 10, 2082 (November 26, 2025). During the meeting, the expert team presented the potential impacts of the sub-project and their proposed mitigation measures. The study team, along with the proponent, invited participants to raise concerns regarding the commencement of the sub-project. It is planned that periodic consultation meetings with the local community and representatives will be organized and executed throughout the project lifecycle. Issues raised during the consultation were documented, collected, and incorporated into this report (Annex 1).

Table 23: Stakeholder Consultation Summary: Issues, Suggestions, and Measures Adopted

Date and Place	Number of Consulted Persons	Issues/ Opinions and Suggestions	Measures adopted to address issues/ opinions and suggestions
2082 Mangshir 10 (November 26, 2025)	18	1. The project should minimize environmental impacts such as noise, dust, and water contamination. 2. Traffic management during construction to avoid disruption. 3. Locals should be prioritized for employment during construction and operation phases according to skills and abilities. 4. Proper signage should be placed during construction to ensure safety 5. Safety measures for workers and the public should be ensured. 6. Fertilizer distribution should prioritize the local market.	1. Measures to control noise, dust, and wastewater; ensure compliance with environmental standards. 2. Traffic management plan implemented during construction to minimize disruptions. 3. Employment opportunities provided to locals, especially women and vulnerable groups, based on qualifications and willingness. 4. Proper signage installed at construction sites for public safety. 5. Safety protocols enforced for workers and the public. 6. Fertilizers produced will be made available to local markets and farmers first.

7.1 Summary of Public Consultation

During the public consultation process, several comments and suggestions were received from local stakeholders regarding the proposed biogas sub-project. These have been carefully considered and incorporated into the project planning and report as follows:

•**Environmental Impacts**: The local Stakeholders gave their concerns regarding environmental impacts. It was clarified that the nearest settlement does not lie within the direct impact zone of sub-project site, and therefore, potential environmental impacts are expected to be minimal. However, the proponent will be responsible for implementing measures to mitigate any adverse environmental effects.

• **Employment Opportunities:** The community emphasized the importance of local employment. It is recommended that local residents be given preference for jobs during both the construction and operation phases, based on their skills and abilities. Special attention should be given to including women and vulnerable groups.

• **Compost and Fertilizer Distribution:** Locals suggested prioritizing the distribution of compost and fertilizers produced by the sub-project. Accordingly, these products will be made available first to local farmers and markets.

• **Project Implementation:** Local Stakeholders supported the implementation of the sub-project, noting that it does not pose significant environmental issues. Instead, the project will contribute to effective organic waste management and generate local employment opportunities.

• **Traffic Management**: Concerns were raised about potential traffic disruptions during construction. A traffic management plan will be implemented to minimize disruptions to the local community.

• **Signage and Safety Measures**: It was suggested that proper signage be installed at the construction site to ensure safety for both workers and the public. Safety protocols will be enforced throughout the project duration.

CHAPTER VIII: ALTERNATIVE ANALYSIS

In order to ensure the project as an environmentally sound project, alternative analysis was carried out to choose better alternative from the environmental perspective and without compromising the process flow or production. The aim of alternative analysis is to arrive at a development option, which maximizes the benefits while minimizing the unwanted impacts. While exercising the alternative analysis, the following aspects were taken into account.

8.1 Alternative Technology and Design

There are several anaerobic digestion technologies to generate biogas from anaerobic digestion. Modified GGC is the native anaerobic digestion technology promoted in Nepal. While, in this project, high efficient CSTR technology with heating is adopted for higher energy yield. While considering biogas purification, there are several types of PSAs which operates in different pressure range. In this project, medium PSA operated in 0.7 bar pressure is adopted which is very energy efficient in comparison to high PSA system. The end-use has been proposed for thermal application supplied from compressed biogas (CBG). While considering the slurry management, there are different types of solid liquid separators that separates solid from the liquid. In this project screw press is adopted which is highly efficient comparing to other solid liquid separation decanters. The separated solid manure will be dried in fertilizer yard to achieve desired TS of 70%, which is a good quality organic fertilizer. The separated liquid from the solid is further treated in the lagoon pond which is designed for four week of storage and then re-circulated in the digester.

8.2 Alternative Schedule, Process, Raw materials and Resources

The sub-project has been proposed to be constructed within the timeframe of eight months. The excavation activities will be accomplished in the dry season in order to reduce the erosion and sedimentation of spoils into nearby farm land and stream. The sub-project machineries will be imported from India whereas the construction materials will be sourced from Nepalese market by competitive bidding process. All the raw materials, sourced from the internal market as far as possible, will be chosen prudently in order to assure quality as well as economic viability.

8.3 No Project Option

This alternative does not allow the implementation of the proposal. This sub-project will be managing about 65 tons of waste daily by converting into **1092 kg** compressed natural gas and **8.45 MT** fertilizer. There cannot be another best option to manage solid waste. Rather it is very advantageous as there will be the availability of gas and fertilizer and due to its insignificant environmental impacts; the no project option was rejected.

CHAPTER IX: ENVIRONMENTAL AND SOCIAL IMPACT MONITORING

9.1 Project Management Responsibility

The implementation of mitigation measures responsibility is entrusted to the sub-project proponent. Because of small nature of the sub-project, the monitoring of environmental parameters in the construction and operation period should also be done by the proponent.

9.2 Environmental Standards

The Government of Nepal has endorsed several environmental standards, including the National Ambient Air Quality Standards (NAAQS) of Nepal, which must be followed by all projects. These environmental standards shall be treated as binding regulations, similar to other acts and regulations, until the Government of Nepal enforces specific standards in the sector for project environmental compliance purposes.

Considering this, the environmental standards are proposed for proposed sub-project construction and operation for compliance which is attached in ***Annex 4***.

9.3 Environmental Monitoring Plan

The environmental monitoring plan designed for the sub-project has three main objectives:

- To ensure that the sub-project baseline conditions were adequately documented such that a comparative assessment of the sub-project baseline before and after the sub-project could be made objectively for impact evaluation.
- To ensure that the mitigation commitments to minimize the predicted adverse impacts and maximize the beneficial impacts including the environmental enhancement programs are sincerely complied and implemented by the sub-project proponent.
- To verify that the sub-project impacts are within limits of the impact prediction or some foreseen impacts also occurred during sub-project development and what measures are taken to minimize the unforeseen impacts.

As baseline environment of the proposal development area is clearly known and also documented in this report, the proponent themselves shall carry out compliance and impact monitoring of the sub-project construction and operation period. The monitoring management plan for compliance and impact is presented in **Table 24.** Below:

Table 24: Compliance Monitoring, Construction and Operation Phase

S. N	Provisions of compliance	Individuals responsible	Methods	Frequency /Time	Monitoring authority	Place	Financial commitment (NRs.)
Construction Phase							
1	• Vehicular emission in compliance with standard set for vehicles and machineries by MoFE • Regular maintenance of vehicles and machineries • Regular spray of water in construction site	Proponent	Site Observation/ records	During construction period	Proponent	Project Site	200,000
2	• Provision of drainage system and sedimentation tank • Storing of spent oil and greases in containers and designated place	Proponent	Site Observation/ records	During construction period	Proponent	Project Site	100,000
3	• Provision of low sound emitting machineries • Regular maintenance of vehicles and machines • Prohibition of construction activities in night time and early morning	Proponent	Site Observation/ records	During construction period	Proponent	Project Site and nearby community	70,000
4	• Stockpiling of construction materials in designated place within construction site • Provision of drainage to avoid muddy surface during rainy season • Covering of stockpiles to avoid washout during rainy season • Using of construction spoils to fill up low land area and ditches • Compaction of spoil	Proponent	Site Observation/ records	During construction period	Proponent	Project Site	40,000
5	• Provision of personnel protective equipment (PPE)	Proponent	Site Observation/ consultation	During construction period	Proponent	Project Site	50,000

S. N	Provisions of compliance	Individuals responsible	Methods	Frequency /Time	Monitoring authority	Place	Financial commitment (NRs.)
	• Provision of necessary safety cautions, signposts and instructions at construction site as well as near moving machineries • Provision of labor registration log with their personal details as well as emergency contact details						
6	• Awareness and orientation to construction workers • Provision of barricade	Proponent	Site Observation/ records	During construction period	Proponent	Project Site	30,000 annually
7	• Establishment of GRC • Appointing ESS focal person for handling grievances and communicate with community • Record book for registration of grievances at subproject level • Instructing construction company to proceed construction work in compliance to ESIA report • Placement of suggestion boxes • Periodic consultation with relevant stakeholders and information disclosure	Proponent	Site Observation/ Records	During Construction Period	Proponent	Project Site	30,000 annually
Operation Phase							
1	• Avoiding direct discharge of slurry and decanted liquid to nearby water bodies • Storage of raw materials in roofed unit with impermeable base • Provision of compost preparation unit with proper seal of base	Proponent	Site Observation	Before Operation Phase	Proponent	Project Site	40,000

S. N	Provisions of compliance	Individuals responsible	Methods	Frequency /Time	Monitoring authority	Place	Financial commitment (NRs.)
2	• Storing of feedstock and post digestate in designated area • Covering of feedstock and post digestate • Regular cleaning around the screw press manure unit and feedstock storage area	Proponent	Observations	Once a year during Operation Phase	Proponent	Project Site	40,000 annually
3	• Proper covering of feedstock while transporting • Proper compaction of feedstock to avoid dropping • Vehicular emission in compliance with emission standards • Sprinkle the road to avoid dust during the transportation.	Proponent	Photographs/ Records	Twice a year during Operation Phase	Proponent	Project Site	50,000 annually
4	• Avoidance of naked flame near plant • Provision of fire extinguisher (5 nos.) • Provision of Fire hose reel, fire control ball and PPE • Scheduled maintenance and testing of gas leakage in plant	Proponent	Observation/ Discussion/Record	Before Operation Phase	Proponent	Project Site	50,000 annually
5	• Provision of personal protective equipment to workers • Provision of first aid kit • Regular health check-up of staffs • Proper orientation and training to staffs about operating plant and waste handling	Proponent	Observation	During construction Phase	Proponent	Project Site	100,000 annually

S. N	Provisions of compliance	Individuals responsible	Methods	Frequency /Time	Monitoring authority	Place	Financial commitment (NRs.)
6	• Cleaning the plant area regularly • Avoidance of haphazard disposal of digestate • Awareness and training to staffs regarding sanitation and operation plant	Proponent	Observation/ Discussion/Record	During Operation Phase	Proponent	Project Site	60,000 annually
7	• Implementation of mitigation measures to avoid potential impacts mentioned in A.2, B.2 & C.2 in Chapter VI • Implement Grievance Redress Mechanism • Arrangement of handling grievances from community	Proponent	Observation/ Record	During operation phase	Proponent	Project site	40,000 annually
						SUBTOTAL	**380,000.00**

Table 25: Impact Monitoring, Construction and Operation Phase

S.N	Monitoring Indicator	Individuals responsible	Methods	Frequency /Time	Monitoring authority	Place	Financial commitment (NRs.)
Construction Phase							
1	Effect on productivity of nearby farmland due to construction waste and percolated water	Proponent	Discussion with local people, visual observation	Twice during construction period	Proponent	Nearby farmland	-
2	Increased Noise level	Proponent	Discussion with local people, noise level meter	Once during peak construction work	Proponent	Nearby settlement	60,000.00 annually
3	Water quality of bore well as well as nearby water bodies	Proponent	Water quality test in the laboratory	During construction period	Proponent	Bore well, Nearby River	20,000 annually

S.N	Monitoring Indicator	Individuals responsible	Methods	Frequency /Time	Monitoring authority	Place	Financial commitment (NRs.)
Operation Phase							
1	Aesthetic degradation due to haphazard disposal of organic slurry in nearby water bodies and area	Proponent	Discussion with local people	Once in a year	Proponent	Nearby settlement/farm land	-
2	Occupational Health and Safety of the staffs/workers	Proponent	Clinical checkup/ Records/interview with staffs/workers	Half yearly	Proponent	Project Site	-
3	Number of grievances received from community	Proponent	Registered file/complains	Quarterly	Proponent	Nearby community	-
4	Water Quality of Bore well as well as nearby water bodies (to compare with the baseline assessment)	Proponent	Water quality tests of source of water supply (bore well water and nearby river	Thrice a year (dry, wet and lean months)	Proponent	Bore well, Nearby River	20,000 annually
5	Increased noise level	Proponent	Discussion with local people, noise level meter	Half yearly	Proponent	Project site/ Nearby Community	60,000 annually
6	Methane Leakage	Proponent	Gas Analyzer	Half yearly	Proponent	Project Site	30,000 annually
						SUBTOTAL	**190,000.00**
						TOTAL	**570,000.00**

Table 26: Environmental Monitoring Cost

Item	Quantity	Rate per month	Frequency	Rate per year (NRs.)	Total (NRs.)
Construction Phase					
Water Quality Monitoring	-	-	One Time	40,000	40,000
Noise Monitoring	-	-	One Time	60,000	60,000
Operation Phase					
Water Quality Monitoring	-	-	Annually	40,000	40,000
Noise Monitoring	-	-	Annually	60,000	60,000
Methane Leakage	-	-	Annually	30,000	30,000
Human Resource					
Environment Expert	1	60,000	Two months input per year	120,000	120,000
Social officer	1	50,000	One month input per year	50,000	50,000
				Total	**400,000**

9.4 Total Environmental and Social Management Cost

The total budget for Environmental and Social management of the project is **NRs. 3,225,000.00** Out of this, **NRs. 2,255,000.00** is allocated for implementing mitigation measures during construction and operation, such as managing dust, emissions, noise, waste, and ensuring worker, greenery and community safety. Another **NRs. 570,000.00** is set aside for environmental compliance monitoring to ensure the project meets national standards and regulatory requirements. Additionally, **NRs. 400,000.00** is allocated for regular environmental monitoring of key indicators like water quality, air emissions, and noise levels. Together, these costs support impact reduction, regulatory compliance, and continuous oversight throughout the project.

Table 27: Summary of Environmental Management Cost

SN	Item	Total (NRs)	Remarks
1	Environmental and Social Mitigation costs	2,255,000.00	Refer Table 22
2	Environmental Compliance Monitoring Cost	570,000.00	Refer Table 24 and 25
3	Environmental Monitoring Cost	400,000.00	Refer Table 26
	TOTAL	**3,225,000**	

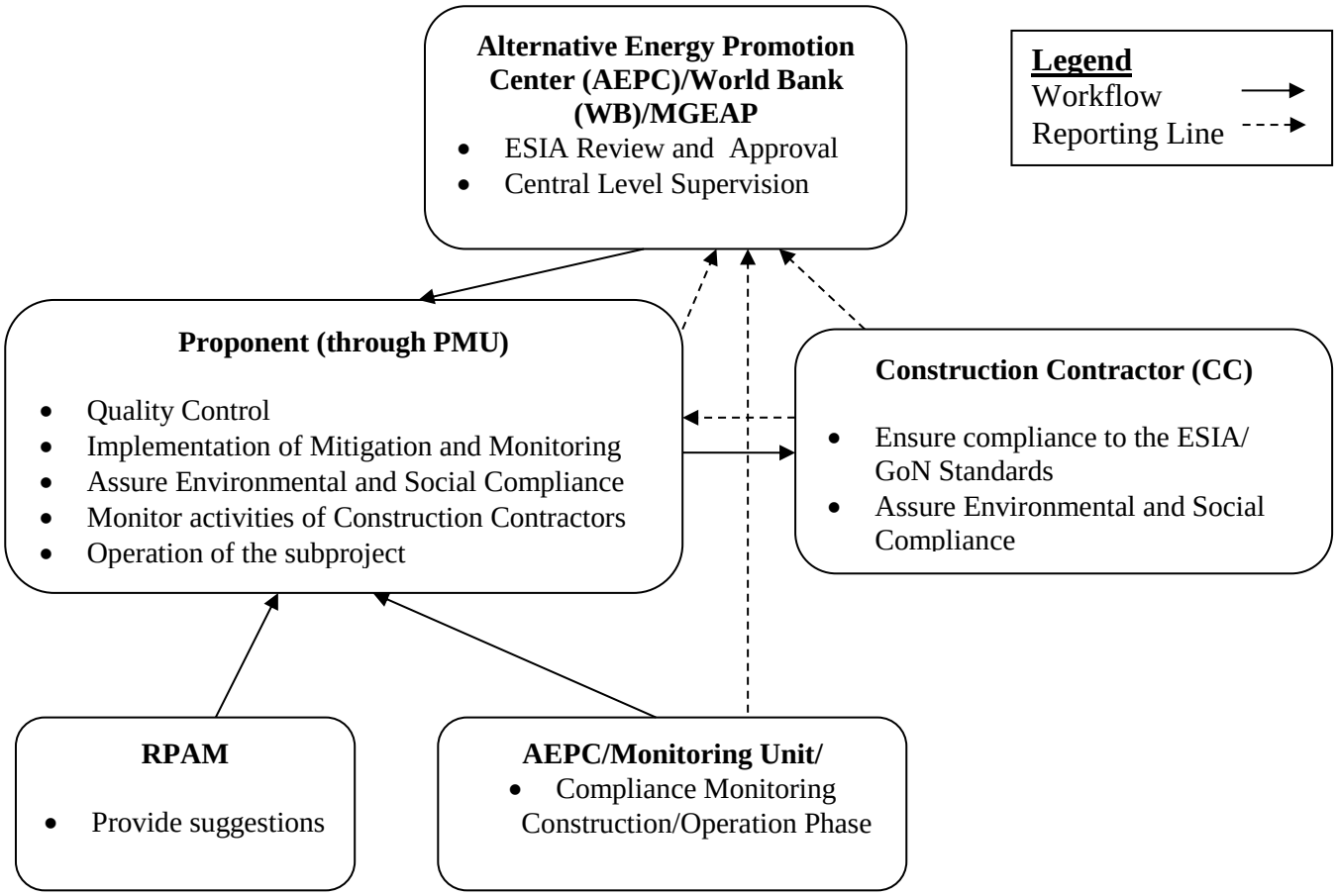
CHAPTER X: INSTITUTIONAL ARRANGEMENT AND GRIEVANCE REDRESS MECHANISM

10.1 Project Environmental Management Plan Structure and Stakeholders Responsibility

The Project Environmental Management Framework of the proposed sub-project is prepared to show linkages with different parties to be involved directly or indirectly during the different phases of project development and operation in compliance with existing Act and Rules.

Overall project environmental and social management is the responsibility of Proponent of the proposed sub-project. Key stakeholders to be involved for project environmental and social management in the hierarchy order are:

- Alternative Energy Promotion Center (AEPC)/ World Bank (WB)/ MGEAP
- Monitoring Unit of AEPC
- Proponent (through Project Management Unit- PMU)
- Construction Contractor (CC)
- Representative from Sub-Project Affected Municipality (SPAMR)

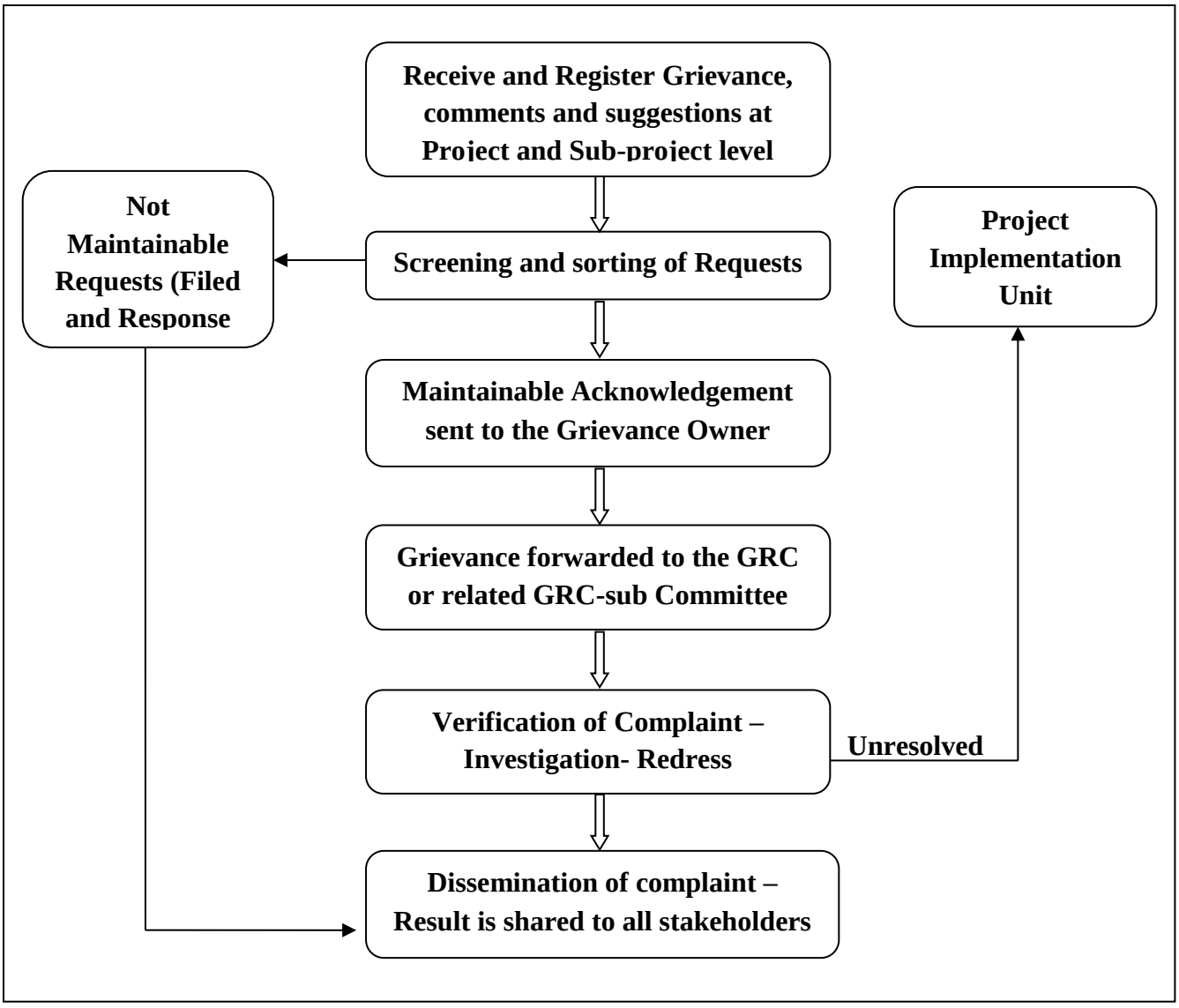


6.1 Grievance Redress Mechanism

Grievance addressing and feedback is important so as to know what negative impact has been occurred in the community due to implementation of the sub-project. Such grievances should be taken care in order to avoid conflicts in the society regarding the sub-project. Grievance redress not only prevents conflicts but will also help developer to take necessary steps to further improve the plant operation and management system.

Grievance Redress Mechanism Process

The figure below describes the process that will be used to resolve any grievances related to this sub-project:



The grievances from the community and nearby inhabitants such as haphazard disposal of organic waste, construction waste, noise pollution, foul odor from the feedstock, increase in flies and vector disease, pollution in nearby water bodies can be received at any stage of the sub-project construction or implementation. Such grievances shall be managed by strictly following the mitigation measures prescribed in this report. In case, if any grievances arise, those complaints will be assessed by the current Grievance Redress Committee (GRC). The management teams of GRC are listed below:

Current Provision of GRC (as in Social Management Framework)

A. Central/AEPC Level Grievance Redress Committee (GRC)

1. Project Manager of AEPC/MGEAP – Chairperson
2. Representatives of the developer–Member (1)
3. Representatives of CSO working in the field of waste management - Member (1)
4. Environmental Safeguard Expert at AEPC - Member (1)
5. Social Safeguard Expert at AEPC – Member Secretary

B. Sub-project Level Grievance Redress Committee (GRC)

1. Chairperson/Representative of the ward office or Chairperson/Managing Director of Developer – Chairperson
2. Representative from Sub-Project Affected people – Member (2)
3. Representative from local NGO/CBO – Members (1)
4. Sexual Exploitation Abuse and Sexual Harassment (SEA/SH) Focal person – Female member (1)
5. ESMF focal person of the perspective developer/Project manager – Member Secretary

Note: To be ensured that at least two member of the GRC should be female/vulnerable group (Representatives of developers/CSOs/PAP).

The central monitoring may be done by AEPC during the operation phase at any time of the sub-project cycle.

The grievance redress mechanism will be assessed as described below:

- ESMF focal person of the developer/ Project Manager/ Site In-charge will be appointed as the focal person (Member secretary of the project level GRC) to receive/ handle any kind of grievance related to the project. His/ her name and contact number will be displayed at the entrance of the sub-project site, so that affected people can have direct access to him/her.
- SEA/SH Focal Person will be representative from developers/CSOs/PAP of GRC formed at subproject level and she will be responsible to record and handle any kind of grievances related SEA/SH.
- A register will be maintained including the name of grievant, date and time of grievance recorded, issue raised and time frame to redress the received grievance. (Format presented in ***Annex 5***).The register will provide information on how the grievance was solved.

- A suggestion box will be placed at the entrance of the sub-project site as well as around the project premises to collect grievances from the employees.
- Grievances can be registered via AEPC's website (https://www.aepc.gov.np/)
- If the project level GRC is not able to redress the grievance, it will be forwarded to the central level GRC
- Grievances received have to be resolved within 3 weeks from the day of complaint filed.
- Affected persons have the option of accessing the court of law in case of dissatisfaction with the decision of GRC.

6.2 Capacity Development and Enhancement Measure

During the construction period, the job priorities will be given to local people with equal opportunities to women and disadvantage groups as well. The skill development training such as unskilled construction works, scaffolding, casting, etc. will be given to the workers so that they are able to use the learned skills in other similar projects and earn their living. The project will require 12 human resources during operation phase. The priority shall be given to locals for skilled job, if they have required skill and qualification.

Enhancement Measure: There are not any household in the direct impact zone the proposed sub-project. The following enhancement measures have been proposed to ensure that the sub-project fully respects the dignity, human rights, economics, values and cultures of vulnerable groups working in the sub-project site, especially women and the IPs.

- Prior to the construction of the sub-project, the human resource involved in construction work will be informed about construction and consulted to address all the sensitive issues.
- Skill development training such as driving, mechanics, plumbing, electrician, etc. and/ or income generation training such as poultry farming, piggery will be offered.
- Priority will be given to the locals especially women and vulnerable groups for job opportunities.
- The produced compost fertilizers will be provided with subsidized rate for sub-project affected areas.

CHAPTER XI: PROJECT ENVIRONMENTAL HEALTH AND SAFETY PLAN

11.1 Occupational Health and Safety Plan

Occupational health and safety plan is a plan of action designed to prevent accidents and occupational diseases. The workers and staffs are prone to getting caught in accidents, injuries and diseases during the construction and operation phase of the sub-project. So, it is the responsibility of the company/ organization to provide safe working environment to workers and staffs. The following safety measures should be provided by the company to its employees.

- Provision of safety equipment such as gloves, masks, boots during construction and operation phase
- Provision of safety aid kit
- Awareness about potential health impacts while handling organic matters to staff
- Orienting staffs to follow proper safety measures during construction and operation phase
- Regular check-up of staffs during operation phase
- Proper maintenance of labor registration for both native and migrant worker along with their detail (name, nationality, contact number, emergency contact detail, etc.) and timely update

To provide a safe working environment to in-house staffs, visitors and the surrounding settlements, it is very necessary to be fully aware of the safety requirements to avoid accidents from the implementation of biogas plant. These provisions are prepared based on mitigation measures suggested against probable impacts. This plan will be prepared before construction and will be implemented during construction and operation phase by developer. The following issues are identified and brief safety plans are provided as follows:

a. General House Keeping

- Workers should be given orientation about the safety/ emergency preparedness plan during construction and operation phase
- The security should inform the concerned staff when visitors arrive. The designated staff should guide the visitor.
- Every person who enters the biogas plant premises should display a valid identification card.
- The sub-project area should be regularly cleaned and ensured that all floors are free from oil spillage and other harmful substances that are flammable.
- No pipe line, power cable shall run across the path ways causing a tripping hazard.

b. Fire Hazard

- Provision of alarm to notify the fire disaster.
- Provision of biogas flaring system for evacuating excess biogas production through combustion.
- Provision of fire extinguisher, fire hydrant, fire control ball and first aid kit.
- Provision of PPE
- Update contact number of fire brigade and ambulance for accidental cases.

c. Vandalism

- Appointing a day and night security guard.
- Provision of physical and technological barriers such as fences, gates, ID card access.
- Ensure lighting of the premises during night time.

d. Leakage detection

- Regular monitoring of leakage detection.
- Provide training to technical staff for handling and resolving gas leakage.

e. Infectious Disease Outbreak

- Effective Vector Control Measures such as regular cleaning in the sub-project area.
- Using gloves, masks and other safety equipment while handling organic materials and feedstock.
- Food and water safety measures to follow within the sub-project premises.
- In case of an outbreak, immediately report to the nearest health authority.

11.2 Gender Action Plan

Gender Action Plan will work on gender equality and empowerment of girls and women during the construction and operation of the sub-project. It will make sure that women enjoy the same right, resources, opportunities and protections as men during the implementation of the project. To have equal implementation of gender right, following measures should be taken in account:

- Women will be given priority for job opportunity
- Ensure female workers' security at work place
- Provide equal wage to female workers as male workers
- Special effort will be made to involve women during sub-project cycle

11.3 Substrate Handling and Slurry Management Plan

The management of substrate storage and post-digestate is a very necessary task as it will create nuisance in the sub-project area and around the vicinity. It could cause groundwater pollution, increase in flies, risks health of workers, etc. if not properly managed. The following steps should be taken by the developer to have well-managed environment in and around the sub-project area.

- Regular cleaning of the facility will be done to prevent flies and safety of workers.
- The solid slurry separated from manure will be dried and sold in the market
- The liquid will be reused as dilution water in the digester. Remaining liquid slurry will be sold as manure.

11.4 Labor Management Plan

Labor Management Plan describes the requirements for the proposed subproject with regards to labor and working conditions during construction. It aims to ensure the management and control of activities that may pose labour-related risks. Following measures shall be taken by developers to manage labor during construction.

- Promote fair and equitable labor practices for the fair treatment, non-discrimination and equal opportunity of workers
- Make sure that there is no child labor during construction and operation phases
- Establish, manage and promote a healthy management-worker relationship
- Protect workers' rights including migrant and third-party workers
- Promote healthy, safe, secure and comfortable accommodation that does not impact negatively on the communities in the surrounding area

11.5 Traffic Management Plan

The purpose of this Traffic Management Plan (TMP) is to ensure the safe and efficient movement of vehicles, equipment, and personnel in and around the biogas plant. This plan aims to minimize traffic-related hazards and disruptions while optimizing the operational efficiency of the plant. Following measures shall be taken by developers to manage the traffic.

a) Signage and Markings

- Install clear, visible signs for speed limits, directional guidance, pedestrian crossings, and safety zones.
- Use high-visibility paint for road markings, especially in pedestrian areas and crossings.

b) Speed Limits

- Enforce a maximum speed limit of 20 km/h within the plant premises to ensure safety.

c) Pedestrian Safety

- Designate pedestrian pathways and crossings with appropriate signage and markings.
- Ensure adequate lighting in pedestrian areas, especially during evening and night operations.

d) Vehicle Safety

- Conduct regular vehicle safety checks for all incoming and outgoing vehicles.
- Ensure all vehicles adhere to plant safety rules, including the use of seat belts and compliance with speed limits.

11.6 Emergency Preparedness Plan

The Emergency Preparedness Plan is prepared in order to take immediate action to minimize the loss. The following section gives protective measures to follow incase hazardous events occur in the project site.

a. During Catastrophe

a. Provision of sensor/ alarm to notify the disaster.
b. Awareness and training program with the workers during construction and operation stage on regular basis to discuss about the possible disaster and its evacuation plan.
c. Allocating Emergency exit.
d. Designation of emergency assembly area for evacuation.

b. Malfunction of the System

a. Regular maintenance of the equipment.
b. Proper segregation of waste before feeding to inlet.
c. Employing skilled technicians to operate the plant.
d. Regular orientation, instruction and guidance to staffs about plant operation.

c. Leakage and Burst

a. Provision of fire alarm, extinguishers and sprinklers.
b. Project insurance to cover the cost of loss from the event.
c. Proper orientation and training to staff to operate the plant.
d. Preparation of emergency exit map and orienting the staffs about it.

d. Accidents

a. Provide personal protective equipment (PPE) to all staff.
b. Conduct regular safety training on handling machinery, chemicals, and hazardous materials.
c. Maintain first aid stations with trained personnel.
d. Record and investigate all accidents to prevent recurrence.
e. Display safety signage and safety plans including contact details of related person, nearby hospitals and exit route.
f. Encourage reporting of near-misses to improve safety measures.

11.1.1 Project Emergency Contact List

Project Location: Badhaiyatal Rural Municipality-08, Bardiya District, Lumbini Province

Emergency Contact List		
Jakhera Urja Tatha Mal Bikas Company Pvt Ltd		
Developer	Mr. Sandip Kandu	9817414297
LOCATION AND USE OF EMERGENCY FACILITIES		
Service	**Emergency Number**	**Service Provided**
Police / Nepal Police	100, +977-084-420199	Emergency Response, Crime, Accident
Fire Brigade	101	Firefighting, Rescue
Ambulance / Medical Emergency (National)	102	Medical Rescue & First Aid
Workplace Health and Safety (OH&S)	9817414297-Mr. Sandip Kandu	Immediate Reporting of Serious Injury and Incidents.
Badhaiyatal Rural Municipality Office	+977-084-401077	Coordination during evacuation, local support
Badhaiyatal Rural Municipality Ambulance Service	+977-9844703100	Local ambulance service run by the rural municipality.
District Police Office, Badaiya	084-420199	Administrative, crime and disaster response coordination.

A. Nearby Hospital Details

Hospital	**Type / Notes**	**Approximate Distance from Site**	**Contact Details**
Bardiya District Hospital	District-level general hospital	6–8 km (site is in Bardiya; hospital is in Gulariya**,** Bardiya)	Phone: +977 084-421177 24-hour emergency service is available
Bardiya Eye Hospital	Specialized for eye care	~ 12 km (located in Sano Shree, Madhuwan Municipality)	Phone: 084-440313

B. Nearby Highway

Postal Highway (Hulaki Road / NH 05)

The Postal Highway runs across the Terai region and goes through Bardiya Distric. The section from Gulariya to Belawa of this road is currently being blacktopped. It is the key artery for transportation and emergency vehicle access.

C. Emergency Response Structure

Role	Responsibilities
Developer	• Leads all emergency actions on site. • Calls police, ambulance, or ward office if a big incident happens. • Makes sure the emergency plan follows Nepal rules and local municipality guidelines. • Keeps emergency phone numbers and contacts ready. • Makes sure all contractors follow safety and emergency procedures.
Site Supervisor	• Watches for hazards and ensures workers wear PPE. • Guides first aid and evacuation during an emergency. • Talks to workers every day about safety (toolbox talk). • Knows the closest Health Post or Hospital for medical help. • Watches out for local dangers like heat, snakes, floods, loose soil, and open pits. • Works with nearby residents to keep roads open for emergency vehicles.
First Aid Attendants	• Give first aid quickly and take care of injured workers. • Know emergency numbers (100 Police, 102 Ambulance). • Treat common site injuries like cuts, falls, dehydration, and snake bites. • Keep first aid kit full and ready. • Inform the worker's family if the injury is serious.
All Workers	• Follow supervisor instructions and report any accidents fast. • Join emergency drills and use PPE properly. • Help keep the site safe and clear for ambulance access. • Report unsafe areas like loose soil, unsafe scaffolding, or open holes. • Work respectfully with nearby community members during emergencies.

CHAPTER XII: CONCLUSION

The proposed 65 TPD biogas plant by **Jakhera Urja Tatha Mal Bikas Company Pvt.**, operating on a single-stage continuous anaerobic digestion system with integrated heating and stirring, is considered technically and environmentally feasible. The planned use of 60 tons of cow dung and 5 tons of press mud is adequate to support the projected daily production of 2,600 m^3 of raw biogas and its subsequent upgrading into approximately 1,092 kg of Bio-CNG. The distribution of Bio-CNG to nearby industries and the sale of compost to farmers contribute to renewable energy promotion, resource recovery, and reduced reliance on fossil fuels within the region.

From an environmental and social standpoint, the project is expected to generate minimal and manageable impacts during both construction and operation. The ESIA has identified potential adverse effects and outlined appropriate mitigation and monitoring measures to ensure effective risk management. If these measures are implemented as prescribed, the overall impact magnitude will remain low.

In addition to environmental benefits, the project will generate significant positive socio-economic outcomes, including local employment opportunities, enhancement of technical skills, and stimulation of the local economy through increased commercial activities and value-chain development.

Therefore, it is concluded that the subproject is recommended for the implementation under AEPC/MGEAP, subject to the adoption of the environmental and social mitigation measures proposed in this ESIA. Furthermore, any unforeseen impacts that may occur during the construction or operational phases shall be addressed efficiently through appropriate corrective actions and adaptive management measures.

References

- *Biogas: Anaerobic Digestion.* (2025). *Biogas-Info.* Retrieved from https://www.biogas-info.co.uk/about/biogas/ Composition and uses of biogas.
- Central Bureau of Statistics. (2021). *National Population and Housing Census 2021: Bardiya District and Badhaiyatal Rural Municipality report*. Government of Nepal.
- Badhaiyatal Rural Municipality. (n.d.). *Profile of Badhaiyatal Rural Municipality, Bardiya District*. Retrieved November 26, 2025, from https://badhaiyatalmun.gov.np/
- CityPopulation.de. (n.d.). *Badhaiyatal (Rural Municipality, Nepal) — Population statistics, charts, map and location*. Retrieved November 26, 2025, from https://www.citypopulation.de/

ANNEXES

Annex 1: Public Consultation

आज मिति २०८२/०८/१० गते लुम्बिनी प्रदेश, दाँदिया जिल्ला बढैयाताल गाउँपालिका, वडा नं ८ मा दैनिक १६०० क्युबिक मिटर बायोग्यास र ८.४५ मेट्रिक टन प्राङ्गारिक मल उत्पादन गर्ने गरी जारवेरा ऊर्जा तथा मल विकास प्रा.लि द्वारा संचालन गर्न लागिएको बायोग्यास परियोजनानिर्माण तथा संचालन गर्दा हुन सक्ने प्रभाव बारे स्थानीयको राय सुझाव संकलन गर्न गरिएको सामुहिक छलफल कार्यक्रममा जारवेरा ऊर्जा तथा मल विकास प्रा.लिका प्रबन्ध निर्देशक श्री सन्दिप कान्डु अध्यक्षतमा बैठक बसी तपसिल उपस्थितिमा निम्न अनुसारका सुझावहरु सहित छलफल गरि निर्णय गरियो।

उपस्थिति

१.	सुनिल चौधरी	बढैया ताल-८	१८. सबै कोनु श्रेष्ठ वातावरण विज्ञ, काठमाडौं
२.	लक्ष्मी कुमारी चौधरी	बढैयाताल-६	
३.	कृष्ण प्रसाद थारु	बढैयाताल-४	
४.	मनोज कुमार थारु	बढैयाताल-६	
५.	सीता देवी चौधरी	बढैयाताल-८	
६.	सुनिता थारु	बढैयाताल-८	
७.	रमेश चौधरी	बढैयाताल-२	
८.	सुनिता थारु	बढैयाताल-८	
९.	रमेश यादव	बढैयाताल-७	
१०.	प्रकाश गुप्ता	बढैयाताल-६	
११.	माया थापा	बढैयाताल-८	
१२.	राजेन्द्र कुमार थारु	बढैयाताल-८	राजेन्द्र
१३.	विष्णु प्रसाद चौधरी	बढैयाताल-६	विष्णु
१४.	हरि बहादुर चौधरी	बढैयाताल-७	हरि बहादुर चौधरी
१५.	अनिता चौधरी	बढैयाताल-८	अनिता
१६.	सुमन यादव	बढैयाताल-८	
१७.	सन्दिप कान्डु	प्रबन्ध निर्देशक, जारवेरा	

प्रस्ताव नं १. परियोजनाले वातावरणमा गर्ने असर जस्तै धुलो, ध्वनी र पानीको प्रदूषण न्यून गर्नुपर्ने

निर्णय नं १. आवाज, ध्वनी र फोहोर पानी नियन्त्रणका उपायहरु लागू गरिने, वातावरणीय मापदण्डको पालना सुनिश्चित गरिने।

प्रस्ताव नं २. निर्माण कार्यको समयमा यातायात/ट्राफिक व्यवस्थापन गर्नुपर्ने

निर्णय नं २. ट्राफिक व्यवस्थापन योजना लागू गरिने र सडकमा बाधा हुने काममा कम र व्यवस्थित रुपले गरिने।

प्रस्ताव नं ३. स्थानीय बासिन्दालाई निर्माण र सञ्चालन चरणमा दक्षता अनुसार रोजगारमा प्राथमिकता दिनुपर्ने।

निर्णय नं ३. योग्य स्थानीय बासिन्दा, विशेष गरी महिला र कमजोर समूहलाई रोजगार दिने।

प्रस्ताव नं ४. निर्माण कार्यको समयमा सार्वजनिक सुरक्षाका संकेत चिन्ह तथा उपयुक्त संकेतस्थापना गर्नुपर्ने।

निर्णय नं ४. निर्माण स्थलमा सार्वजनिक सुरक्षाका लागि उचित संकेतस्थापना गरिने।

प्रस्ताव नं ५. कामदार र सर्वसाधारणको सुरक्षा सुनिश्चित गर्नुपर्ने।

निर्णय नं ५. सुरक्षा नियम र उपायहरु पालना गरिने।

प्रस्ताव नं ६. मल वितरणमा स्थानीयलाई प्राथमिकता दिने।

निर्णय नं ६. उद्योगबाट उत्पादन हुने मल स्थानीय कृषकहरुको माग पुरा गरि क्रमशः वितरण गर्ने।

Community Consultation Plan

Objectives:

- To involve nearby community in the project during its planning, construction and implementation phase.
- Disclosure of safeguard measures to be considered during project construction and implementation
- Management of stakeholder expectations
- Reduction in the potential for delays in future project related issues

Method

The method of community consultation will be public meetings with involvement of nearby community, project developer, construction contractor, representative from local level.

Timing

During project design phase: already accomplished during ESIA phase

During Construction Phase: At the starting of construction

During Operation Phase: 2 months after successful testing and commissioning

Community Consultation Plan Matrix

Phase	Activities	Responsibility
During Project Design Phase	• To disclose non-technical project information to locals • Highlighting objectives of preparation of ESIA • To seek comments and suggestions from community	Developer/Consultant
During Construction Phase	• Informing locals/nearby community about start of project construction • Highlighting the project safeguard document provisions and mitigation measures mentioned in ESIA document which will going to be implemented during project construction and operation phase	Developer/ In-house Safeguard Team
During operation Phase	• Information on ESIA Implementation and its progress • Highlighting the mitigation measures adopted for the project • Periodic disclosure of grievances received • To seek comments and suggestions from community	Developer/ In-house Safeguard Team

Site Pictures:

Pictures of Public Consultation

Annex 2: Legal Documents of the Developer

1. Company Registration Certificate

उद्योग, वाणिज्य तथा आपूर्ति मन्त्रालय

कम्पनी रजिष्ट्रारको कार्यालय

कम्पनी दर्ताको प्रमाण - पत्र

दर्ता नं: ३८७२८५/८१/८२

श्री जाखेरा उर्जा तथा मल विकास कम्पनी

नामको प्राइभेट लिमिटेड कम्पनी संम्वत् २०८२ साल चैत महिना ११ गते रोज १ मा दर्ता भएको कुनाले कम्पनी ऐन, २०६३ को दफा ५ को उपदफा (१) बमोजिम यो प्रमाण-पत्र दिइएको छ।

Government of Nepal

Ministry of Industry, Commerce & Supplies

Office of the Company Registrar

CERTIFICATE OF INCORPORATION OF COMPANY

Registration No: 387285/81/82

This Certificate of Incorporation has been issued to

M/s Jakhera Urja Tatha Mal Bikas Company

Private Limited Company having incorporated it on the 25 day of May 2025, pursuant to sub-section (1) of section 5 of the Companies Act, 2006.

नोट: कम्पनीले अनुमतिपत्र लिई कारोबार गर्नुपर्ने उद्देश्यका लागि सम्बन्धित निकायबाट अनुमतिपत्र लिएर मात्र कारोबार गर्नुपर्नेछ।

Condition: For objectives that need approval/license, the registered company must receive the same from the competent authority.

प्रमाणित डिजिटल हस्ताक्षर गर्ने व्यक्ति

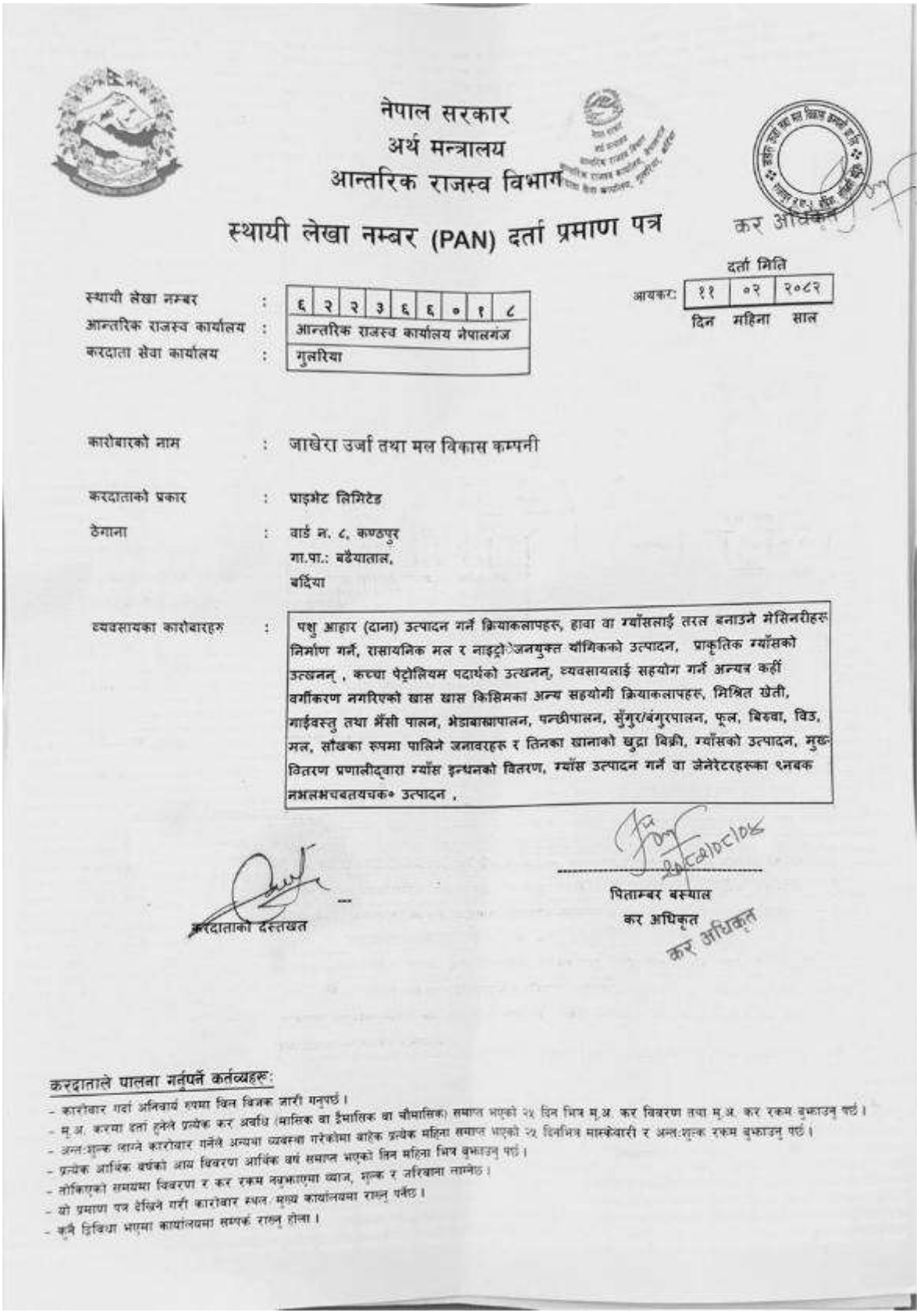
नामथर : रेशम भण्डारी

पद : सहायक रजिस्ट्रार

मिति : २०८२-०२-११

कम्पनी रजिष्ट्रारको कार्यालय

2. PAN Registration Certificate



नेपाल सरकार
अर्थ मन्त्रालय
आन्तरिक राजस्व विभाग

स्थायी लेखा नम्बर (PAN) दर्ता प्रमाण पत्र

कर अधिकृत

दर्ता मिति
आयकर: ११ (दिन) ०२ (महिना) २०८२ (साल)

स्थायी लेखा नम्बर : ६ २ २ ३ ६ ६ ० १ ८
आन्तरिक राजस्व कार्यालय : आन्तरिक राजस्व कार्यालय नेपालगंज
करदाता सेवा कार्यालय : गुलरिया

कारोबारको नाम : जाखेरा उर्जा तथा मल विकास कम्पनी

करदाताको प्रकार : प्राइभेट लिमिटेड

ठेगाना : वार्ड न. ८, कण्ठपुर
गा.पा.: बढैयाताल,
बर्दिया

व्यवसायका कारोबारहरु : पशु आहार (दाना) उत्पादन गर्ने क्रियाकलापहरू, हावा वा ग्यासलाई तरल बनाउने मेसिनरीहरू निर्माण गर्ने, रासायनिक मल र नाइट्रोजनयुक्त यौगिकको उत्पादन, प्राकृतिक ग्यासको उत्खनन् , कच्चा पेट्रोलियम पदार्थको उत्खनन, व्यवसायलाई सहयोग गर्ने अन्यत्र कहीं वर्गीकरण नगरिएको खास खास किसिमका अन्य सहयोगी क्रियाकलापहरू, मिश्रित खेती, गाईवस्तु तथा भैंसी पालन, भेडाबाख्रापालन, पन्छीपालन, सुँगुर/बंगुरपालन, फूल, बिरुवा, बिउ, मल, साँचका रूपमा पातिने जनावरहरू र तिनका खानाको खुद्रा बिक्री, ग्यासको उत्पादन, मुख्य वितरण प्रणालीद्वारा ग्यास इन्धनको वितरण, ग्यास उत्पादन गर्ने वा जेनेरेटरहरूका ९नबक नभलभचबतयचक० उत्पादन ,

करदाताको दस्तखत

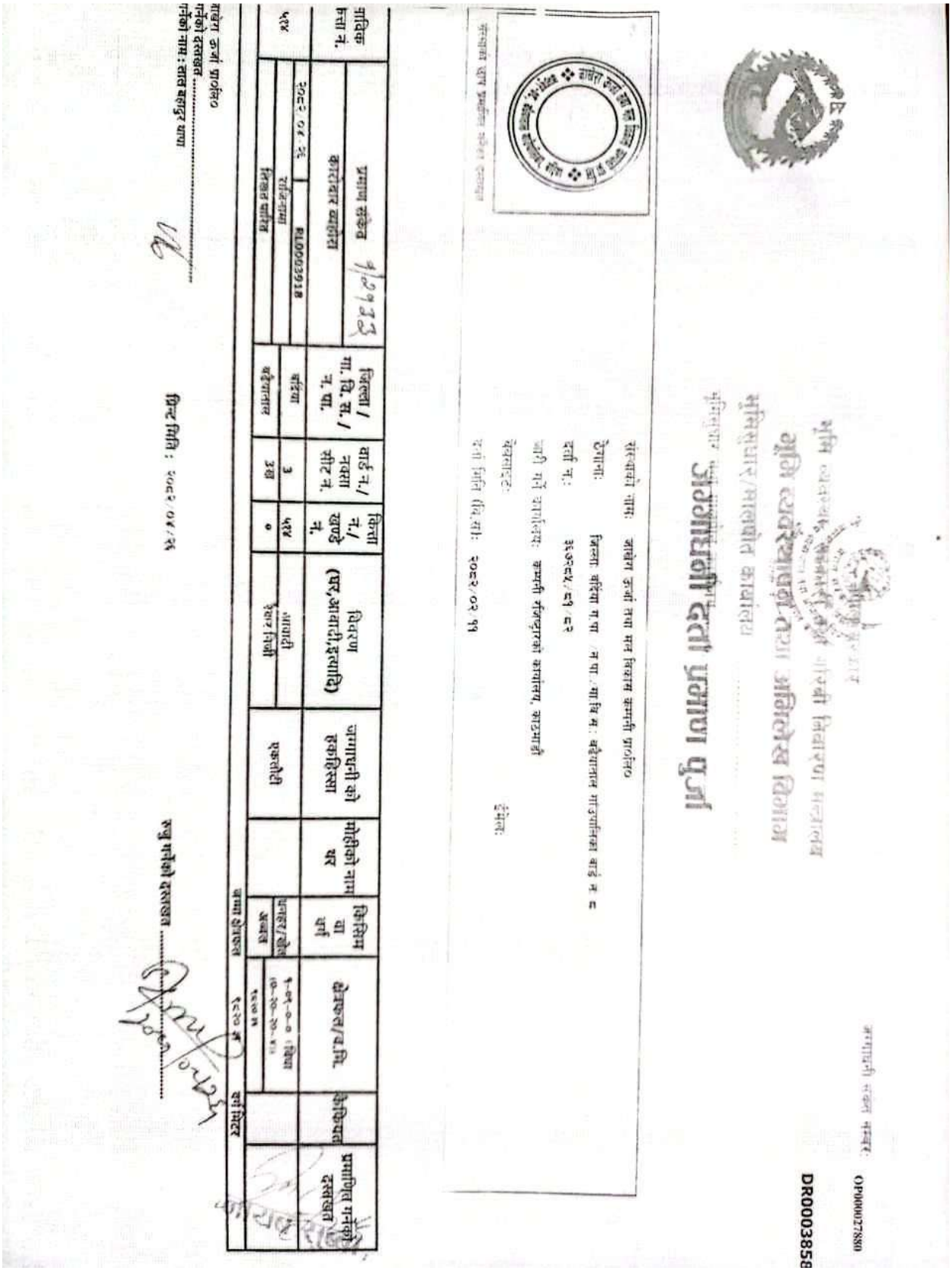
पिताम्बर बस्याल
कर अधिकृत

कर अधिकृत

करदाताले पालना गर्नुपर्ने कर्तव्यहरू:

- कारोबार गर्दा अनिवार्य रुपमा खिल बिजक जारी गर्नुपर्छ ।
- म.अ. करमा दर्ता हुनेले प्रत्येक कर अवधि (मासिक वा त्रैमासिक वा चौमासिक) समाप्त भएको २५ दिन भित्र म.अ. कर विवरण तथा म.अ. कर रकम बुझाउनु पर्छ ।
- अन्तःशुल्क लाग्ने कारोबार गर्नेले अन्यथा व्यवस्था गरेकोमा बाहेक प्रत्येक महिना समाप्त भएको २५ दिनभित्र मासिकेवारी र अन्तःशुल्क रकम बुझाउनु पर्छ ।
- प्रत्येक आर्थिक वर्षको आय विवरण आर्थिक वर्ष समाप्त भएको तिन महिना भित्र बुझाउनु पर्छ ।
- तोकिएको समयमा विवरण र कर रकम नबुझाएमा ब्याज, शुल्क र जरिवाना लाग्नेछ ।
- यो प्रमाण पत्र देखिने गरी कारोबार स्थल/मुख्य कार्यालयमा राख्नु पर्नेछ ।
- कुनै द्विविधा भएमा कार्यालयमा सम्पर्क राख्नु होला ।

3. Land Ownership Document



4. Sample Agreement with Substrate Suppliers

गोवर आपूर्ति सम्झौता

प्रिय महोदय,
सादर नमस्कार।

यस पत्रमार्फत जानकारी गराउन चाहन्छौं कि हामीबीच निम्न विवरण अनुसार गोवर आपूर्ति सम्बन्धी समझौता भएको छ:

१. पहिलो पक्ष (सञ्चालक):
नाम: **जाखेरा ऊर्जा तथा मल विकास कम्पनी प्रा. लि**
ठेगाना: **राजापुर नगरपालिका-०३, बर्दिया, लुम्बिनी प्रदेश, नेपाल**
फोन नम्बर: ९८१७६१७२६७

२. दोस्रो पक्ष (गाई तथा गोवर आपूर्ति गर्ने व्यक्ति/संस्था):
नाम: मा गायत्री भैंसी पालन
ठेगाना: गुलरिया-११
फोन नम्बर: ९८१९५७७००७

जम्मा गाईको संख्या: ७३ वटा

गोबरका प्रकार **आलो गोबर**

गोवर आपूर्तिः
हामीले पहिलो पक्षलाई प्रतिदिन करिब १४६० **किलो** ताजा गोवर आपूर्ति गर्नेछौं।

क्तानी व्यवस्था:
उक्त समझौता अनुसार पहिलो पक्षले प्रति **किलो** रु. ..../-
(अक्षरमा: ....) भुक्तानी गर्ने व्यवस्था गरिएको छ।सो भुक्तानीमा **दुवानी तथा लोडिङ खर्च** पहिलो **पक्ष** गर्नेछ।

१. पहिलो पक्ष (सञ्चालक):
नाम: मनोज [illegible]
हस्ताक्षर: [signature]
मिति: 2082/04/07

२. दोस्रो पक्ष (सञ्चालकव्यक्ति/संस्था):
नाम: ....
हस्ताक्षर: ....
रनजीत यादव

गोवर आपूर्ति सम्झौता

प्रिय महोदय,
सादर नमस्कार।

यस पत्रमार्फत जानकारी गराउन चाहन्छौं कि हामीबीच निम्न विवरण अनुसार गोवर आपूर्ति सम्बन्धी समझौता भएको छ:

१. पहिलो पक्ष (सञ्चालक):
नाम: जाखेरा ऊर्जा तथा मल विकास कम्पनी प्रा. लि
ठेगाना: राजापुर नगरपालिका-०३, बर्दिया, लुम्बिनी प्रदेश, नेपाल
फोन नम्बर: ९८१०४१२२१७

२. दोस्रो पक्ष (गाई तथा गोवर आपूर्ति गर्ने व्यक्ति/संस्था):
नाम: गणेश भैसी पालन फार्म
ठेगाना: गुलरिया-०२
फोन नम्बर: ९८१४०४४५४

जम्मा गाईको संख्या: १३० वटा

गोबरका प्रकार **आलो गोबर**

गोबर आपूर्ति:
हामीले पहिलो पक्षलाई प्रतिदिन करिब २६०० **किलो** ताजा गोवर आपूर्ति गर्नेछौं।

कत्तानी व्यवस्था:
उक्त समझौता अनुसार पहिलो पक्षले प्रति **किलो रु.** ...../-
(अक्षरमा: .....) भुक्तानी गर्ने व्यवस्था गरिएको छ।सो भुक्तानीमा **ढुवानी तथा लोडिङ खर्च** पहिलो पक्ष गर्नेछ।

१. पहिलो पक्ष (सञ्चालक):
नाम: [illegible]
हस्ताक्षर:
मिति: २०८२/०४/०७

२. दोस्रो पक्ष (सञ्चालकव्यक्ति/संस्था):
नाम: [illegible]
हस्ताक्षर:

Rajapur Sugar and Chemical Industries Pvt.Ltd
Rajapur 05, Bardiya

Date: 20/11/2025

To

Jakhera Urja Tatha Mal Bikas Company
kantapur-08 badhaital gaupalika,bardiya

Subject: Regarding supply of press mud

Dear Sir,

In continuation with our telephonic conversation, this letter is a confirmation that we can supply **2500 MT of sugarcane press mud annually** to your organization.

We wish you all the best for your project.

Regards,

.....
SK Mahat
General Manager

SHRAVASTI KISAN SAHKARI CHINI MILL
Nanpara Rd Balha, Uttar Pradeth 271865, India

Date : 20/11/2025

Letter Of Intent

To

Jakhera urja tatha mal bikas company
Badhaital-08, Bardiya district ,Nepal

SUB: Letter Of Intent

This is to bring to your kind notice that we hereby commit to supply **3000 tons** of press mud for the milling year 2025/26.

The agreed price will be INR. 400 per ton as per verbal conversation with our Director. The loading charges, freight and customs will be extra. The price quoted above is solely for the pressmud ex-mill basis.

Kindly note that this price is valid for the milling year 2025-2026..

Regards,

.....

Bikrant Sharma.

General Manager.

Annex 3: Reviews of Plans/ Policies/ Legislations and Guidelines

1. The Constitution of Nepal

The Constitution of Nepal prioritizes the human rights and protection of environment. Article 30 (1) of the Constitution asserts that every person shall have the right to live in a healthy environment. Similarly, Article 51 (G) asserts that; the state shall make such arrangements as may be required to keep the environment clean and stated policies relating to protection, promotion and use of natural resources. The state shall give priority to the prevention of adverse impacts in the environment from physical development activities, by increasing the awareness of the general public about environmental cleanliness, as well as to the protection of the environment and special safeguard of the rare wildlife. The state shall make arrangements for the protection of sustainable uses of and equitable distribution of benefits derived from, the flora, fauna and biological diversity.

2. Plans and Policies

a. Fourteenth Plan 2013-2016

According to 14th plan, Government of Nepal has intention to raise the human development index by safeguarding social development and social security. Increase on the average economic growth by 7.2% and industrial economic growth with 10.6% within 2019 is also included in this plan. This plan also comprises the condition to attract the foreign and national investor in goods and services so that there will be comparison and competition in markets.

b. Fifteenth Plan FY 2076/77- 2080/81

The Fifteenth Plan of Nepal (FY 2076/77 to 2080/81) aimed at laying the foundation for transforming Nepal into a middle-income country by 2030, emphasizing sustainable, inclusive, and equitable economic growth. The plan targeted an average annual GDP growth rate of 9.6%, focusing on sectors like agriculture, tourism, industry, and services. Infrastructure development, particularly in transportation, energy, and urban development, was prioritized to support economic activities. The plan also stressed improving education, healthcare, and social protection to enhance human capital and reduce poverty and inequality. Environmental conservation and climate resilience were integral, promoting sustainable use of natural resources. Strengthening governance, enhancing public service delivery, and fostering regional and international cooperation were key elements to ensure effective implementation. The Fifteenth Plan envisioned a holistic approach to development, aiming to elevate the overall well-being of Nepali citizens and create a robust, diversified economy.

c. Sixteenth Plan FY 2081/82 to 2085/86

The Sixteenth Plan of Nepal (FY 2081/82 to 2085/86) outlines a strategic vision for socio-economic development with the goal of achieving a 7.5% annual GDP growth rate and transforming Nepal into a middle-income country by 2030. Key focuses include diversifying the economy, enhancing infrastructure such as transport and digital networks, and boosting energy production from renewable sources. Social development aims to improve education, healthcare, reduce poverty, and promote gender equality. The plan also emphasizes modernizing agriculture, supporting rural development, and ensuring environmental sustainability through climate change mitigation and disaster resilience. Good governance, strengthened institutions, and enhanced

public service delivery are prioritized alongside creating a conducive environment for private sector growth and investment. Sustainable tourism development, fostering innovation and technology adoption, and enhancing regional and international cooperation are integral components. This comprehensive blueprint aims for sustainable, inclusive, and resilient growth to improve the quality of life for all Nepali citizens.

d. Rural Energy Policy, 2006

The main rationale of formulating Rural Energy Policy is to create conducive environment that will self-motivate and mobilize local institutions, rural energy user groups, non-governmental organizations, cooperatives and private sector organization for the development and expansion of rural energy resources. The government will act as facilitator and promoter for involving private sector and non-governmental organizations to be involved in rural energy development for development and expansion of new technologies. It has also envisioned subsidy provision for promotion of such renewable energy technologies.

e. Renewable Energy Subsidy Policy, 2016

The objective of Renewable Energy Subsidy Policy is to encourage very poor households to use RETs and to encourage private sectors and financial institutions to invest in the sector while focusing on providing service delivery of utmost quality. The subsidy policy is based on cost per unit of energy output. Although subsidy amount differs according to technology and region, subsidy amount generally covers 40% of the total costs.

3. Acts and Rules

a. Environment Protection Act, 2076 and Environment Protection Rules, 2077

The Environment Protection Act, 2076 and Environment Protection Rules, 2077 of Nepal together create a robust framework for environmental conservation and sustainable development. The Act mandates Environmental Impact Assessments (EIAs) for development projects to identify and mitigate potential environmental impacts, and establishes guidelines for pollution control, waste management, and natural resource conservation. It emphasizes public participation, transparency, and the establishment of environmental standards and monitoring mechanisms. The Rules, enacted in 2077, provide detailed procedures and standards for implementing the Act, including specific requirements for EIAs, pollution control measures, and penalties for violations. Together, these legal instruments aim to balance economic development with environmental protection, ensuring sustainable use of resources and the well-being of present and future generations.

b. Local Government Operation Act, 2074 (2017)

Local Government Operation Act, 2074 outlines work, responsibility and powers of the local governments (Rural Municipality and Municipality levels). It specifies authorities devolved by the Constitution of Nepal to the local bodies. Section 3 of the act specifies the authorities of the local government bodies. Section 11 empowers local government to formulate local level policy

for the environmental conversation and biodiversity and requires the local bodies to act for the environmental risk reduction, pollution control and control of hazardous substances.

c. Water Resources Act, 1992

The water Resource Act (1992) makes arrangements for the rational use of surface and underground water. The Act seeks to prevent environmental and hazardous effects from the use of water and prohibit water pollution by chemicals, industrial waste or litter. Water may only be used in a manner that does not permit soil erosion, landslide or flood. Pollution of drinking water is prohibited under the Nepal Drinking Water Corporation Act (1989).

d. Solid waste Management Act, 2011

The Solid Waste Management Act, 2011 emphasize on the responsibility of waste producers (individuals/institutions) for the treatment and management of hazardous waste, chemical and industrial waste as per the mandated standards. Section 4 outlines the duties of local government to take actions to control haphazard waste generation, disposal or collection and has provisions for various measures against those engaged in activities detrimental to the intentions of the act. Section 5 emphasizes any individual, organization or institution shall have to reduce the amount of generated solid waste as much as possible while carrying out any work or business. Section 38 of the Act states that "To throw, keep, discharge or cause to discharge chemical waste, industrial waste, medical waste or hazardous waste haphazardly are considered as offensive and could lead to punishment and penalties as mentioned in Section 39 of the Act.

e. Solid Waste Management Regulation, 2013

The Solid Waste Management Regulation 2013 of Nepal provides a comprehensive framework for managing solid waste to protect public health and the environment. It outlines responsibilities for various stakeholders, including government bodies, private sector entities, and individuals, to ensure effective waste management practices. Key provisions include waste segregation at the source, promoting recycling and reuse, and proper disposal methods. The regulation mandates local governments to develop and implement solid waste management plans, conduct public awareness programs, and establish necessary infrastructure such as waste treatment and disposal facilities. It also emphasizes the role of private sector participation through public-private partnerships. The regulation enforces penalties for non-compliance and encourages community involvement to maintain cleanliness and sustainability. Overall, it aims to create an integrated and sustainable waste management system in Nepal.

f. Child Labor (Prohibition and Regulation) Act, 2000

The Child Labor (Prohibition and Regulation) Act 2000 is the main legal expedient to prohibit engaging children in factories, mines or similar risky activities and to make necessary provisions with regard to their health, security, services and facilities while engaging then in other activities.

Under Section 3 of the Act, child having not attained the age of 14 years is strictly prohibited to be engaged in works as a laborer. Similarly, under Section 4, engagement of child in works as a laborer against his/her will by way of persuasion, misrepresentation or by subjecting he/she to

any influence or fear or threat or coercion or by any other means is prohibited. Under Section 6, in case any Enterprise has to engage a child in works, an approval has to be obtained from the concerned Labor Office or any authority or official prescribed by that office and form the father, mother or guardian of the child.

g. Labor Act, 2074 and Labor Rule, 2075 B.S.

This Act strictly prohibits the concerned parties who hire the work force to over utilize them during its different activities. Section 5 of the Act prohibits child labor engagement. Similarly, Section 6 prohibits any kind of discriminations like religion, gender, caste ethnicity, mother tongue etc. among employees. Section 22 states that prior work permit is required for non-Nepali citizens and they are allowed to work in Nepal for certain period only in the area where the Nepali work force is not available or not competent. Section 28 provisioned the working hours as 8 hours a day and 48 hours a week. The same section provisioned that thirty minutes must be allowed for rest and/or refreshments should be given in every five hours of work. Likewise, Section 30 allows employer to engage employee additional of 4 hours per day or 24 hours per week and shall provide over-time payment as 1.5 times the normal wage as per Section 31. Section 74 emphasizes constitution of Safety and Health Committee where 20 or more employees are engaged.

4. Guidelines/ Framework

a. National EIA Guidelines, 1993

To address environmental impact assessment as envisaged by NCS, 1987, National Environmental Impact Assessment (EIA) Guidelines were endorsed by Government of Nepal on 27 September 1992 A.D. and gazetted on 19 July in 1993 A.D., Volume 43, Number 5. The guideline provides criteria for project screening and initial environmental examination (IEE). This also includes scoping, preparation of terms of reference for EIA, methods of EIA report, impact identification and prediction, impact mitigation measures, review of the draft EIA report, impact monitoring, evaluation of impact studies, impact auditing, community participation and schedules and annexes to IEE and EIA.

Many of the guideline provisions are now included in the Environment Protection Act, 1997, and Environmental Protection Regulation, 1997. EIA in Nepal has now become legally mandatory. However, as the National Environmental Guidelines, 1993 have not been issued under the Environmental Protection Act (1997); they do not have any legal force. It is a policy guideline issued by the Government that is still followed in the matters which are not covered by the Environment Protection Act (1997) and Environment Protection Regulations (1997).

b. SREP Environment Management Framework (EMF), 2013

SREP Environment Management Framework (EMF) has been formulated on 2013 during the SREP project formulation. This document is the key document to assure environmental protection while implementing biogas subprojects under SREP Extended Biogas Programme. This document identified generic impacts caused by implementation of biogas subprojects and

prescribed generic mitigation measures. The EMF proposes three levels of interventions for all biogas sub-projects in order to ensure adequate environmental considerations. Environmental Screening and appropriate subproject categorization through comprehensive checklist, preparation of Environmental Management Plan (EMP) based on site specific baseline which will consist alternative analysis, mitigation measures and environmental monitoring plan. The document provides procedure for environmental impact identification and preparation of safeguard documents.

Any project is classified as Category B, if its potential adverse environmental impacts on human populations or environmentally important areas—including wetlands, forests, grasslands, and other natural habitats—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 mitigatory measures can be designed more readily than for Category A projects. The scope of EA a Category B project may vary from project to project, but it is narrower than that of Category A. Category B projects require Initial Environmental Examination (IEE) or more often known as limited EIA.

5. Standards

a. National Ambient Air Quality Standards, 2012

The National Ambient Air Quality Standards, 2012 enforced by GON has set quality standards for seven parameters: TSP, PM10, sulphur dioxide, nitrogen oxide, carbon mono-oxide, lead and benzene for the maintenance of the ambient air quality. The project during its construction and operation will have to comply with the set standards for the ambient air quality.

b. Nepal Vehicle Mass Emission Standards, 1999

Nepal Vehicular Emission Standard, 1999 enforced for the vehicles operating on petrol, gas, and diesel. The emission standards are very specific for two, three and four wheeler vehicles. The vehicles used by the project should comply with the vehicular emission standards during the construction and operation phase.

c. Generic Standard for Discharging industrial effluent in inland surface water, 2001

The government of Nepal exercising the right from Rule 15 of Environment Protection Regulation has set tolerance limits for industrial effluents discharged into inland surface water through Gazette Notification. Since the project is considered as an industry it will have to comply with tolerance limits in the generic standard prior to the discharge of the effluents into the inland surface water during the construction and operation period.

6. International Policies and Conventions

a. World Bank Safeguard Policy (OP 4.01 Environment Assessment)

An Environmental Assessment (EA) shall be conducted to ensure that bank-financed project are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. Any WB project that is likely to have potential adverse environmental risks and impacts in its area of influence requires

an EA indicating the potential risks, mitigation measures and environmental management framework or plan.

EA takes into account the natural environment (air, water, and land), human health and safety, social aspects (involuntary resettlement, indigenous peoples, and physical cultural resources) and trans-boundary and global environmental aspects. EA considers natural and social aspects in an integrated way. It also takes into account the variations in project and country conditions; the findings of country environmental studies; national environmental action plans; the country's overall policy framework, national legislation, and institutional capabilities related to the environment and social aspects; and obligations of the country, pertaining to project activities, under relevant international environmental treaties and agreements. The Bank does not finance project activities that would contravene such country obligations, as identified during the EA. EA is initiated as early as possible in project processing and is integrated closely with the economic, financial, institutional, social, and technical analyses of a proposed project.

Limited EIA or IEE examines the project's potential negative and positive environmental impacts and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance.

b. World Bank Safeguard Policy (OP 4.10 Indigenous Peoples)

The World Bank Safeguard Policy (OP 4.10) on Indigenous Peoples ensures that development projects respect the dignity, rights, economies, and cultures of Indigenous Peoples. Applicable to projects affecting these communities, the policy mandates thorough assessments to identify potential impacts and requires the preparation of an Indigenous Peoples Plan (IPP) or Indigenous Peoples Planning Framework (IPPF). Key elements include ensuring Free, Prior, and Informed Consultation (FPIC) for participation in decision-making, conducting social assessments to analyze impacts, and promoting benefit-sharing aligned with Indigenous preferences. The policy also establishes accessible grievance mechanisms and supports capacity-building initiatives for effective engagement in the development process. Continuous monitoring and evaluation are mandated to ensure compliance and effectiveness. This policy recognizes the unique vulnerabilities of Indigenous Peoples and aims to foster their development while respecting their rights and promoting sustainable outcomes.

c. World Bank Safeguard Policy (OP 4.11 Physical Cultural Resources)

The World Bank Safeguard Policy (OP 4.11) on Physical Cultural Resources aims to preserve and protect cultural heritage within development projects. It applies to projects that may impact cultural resources, including archaeological, historical, architectural, and other culturally significant sites and objects. The policy mandates thorough assessments to identify and evaluate the significance of affected resources and involves stakeholder consultation to ensure informed decision-making. It requires the development and implementation of mitigation measures to avoid, minimize, or mitigate adverse impacts, including provisions for chance finds during project implementation. Physical Cultural Resources Management Plans (PCRMP) are prepared to

outline specific actions and responsibilities, ensuring ongoing protection and management. The policy also supports capacity building and training for effective resource management and mandates continuous monitoring and supervision to track the implementation of mitigation measures. Overall, the policy integrates cultural heritage preservation into sustainable development, ensuring cultural resources are respected and appropriately managed.

d. World Bank Safeguard Policy (OP 4.12 Involuntary Resettlement)

The World Bank Safeguard Policy (OP 4.12) on Involuntary Resettlement aims to mitigate the adverse social and economic impacts of development projects that cause involuntary displacement. The policy requires that resettlement activities improve or at least restore the livelihoods and living standards of displaced persons. Key measures include conducting a comprehensive assessment to identify affected individuals and communities, consulting with stakeholders to ensure their participation in planning and decision-making, and preparing Resettlement Action Plans (RAPs) or Resettlement Policy Frameworks (RPFs). These plans outline measures to provide compensation for lost assets, assist in relocation, and support livelihood restoration. The policy also mandates the provision of adequate housing, infrastructure, and social services at resettlement sites. Additionally, it ensures grievance mechanisms are in place for addressing concerns and disputes. Continuous monitoring and evaluation are required to ensure effective implementation and compliance with the policy objectives. Overall, OP 4.12 emphasizes the need to treat resettled individuals and communities fairly and equitably, aiming to achieve sustainable development outcomes.

e. Convention on Biodiversity (CBD), 1993

The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding.

f. **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973**

The convention classifies species according to criteria where access or control is important (e.g. I- species threatened with extinction; II- species which could become endangered; III- species that are protected; E- Endangered; V- Vulnerable, R- Rare (CITES 1983)). The project will have to minimize the impacts to the CITES species as far as possible.

g. Convention (No. 169) Concerning Indigenous and Tribal Peoples in Independent Countries, 1989

The Article 7 of the convention provide right to the indigenous and tribal people to decide their own priorities for the process of development. However, for the national development plans and programs, it mandates consultation with them in the formulation of plans and programs.

Article12, 13, 14 and 15 safeguards rights of the indigenous people in the land and natural resources in their territories, it mandates formulation of special provisions under the state legislation for participation in the decision-making process and resettlement process with full compensation of the resulting loss or injury (Article 16)

Annex 4: Environmental Standards

Table A: Standards for Effluents Discharged into Inland Waters

SN	Parameters	Tolerance Limits
1	Total Suspended solids, mg/L, Max	30-200
2	Particle size of total suspended particles	Shall pass 850-micron Sieve.
3	pH	5.5 to 9.0
4	Temperature	Shall not exceed 40 degree C in any section
5	Biochemical oxygen demand (BOD) for 5	30-100
6	Oils and grease, mg/L, Max	10
7	Phenolic compounds, mg/L, Max	1
8	Cyanides (as CN), mg/L, Max	0.2
9	Sulphides (as S), mg/L, Max	2
10	Radioactive materials:	
11	a. Alpha emitters, c/ml, Max	7 OCT
12	b. Beta emitters, c/ml, Max	8 OCT
13	Insecticides	Absent
14	Total residual chlorine, mg/L	1
15	Fluorides (as F), mg/L, Max	2
16	Arsenic (as As), mg/L, Max	0.2
17	Cadmium (as, Cd), mg/L, Max	2
18	Hexavalent chromium (as Cr), mg/L, Max	0.1
19	Copper (as Cu), mg/L, Max	3
20	Lead (as Pb), mg/L, Max	0.1
21	Mercury (as Hg), mg/L, Max	.01
22	Nickel (as Ni), mg/L, Max	3
23	Selenium (as Se), mg/L, Max	0.05
24	Zinc (as Zn), mg/L, Max	5
25	Ammonical nitrogen, mg/L, Max	50
26	Chemical Oxygen Demand, mg/L, Max	250
27	Silver, mg/L, Max	0.1

(Source: Standards adopted from MoEST, gazette on 2058/01/17 by GoN)

Table B: Drinking Water Quality Standards

SN	Parameters	Desirable	Maximum Tolerable
1.	Colour, Hazen units, Max	10	15
2.	Odour	Unobjectionable	
3.	Taste	Agreeable	
4.	Turbidity, NTU, Max	5[1]	10
5.	Total Dissolved Solids, mg/l , Max	500	1500
6.	pH value	6.5 – 8.5	May be relaxed up to 5.5 on the lower and up to 9 on higher side.
7.	Total Hardness (as $CaCO_3$) mg/l, Max	250	
8.	Calcium (as Ca), mg/l, Max	75	
9.	Magnesium (as Mg), mg/l, Max	30	
10.	Copper (as Cu), mg/l, Max	1	may be extended up to 1.5
11.	Iron (as Fe), mg/l, Max	0.3	
12.	Manganese (as Mn), mg/l, Max	0.1	may be extended up to 0.5
13.	Chlorides (as Cl), mg/l, Max	250	
14.	Sulphate, (as SO_4), mg/l, Max	150[2]	
15.	Nitrate (as NO_3), mg/l, Max	45	No relaxation
16.	Fluoride (as F), mg/l, Max	1.5	
17.	Phenolic compounds, (as C_6H_5OH), mg/l,	0.001	May be relaxed up to 0.002
18.	Mercury (as Hg), mg/l, Max	0.001	No relaxation
19.	Cadmium (as Cd), mg/l, Max	0.01	No relaxation
20.	Selenium (as Se), mg/l, Max	0.01	No relaxation
21.	Lead (as Pb), mg/l, Max	0.01	No relaxation
22.	Arsenic (as As), mg/l, Max	0.05	No relaxation
23.	Cyanide (as CN), mg/l, Max	0.05	No relaxation
24.	Chromium (as Cr^{6+}), mg/l, Max	0.05	No relaxation
25.	Residual free Chlorine, (as Cl), mg/l, Min	0.2	
26.	Ammonia, mg/l, Max	1.5	
27.	Aluminium, mg/l, max	0.2	
28.	Boron mg/l, max	0.3	
29.	Nickel, mg/l, max	0.02	
30.	Hydrogen sulphide, mg/l, max	0.1	
31.	Zinc, mg/l, max	3	

[1] Value for turbidity is 5 in FAR(for mineral water), PFA, BS, WHO

[2] Value for Sulphate BS:200, FAR(for mineral water) and PFA:250

(Source: Standards adopted from Department of Water Supply & Sewerage)

Table C: National Standard for Noise Quality

SN	Area of Exposure	Noise Limit (L_{eq}) in decibels	
		Day Time	Night Time
1.	Industrial Area	75	70
2.	Commercial Area	65	55
3.	Rural Residential Area	45	40
4.	Urban Residential Area	55	50
5.	Mixed Residential Area	63	55
6.	Quiet Area	50	40

(Source: Gazette Notification, 2012)

Table D: Permissible Emission Standards for Biogas Generator (adopted from Diesel Generator Standard)

Category (KW)	CO (g/kWh)	HC+NOx (g/kWh)	PM (g/kWh)
kW <8	8.00	7.50	0.80
8=kW<19	6.60	7.50	0.80
19=kW<37	5.50	7.50	0.60
37=kW<75	5.00	4.70	0.40
75=kW<130	5.00	4.00	0.30
130=kW<560	3.50	4.00	0.20

Source: Nepal Gazette (Nepal Gazette Notification, 2069 Kartik 13, BS

Annex 5: Grievance Redress Format

Company's Name

Address (Sub-project area)

Grievance Record Form

Grievance Record Form
(सल्लाह/सुझाव वा गुनासो टिपोट/रेकर्ड फारम)

Name of Subproject and address (परियोजनाको नाम र ठेगाना):

Name of Developer :

Name of Grievant (सल्लाह/सुझाव/गुनासो राख्ने/हाल्नेको नाम):	Contact detail (सम्पर्क विवरण) Work Phone (कार्यालयको फोन नं.): Home Phone (घरको फोन नं.): Mobile No. (मोबाइल नं.): E-mail (ईमेल) :
Home Mailing Address (घरको ठेगाना):	Work Mailing Address (कार्यालयको ठेगाना):
Date, time and place of grievance recorded (गुनासो टिपोट/रेकर्ड गरिएको मिति, समय र स्थान) :	
Detailed description of grievance (गुनासोको विस्तृत विवरण):	
Proposed solution to grievance (गुनासो समाधानका लागि प्रस्तावित प्रस्ताव):	
_____ Signature of Grievant (गुनासोकर्ताको दस्तखत)	_____ Name and Signature of Grievance Received (गुनासो प्राप्तगर्नेको नाम र दस्तखत)

गुनासो सुनुवाई दर्ता पुस्तिका

क स	गुनासो/सल्लाह/सुझाव	गुनासो/सल्लाह/सुझाव दर्ता गर्नेको नाम, ठेगाना र सम्पर्क नम्बर वा इमेल	गुनासो /सल्लाह/सुझाव प्राप्त गरेको माध्यम	गुनासो /सल्लाह/ सुझाव प्राप्त गरेको मिति	गुनासो/सल्लाह/सुझावको सुनवाई वा समाधान कसरी भयो	गुनासो /सल्लाह/ सुझाव समाधान गरेको मिति	प्राप्त गुनासो/सल्लाह/सुझाव को जानकारी AEPC लाई गराईयो/गराईएन

Annex 6: Study Team

Team Composition

Team Leader	: Mr. Rabindra Prasad Dhital
Environmentalist	: Mr. Manish Thapa
Environmental Engineer	: Mrs. Rubee Koju Shrestha
Sociologist	: Mr. Krishna Kant Kamali
Waste to Energy Expert	: Mr. Kshitiz Subedi

Annex 7: Checklist for Information Collection

Checklist for Physical Environment

A. Topography/Physiography

1. Study of Topographic maps/ other available maps and identify the ground topographic characteristics of land covered by the proposed Biogas Project
2. Verify the topographic characteristics of the land in the field

B. Geology and Soil Type

1. Classify the type of soil found in the sub-project area
2. Study the geological characteristics of the sub-project area
3. Investigate suspended sediment loads data from available literature

C. Climate

1. Study of published data (DHM) of regarding temperature, rainfall, humidity,
2. If possible classify the climatic zone and its verification

D. River Hydrology/ Drainage Pattern

1. Study of Topographic maps/ other available maps and identify the drainage patterns
2. Verify the topographic characteristics of the river system/drainage pattern in the field
3. Collect the available information regarding the quality of river water
4. Investigate flood potential in the river and seasons of occurrence, past history of flooding

E. Land Use

1. Investigate on the land use of the sub-project area from the topo-maps, and other available land use maps
2. Investigate the land use type of areas proposed for project components and support facilities from the statistics published by Department of Forest

F. Air Quality, Water Quality and Noise Levels

1. Collect any data on air, water and noise quality of the area from previous literature, if available
2. Investigate major water and noise polluting sources and activities of the area
3. Identify information related to water use like drinking water source, irrigation facility

Checklist For Biological Environment

A. Forest and Vegetation

A. Forest Classification by types (from expert observation supported by available forest resource maps or GIS based maps)
B. Classification of affected forest (through consultation with locals, CFUGs or management committees)
    i. Community Forest
    ii. Religious Forest
    iii. Government Managed Forest
    iv. Private Forest
C. Vegetation and Biodiversity observed: List of tree, shrub, herbfound within the influence area of the project
D. Conservation significance: The species found shall also be categorized according IUCN, CITES. and Government of Nepal Protection Category

B. Wildlife and Birds:

1. List of wildlife and birds found in and around vicinity through consultation with community and key informants

Checklist for Socio-economic and Cultural Environment

A. Sub-project District and Municipality

The details about the district and municipality will be extracted from the district and municipality profile and investigation with officials from the municipality. Most recent statistics available will be used to study about the socio-economic status of the sub-project area. The following information will be extracted to study about the socio-economic status of the sub-project area.

1. Demographic information (Households, Population with male and female, sex ratio, average household size)
2. Caste and Ethnicity (number of caste group in both district and municipality)
3. Language Spoken (mother tongue, major language)
4. Age wise population (infant, young, economically active, old)
5. Literacy rate
6. Sanitation (HH with and without toilet, Flush toilet/ pan toilet)
7. Drinking water facility (municipal water supply, deep boring, well, river water)

8. Source of energy for cooking and electricity (cow dung, firewood, biogas, kerosene, LPG, national electricity gridline)

B. Cultural Environment

1. Investigate the major historical and religious sites of the sub-project area during the field visit

Checklist for Key Informant Interviews

Name of the Key Informant:
Date:
Venue:

Project description

- Project category (as per MGEAP)
- Proponent, partners, concerned stakeholders, and affected entities (HH, community, etc.)
- Project objectives and targets, dimension of outputs (and inputs)
- Location and affected area
- Project component and their dimensions
- Project benefits/beneficiaries (if different than those mentioned above)

Environmental risks and concerns

Risks to the physical environment

- Contamination of surface water body and ground water
    a) Observation of the water bodies/wetlands nearby that can be affected by project components or activities.
    b) Disposal of slurry into the water body.
    c) Seeping of leachate from the digester or other components

- Gaseous release or air contamination
    d) Release of methane from the digester, storage, slurry or incomplete digested slurry, release of excess produced methane
    e) Exhaust from the transport as well as dust originating from the roads use for hauling (specially for large scale project)

- Noise from transportation

- Soil contamination
    a) Disposal of slurry etc. into the soil

- Slope instability and erosion
    a) Slope and terrain condition of the project components sites
    b) Construction of components
    c) Removal of vegetation, exposure of soil (soil type), and disruption of local drainage

Risks to the biological environment

- Loss of vegetation and diversity (from collection and management of forest – tendency of maintaining preferred species with higher commercial value from the project will motivate removal of other local species reducing diversity)

- Disturbance to animals
    a) Wildlife in and around sub-project area (population, diversity, protection status)

- Loss of habitat
    a) Project location in and/or in vicinity of the critical habitats that can be affected such as protected area, habitat of endangered species, important corridors
    b) Disturbance of habitat (space, food, breeding ground) from collection of resources (e.g. forest products), disposal waste, noise, etc.

Risks to the social environment

- Disruption to the existing water use
    a) Source of water for the settlement in the project affected area
    b) Possibility of contamination due to project component or activities.
    c) Demography, economic, cultural and ethnic composition of the water users
    d) Effect on vulnerable groups and women

- Foul odor and sanitation condition
    a) Location of settlement/houses close to project components
    b) possibility of dispersion of foul order from the digester, storage, transportation and other components
    c) Possibility of health hazard from the project to the surrounding settlements e.g. mosquito
    d) Demography, economic, cultural and ethnic composition
    e) Effect on vulnerable groups and women

- Effect of divergence of the resources to the project that the communities were dependent on, e.g. (a) forest products such as litter and fire wood (b) cow dung for cooking, (c) manure, (d) livelihood they are managing to secure through labor for existing management etc.
    a) Demography, economic, cultural and ethnic composition of the affected HHs.
    b) Effect on the vulnerable group and women