ENVIRONMENTAL AND SOCIAL ASSESSMENT
of
3341.22 m^3 BIO-METHANATION PLANT
at
DHANPALTHAN RURAL MUNICIPALITY

Submitted To:

Scaling Up Renewable Energy Programme (SREP)
Biogas Subcomponent
Alternative Energy Promotion Centre (AEPC)
Khumaltar, Lalitpur

Submitted By:
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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
CO_2	Carbon dioxide
CNG	Compressed Natural Gas
DIA	Direct Impact Area
EPA	Environment Protection Act 1997
EPR	Environment Protection Rules 1997
EMF	Environmental Management Framework
ESA	Environmental and Social 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
NOx	Nitrogen Oxides
PSA	Pressure Swing Adsorption
SO_2	Sulfur dioxide
SMF	Social Management Framework
SREP	Scaling -Up Renewable Energy Program
TPD	Tons per day
ZoI	Zone of Influence

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EXECUTIVE SUMMARY

The objective of this sub-project is to develop a Continuously Stirred Reactor Tank (CSTR) based biogas plant with the digester size of 3341.22 m^3 that generates 2501.59 m^3/day of gas and use it for commercial production of bottled Bio-CNG with an aim of replacing LPG as cooking fuel.
The proposed biogas plant will be constructed in Dhanpalthan Rural Municipality – 3, Morang. The proposed biogas plant will utilize cow dung available within its own farm and surroundings including press mud, poultry waste and vegetable waste as its feedstock. Based on the assessment, the substrate available for the commencement of the sub-project is 47.13 tons/day yielding 2501.59 m^3 of biogas daily which is also the target gas generation as proposed by the developer. A total of 7.60 tons of compost (75% DS) will be produced as a valuable by-product. Jeevan Bikas Samaj will be hiring qualified personnel to manage the biogas plant.

The potential pollutants resulting from the construction activities for the implementation of the 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 are few of the beneficial impacts during the operation phase of the project.

However, the above predicted potential impacts can be mitigated by strictly following the mitigation measures proposed in this ESA 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, 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 use appropriate Personnel Protective Equipment like helmets, safety jacket, gloves, boots in both construction and operation phase. Proper training should be provided to staff on safety so that accidents and diseases can be avoided. Hence, from the environment and social point of view, if the mitigation measures are followed in a proper way, the sub-project will not cause significant impact.

CHAPTER I: INTRODUCTION

1.1 Project Description and Location

Jeevan Bikas Samaj (JBS) is a national level NGO established to improve the socio-economic and cultural circumstances of marginalized people. JBS has proposed to install commercial scale biogas plant in Dhanpalthan Rural Municipality Ward No. 3 (previously known as Sorabhag – 6, VDC) in Morang district. To make use of renewable energy from available organic waste, Jeevan BikasSamaj has envisioned establishing the company as waste to energy entrepreneur by installing and operating CSTR based large biogas plant under Scaling up Renewable Energy Program (SREP)/Extended Biogas Program through AEPC. The produced biogas will be upgraded and compressed and hence will be distributed to nearby business entities comprising hotels through Bio-CNG bottles.

The developer has selected Green Energy Consultancy Pvt. Ltd., Bhairahawa, Rupandehi as a technology provider which is a prequalified construction company registered in AEPC for biogas plant construction. 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.

As per the requirement of EMF and SMF under SREP Extended Biogas Program, the study team effectively assessed the screening of the environmental and social aspects of the proposed project at Dhanpalthan Rural Municipality and prepared Environmental and Social Assessment (ESA) Report to minimize and/or mitigate the identified impacts. The sub-project will be implemented and will be supported with subsidy after the approval from AEPC/SREP.

1.2 Project Location and Accessibility

The proposed project site is located at Dhanpalthan Rural Municipality – 3, Morang, having a total land area of 10 Bigha (67724 sq. m). Geographically, the project location is situated at 26°26'34.88"N latitude and 87°26'11.31"E longitude at an elevation of 69 m. There are no any households nearby the proposed project vicinity. However, the nearest settlement is Dakuwadanda which is approximately 600 m from the project area. The nearest river from the project site is Bhaluwa river which is adjacent to the proposed project location. The location map of the project site is shown in figure below.

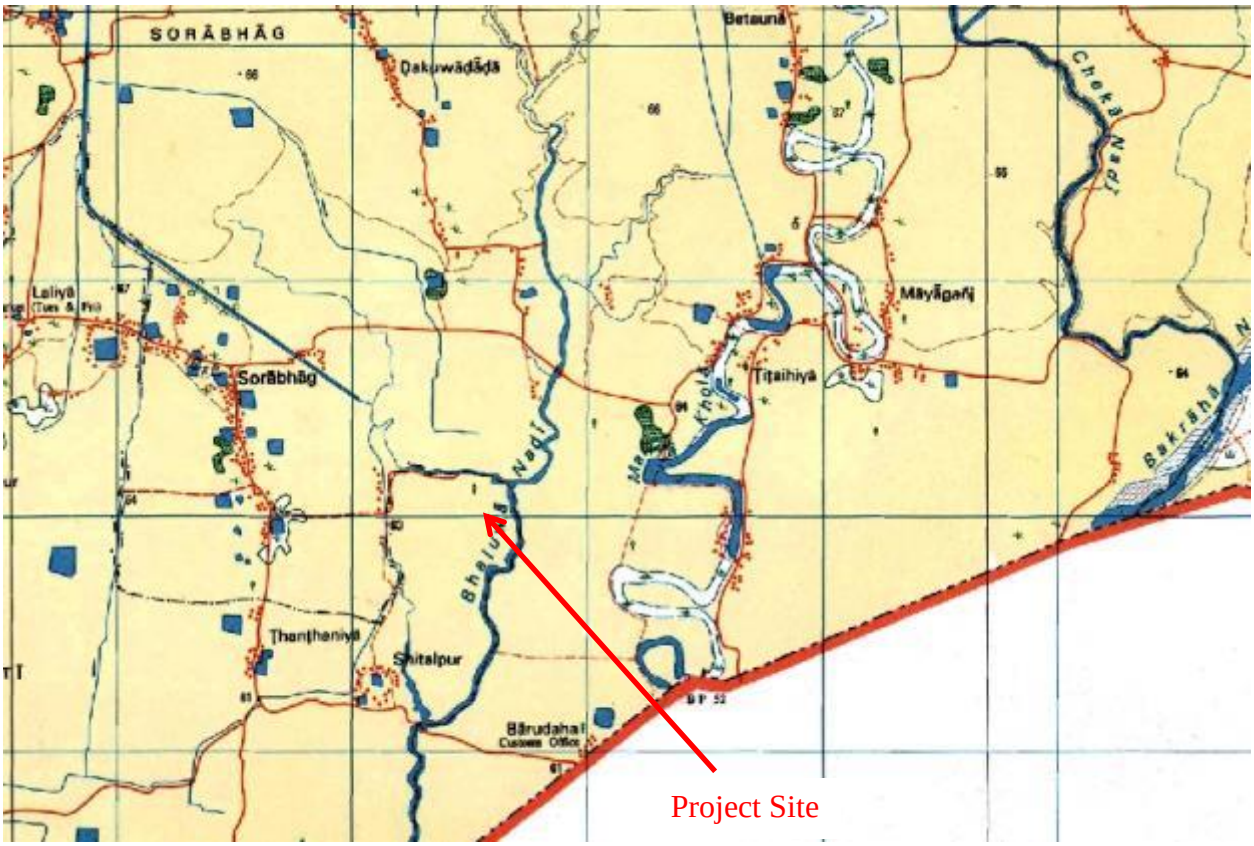

Figure 1: Topographic Map of Proposed Project Location

Figure 2: Satellite Image of the Proposed Project Location

1.3 Salient Feature of the Project

The main objective of the project is to install a biogas plant using anaerobically digestible organic waste from the nearby household of project location. The produced Biogas will be distributed to nearby communities and hotels for thermal purpose. The salient features of the project are presented in **Table 1**.

Table 1: Salient Features of the Project

Name of Commercial Entity:		Jeevan Bikas Samaj (Profit Not Distributing Company)
Address of Commercial Entity:		Katahari, Morang
Name of Contact Person (Developer):		Mr. Rohit Bhandari
Contact Number of Contact Person (Developer):		9852026392
Biogas Project Location		Dhanpalthan Rural Municipality Ward No. 3, Morang
Recommended Technology:		Continuously Stirred Tank Reactor (CSTR) based biogas plant
Name of Contact Person from PQ Consulting Firm:		Ms. Bisweta Bajracharya
Contact Number of Responsible Person from Consulting Firm		9847230927
Digester Volume (m^3)		3341.22 m^3
Biogas Production		2501.59 m^3/day
Saleable Bio-CNG Production		903.95 kg/day
Compost Production		7.60 tons/day (75% DS)
End Use:		Thermal (Bio-CNG) Selling
Tentative Total Project Cost		NRs. 75,949,000.00
Safeguard Document to be prepared during DD	Environmental and Social Safeguard	ESA (IEE) – Category B project
Legal Clearance Required		No

1.4 The Proponent

The proponent of above mentioned project is Jeevan Bikas Samaj whose complete address and contact details are provided below:

Jeevan Bikas Samaj
Katahari, Morang

Contact Person: Rohit Bhandari
Contact Number: 9852026392

Contact Details of consulting firm:

Prakriti Consult Pvt. Ltd. has been assigned for conduction of ESA of the project. This ESA has been prepared by multi-disciplinary team specialist on environmental aspects.

Prakriti Consult Pvt. Ltd.
Baneshwor, Kathmandu
Phone No. 01-5172226, 2298708
Email: info@prakriticonsult.com.np

1.5 Objective of ESA

The objectives of ESA are as follows:

- Identify the main environmental and social issues/impacts related to construction and operation of bio-methanation plant.
- Describe and predict the extent of potential impacts on physical, biological and socio-economic environment (based on both field inspection and desk research).
- Identify pragmatic mitigation measures to avoid, minimize or compensate the predicted impacts
- Define monitoring and management systems which are applicable and suitable in the 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 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.
- Involvement of concerned stakeholders including affected people/ parties in planning, construction and operation stage.

1.6 Study Methodology

The ESA was undertaken considering Environment Management Framework (EMF) and Social Management Framework (SMF) of SREP and National EIA Guidelines 1993.

1.6.1 Desk Review

The secondary data were collected from various sources such as published reports, topographic maps, land use maps, aerial photographs (Google Earth), etc. Likewise, detailed feasibility study report of the project, environmental standards, Acts and Regulations, etc. were reviewed as necessary. The

district profile of Morang was also reviewed for acquiring demographic information of the project location.

1.6.2 Field Based Study

A field visit was conducted on March 27, 2019 (Chaitra 13, 2075 B.S.) 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 project site. The details discussed in public consultation are explained in Chapter VII of this ESA report and the minute for public consultation is attached in ***Annex 1***. 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 for the field visit is attached in ***Annex 7*** of this ESA report.

Biological Environment: Based on expert observation and consultation with local people, not any protected vegetation (rare, endangered, indigenous, etc.) exists in the project influence area.

Socio-economic Environment: The information on socio-economic condition of the people of project affected area were collected through public consultation, key informant survey at project vicinity. The key informants were locals near proposed project vicinity and officials from Dhanpalthan Rural Municipality. The information about public institution and social infrastructure such as school, health post drinking water structure was collected from ward office and public consultation. All sites of religious, cultural and historical importance within the direct zone of influence were visited and observed. The social, cultural and religious values and significance of these sites were noted through consultation with locals.

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

- Population, ethnicity, settlement, and occupation of the influenced area
- Social services and other facilities
- Data of local resources like school, health post, temples, etc.
- Major economic activities
- Religious and cultural values of the influenced area
- Educational status of influenced area

- Health and sanitation condition of the influenced area

1.6.3 Impact Assessment

After the complete documentation of baseline environmental data of the project area, each of the environmental parameters were examined against the project activities in the different stages of project development using various methods and tools. Then the impacts were categorized as direct and indirect which were further evaluated in terms of their extent as site-specific, local or regional. Each of these were further analyzed in terms of duration as short-term, medium-term and long-term. The magnitude of each of the impact is then evaluated based on the National Environmental Assessment Guideline (1993).

1.6.4 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 project. The consultation was held on March 27, 2019 (Chaitra 13, 2075 B.S). The issues raised by the public during consultation meeting have been incorporated in the report ***(Annex 1)***.

1.6.5 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.

Direct Impact Area (DIA): Direct Impact Area includes the area where direct activity during construction and operation of the project occurs. This area experiences site specific impacts which could not be avoided but its effect could be minimized or compensated by taking relevant measures. The direct impact area can be categorized as the area of 100 m radius from the project site, where the construction and operation activities take place. DIA includes the surrounding agricultural lands in the project site and some part of Bhaluwa river which is approx. 20 m away from project site.

Indirect Impact Area (IIA): Indirect impact area includes all the areas which experiences indirect impact by the construction and operational activities that can be minimized and mitigated and mostly the activities of construction workers. The area of 500 m periphery from the project vicinity is considered as Indirect Impact Area. IIA of the project site does not include any kind of physical structure such as houses, industries, however; it includes the greater extent of Bhaluwa River. The whole stretch of transportation route i.e. substrate generation zone to sub-project location is considered as indirect impact zone.

Figure 3: Satellite Image Showing Direct Impact Zone

CHAPTER II: PLANT DESIGN AND TECHNOLOGY

2.1 Description of the Technology

Among the variety of waste to energy recovery technologies and in align with SREP modality, anaerobic digestion technology has been proposed for this project. The prime benefit of the anaerobic digestion technology is that the organic fraction of the waste will be decomposed in absence of aerobic (oxygen) environment and finally biogas (CH_4, CO_2 and other traces) is produced. This biogas can be utilized as clean fuel and can be utilized as thermal as well as electricity generation. The project proposes use of thus produced gas for thermal application in nearby bulk users like hotels and industries in the form of compressed biogas. Apart from biogas, the secondary but valuable by-product (compost fertilizer) will also be produced and can be used as organic manure. So, adoption of anaerobic digestion technology can manage organic wastes by converting it into useful energy source. Thus produced biogas energy is renewable form of energy produced from waste source and replaces firewood or fossil fuels (kerosene or LPGs) which ultimately contribute in reducing greenhouse gases emission in the atmosphere.

With regards to model of biogas plant, the developer of the sub-project intends to use Continuously Stirred Tank Reactor (CSTR) based biogas plant equipped with additional heating and stirring facility. Hence, due to additional heating, the environment could be maintained in higher mesophilic range and hence 30 days hydraulic retention time (HRT) is considered for design

2.2 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 project are cattle dung (cow and buffalo), poultry litter, press mud and vegetable and food wastes. The substrate will be continuously fed into the digester in daily basis or need only one or two days of storage. Due to the seasonality of availability of press mud, the storage of press mud is essential for which 400 sq. m. of area will be provisioned as storage yard.

ii. **Biogas Digester:** The substrates are digested inside the digester for production of biogas in the absence of oxygen. The digester of proposed biogas plant is based on CSTR, mesophilic fitted with double gas membrane. The digesters will have total capacity of around 3341.22 m3 hydraulic volume. The ancillary facilities viz. electromechanical stirring, digester heating through hot water circulation. Temperature and pH sensors are attached with the digester. The adjusting facility will be provided in outside of the digester for controlling desired stirring styles.

Stirring/Agitation: The stirrers or agitators will run automatically for five minutes in every half an hour cycle controlled through SCADA and on auto mode. There will be two agitators of capacity 18.5 KW each inside the digester.

Digester Heating Arrangement: The electrically fired hot water generator will be connected through SCADA and will start only when temperature falls below 35°C and will stop once 37°C has been achieved. It is a slow process and takes generally one day of continuous running to increase 1 degree inside the digester. Temperature transmitters will be installed at 1m, 3m and 5m height.

The double membrane gas holder is a durable air supported structure specifically designed for the purpose of biogas storage. It consists of two spherically shaped membranes. The outer membrane is permanently inflated textile structure. The membrane is inflated by the use of electrically operated blower. The inner membrane forms the variable volume of gas containment within the outer membrane. For the proposed biogas plant, the double membrane used will be of Type 3 PVC coated polyester fabric which will be imported from India with a storage capacity of approx. 600 m3 and comes with an ultra -sonic level indicator for measuring the quantity of the gas in the gas holder.

iii. 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 150 m^3/hr and will be installed at 9 meters height from the ground. It is equipped with moisture trap and flame arrestor.

iv. Biogas Purification Units

H_2S Scrubber: H_2S scrubber removes H_2S gas from the biogas. The H_2S scavenging process will be done by use of NaOH dosing. H_2S and CO_2 are both considered weak acid gases and to scrub them out of a gas stream effectively one needs a strong alkali, such as NAOH (sodium hydroxide/caustic soda). About 10 kg of NaOH will be required daily for treatment of raw biogas produced in the proposed project. The reaction of H_2S with caustic soda will produce either NaHS (sodium bisulfide) and/or Na_2S (sodium sulfide) as a final by-product depending on the pH of the reacted solution. Na_2S is a chemical which finds lots of use in industry, especially in leather processing and sold to the vendors or industries. However, the complete scrubbing system shall be manually cleaned twice a year.

Moisture Removal/ Dehumidifier: Once after H_2S scrubbing the biogas stream enters dehumidifier where the biogas is cooled down to dew point at 5 degree centigrade. The condensed water will be collected from the water collection outlet and dry gas will be transferred into further processing at Pressure Swing Adsorption (PSA) module.

Pressure Swing Adsorption (PSA): Pressure Swing Adsorption is the most employed techniques for biogas upgrading. In PSA processes, biogas is compressed to certain working pressure and is fed to a vessel column where biogas is put in contact with a material (adsorbent) that will selectively retain CO_2. The purified methane is recovered at the top of the column with a very small pressure drop. One of the most important properties of the PSA process is that it can be adapted to biogas upgrading in any part of the world since it does not depend on the availability of cold or hot sources. The PSA can purify the biogas up to 95% of methane content.

v. **Biogas Compression and Filling Station:** The biomethane after PSA treatment will be compressed at 200 bars in biogas compression unit. Then the compressed biogas (CBG) will be filled into the cylinder through cylinder filling manifold. The capacity of each cylinder will be 7.8 kg of CBG. The working pressure of Cylinder will be 200 bar and its burst pressure will be 400 bars as a safety margin. The cylinders with head valves will be procured from Petroleum and Explosives Safety Organization (PESO) approved manufacturers of CNG cylinders.

vi. **Post Digested Slurry Handling and Compost Production**

Screw Press: Screw Press is used for separating solid digestate from liquid. The solid digestate (organic fertilizer) which has a high value can be commercially sold in markets and to farmers. The separated water from the slurry can be re-circulated as dilution water for next day's operation which will be stored in slurry storage lagoon. The capacity of screw press will be approximately $15m^3$/hr

Slurry Storage Lagoon: The Digester (liquid manure) Storage Lagoon will be designed with its holding capacity of approx. $500m^3$ of slurry from screw press. The outlet (separated liquid) of screw press will be connected to the storage lagoon. The lagoon's side walls/bottom will be treated to prevent any leaching. The lagoon would have facility to enable periodic cleaning of the lagoon & yard. The required water for dilution will be sourced from this slurry storage lagoon which can cover 80% of daily dilution water requirement.

vii. **Compost Production and Packaging Unit:** The compost manure separated from the slurry solid separator will be stored in fertilizer yard of area spread to 200 m^2 where the collected manure will be stored and dried to achieve desired TS (75%). Workers manually fill the final compost product in the bag (of capacity 5kg and 25kg or customized size as per requirement) and seal with hand stitching gun.

Supervisory Control and Data Acquisition (SCADA): SCADA is a system of software and hardware elements that allows industrial organizations to control industrial processes locally or at remote locations, monitor, gather and process real-time data, directly interact with devices such as sensors, valves, pumps, motors and more through human-machine interface (HMI) software and records events into log file. This SCADA system will be adopted in the proposed

CSTR bio-gas system to control and operate all its parameter such as temperature, pressure, flow rates, level indicators for gas and slurry.

2.3 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 through Medium Pressure Swing Adsorption (MPSA) technology. After this stage, the biogas will be upgraded to methane with 93-94% purity.

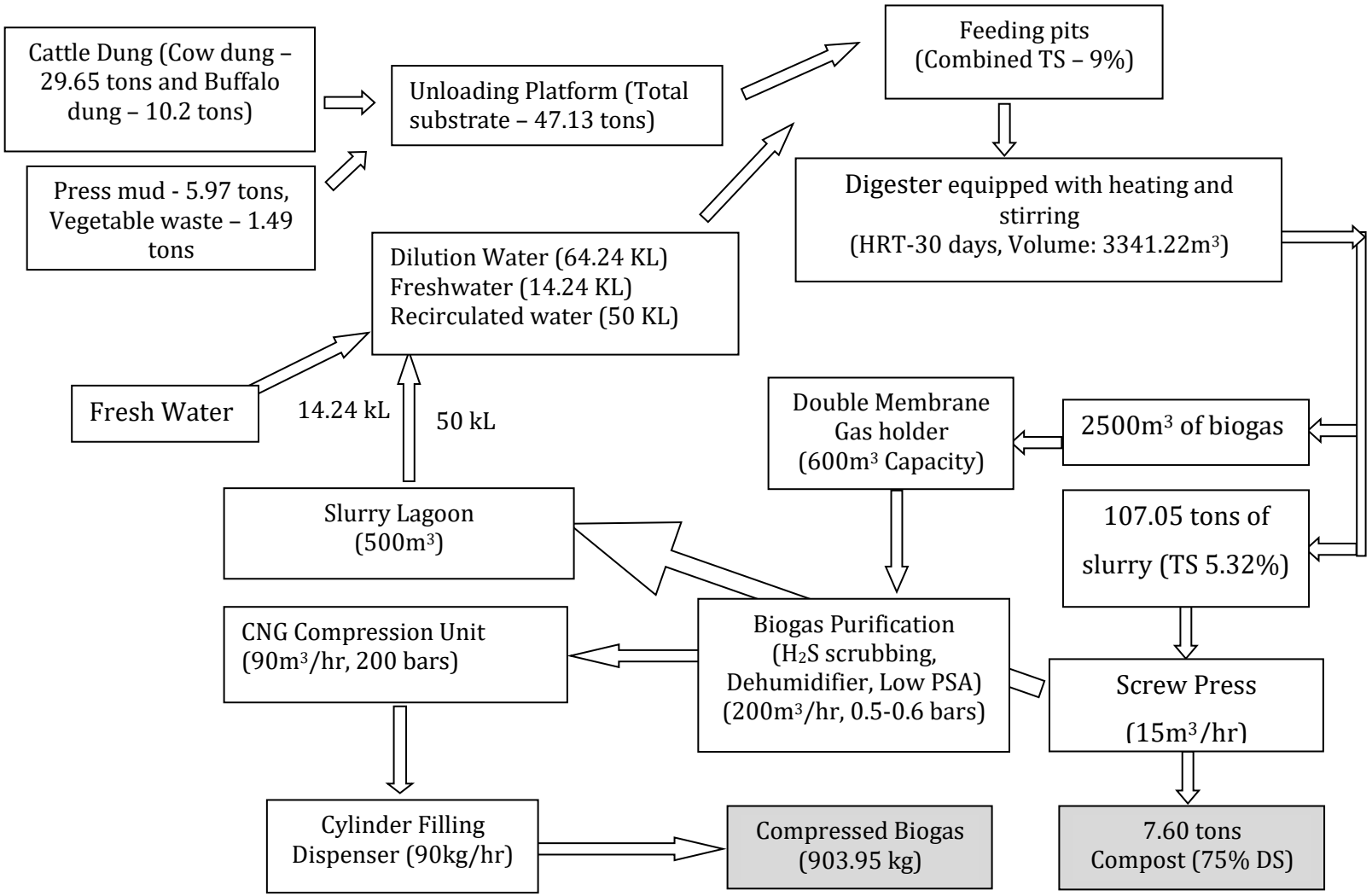

Figure 4: Process Flow Diagram and Mass Balance

2.3.1 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	0.045	20	20	80
Water buffalo	0.045	20	20	80
Press mud	0.100	30	25	75
Agricultural/Vegetable waste	0.08	60	40	65

(Source: Biogas Calculation Tool v.3.31 by AEPC)

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)	Methane Content	Density of Methane (kg/m^3)	Probable CBG (Methane) Production
Cow dung	29.65	0.045	1334.10	55%	0.657	482.08
Water buffalo	10.02	0.045	451.07	55%	0.657	163.00
Press mud	5.97	0.100	597.02	55%	0.657	215.73
Agricultural/ Vegetable Waste	1.49	0.080	119.40	55%	0.657	43.15
Total	**47.13**		**2501.59**			**903.95**

2.3.2 Design Parameter

The following design parameters are considered while designing the biogas plant. The combination of substrates shall be recommended to maintain C: N Ratio and OLR.

Table 4: Preferred Design Parameter

Type of Digestion	Wet
Stage	Single Stage
Temperature	35°C - 40°C
Type of Feeding	Continuous
Hydraulic Retention Time	30 Days (Higher Mesophilic)

Preferred CN Ratio	20:1 to 30:1
Preferred OLR	2 to 3 kg VS/m^3 Day
DS of Feedstock input	9%

2.3.3 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 5**

Table 5: Design Parameters of proposed biogas plant

Substrates to be used	**Cattle Dung, Press mud, and Agricultural/Vegetable Waste**
Total Substrate quantity	47133 kg/day (47.13 tons/day)
Combined TS of substrate	21.27%
Dilution Water Requirement	**64240.85 litres/day**
TS of feedstock after dilution	9%
Hydraulic Retention Time	**30 Days (Higher Mesophilic)**
Volume of Digester	3341.22 m^3
Combined CN Ratio	**22.53**
OLR	2.35 kg VS/m^3 day
Total Biogas Production	**2501.59m^3**
Total VS Destruction	4321.66 kg/day (55% of total VS Destruction assumed)
Total slurry (liquid) from outlet	**107.05 tons per day**
TS of Slurry (after VS destruction)	5.326%
Total compost production	**7.60 tons per day (75% DS)**
Total Liquid slurry available after compost (Screw press)	**99.45 tons/day** • **Slurry Recirculation : 25,000 kg/day** • **Liquid Fertilizer : 74449 kg/day**

Daily feeding of substrate shall be done as per **Table 6** to achieve optimum gas production based on above parametric condition.

Table 6: Recommended substrate quantity for proposed biogas plant

Substrate	Available Quantity (tons/day)	Biogas Yield (m^3/kg day)	Daily biogas production (m^3/day)	Methane Content	Density of Methane (kg/m^3)	Probable CBG (Methane) Production
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Agricultural/ Vegetable Waste	1.49	0.080	119.40	55%	0.657	43.15
Total	**47.13**		**2501.59**			**903.95**

The estimated compressed biogas (CBG) and compost produced from the proposed plant is calculated as approximately 903.95 kg of CBG and 7.6 tons of compost fertilizer daily.

Table 7: Biogas and Compost Fertilizer Production

Total Biogas Generation		**2501.59 m^3/day**		
Composition	**Percent (%)**	**Volume (m^3/day)**	**Density (kg/m^3)**	**Quantity (kg/day)**
Methane	55%	1375.88	0.657	903.95
Carbon Dioxide	44%	1100.70	1.98	2179.39
Others	1%	25.02	-	
Total Slurry Production		99.45 tons/day (5.326 % DS) After Compost		
Total Compost Production		7.60 tons/day (75% DS)		

2.3.4 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 project will use Chemical H_2S Scrubbing and Pressure Swing Adsorption (MPSA) technology for biogas purification and will produce 95% of methane as final output. Hence, the calorific value is considered equal for LPG and CBG. With this assumption, the produced CBG will replace approx. 63.65 cylinders of LPG equivalent marketed in Nepal (14.2 kg of LPG in each cylinder).

2.4 Sub-Project Requirements

2.4.1 Water Requirement

During construction period, estimated water requirement is approx.10 m^3/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 project, water requirement is estimated to be 130 litres/ day. The water demand will be fulfilled through deep boring and recirculation of liquid slurry generated from digester.

2.4.2 Land Requirement

The proposed land is owned by the developer himself. The total land area of the project site is 67,726.32 sq. m, out of which 4,000 sq. m of land area is required for the installation of biogas plant including all components and ancillary facilities (land document provided).

2.4.3 Work Force Requirement

During the construction phase of the project, it is estimated that about 50-100 person of unskilled and skilled human resource will be required to carry out the construction work. The project has the strategy to provide priority for local employment opportunities based on their ability, skills and knowledge in order to meet the labor requirement.

The sub-project requires about 16 human resources (6 skilled and 10 semiskilled) during operation phase. While employing workers, the preference will be given to local especially women, disadvantage groups and vulnerable people according to their qualification, skill and interest. Except for the skilled human resource, all the semiskilled and unskilled workers will be employed from the surrounding vicinity of the project area.

It will also be kept in mind that no child labor or forced labor be entertained in the project vicinity.

2.4.4 Energy Requirement

Fossil fuel energy (Gasoline) and electrical energy will be used during the construction phase. National grid electricity will be used for meeting electrical demand. Diesel will be used for vehicular transportation of construction materials and operating generators as and when required. During operation period, National Grid Electricity will be used as power source for operating the proposed plant to run ancillary facilities like pumping water, raw material feed pumps, stirrer, Medium Pressure Adsorption Swing (PSA) unit etc.

2.5 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 project. Different nature of wastes produced during the construction phase and operation phase are discussed in **Table 8**.

Table 8: 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

Pollutant Category	**Pollutants/Emissions**	**Sources**
		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 project area based on the site-specific information gathered through primary and secondary sources of information. The district and rural municipality level information of the 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

Morang lies in the southern Terai, or plains, of Eastern Nepal in Province no. 1 and is connected with Jhapa to the East, Sunsari to the west, Dhankuta & Panchthar to the North and Bihar (India) to the South. It covers an area of 1,855 km^2 with lowest and highest elevation point as 60 meter and 2410 meter, respectively. The project site is located at 26°26'34.88"N latitude and 87°26'11.31"E longitude, at an elevation of 69 meter above sea level. The project will be commissioned in 10 Bigha (67,726.32 sq. m) which lies approximately 20 meters from Bhaluwa Rivulet and 8 km from Rangeli road.

3.1.2 Geology and Soil Type

As the district lies in southern Terai, the land is fertile and covered with agricultural land. The Terai plain of Morang district is underlain by thick alluvium deposits. It is composed mainly of quaternary sediments with very fertile soil mixed with clay, silt and sand. The project site, particularly, is composed of grey to greenish grey phillites, gritty phyllites and quartzites with minor conglomeratic layers. Basic intrusions are also noted in this area.

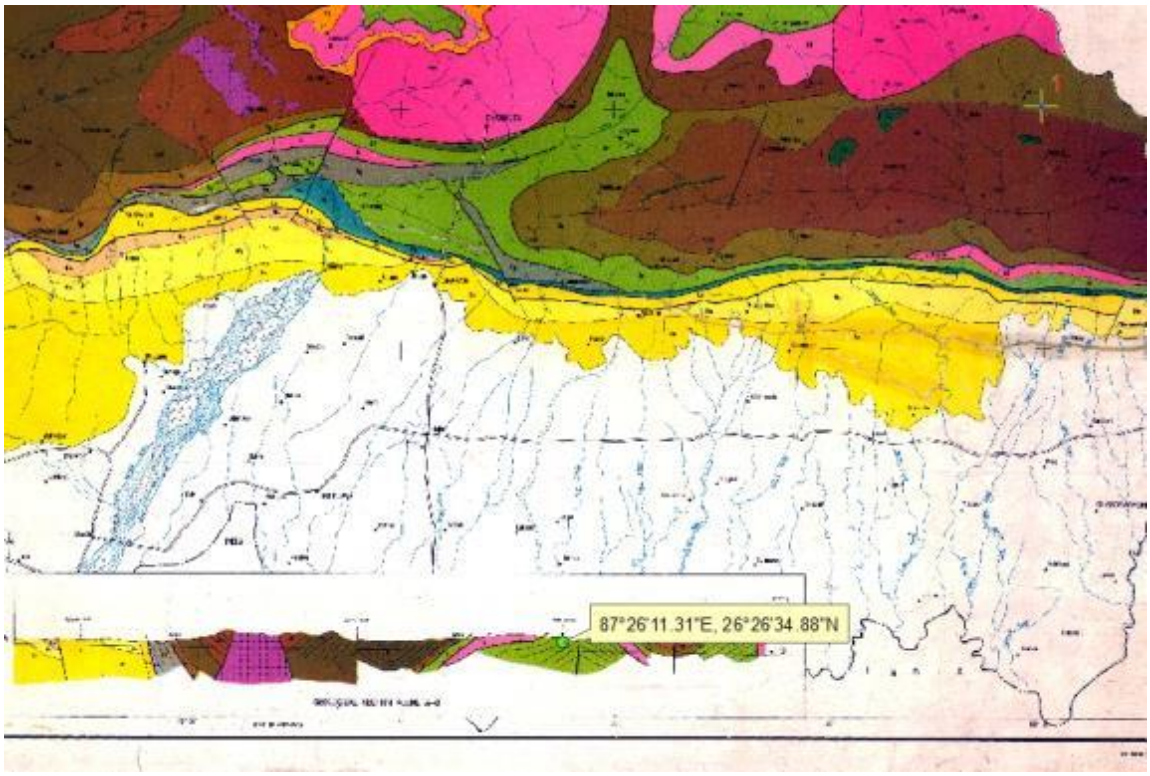


Figure 5: Geological and Soil Type of Project Area

3.1.3 Climate

The project area experiences tropical climate with hot and humid summer followed by mild winter. According to the data provided by Department of Hydrology and Meteorology, the absolute maximum temperature was found to be 39.6°C and the absolute minimum Temperature was 5.5°C. **Table 9** presents the general climatic condition of Biratnagar Airport, which lies approximately 18 km from the project site.

Table 9: Climate Data of Project Area

Month	Mean Temperature °C			Absolute Extreme Temperature		Total Precipitation mm
	Maximum	Minimum	Daily	Maximum	Minimum	
Jan	22.7	10.6	16.7	28.5	5.5	0.8
Feb	23.7	11.4	17.5	27.5	7.2	27.2
Mar	31.3	15.9	23.6	37.5	10.6	0.0
Apr	36.3	20.1	28.2	39.6	14.6	11.7
May	34.5	24.1	29.3	39.5	20.7	202.2
Jun	33.6	24.7	29.1	37.8	19.6	427.4
Jul	33.7	26.5	30.1	36.1	25.2	132.0
Aug	33.1	25.9	29.5	36	24.2	430.4

Sept	32.6	25.0	28.8	35.6	23	258.7
Oct	32.2	21.3	26.8	35.4	17.5	57.1
Nov	29.5	15.5	22.5	34	11.7	0.0
Dec	23.9	12.1	18.0	29	8.5	0.0
Yearly	30.6	19.4	25.0	39.6	5.5	1547.5

(Source: Department of Hydrology and Meteorology, Biratnagar Airport Station (Station ID: 1319, Latitude: 26°48', Longitude: 87°26', elevation: 72m)

According to DHM, Biratnagar received a total of 1547.5 mm of precipitation in the year 2014.

3.1.4 Drainage and Hydrology

Bhaluwa Rivulet is the principal drainage in the project vicinity which lies approx. 20m away from the project site. The hydrology of Bhaluwa Rivulet is influenced by the monsoon rain. Any incident of extreme flood or water over flow in Bhaluwa river has not been recorded yet. According to the locals, the discharge and flow of Bhaluwa Rivulet is low throughout the year which is enough to quench the thirst of animals and birds.

3.1.5 Land Use

The land use pattern of Morang district is dominated by agricultural land accounting about 69.3% followed by forest (23.93%). The area covered by water bodies is found to be the lowest compared to other land use pattern. The different land use and its percentage coverage of Morang district is presented in **Table 10**.

Table 10: Land Use Pattern of Morang District

S.N.	Land Use	Percent (%)
1	Agricultural Land	69.3
2	Forest	23.93
3	Shrub	3.29
4	Water Bodies	0.75
5	Barren Land	2.73
Total		**100**

Source: CBS 2013, Department of Forest

3.1.6 Air Quality, Water Quality and Noise Levels

There are no instrumentally monitored baseline data on air quality. The project vicinity (around 500 m) is devoid of any industrial activities and is surrounded by agricultural land. Considering the local anthropogenic sources of air pollutants the ambient air quality of the area is assumed not to be polluted by point source industrial activities.

The water quality of Bhaluwa Rivulet was assessed and all the parameters were found to be below the Drinking Water Quality Standards published by Department of Water Supply and Sewerage. According to the locals, the river water is used to quench the thirst of animals and birds. The test report for water quality of Bhaluwa Rivulet is presented in **Annex 8**.

Noise Quality level was measured in the project area at an interval of 5 seconds for 5 minutes. The maximum sound level (L_{max}), minimum sound level (L_{min}) and equivalent sound level, (L_{eq}) have been calculated as 52.9 dB, 27.9 dB and 38.73 dB, respectively. This value meets the National Standard for Noise Quality in quiet area as stated in Nepal Gazette Notification, 2012. Therefore, it can be said that the proposed project site has quiet and calm environment. The noise level data calculated as L_{max}, L_{min} and L_{eq} is presented in **Table 11**. The report for noise level monitoring conducted at the propose site on March 27, 2019 is presented in **Annex 8**.

Table 11: Noise level data at project site

Result		
Time Interval	0:00:05	Seconds
Number of Samples	60	numbers
Date	27-03-19	AD
Start time	18:23:16	HHMMSS
End Time	18:28:11	HHMMSS
L_{max}	**52.9**	**dBA**
L_{min}	**27.9**	**dBA**
L_{eq}	**38.73**	**dBA**

3.1.7 Cultural and Religious Sites

The main pilgrimage site in Morang District is Jwaladevi and Pancha Tirtha. The project situated community has some temples around its vicinity: Shivalaya and Kartik Mandir, which lies at the distance of approx. 800m.

3.2 Biological Environment

3.2.1 Vegetation and Forest

The land in Dhanpalthan Rural municipality is explicitly used for agricultural purpose and hence no any forest stretches lies within the project area. However, few sparse tree species are found around and within the project site which are planted by farmers or grown naturally on the river banks. The plant species include: Burflower (*Neolamarckiacadamba),* Date Palm (*Phoenix dactylifera*), Palm

(*Borassusflabellifer*), Bamboo (*Bambusoideae*), Sweet Tamarind (*Pithecellobiumdulce*), etc. Any kind of protected, rare or endangered herbs or shrubs were not found in the project area.

3.2.2 Wildlife

The commonly reported birds within project locality are: Dove (*Streptopeliachinensis*), Maina, Red-vented Bulbul (*Pyconotuscafer*), House Sparrow (Passer domestica), House Crow (*Corvussplendes)* and Bagla. Wild animals are not reported in the area.Some of the herpetofauna found in the river area and project vicinity are King Cobra (*Ophiophagus Hannah*), Oriental rat snake (*Ptyas mucosa*) and Common krait (*Bungaruscaeruleus*). The project area lies alongside the river where few species of aquatic vertebrates can be found, namely: Helicopter catfish (*Wallagoattu*), Walking catfish (*Clariasbatrachus*) and Gangeticmystus (*Mystuscavasius*)

3.3 Socio-Economic and Cultural Environment

3.3.1 Morang District and Dhanpalthan Rural Municipality

Morang district is the largest district in province No. 1 and third largest district in Nepal by population. It is known as industrial district and historical capital of Birat kingdom in province No. 1 and Nepal. It has 1 metropolitan city, 8 municipalities and 8 rural municipalities. Morang district shares border with Jhapa and Ilam districts in the east, Sunsari district in the west, Dhankuta and Panchthar districts in the north and Bihar state of India in south.

Dhanpalthan is a rural municipality in Morang District covering a total area of 70.26 sq. km. This rural municipality shares border with Rangeli Municipality in the East, Kathari rural municipality and Rangeli municipality in the North, Katahari and Jahada rural municipalities in the West, and Jahada rural municipality and India in the South.

a. Demography and households

Morang district has the population of 965,370 with 466,712 male with 498,658 female. It has 213,870 total households (Source: CBS, 2011). Dhanpalthan rural municipality has 7,957 households and total population of 39,394 with 19,459 male and 19,935 female (source: CBS, 2011). The detail population and households information is presented in **Table 12**.

Table 12: Demographic information of district and rural municipality

SN	Total population	Morang District	Dhanpalthan RM
		965,370	39,394
1	Male	466,712	19,459
2	Female	498,658	19,935
3	HHs	213,870	7,957
4	M/F Ration	93.59	97.61

5	HHs	4.51	5

(Source: CBS, 2011)

b. Population by age group in district and rural municipality

The economically active population in Morang District and Dhanpalthan Rural Municipality are 60.27% and 56.87%, respectively. The age group of population is presented in Table 13.

Table 13: Population by age group in district and rural municipality

SN	Age group	Morang District				Dhanpalthan Rural municipality			
		Both sex	%	Male%	Female%	Both sex	%	Male%	Female%
1	00-04	85,141	8.82	4.50	4.32	4,099	10.41	5.35	5.05
2	5 -14	218,733	22.66	11.53	11.12	10,296	26.14	13.03	13.10
3	15-59	581,860	60.27	28.18	32.09	22,403	56.87	27.63	29.24
4	60+	79,636	8.25	4.13	4.12	2,596	6.59	3.38	3.21
Total		**965,370**	**100**	**48.35**	**51.65**	**39,394**	**100**	**49.40**	**50.60**

(Source: CBS, 2011)

c. Spoken language in district and rural municipality

Maithili is the language spoken by majority of people in Morang District, with 53.32% of population in Dhanpalthan Rural Municipality. Additionally, Angika, Santhali, Bhujel, Urdu, Tharu, etc are also spoken by people residing in this area.

Table 14: Spoken language in district and rural municipality

SN	Mother tongue	Morang District		Dhanpalthan RM	
		Population	%	Population	%
1	Nepali	362892	37.59	1475	3.74
2	Maithili	228215	23.64	21005	53.32
3	Tharu	57439	5.95	124	0.31
4	Rajbanshi	36435	3.77	2020	5.13
5	Limbu	35396	3.67	8	0.02
6	Urdu	31135	3.23	2491	6.32
7	Rai	19733	2.04	14	0.04
8	Santhali	18949	1.96	1180	3.00
9	Tamang	18704	1.94	7	0.02
10	Angika	18551	1.92	9079	23.05
11	Magar	18346	1.90	10	0.03
12	Bhujel	12164	1.26	693	1.76
13	Others	107411	11.13	1288	3.27

Total	**965370**	**100**	**39394**	**100**

(Source: CBS, 2011)

d. Caste and ethnicity in district and rural municipality

People with more than 100 castes and ethnic groups live in Morang district. Majority of population belong to Gangai caste in rural municipality, followed by Bantar/Sardar, Kewat, Mushahar, Musalman etc. The detail caste and ethnicity is presented **Table 15**.

Table 15: Caste and ethnicity in district and municipality

SN	Caste	Morang District		Dhnapalthan RM	
		Population	%	Population	%
1	Brahmin-Hill	126,195	13.07	470	1.19
2	Chhetri	116,015	12.02	447	1.13
3	Tharu	60,566	6.27	183	0.46
4	Rai	47,957	4.97	453	1.15
5	Muslim	45,750	4.74	2474	6.28
6	Limbu	40,771	4.22	21	0.05
7	Rajbansi	37,148	3.85	2093	5.31
8	Newar	30,646	3.17	49	0.12
9	Musahar	28,863	2.99	2474	6.28
10	Gangai	26,730	2.77	10701	27.16
11	Kewat	25,464	2.64	2874	7.30
12	Magar	25,126	2.60	43	0.11
13	Tamang	23,736	2.46	20	0.05
14	Bantar/Sardar	22,536	2.33	3091	7.85
15	Yadav	21,367	2.21	1220	3.10
16	Kami	19,706	2.04	78	0.20
17	Satar/Santhal	19,322	2.00	1250	3.17
18	Teli	15,698	1.63	240	0.61
19	Khawas	12,739	1.32	712	1.81
20	Mallaha	12,528	1.30	940	2.39
21	Damai/Dholi	12,200	1.26	47	0.12
22	Dhanuk	11,863	1.23	194	0.49
23	Others	182,444	18.90	9320	23.66
Total		**965,370**	**100**	**39,394**	**100**

(Source: CBS, 2011)

e. Literacy status in district and rural municipality

The literacy rate of Morang District and Dhanpalthan Rural Municipality is 70.63% and 55.5%, respectively. Male population is more literate as compared to female population.

Table 16: Literacy status in district and rural municipality

SN	Literacy	Morang District	Dhanpalthan RM
1	Total Literacy	70.63	55.5
2	Male	78.73	66.01
3	Female	63.13	45.33

(Source: CBS, 2011)

f. Drinking water facility in district and rural municipality

Major source of water for the household purpose is groundwater (tube well and hand pump) in both district (78%) and rural municipality (97.95%). Only 18.92% of households have the facility of municipal water pipeline in Sarlahi District and 0.43% in Dhanpalthan Rural Municipality. Likewise, 0.75% and 0.6% of households consume water from uncovered well in the district and rural municipality, respectively. The detail drinking facility of district and municipality is presented in **Table 17**.

Table 17: Drinking water facility in district and rural municipality

SN	Sources of water	Morang District		Dhanpalthan RM	
		HHs	%	HHs	%
1	Tube well/hand pump	166,823	78.00	7,794	97.95
2	Tap/piped	40,468	18.92	34	0.43
3	Uncovered well/kuwa	1,602	0.75	48	0.60
4	Spout water	1,091	0.51	2	0.03
5	Covered well/kuwa	747	0.35	6	0.08
6	River/stream	536	0.25	1	0.01
7	Others	1,762	0.82	48	0.60
8	Not stated	841	0.39	24	0.30
Total		**213,870**	**100**	**7,957**	**100**

(Source: CBS, 2011)

g. Sanitation status in district and municipality

Principally, sanitation status of any place is dependent on the toilet facility of that place Majority of households in Dhanpalthan Rural Municipality do not have the toilet facility (70.91%), which indicates the poor sanitation of the area. Only, 18.73% of household have toilet with flush system and septic tank and only 8.80% of household have ordinary toilet. The detail toilet facility in district and rural municipality is presented in Table 18.

Table 18: Sanitation status in district and rural municipality

SN	Type of toilets	Morang District		Danpalthan RM	
		HHs	%	HHs	%
1	Flush toilet (septic tank)	84671	39.59	1490	18.73
2	Without toilet	77478	36.23	5642	70.91
3	Ordinary toilet	47907	22.40	700	8.80
4	Flush toilet(public sewerage)	2939	1.37	101	1.27
5	Not stated	875	0.41	24	0.30
Total		**213870**	**100**	**7957**	**100**

(Source: CBS, 2011)

h. Energy for cooking in district and rural municipality

In Dhanpalthan Rural Municipality, majority of households use cow dung as the source of energy for cooking purpose (81.99%). The use of firewood is low compared to cow dung as firewood is not easily accessible in the community. Cooking energy of district and rural municipality is depicted in **Table 19**.

Table 19: Energy for cooking in district and rural municipality

SN	Sources of cooking energy	Morang District		Dhanpalthan RM	
		HHs	%	HHs	%
1	Wood/firewood	96,037	44.90	845	10.62
2	Cow dung	52,659	24.62	6,524	81.99
3	LP gas	49,769	23.27	146	1.83
4	Kerosene	2,806	1.31	140	1.76
5	Bio-gas	8,480	3.97	38	0.48
6	Electricity	83	0.04	1	0.01
7	Others	3,168	1.48	239	3.00
8	Not stated	868	0.41	24	0.30
Total		**213,870**	**100**	**7,957**	**100**

(Source: CBS, 2011)

i. Energy for lighting in district and rural municipality

National grid electricity has reached to most of the household in Morang district, but many household in Dhanpalthan Rural Municipality lack the facility. About 47.59% of household use kerosene, 0.16% use Bio-gas, 0.98% use Solar for lighting purpose. The detail energy for lighting of district and Rural Municipality is presented in **Table 20**.

Table 20: Light Energy facility in district and rural municipality

SN	Types of lighting energy	Morang District		Dhanpalthan RM	
		HHs	%	HHs	%
1	Electricity	162,107	75.80	4,052	50.92
2	Kerosene	47,348	22.14	3,787	47.59
3	Bio-Gas	705	0.33	13	0.16
4	Solar	2,190	1.02	78	0.98
5	Others	639	0.30	3	0.04
6	Not stated	881	0.41	24	0.30
Total		**213,870**	**100**	**7,957**	**100**

(Source: CBS, 2011)

j. The project affected area

The project area lies in Ward number 3 of Dhanpalthan rural municipality. Dakuwadada is the nearest settlement of project area located about 800 meters far from the project area. There are total 40 households in Dakuwadada forming a Madhesi community. Households with only 4 caste group: Mandal (16), Paswan (14), Rishhidev (7) and Yadav (3), lives in this area. Agriculture is the main occupation of the people in this locality. Furthermore, people are involved in labor (such as construction of buildings) to meet their daily wages. Only 7 people from the settlement are involved in overseas employment, especially in Malaysia and Gulf country.

Jeevan Bikas Samaj has provided the informal education service in this settlement to make people literate, due to which, every individual in this area is literate. The nearest school (Shivashakti Higher Secondary school) and nearest health post is located in (Sorabhag), approx. 500 meter from the settlement (Dakuwadada). Biratnagar is about 14 kilometer and Rangeli road is about 8 kilometer far from this settlement with hospital facility and higher education. The main source of energy used for cooking is cow dung and haystack. The lighting energy is provided by NEA in all households. All the households have ordinary toilet facility. Hand pump is the main source of drinking water. Maithili language is the main language spoken in the settlement along with basic understanding of Nepali and Hindi. Majority of people in Dakuwadada follow Hinduism celebrating Chhath, Holi, Dipawali and Dashain. Every year on the day of Kartik Purnima, people from surrounding communities come to worship Lord Shiva in "Shivalaya", located in the heart of this settlement.

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 ESA 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

Plans and Policies

- Fifteenth Plan Approach Paper
- Fourteenth Plan 2013-2016
- Rural Energy Policy, 2006
- Renewable Energy Subsidy Policy, 2016

Acts and Rules

- Environment Protection Act, 1997 and Environment Protection Rule, 1997 (amendment 1999, 2007)
- Local Government Operation Act, 2074 (2017)
- Water Resource Act, 1992
- Solid Waste Management Act, 2011
- Child Labor (Prohibition and Regulation) Act, 2000
- Labor Act, 2074 (2017)

Guidelines/ Framework

- National EIA Guidelines, 1993
- SREP Environment Management Framework (EMF), 2013
- SREP Social Management Framework (SMF), 2013

Standards

- National Ambient Air Quality Standards, 2003
- Nepal Vehicle Mass Emission Standards, 1999
- National Ambient Sound Quality Standard, 2012

- Generic Standard for effluents to be discharged in inland surface water,2003

International Policies and Conventions

- World Bank Safeguard Policy (OP 4.01 Environment Assessment)
- Convention on Biodiversity (CBD), 1993
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973
- Convention (No. 169) Concerning Indigenous and Tribal Peoples in Independent Countries, 1989

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, chemical, biological and socio-economic environment and assessed with extent, magnitude and duration of the predicted impacts.

5.1 Beneficial Impacts

5.1.1 Construction Phase

a. Employment Opportunity to Locals

The project will require 50-100 numbers of skilled as well as unskilled human resources during the construction period. Most of the required human resources will be employed from the local community itself as possible, depending on their skills and qualification, which will provide opportunity to locals to uplift their economy.

b. Skill Development of Locals

During the construction period, the locals involved will get to learn the skills and techniques required to carry out construction work. This will help them to build their capacity and can use their learned skills to apply in similar projects after completion of construction work.

5.1.2 Operation Phase

a. Employment Opportunity to Locals

For smooth operation of biogas plant, about 16 human resources (6 skilled and 10 semi-skilled) are required at several sectors of the project. 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 uplift the economy of the project area as well as the community of Dakuwa danda.

b. 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.

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

The biogas produced from the plant will be purified, compressed and distributed to nearby community (Dakuwadada, Sorabhag and hotels of Biratnagar) to meet their daily thermal energy requirement. This will reduce the areas dependency upon cow dung and haystack for cooking purpose. The project will also act as an example to other investors in Nepal to take initiative on developing such renewable energy projects. Significantly, the implementation of project will help reduce emission of GHG into the atmosphere.

d. Sustainable Waste Management

Cow dung, poultry waste, vegetable waste and press mud will be used as a substrate for the production of biogas. Cow dung cake is being used as the energy source for thermal purpose whereas the other wastes are being haphazardly deposited in the surrounding. The efficiency of cow dung is increased if converted to biogas as it contains >50% of methane gas. This project helps to convert waste into clean thermal energy which could uplift the standard of living of the area.

5.2 Adverse Issues

5.2.1 Construction Phase

5.2.1.1 Physical Environment

a. Change in Land use

The land use pattern of sub-project area is agricultural land. The developer owns a total of 10 Bigha (67,726.32 sq.m.) of land, of which 11 Katha, 16 Dhur (4,000 sq. m.) will be used for the commissioning of biogas plant. Construction work shall be carried out with minimum loss of trees, therefore adverse impact is not envisaged.

b. 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. However, the air pollution is less likely to affect the local people as the nearest settlement is about 800 m away from the project site. Since such activities will only continue until the construction work completes, the envisaged impact can be considered as site-specific in nature, low in magnitude and short-term duration.

c. 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 ground water as well as the river which flows just beside the project site. The local

depending upon groundwater source for running various domestic purposes can also get affected from such activities. However, there does not seem much construction activities as most of the construction components are prefabricated so the envisaged impact on water sources can be considered as low in magnitude, local in nature and short term.

d. 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 project site. The envisaged impact is site specific, low in magnitude and short term in duration.

e. Increase in Noise Level due to Construction Activities

The operations of different machineries during the construction period like excavators, movement of vehicles generate noise in the project site and around project vicinity. However, the locals would not significantly get affected since the nearest settlement is 800 m away from the project site. But the increase in noise is most likely to impact construction workers. The envisaged impact is low in magnitude, site-specific in nature and short-term.

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 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 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. Hence, the envisaged impact can be considered low in magnitude, site-specific in nature and short term.

5.2.1.2 Biological Environment

a. Loss of vegetation

The construction of the proposed biogas plant will be carried out in the designated agricultural land. The livelihood of farmers is not affected as they will be employed in the construction as well as operation phase of biogas plant. Therefore, the impact on the biological environment is not foreseen.

5.2.1.3 Socio-economic Environment

a. Occupational health and safety of workers

During the construction phase, the construction work force is expected to expose to a number of construction 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 envisaged impact is moderate in magnitude, site-specific in nature and short term.

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. 5-7 months and construction workers are in limited numbers, there will be very negligible pressure in utilities in the community. Moreover, the project

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 project area. The impact is moderate, local and short-term.

d. Labor Influx and Associated Impacts in the Local Community

During the development of the project, various background of workforce will be employed which might create social conflicts in the community. However, the labor influx during construction phase is estimated to be 50-100 person/ day which cause minimum community disturbances. Hence the impact caused by influx of labors to local community is negligible.

e. Involuntary Land Acquisition and Displacement Issue

The land proposed for the construction and implementation of the biogas plant is owned by the organization, Jeevan Bikas Samaj itself. Therefore, there is no requirement of land acquisition and issue of displacement for this project commencement

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. Hence, the envisaged impact is low, site-specific and long-term.

5.2.2 Operation Phase

5.2.2.1 Physical Environment

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 envisaged is moderate, site-specific to local in nature and long-term.

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 week period before they are fed into biogas plant. Open storage of such large amount of substrate could cause foul odor in the 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 800 m away. So, the receptors of impact are apparently the in-house staffs. The envisaged impact is moderate, site-specific in nature and long-term.

c. Issues Related to Extraction of Water for Meeting Demand

The water required to operate the project is 130 m^3/day, which will be sourced from ground water extraction. The 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. Hence, the envisaged impact is low in magnitude, local and long term.

d. Management of Wastewater from Digested Slurry

The digested slurry produced from anaerobic digestion is proposed to be used as compost. Manure-Sludge separator (Model Ap15) 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 for operation of plant. The remaining liquid slurry, after the recirculation, is proposed to be sold to local farmers as per demand basis. However, if the liquid effluent is directly discharged to the water body, it would increase BOD, total suspended solid and turbidity of the receiving water. Hence, the impact due to this activity is moderate, site-specific to local and long-term.

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

The collection and transport of feed to the 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 impacts that can be foreseen due to such activities are moderate in magnitude, local in nature and short-term.

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 and can cause temporary hearing loss, annoyance among working staffs if exposed for long time. In this regard, the impact is moderate in magnitude, sit-specific in nature and long-term.

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, emission of methane gas in atmosphere will contribute in greenhouse gas emission, which is almost 30 times more potent than CO_2 on heating up our planet. Therefore, the impact due to gas leakage can be envisaged to be moderate in magnitude, site-specific to local and long-term.

h. Flood Hazard

From the consultation with the local people, there has not been any incident of flood in the Bhaluwa rivulet. Therefore, there is no any threat of flood, however; in extreme conditions like in rainy season when water volume can rise, river bank erosion and loss of land may occur. The envisaged impact is direct, local, short term and moderate.

5.2.2.2 Biological Environment

a. Maintenance and Protection of greenery in the project area

There will not be any nuisance to the biological environment as the biogas plant will be installed in a well demarcated land area. Instead, plantation of trees will be done to maintain the greenery in the project area.

5.2.2.3 Socio-economic Environment

a. 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. Without proper safety measures, prolonged exposure to such activities can cause long term health hazard. The envisaged impact is high, site-specific in nature and long-term.

b. 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 project. In this regard, the envisaged impact is high, site-specific and long-term.

c. Inflow of people in the 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 project site. The envisaged impact is considered to be low, site-specific and long term.

d. 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. However, the impact is considered to be low, local and long-term.

Table 21: Summary of Impact Prediction

Environmental Issues	Impacts	Direct/ Indirect Impact	Extent	Duration	Magnitude	Significance
Construction Phase						
Physical Environment						
Change in Land use	• Residual Impact	-	-	-	-	
Issues Related to Air Pollution	• Emission of dust, smoke, CO_2 and other harmful gases through vehicular movement, excavation and related construction activities	D	S(10)	ST(5)	Lo(10)	25 Insignificant
Issues Related to Water Pollution	• Pollution of groundwater through percolation of wash water from construction materials, spillage of lubricants.	D	L(20)	ST(5)	Lo(10)	35 Insignificant
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	D	S(10)	ST(5)	Lo(10)	25 Insignificant
Increase in Noise Level due to Construction Activities	• Increase in noise from operation of machineries, excavation and vehicular activities.	D	S(10)	ST(5)	Lo(10)	25 Insignificant
Issues Related with Spoil	• Degradation in aesthetic beauty	D	S(10)	ST(5)	Lo(10)	25

Disposal and Stockpiling of Construction Materials	• Percolation of chemical content in waste water from construction material into agricultural land • Loss of soil fertility • Formation of muddy ditches during rainy season					Insignificant
Flood Hazard	• River Bank erosion and Loss of land (in extreme weather condition like heavy rainfall)	D	L(20)	ST(5)	Lo(10)	35 Significant
Biological Environment						
Loss of Vegetation	• No need to fell down any trees. The impact is not envisaged	-	-	-	-	
Socio-economic and Cultural Environment						
Issues Related to Occupational Health and Safety of Workers	• Exposure to fugitive emission, noise and risk of physical injury	D	S(10)	ST(5)	H(60)	75 Very Significant
Pressure on Utilities and Infrastructure	• Due to shorter construction period and limited construction workers, the impact is not envisaged	-	-	-	-	
Health and Sanitation Related Issues in and around project site	• Injuries to the workers while handling machineries • Community children getting into accidents	D	L(20)	ST(5)	Mo(20)	45 Significant
Grievances Management	• Grievances related with improper management of construction materials, aesthetic degradation, conflicts.	I	S(10)	LT(20)	Lo(10)	40 Insignificant
Operation Phase						
Physical Environment						
Issues Related to	• Contamination of land and water	D	L(20)	LT(2	Mo(20	60

Management of Raw Materials Storage and Post Digestate	sources from leaching of raw materials and post-digestate into underground water due to improper storage system.			0)	)	Significant
Issues Related to foul odor during storage of raw materials and post-digestate	• Increase in flies and vector disease due to improper raw material storage system and haphazard disposal of post-digestate.	D	S(10)	LT(20)	Mo(20)	50 Significant
Over-Extraction of Water	• About 130 litres/day of water is required which will be extracted from underground and will also be covered through decanted water from slurry. • Excessive use of underground could lower the water table and could cause impact on availability of water in the locality that depends on underground water.	D	L (20)	LT (20)	Lo (10)	50 Significant
Management of wastewater from digested slurry	• Increase in BOD, turbidity and TS of nearby water body if discharged directly into it • Groundwater Pollution	D	L(20)	LT(20)	Mo(20)	60 Significant
Impact Associated with collection and transportation of waste	• Foul smell along the transportation route • Possibility of dropping of waste on road • Vehicular emission	D	L(20)	ST(5)	Mo(20)	45 Significant
Increase in noise level from plant operation	• Increase in noise due to operation of biogas plant components, biogas generator, etc. • Temporary hearing loss, annoyance	D	S(10)	LT(20)	Mo(20)	50 Significant

	among the staffs due to prolonged exposure					
Gas leakage and fire hazard	• Methane gas being highly flammable can cause fire hazard; loss of property and life • Contribution to GHG emission	D	L(20)	LT(20)	Mo(20)	60 Significant
Flood Hazard	• Probability of river bank erosion and loss of land in extreme condition	D	L(20)	ST(5)	Mo(20)	45
Biological Environment						
Maintenance and protection of greenery in project area	• Although no tress will be required to cut, plantation will be emphasized	-	-	-	-	-
Socio-economic and Cultural Environment						
Issues related to occupational health and safety	• Physical injury to staffs • Prone to catch disease from organic waste handling	D	S(10)	LT(20)	H(60)	90 Very Significant
Issues related with health and sanitation in and around project site	• Spread of vector borne disease around the community and staffs due to improper management of organic waste • Opposition from the community against the project	D	L(20)	LT(20)	Mo(20)	60 Significant
Inflow of people in project area	• Increase in quarrel and debates among workforce and community	D	S(10)	LT(20)	Lo(10)	40 Insignificant
Grievances Management	• Grievances with aesthetics, odor, noise, haphazard disposal of digestate from local residents resulting opposition and conflict	I	L(20)	LT(20)	Lo(10)	50 Significant

Note: D= Direct, ID= Indirect, S= Site specific; L= Local, R= Regional; ST= short term, NA= Not Applicable, MT= Medium Term, LT= Long Term; Lo= Low, Mo=Moderate, H= High

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 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 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 project proponent ensures to implement these measures during the construction and operation of the project.

6.1 Mitigation Measures

In order to prevent the likely environmental impacts identified in previous section, **Table 22** presents prescribed environmental mitigation measures and their estimated mitigation costs.

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

S.N.	Environmental Impacts	Mitigation Measures	Time of action	Mitigation Cost (Rs.)
A. Construction Phase				
A.1 Physical Environment				
A.1.1	• Change in Land use	• Minimum land disturbance will be made while project construction. Greenery will be maintained	During Construction Phase	Cost of greenery maintenance is provisioned below
A.1.2	• Emission of dust, smoke, CO_2 and other harmful gases through vehicular movement, excavation and related construction activities	• 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	50,000.00
A.1.3	• Contamination of groundwater through percolation of wash water from construction materials, spillage of lubricants.	• Waste water 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	100,000.00
A.1.4	• Decrease in soil fertility of nearby agricultural land from spillage of grease and	• Spent lubricants and greases, petroleum will be stored in designated vessels only.	During Construction Phase	-

	petroleum fuel from generators and construction materials including vehicles • Formation of muddy ditches during rainy season	• Covering and storage of construction debris in specific place within the construction site		
A.1.5	• Increase in noise from operation of machineries, excavation and vehicular activities.	• 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	-
A.1.6	• Degradation in aesthetic beauty • Percolation of chemical content in waste water from construction material into agricultural land • Formation of muddy ditches during rainy season	• 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	50,000.00
A.2 Biological Environment				
A.2.1	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	Included in construction costs for building garden area. Included in operation costs for buying shrubs, flowers and

				saplings.
A.3 Socio-economic Environment				
A.3.1	• Exposure to fugitive emission, noise and risk of physical injury	• Provision of Personnel Protective Equipment (PPE) like helmets, masks, safety jacket, gloves and boots, safety harness to construction workers. • Safety Signage shall be placed in construction site	During Construction Phase	300,000.00
A.3.2	• Injuries to the workers while handling machineries • Community children getting into accidents	• Provision of PPE and Safety aid boxes • Provision of well barricade wall in construction site • 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) • Awareness and orientation to construction workers to respect locals • Proper maintenance of labor log with their personal & contact details along with emergency contact numbers	During Construction Phase	50,000.00
A.3.3	• Grievances related with improper management of construction materials,	• Appoint a staff for handling grievances (Grievance Redress Mechanism)	During Construction/OperationPhase	-

	aesthetic degradation, conflicts.	• Establish project specific Grievance Redress Committee • Instruct construction company to proceed construction work in compliance to ESA report • Consultation with locals and concerned stakeholders regarding the various scope of the project and organize awareness raising program		
B. Operation Phase				
B.1 Physical Environment				
B.1.1	• Contamination of land and water sources • Leaching of raw materials and post-digestate into underground water due to improper storage system. • Alter in water quality parameter	• Avoid direct discharge of slurry and decanted liquid waste into nearby water bodies and agricultural field • Storing the raw materials in roofed unit with impermeable base • Provision of compost preparation unit with sealing of base for settling solid and liquid slurry and use of slurry to make compost • Provision of proper drainage system	During Post Construction/ Operation Phase	Included in project cost
B.1.2	• Increase in flies and vector disease due to improper raw material storage system and haphazard disposal of post-digestate.	• 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	During Operation Phase	100,000.00
B.1.3	• Depletion of Water Table and	• Extraction of groundwater as per	During operation phase	-

	Groundwater Pollution	groundwater license • Rechargeable pits will be constructed to recharge ground water		
B.1.4	• Increase in BOD, turbidity and TS of nearby water body if discharged directly into it • Groundwater Pollution	• Provision of proper drainage system • Prohibition of direct disposal into nearby agricultural field and water body • Waste water will be settled in a sedimentation tank before releasing to prevent groundwater contamination.	During Operation Phase	-
B.1.5	• Foul smell along the transportation route • Possibility of dropping of waste on road • Vehicular emission	• Proper covering of feedstock while transporting • Proper compaction of feedstock to avoid dropping • Use of vehicles complying Vehicle Mass Emission Standard, 2056	During Operation Phase	100,000.00
B.1.6	• Increase in noise due to operation of biogas plant components, biogas generator, etc. • Temporary hearing loss, annoyance among the staffs due to prolonged exposure	• Use of low sound emitting machineries • Provision of shed wherever necessary	Before Operation Phase	Included in project cost
B.1.7	• Methane gas being highly flammable can cause fire hazard; loss of property and life	• Avoid naked flame near the plant • Provision of fire extinguisher and emergency firefighting water storage and fire hose reel, Fire	During Operation Phase	150,000.00

	• Contribution to GHG emission	Control Balls • Designation of assembly location for workers in case of occurrence of firing • Regular checking of leakage in plant		
B.2 Biological Environment				
B.2.1	• 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 project area	During Operation Phase	300,000.00
B.3 Socio-economic and Cultural Environment				
B.3.1	• Physical injury to staffs • Prone to catch disease from organic waste handling	• Workers shall be provided with PPE like helmet, safety boots, safety jacket, gloves and masks • 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	During Operation Phase	300,000

		• 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)		
B.3.2	• Spread of vector borne disease around the community and staffs due to improper management of organic waste • Opposition from the community against the project	• Keeping the unit areas clean with disinfectants • Avoid haphazard disposal of digestate • Awareness and training to staffs regarding sanitation and operation of plant	During Operation Phase	30,000
B.3.3	• Increase in quarrel and debates among workforce and community	• 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.	During Operation Phase	-
B.3.4	• 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 • Appoint grievance handling officer and ensure the grievance handling through Grievance Redress Committee • Arrangement of handling received	During Operation Phase	-

		grievances and proceeds immediate action thereof, if any. (Grievance Redress Mechanism) • Establish Grievance Redress Committee • 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		

CHAPTER VII: STAKEHOLDER CONSULTATION, COMMUNITY PARTICIPATION AND DISCLOSURE

A public consultation meeting was held within project premises with the presence of nearby localities and agricultural land owners on 2075 Chaitra 13 (March 27, 2019). During consultation, there was presence of 26 local people including a representative from ward office (Ward President) where brief description of proposed project was delivered. Out of 25 individual, 11 were male and 14 female. The probable impacts and their mitigation measures were delivered by the expert team. In addition, the study team in presence of the proponent requested to lodge their issues regarding commencement of this project. During meeting, the issues raised by the public during the consultation meeting were noted, collected and incorporated in report.

The major concerns and issues raised during public consultation were:

- The locals should be given preference for employment during the construction and operation phase, according to their skills and abilities.
- The compost produced from the project should be provided with some concessions to the locals.
- The proponent or project management unit shall implement mitigation measures to reduce the negative impacts caused by the project.
- The nearby agricultural lands shall not be obstructed by discharging effluent to the nearby land.

The issues raised during public consultations are adequately addressed in mitigation measures proposed in this report. The mitigation plan strictly mentioned that solid and semi-solid wastes shall not be discharged into public places including nearby Bhaluwa river and surrounding agricultural land. Employment opportunity has to be provided to locals, especially women and vulnerable groups if any, according to their qualifications, competencies and willingness. The construction work has been suggested to be done prior to rainy season which will help several constructions related impacts and reduces costs too. It is also prescribed to appoint a grievance handling officer and establish grievance redress committee to lodge grievances of locals against the project construction and operation approaches and any impacts thereby. Such grievances will be transmitted to sub-project level grievance redress committee at first then transferred to proponent or project management unit, if not resolved. Furthermore, to overcome grievances from locals, public consultation will be conduct periodically during construction and operation phase with nearest communities and concerned stakeholders.

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, low PSA is adopted which is very energy efficient in comparison. The end-use has been proposed for thermal application supplied from compressed biogas (CBG).

8.2 Alternative Schedule, Process, Raw materials and Resources

The sub-project has been proposed to be constructed within the timeframe of six 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 river. 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

The project utilizes organic waste which are otherwise disposed carelessly to the nearby agricultural land or river. So "No Project Option" is out of scope for this study.

CHAPTER IX: ENVIRONMENTAL MONITORING

9.1 Project Management Responsibility

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

9.1.1 Environmental Standards

The Government of Nepal has endorsed few environmental standards on air and noise quality. These environmental standards shall be treated as other acts and regulations until Government of Nepal enforces standards in the specified sector for the project environmental compliance purpose.

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

9.1.2 Environmental Monitoring Plan

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

- To ensure that the project baseline conditions were adequately documented such that a comparative assessment of the project baseline before and after the 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 project proponent.
- To verify that the project impacts are within limits of the impact prediction or some foreseen impacts also occurred during 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 project construction and operation period. The monitoring management plan for baseline, compliance and impact is presented in table below.

Table 23: Baseline Monitoring, Construction and operation Phase

S.N	Provisions of compliance	Individuals responsible	Methods	Frequency /Time	Monitoring authority	Place	Financial commitment (NRs.)
Prior Construction Phase							
1	• Air Quality (TSP, PM 2.5, PM 10, Methane Fraction)	Proponent	Low Volume Sampler, Gas Analyzer	Prior to construction period	Proponent	Project Site	75,000.00
2	• Water quality testing of nearby BhaluwaRiver	Proponent	Laboratory Analysis	Prior to construction period	Proponent	Project Site	15,000.00
3	• Noise level monitoring of project location	Proponent	Noise level Meter	Prior to construction period	Proponent	Project Site	10,000.00

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	Proponent	Site Observation / records	During Construction Period	Proponent	Project Site	-

	construction site						
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	Already provisioned in construction site
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	Already provisioned in construction site
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 area and ditches • Compaction of spoil	Proponent	Site Observation / records	During Construction Period	Proponent	Project Site	-
5.	• Provision of PPE (Personnel Protective Equipment) • Provision of necessary safety cautions, signposts and instructions at construction site as well as near moving machineries	Proponent	Site Observation / records	During Construction Period	Proponent	Project Site	-

6.	• Awareness and orientation to construction workers • Proper maintenance of labor log with personal details and emergency contact details • Provision of barricade	Proponent	Site Observation / records	During Construction Period	Proponent	Project Site	-
7.	• Appointing a staff for handling grievances and communicate with community • Establishment of Grievance Redress Committee specific to this project • Instructing construction company to proceed construction work in compliance to ESA report	Proponent	Site Observation / records	During Construction Period	Proponent	Project Site	Already provisioned in human resource requirement
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	Already provisioned in project cost
2.	• Storing of feedstock and post digestate in designated area • Covering of feedstock and post digestate • Regular cleaning around the manure unit and feedstock storage	Proponent	Site Observation	Once a year during Operation Phase	Proponent	Project Site	-

	area						
3.	• Proper covering of feedstock while transporting • Proper compaction of feedstock to avoid dropping • Vehicular emission in compliance with emission standards	Proponent	Photographs / Records	Twice a year during Operation Phase	Proponent	Project Site	-
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	Already provisioned in project cost
5.	• Provision of PPE to workers • Provision of first aid kit • Regular check-up of staffs • Proper orientation and training to staffs about operating plant and waste handling • Proper maintenance of labor log with personal details and emergency contact details •	Proponent	Observation	During Operation Phase	Proponent	Project Site	Already provisioned in project cost
6.	• Cleaning of plant area regularly • Avoidance of haphazard disposal of digestate • Awareness and training to staffs	Proponent	Observation / Discussion/ Record	During Operation Phase	Proponent	Project Site	-

	regarding sanitation and operation plant						
7.	• Implementation of mitigation measures to avoid potential impacts mentioned in B.1, B.2 and B.3 in Chapter VI • Arrangement of handling grievances from community • Implementation of Grievance Redress Mechanism	Proponent	Observation / Record	During Operation Phase	Proponent	Project Site	-

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
Operation Phase							
a.	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/ farmland	-

b.	Occupational Health and Safety of the staffs/ workers	Proponent	Clinical checkup/ Records/ interview with staffs/ workers	Twice in a year	Proponent	Project site	-
c.	Number of grievances received from community	Proponent	Registered file/ complains	Every month	Proponent	Nearby community	-
d.	Water Quality of nearby water body (Bhaluwa River) (to compare with baseline assessment)	Proponent	Water Quality test of ground water and river water	Once in a year	Proponent	Borewell, Nearby River	15,000.00anually
e.	Increased noise level	Proponent	Discussion with local people, noise level meter	Once in a year	Proponent	Project site/ Nearby Community	10,000.00 annually
f.	Methane Leakage	Proponent	Gas Analyzer	Twice in a year	Proponent	Project Site	30,000.00

Table 26: Summary of Environmental Monitoring Cost

Item	Quantity	Rate per month	Rate per year (NRs.)	Total (NRs.)
Construction Phase				
Water Quality Monitoring	-	-	15,000 (Once)	15,000
Noise Monitoring	-	-	10,000	10,000
Operation Phase				
Water Quality Monitoring	-	-	15,000 (annual)	15,000
Noise Monitoring	-	-	10,000 (annual)	10,000
Methane Leakage	-	-	30,000 (annual)	30,000

Human Resource				
Environment Expert	1	60,000	120,000	120,000
Grievance handling officer	1	(already in human resource cost)	-	-
Total				200,000.00

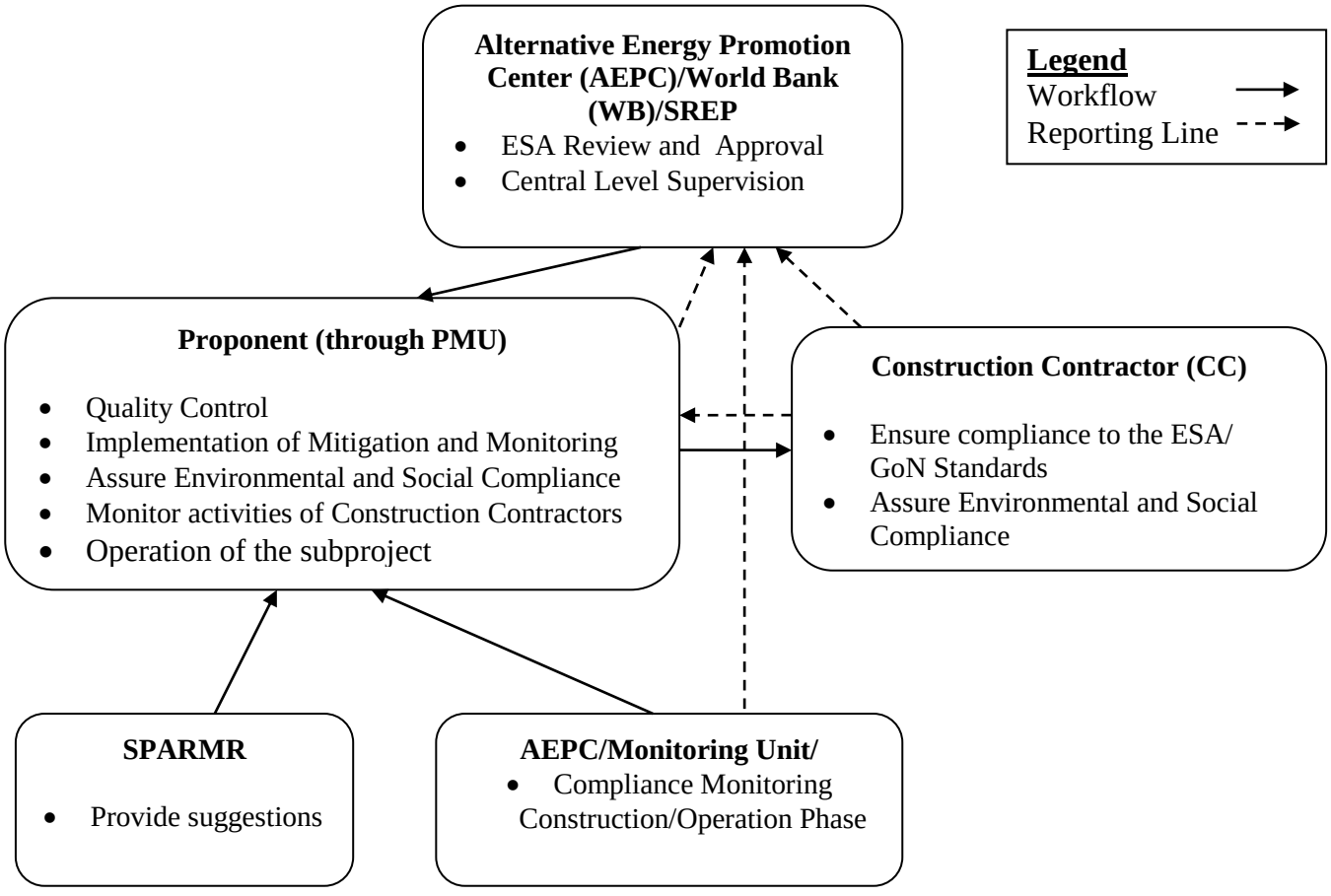
CHAPTER X: INSTITUTIONAL ARRANGEMENT AND GRIEVANCE REDRESS MECHANISM

10.1 Project Environmental Management Plan Structure and Stakeholders Responsibility

The Project Environmental Management Framework of the proposed 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 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)/ SREP
- Monitoring Unit of AEPC
- Proponent (through Project Management Unit- PMU)
- Construction Contractor (CC)
- Representative from project affected Rural Municipality (RPARM)

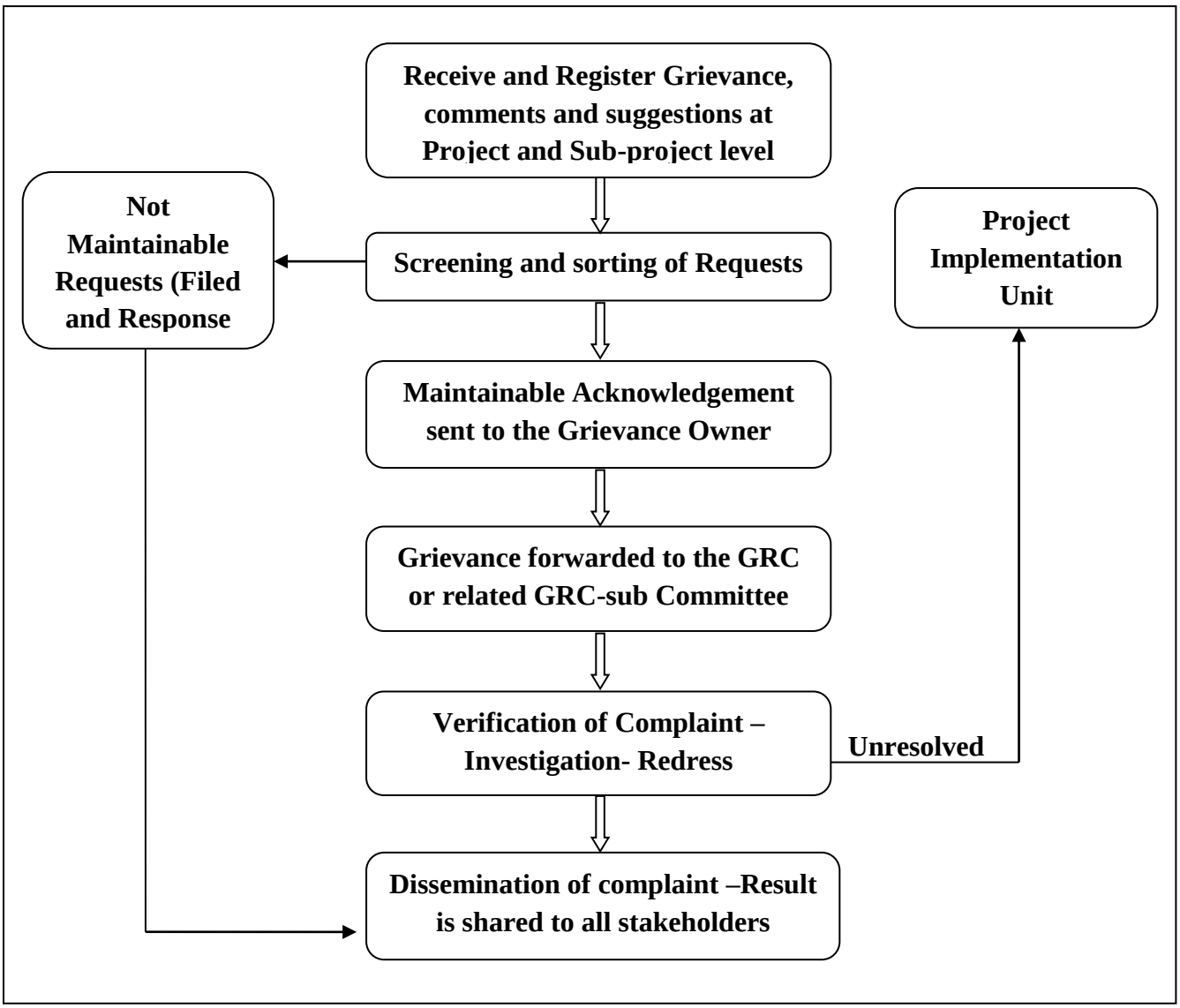


10.2 Grievance Redress Mechanism

Grievance addressing and feedback is important so as to know what negative impact has been occurred in the community due to implementation of the project. Such grievances should be taken care in order to avoid conflicts in the society regarding the 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 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 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. BSC Manager of AEPC – Chair**p**erson
2. Representatives of the developers from different categories of waste –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. Subproject Level Grievance Redress Committee (GRC)

1. Chairperson/Representative of the ward office or Chairperson/Managing Director of Developer – Chairperson
2. Representative from Project Affected people – Member (2)
3. Representative from local NGO/CBO – Members (1)
4. ESMF focal person of the perspective developer/Project manager – Member Secretary

Note: To be ensured that at least one 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 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 project site, so that affected people can have direct access to him/her.
- 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 suggested box will be placed at the entrance of the project site as well as around the project premises to collect grievances from the employees.
- Grievances can be registered via http://www.aepc.gov.np/gform/gform.php
- If the project level GRC is not able to redress the grievance, it will be forwarded to the national 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.

10.3 Capacity Development and Enhancement Measure

During the construction period, the job priorities will be given to local people with equal opportunities to women 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 13 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 and indirect impact zone of the proposed land. The following enhancement measures have been proposed to ensure that the project fully respects the dignity, human rights, economics, values and cultures of vulnerable groups working in the project site, especially women and the IPs.

- Prior to the construction of the 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 project affected areas.

10.4 Formation of Grievance Redress Committee

Grievance Redress Committee was formed by the proponent Jeevan Bikas Samaj on Shrawan 2, 2076 B.S. with an aim to mitigate the problems raised during the construction and operation of biogas plant. The committee has been formed with a total of 5 members that include 3 local and 2 representatives from non-profit organization itself. The meeting minute of thus formed committee has been attached in ***Annex 9*** of this report.

CHAPTER XI: PROJECT ENVIRONMENTAL HEALTH AND SAFETY PLAN

11.1 Health and Safety Policy and Plan

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 and implement by the developers before construction and operation phase. 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 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 project area.
- Using gloves, masks and other safety equipment while handling organic materials and feedstock.
- Food and water safety measures to follow within the project premises.
- In case of an outbreak, immediately report to the nearest health authority.

11.2 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 program with the workers during construction and operation stage in a regular basis to discuss about 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 training to staff to operate the plant.
d. Preparation of emergency exit map and orienting the staffs about it.

11.3 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 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

11.4 Gender Action Plan

Gender Action Plan will work on gender equality and empowerment of girls and women during the construction and operation of the 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 project cycle

11.5 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

11.6 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 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 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.

CHAPTER XII: CONCLUSION

Jeevan Bikas Samaj has proposed to establish biogas digester of 3341.22 m^3 capacity based on single stage continuous digestion with heating and stirring facility producing 2501.59 m^3/day of biogas. The biogas produced from the plant will be distributed to nearby community (Dakuwadada and Sorabhag) and hotels (Biratnagar) whereas compost will be sold to farmers and in markets. The development of project will reduce the dependency on using fossil fuels as means of thermal energy in the community as well as promote the use of renewable energy encouraging other investors to take the initiatives in similar projects.

Regarding environmental implications, different types of wastes and pollutants are assumed to be produced during the construction and operation phase of the project, most of the identified impacts can be mitigated by adopting prescribed mitigation measures in this report. This ESA has envisaged the impacts during the implementation of this proposal and also suggested mitigation measures to minimize or reduce the impacts. The subproject proponent should strictly follow the mitigation measures as prescribed out in this report.

The overall environmental and social impact from the sub-project is considered of lower magnitude. However, this ESA recommends pragmatic mitigation measures and also formulated the monitoring plan. Hence, it is recommended implementation of bio-methanation plant in Dhanpalthan Rural Municipality. Any impacts, not foreseen in this ESA study, if perceived during construction as well as operation phase, shall also be mitigated with appropriate mitigation measures.

PICTORIAL HIGHLIGHTS

Proposed Project Site

Bhaluwa River

Public Consultation

Public Consultation

Taking Water Sample of nearby River

Socio-economic Survey

Access way to project site

Settlement area near project site

ANNEXES

Annex 1: Public Consultation

आज मिति २०७५ साल चैत्र २३ गते मोरङ्ग जिल्ला धनपालथान गाउँपालिकाको वडा नं ३ मा जीवन विकास समाज ले ठुलो बायोग्यास प्लाण्ट को निर्माण तथा सञ्चालनको प्रस्ताव गरेकोमा प्लाण्ट निर्माण गर्दा हुनसक्ने भौतिक, जैविक तथा सामाजिक आर्थिक अवयवहरुमा पर्न सक्ने प्रभावहरु बारे स्थानीयको राय सुझाव संकलनका लागि गरिएको सामुहिक छलफलमा उपस्थित हुनुभएका महानुभावहरुको नामावली :

क.स.	नाम	ठेगाना	हस्ताक्षर
१	रविन्द्र पासवान	धनपालथान-३, डुकोडङा	रविन्द्र पासवान
२	मंगला पासवान	" "	[illegible]
३	गणेश पासवान	" "	गणेश
४	कमला मण्डल	" "	अम्रता
५	रिता पासवान	" "	रिता
६	रिना देवी मण्डल	" "	रिना देवी
७	बहदी पासमान	" "	बहदी
८	मुनिया देवी पासमान	" "	[illegible]
९	शरदा देवी पासमान	" "	[illegible]
१०	सुनिता पासमान	" "	सुनिता
११	राधा देवी मण्डल	" "	राधा
१२	कलावतीया पासमान	" "	[illegible]
१३	विमला देवी पासमान	" "	विमला देवी
१४	रंजिया देवी उरांव	" "	रंजुला
१५	रिता मण्डल	" "	रीता
१६	रिङ्कु देवी पासमान	" "	रिङ्की
१७	आरती देवी पासमान	" "	आरती
१८	प्रमिला पासमान	" "	प्रमिला
१९	मिरा देवी मण्डल	" "	मिरा
२०	सुषमा यादव	" "	सुषमा

(२१) प्रकाश लामिछाने — कार्येया — [signature]

(२२) दिप ना० मोची — " — [signature]

~~छलफलमा प्राप्त राय सुझावहरु:~~

(२३) विरेन्द्र कु० पाण्डेय — " — [signature]

(२४) प्रदिप पासमान — धनपाल्थ -३, डाकुडाँडा — [signature]

(२५) राजदेव मण्डल — " — [signature]

(२६) गायत्री पोखरेल — [illegible] — [signature]

राय सल्लाह सुझाव

१) परियोजनाबाट हाम्रो वस्तीको दुरी टाढा रहेकाले परियोजनाको कारण गन्धको समस्या नआउने देखिन्छ ।

२) परियोजनाको लागि चाहिने जनशक्तिका योग्यता अनुसार स्थानीयलाई रोजगारीको व्यवस्था मिलाइयोस ।

३) परियोजना निर्माण तथा सञ्चालनका क्रममा हुन सक्ने नकारात्मक वातावरण प्रभावको न्यूनिकरण स्वयं परियोजनाले गर्नु पर्ने छ

४) परियोजनाबाट उत्पादित मल स्थानीयलाई सहुलियत मूल्यमा उपलब्ध गराइयोस ।

५) स्थानीय स्तरमा निर्माण तथा सञ्चालन हुन लागेको यो परियोजनाबाट स्थानीयको आर्थिक सहाई (पशुपालन, व्यवसाय) बढ्ने देखिएकाले हामी यस परियोजना प्रति सकारात्मक छौं ।

राधा · अमृता रिता [illegible] नोकी

दुर्गा हीरामाया [illegible] बीमा [illegible]

[illegible] रेखा मनोरथ [illegible] मिरा

सोम्सा [illegible] सवतीम

आरती इन्दिरा [illegible] सुनैना रीता [illegible]

Summary of Public Consultation

Comments received during public consultation and their incorporations in the report:

- The locals should be given preference of employment, during the construction and operation phase, according to their skills and abilities.
- The compost produced from the project should be provided with some concessions to the locals.
- The proponent or project management unit shall implement mitigation measures to reduce the negative impacts caused by the project.
- The nearby agricultural lands shall not be obstructed by discharging effluent.

Annex 2: Land Provision for Proposed Project

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. 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.

c. 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, 1997 and Environment Protection Rules, 1997 (amendment 1999, 2007)

Nepal has enacted a comprehensive and umbrella type environmental act, the Environment Protection Act (EPA) 1997, and followed by Environmental Protection Regulation 1997 and as amended (1999, 2007, 2009 & 2010) which are now enforced through appropriate regulatory measures.

Under section 7 of the Act, industries or any others development projects owners are required not to discharge, emit or dispose waste, sound, radiation or any such acts which will cause pollution or to allow pollution to be caused in a manner which is likely to have significant adverse impacts on the environment or to harm human life or public health. Further, the section stipulates that causing pollution or allowing such pollution to be caused a punishable act.

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 an 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. 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.

f. 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 foe 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, 2003

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. 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.

c. 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.

d. 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. Article 12, 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 days	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 Limit
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 (Subproject Area)

Grievance Record Form

Name of Grievant:	**Contact detail** **Work Phone:** **Home Phone:** **Mobile No.:**
Home Mailing Address:	**Work Mailing Address:**
Date, time and place of grievance recorded:	
Detailed description of grievance:	
Proposed solution to grievance:	
_____ Signature of Grievant Receiver	_____ Signature of Grievance

Grievance Redress Format

S.N.	Name of Grievant	Date	Time of Grievance Recorded	Issue Raised	Time Frame to Resolve

Annex 6: Study Team

Team Composition

Team Leader : Mr. SujeshShrestha (Environmental Expert)
Environmental Officer : Ms. Bisweta Bajracharya
Sociologist : Mr. TulsiGiri

Annex 7: Checklist for Field Visit

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 project area
2. Study the geological characteristics of the 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 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 project area. The following information will be extracted to study about the socio-economic status of the 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 religious sites of the project area during the field visit
2. Study about the main festivals of the area

Annex 8: Noise and Water Quality Assessment

Noise Quality Assessment of Project Site (Katahari, Morang)

S.N.	Place	Date	Time	Value (dB)	S.N.	Place	Date	Time	Value (dB)
1	18347	27-03-19	18:23:16	35.1	31	18377	27-03-19	18:25:46	28.1
2	18348	27-03-19	18:23:21	46.8	32	18378	27-03-19	18:25:51	28.6
3	18349	27-03-19	18:23:26	28.4	33	18379	27-03-19	18:25:56	**27.9**
4	18350	27-03-19	18:23:31	36.9	34	18380	27-03-19	18:26:01	29.2
5	18351	27-03-19	18:23:36	30.3	35	18381	27-03-19	18:26:06	28.5
6	18352	27-03-19	18:23:41	33.9	36	18382	27-03-19	18:26:11	29.1
7	18353	27-03-19	18:23:46	34.5	37	18383	27-03-19	18:26:16	28.5
8	18354	27-03-19	18:23:51	29.3	38	18384	27-03-19	18:26:21	29.8
9	18355	27-03-19	18:23:56	30.7	39	18385	27-03-19	18:26:26	28.4
10	18356	27-03-19	18:24:01	42.7	40	18386	27-03-19	18:26:31	29.4
11	18357	27-03-19	18:24:06	42.1	41	18387	27-03-19	18:26:36	28.6
12	18358	27-03-19	18:24:11	33.2	42	18388	27-03-19	18:26:41	28.2
13	18359	27-03-19	18:24:16	28.5	43	18389	27-03-19	18:26:46	28.4
14	18360	27-03-19	18:24:21	30.9	44	18390	27-03-19	18:26:51	30.2
15	18361	27-03-19	18:24:26	31.7	45	18391	27-03-19	18:26:56	27.9
16	18362	27-03-19	18:24:31	28.4	46	18392	27-03-19	18:27:01	29.1
17	18363	27-03-19	18:24:36	29.9	47	18393	27-03-19	18:27:06	50.2
18	18364	27-03-19	18:24:41	30.6	48	18394	27-03-19	18:27:11	29.7
19	18365	27-03-19	18:24:46	31.4	59	18395	27-03-19	18:27:16	29
20	18366	27-03-19	18:24:51	29.6	50	18396	27-03-19	18:27:21	29.5
21	18367	27-03-19	18:24:56	32.4	51	18397	27-03-19	18:27:26	29.1
22	18368	27-03-19	18:25:01	31.9	52	18398	27-03-19	18:27:31	29.4
23	18369	27-03-19	18:25:06	28.7	53	18399	27-03-19	18:27:36	30.6
24	18370	27-03-19	18:25:11	28	54	18400	27-03-19	18:27:41	29
25	18371	27-03-19	18:25:16	28	55	18401	27-03-19	18:27:46	28.7
26	18372	27-03-19	18:25:21	29.4	56	18402	27-03-19	18:27:51	28.8
27	18373	27-03-19	18:25:26	29.2	57	18403	27-03-19	18:27:56	29.6
28	18374	27-03-19	18:25:31	28.1	58	18404	27-03-19	18:28:01	32
29	18375	27-03-19	18:25:36	30.5	59	18405	27-03-19	18:28:06	**52.9**
30	18376	27-03-19	18:25:41	30.8	60	18406	27-03-19	18:28:11	37.3

Nepal Environmental & Scientific Services (P) Ltd.
G.P.O. Box: 7301, Thapathali, Kathmandu, Nepal
Phone : +977-1-4244989, 4241001, Fax No.: +977-1-4226028, Email: ness@mos.com.np
http://www.nesspltd.com

NESS/Lab, M-03/R1.1

QS Test Report / Certificate

NS Accreditation No. Pra. 01/053-54

Entry No. : NCL - 491 (W) (1) - 04 - 2019
Sample : Water (Baluwa Khola Ko Paani)
Client : JBS-Biogas Project
Sampled By : Client

Date Received : 04 - 04 - 2019
Date Completed : 16 - 04 - 2019
Sampling Date : 01 - 04 - 2019
Location : Morang, Nepal

S. N.	Parameters	Test Methods	Observed Values
1.	pH @ 20°C	Electromeric, 4500 - H^+ B.: APHA	7.5
2.	Total Dissolved Solids, (mg/L)	Oven Drying Method, 180°C, 2540 C, APHA	98
3.	Total Hardness as $CaCO_3$, (mg/L)	EDTA Titrimetric, 2340 C, APHA	84
4.	Oil & Grease, (mg/L)	Partition – Gravimetric, 5520 B, APHA	<0.2
5.	Nitrate, (mg/L)	UV Spectrophotometric Screening, 4500 - NO_3^- B, APHA	0.37
6.	Nitrite, (mg/L)	NEDA, Colorimetric, 4500 - NO_2^- B, APHA	0.14
7.	Aluminum, (mg/L)	Erichrome Cyanine R, 3500-AL A: APHA	0.02
8.	Total Phosphate, (mg/L)	Ascorbic Acid, 4500 - P E, APHA	0.29
9.	Total Phosphorous, (mg/L)		0.09
10.	Fluoride, (mg/L)	SPANDS, 4500 – F- D, APHA	<0.05
11.	Manganese, (mg/L)	Direct Air – Acetylene AAS, 3111 B, APHA	0.17
12.	Lead, (mg/L)		<0.01
13.	Copper , (mg/L)		<0.01
14.	Cadmium, (mg/L)		<0.003
15.	*Hexavalent Chromium, (mg/L)	Diphenylcarbazide Method, IS 3025 (Part 52): 2003	N. D. (<0.01)

*: Non accredited parameter

N. D.: Not Detected

Note: The gravimetric analysis was carried out in controlled temperature (20°C) condition.
APHA: American Public Health Association; AAS: Atomic Absorption Spectrophotometer; UV: Ultraviolet; EDTA: Ethyelenediaminetetraacetic acid; NEDA: N-1-Naphthyleethylenediamine dihydrochloride; IS: Indian Standard.

(Analyzed By) (Checked By) (Authorized Signature)

Note:
1. This report/certificate is in reference to Laboratory Quality Control Manual, QS (017), section OPT.
2. The result listed refer only to the tested samples & applicable parameters. Endorsement of products is neither inferred nor implied.
3. Liability of our institute is limited to the invoiced test parameters & amount only.
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Annex 9: Meeting Minute of Grievance Redress Committee Formation