

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

of

**400 KW Biogas Based Power Plant at
Satghoria, Halodia, Lohajang, Munshiganj, Bangladesh**



SEPTEMBER 2020

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ABBREVIATIONS

AEZs	Agro-ecological Zones
BBS	Bangladesh Bureau of Statistics
CoI	Corridor of Impact
CDMP	Comprehensive Disaster Management Programme
CEGIS	Center for Environmental and Geographic Information Center
DDL	Dutch Dairy Limited
DoE	Department of Environment
DPHE	Department of Public Health Engineering
ECA	Ecologically critical area
ECC	Environmental Clearance Certificate
ECR	Environmental Conservation Rule
ESIA	Environmental and Social Impact Assessment
EMP	Environmental Management Plan
ESMP	Environmental and Social Management Plan
EQS	Environmental Quality Standards
FGD	Focus Group Discussion
GHGs	Greenhouse Gases
GIS	Geographical Information System
GPS	Global Positioning System
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IP	Indigenous People
IPCC	Inter-government Panel on Climate Change
IUCN	International Union for Conservation of Nature
IDCOL	Infrastructure Development Company Limited
MoEFCC	Ministry of Environment, Forests and Climate Change
NAPA	National Adaptation Programme on Action
NOC	No Objection Certificate
OSHA	Occupational Safety and Health Administration
PSMP	Power Sector Master Plan
PRECIS	Providing Regional Climates for Impacts Studies
RCP	Representative Concentration Pathway
SLM	Sound Level Meter
SPM	Suspended particulate matter
SRDI	Soil Resource Development Institute
SREDA	Sustainable and Renewable Energy Development Agency
TDS	Total Dissolved Solids
ToR	Terms of References
UNDP	United Nations Development Program

EXECUTIVE SUMMARY

Introduction

The name 'Biogas' is commonly used to refer to a gas which has been produced by the biological degradation of organic matter. Biogas is a renewable type of energy that is produced from the anaerobic digestion of organic waste. During biogas production, the organic waste is converted to methane (55-70%), carbon dioxide (30-45%) and trace components which include hydrogen sulphide (<2%), water vapor (2-7%), oxygen (<2%) and ammonia (<2%). A solid residue, digestate is also produced and has potential to be used as an organic fertilizer.

Bangladesh is having to have to increase the other renewable sources instead of fossil fuel energy and is experiencing difficulties to meet the need of energy from all different sectors i.e. industry, business and households. As there are a good number of medium to large poultry and dairy farms are available in Bangladesh, Biogas based electricity production will quickly enhance total production of electricity in Bangladesh.

Access to energy has become essential to the functioning of modern economies and the government of Bangladesh has been putting its best efforts to develop the indigenous energy resources, which ultimately plays a vital role in the socioeconomic development of the country. Traditional sources of energy i.e. biomass that includes but not limited to fuel wood, agricultural residues, dry leaves and dung cake etc. Usually the traditional energy sources are used in rural households for cooking purposes. Commercial sources of energy i.e. electricity, petroleum products, natural gas and coal etc. Typically, these types of energy are in use at factory and commercial establishments, transportation and urban households. As there are a good number of medium to large poultry and dairy farms are available in Bangladesh, Biogas based electricity production will quickly enhance total production of electricity in Bangladesh.

The main objective of the ESIA study is to assess both positive and negative environmental and social impacts due to the project activities. Assess the impacts and recommend appropriate mitigation measures during preconstruction, construction, and operation phases to minimize negative impacts of the project to acceptable levels. Prepare the ESIA including ESMP for the project in compliance with the Government and donor agencies requirements and obtain ECC from the DoE, Bangladesh.

The ESIA study team also observed, to the extent possible, the present condition of the existing infrastructure during the field visit. Opinion of the local people on the performance of the existing infrastructure and their perception about the proposed interventions were also obtained.

Interest in biogas technology is growing in Bangladesh because of the increasing awareness of the importance of the renewable energy sources and their potential role in decentralized energy generation. The current undertaking by the Dutch Dairy Ltd constructing 400 KW Biogas Based Power Plant at Satghoria under Lohajang Upazila of Munshiganj District, Bangladesh has been implemented under this project. The EPC will use cattle/goat/sheep manure produced from their own farm to produce biogas, biofertilizer and electricity. The manure will enrich the soil quality, reduce soil erosion as well as reduce the greenhouse gas emissions (nitrous oxide and methane), while providing a renewable source of energy that can replace fossil fuels.

Methodology

As constrained auxiliary data on the environmental quality and the biology of the examination zone are accessible, the Consultant utilized various strategies and methods to survey the natural issues of the proposed biogas-based Project. These included desktop review of the background information, GIS mapping, reconnaissance survey, consultation with stakeholders and

community members, and professional judgment. The main purpose of this approach was to obtain a fair impression on the people's perceptions of the project and its environmental impacts. GIS was used as a specialized analysis and presentation tool. A review was led of the physical, biological and legitimate writing applicable to the Project. The review of secondary sources and casual introductory field examinations were attempted so as to set up a fundamental appraisal of the physical and social condition, biodiversity, and preservation essentialness of the distinguished investigation region. This preliminary literature review also assisted in identifying data gaps, which would require collection of additional primary information through physical field survey. Primary data of physical, biological and sociocultural environment was collected to comprehensively evaluate the existing Project area baseline conditions. The environmental quality assessment in the project influence area has been carried out. The sampling focused on air quality, noise, surface water quality and groundwater quality. The resulting data provided information on existing conditions against which predictions of changes and field measurements during the construction period will be compared in order to assess change and its significance. An extensive stakeholder consultation has been done as part of this environmental and social impact assessment process.

Policy, Legal, and Administrative Framework

This section of the ESIA details the Policy and Legal considerations for the Project, covering national requirements as well as applicable international treaties and conventions. The intent of this section is to lay out the regulatory and non-regulatory performance requirements for all stages of the Project. For the purposes of this report, only those regulatory elements directly relevant to the proposed Project are discussed. Department of Environment (DoE), under the Ministry of Environment, Forests and Climate Change (MoEFCC) is the regulatory body responsible for enforcing the ECA'95 and ECR'97. It is the responsibility of the proponent to conduct an Environmental Assessment (EA) of development proposal and the responsibility to review EIAs for the purpose of issuing Environmental Clearance Certificate (ECC) from the DOE. According to the Gazette on 24 December 2017 under Environment Division-3 of Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, the proposed project of a 400 KW Biogas Based Power Plant at Satghoria, Halodia, Laohajung, Munshiganj is considered as the "Orange B" category. According to the environmental categorization of ESMF of IDCOL, the project has been categorized as High-Risk project requiring significant compliance safeguards including comprehensive environmental, social impact assessment, and regular monitoring.

Project Description

The proposed project involves construction and operation of a biogas-based power plant at Satghoria, Halodia, Laohajung, Munshiganj by DDL. The GPS location of the project site is 23.47803°N; 90.29655°E. The project will be located within the premise of the dairy farm of DDL. The whole farm area is separated by a boundary wall which is owned by DDL.

The proposed plant consists of a single digester (of 2036 m³) providing a total daily production capacity of 1,800 m³ of biogas as fuel. Electricity will be generated by two biogas generators (each with a capacity of 200 kW). With 10 hours of daily operation, the project will generate approximately 3,600 kWh of electricity per day. This project is intended to produce 3600 kWh of electricity per day for own consumption (captive) in the dairy farm using the cattle manure of 34,000 kg/day.

Once completed, the project is expected to supply 1,168,000 kWh electricity per year, replacing 70,560-liter diesel per year and 956,320 kWh grid electricity. Besides, about 7 ton organic/ bio-fertilizer will be produced per day from the Project.

The proposed Project involves setting up of one (01) biogas-based electricity generation system for captive consumption. Under the proposed project, cow dung and manure generated inside the farm will be used as feed material in the biogas digesters for production of biogas which will be used to run the biogas generator after performing purification process. The bio fertilizer produced as byproduct from the biogas digesters will be filtered to separate solid content of the slurry. Retained solids will be sold out as raw material for bio fertilizer or be used as fish food or agricultural activities inside the farm. The main objective of this project is to use 34 tons of dung produced everyday by Farm Cattle, Sheep and Goats to generate electricity via Biogas route for captive consumption and raw (unprocessed) organic fertilizer.

Description of Baseline Environment

The baseline conditions define the physical and biological conditions that prevail in the Project Study Area. The baseline was collected from three different areas such as physical environment, biological environment, and social environment. Both primary and secondary data sources were the main strength of this baseline. The major secondary sources included Banglapedia, BMD and BBS. Primary data were collected during field visits to the study area. The details of the baseline conditions are described in the following sections.

In this study, considering all the above-mentioned criteria, 1Km buffer areas were selected as the AOI, in which, all the baseline information was collected and described in the following sections.

Heavy rainfall is a characteristic of Bangladesh which frequently causing flood across the country or at local scale. The project area is located in the South-central climatic zone. The average temperature in January varies from 17°C in the northwest and north-eastern parts of the country to 20°C to 21°C in the coastal areas. Minimum temperatures in the extreme northwest in late December and early January reach between 3°C to 4°C. The highest average recorded temperature in this weather station was 28.30°C in June. The lowest average recorded temperature was found in the month of January which was 18.2°C. In the month of December of winter season lowest around 6.2 mm rainfall occurred in the region of Dhaka weather station.

The Project area falls in Earthquake Zone II, i.e. medium seismic intensity of the country. The project area falls in the Ganges river floodplain physiographic unit. The general topography of the project area is relatively flat. The topography of the specific project location is 8 m a.m.s.l Topographically the cluster of the project location is almost flat, with many depressions, natural water bodies, bounded by the Major Padma River.

Total of 33 plant species has been recorded from the project surrounding area. Among the species maximum represented by herbs followed by trees, shrubs and climbers. Among the species no endemic species were found in the project site. Some wildlife supporting species recorded in the project site. The major species are Banyan tree, Black berry, Laurel, Neem, etc. There are many Mangoes tree surroundings the project. Such species are available outside the project. Data analysis shows that maximum diversity was found in roadsides followed by homestead, cultivated land and wetlands. Among the use's categories, medicinal plants scored highest followed by fodder plants, edible fruits, ornamental plants, vegetable plants, timber plants, fuel wood plants, commercial plants and duck weed plants. Vegetation density of most of the area was found high.

A few of species of wildlife were observed in the area on the proposed project influence area. Among them, 1 were amphibians, 3 were reptiles, 16 were birds and 18 were mammals.

According to (IUCN Bangladesh, 2003) near threatened wildlife in the area were. Jungle Cat (*Felis chaus*). Bengal Fox (*Vulpes bengalensis*) was reported as vulnerable species in the project area. Fish is the most important aquatic fauna of the project areas, along with other groups. The aquatic fauna includes Prawns (*Macrobrachium sp.*), crabs, snails (*Pila*, *Vivipara*, *Lymna* etc.), freshwater mussels (*Lamellidens sp.*) etc. invertebrates and several species of fish. Kolabang (*Rana tigrina*); Guishap (*Varanus bengalensis*) and Matia sap (*Enhydrisenhydris*) are common. The aquatic birds are Pancowri (*Phalacrocoraxcarto*), Kanibok (*Ardeolagrayii*), Sadabok (*Egretta garzetta*), Borobok (*Egretta alba*), Machranga (*Halcyon pileata*), Dahuk (*Gallinix cinerea*), and winter migratory birds – Balihash (*Dendrocygnajavanica*) and Chakha (*Tadorna ferruginea*).

The key air quality parameters (particulate matter- PM₁₀ and PM_{2.5}, oxides of sulphur - SO_x, carbon monoxide- CO, oxides of nitrogen – NO_x and SPM) were analyzed from samples collected over an effective sampling period at sample site. Particulate matter (PM₁₀ and PM_{2.5}), CO, NO_x, SO_x and O₃ concentrations in all the sampling points showed compliance with DOE standard of ambient air quality. The noise level has been monitored at inside and outside of the project location during day time and the time weighted average value of the sound monitored at inside and outside of the project area are within the standard fixed for the respective areas. Water is an indispensable natural resource for survival of human life and another biota of a region. The test result of groundwater show that all the parameters are well within the standard limit. Surface water result shows that some of the parameters are within the national standard according to ECR, 97 and some of the remaining parameters are NYS according to DoE (ECR, 1997).

Lands at the project area are used for agriculture, fisheries, agro-forestry, homestead, homestead forestry and vegetation, animal husbandry, etc. The area at where the project is proposed characterized by an agricultural ecosystem. The Project area is located beside the Padma River and floodplain and therefore rice paddy is a substantial crop.

The people are typically involved in activities such as agriculture, livestock breeding, fishing and trade. Income provides the basis for food security and self-reliance, contributing towards general stability, prosperity and peace. In this Upazila 32.16% people engaged with agriculture. The health facilities of this area are not satisfactory.

Anticipated Environmental & Social Impacts and Mitigation Measures

As part of the ESIA process, a screening matrix was used specifically for the proposed project, focusing on the potential environmental impacts during the land development, construction and operation phases. Assessment was carried out considering present environmental setting of the project area, and nature and extent of the proposed activities. Potential environmental impacts associated with the proposed project activities are classified as: (i) impacts during pre-construction and construction phase and ii) impacts during operation phase (iii) impacts during decommissioning phase.

During pre-construction phase, the impacts associated with the land use only. No anticipated impacts during the planning phase of the Project as the project will be implemented within the own factory premises.

During construction phases, the major impact associated with environmental quality like air, noise, water, soil quality might be degraded due to improper management of the generated waste. Dust generated from construction machineries and gaseous emissions from vehicular transport as well machineries may deteriorate the air quality of the local area. Noise quality can be deteriorated due to the operation of various machineries and equipment. Various grease and oily substances may be released from the construction machineries may deteriorate the natural water of the project site. All the impacts will be very much localized in nature. The project

contractor is to take responsibility of minimizing environmental impact on the surroundings during construction phases by following the project's ESMP. Other social impacts associated with the visual amenity, health safety of the labors, cultural resources, employment opportunity etc. such type of impacts will be localized in nature and not anticipate to the project. During the recruitment of workers and other professionals, local poor and distressed people followed by project affected people and poor women should be given priority as per their competence and skill. While recruiting and giving wage gender equity must be maintained. The project owner should follow the rules and guidelines related to the environmental and social management mentioned in the ESMP.

During the operation period, due to increased activities and efficient operational systems, there will be some impacts on the environmental set-up in the project area. The main impact is associated with digester and power plant operation activities. Some smell emission and spillage are coming while the waste from cattle manure is transporting for digestion process. During the digestion process, gaseous nitrogen (N) is converted to ammonia (NH₃). In this water-soluble form the nitrogen is available to the plants as a nutrient called bio fertilizer. There will be some GHG emissions which will be treated by following the ESMP and also the detail mitigation measures are also included in the impact mitigation chapter of this report. To minimize/mitigate the impacts the developer should follow the Environmental and Social Management Plan (ESMP) properly.

Agriculture is the major food supplier for the people of the project area. The major portion of the amazingly fertile agricultural land occurs on the immense floodplains was formed by the deposition of sediments from the river Meghna.

Social aspect of biogas-based power plant has significant impact. The option of additional energy activities implementation offers to farmers the additional economic reference point. Besides that, the biogas plants operation requires the employment of more manpower, what enables to decrease the unemployment level in the regions.

It is also possible to increase the interest in the construction of biogas plants in small / large livestock farms on the manure and green waste from agriculture, if the state adopts the Regulations on purchase of electricity from qualified producers.

Stakeholder Consultation and Disclosure

The strength of FGD relies on allowing the participants to agree or disagree with each other so that it provides an insight into how a group thinks about an issue, about the range of opinion and ideas, and the inconsistencies and variation that exists in a particular community in terms of beliefs and their experiences and practices. During the consultation the participants appreciated the new project explaining their desires and expectations. The project will increase and improve the quality of their life. No major impact will take place due to the implementation of this project. Most of the people argued that they are willing to endure the negative impact to some extent for the sake of this project which they believe will improve their livelihood.

Environmental & Social Management and Monitoring Plan

The primary objective of the environmental management is to record environmental impacts resulting from the project activities and to ensure implementation of the "mitigation measures" identified earlier in order to reduce adverse impacts and enhance positive impacts from the specific project activities. Besides, it would also address any unexpected or unforeseen environmental impacts that may arise during construction and operation phases of the project. Environmental Monitoring Plan has incorporated key environmental components and parameters

to be monitored their indicators, frequency, timing and locations of monitoring and also the actors responsible for carrying out such monitoring.

DDL the project owner, responsible for overall project implementation and established a PMU to manage the project on their behalf. The project will be implemented within their farm and thus no further land acquisition is necessary. Besides, DoE and IDCOL also supervise the project.

Mitigation is the responsibility of Dutch Dairy Limited. The project authority will implement the ESMP along with mitigation measures, as part of the contractual obligation. The cost for mitigation and monitoring will be included in the project cost and allocated of fund will made accordingly. The monitoring plan and details of monitoring locations for environmental condition indicators of the project during pre-construction, construction and operation stages are presented in the report.

Conclusion & Recommendation

As part of ESMP, preventative measures will be implemented to mitigate the risk of adverse environmental impacts. During construction, environmental performance will be monitored daily through visual inspections of the site and work activities. Environmental impacts associated with construction activities are anticipated to be minimal and this can be confirmed through monitoring. Noise monitoring will be carried out to ensure that noise impacts are not significant. During operations, liquid effluent will be monitored at the discharge of the plant. The strategy will ensure sustainable execution of project activities and protection of the environment; and guaranteeing a respectful and fair treatment of all people working on the project and general public including motorists.

In addition, the overall impacts associated with the proposed project can be managed within reasonable and acceptable limits by applying all identified mitigation measures including suggested monitoring plan contained within this report. The potential risks that are identified will be possible to be managed by applying the suggested mitigation measures as described in this report. The benefits which are expected due to implementation of the proposed project are found to be greater than the short-term environmental effect.

1 INTRODUCTION

1.1 Background of the Project

Renewable sources for energy production will continue to be of great importance for the supply of the world's energy demand. Over the last few years, interest has grown in renewable energy especially in the global awareness of greenhouse gas (GHG) emissions. Natural resources are being depleted at a quicker rate than they can replenish and it is now time to adopt potentially renewable resources. Establishment of biogas-based electricity plants in the dairy/poultry farms reduces dependency on fossil fuel used for running captive generators, which can ensure biosecurity and proper litter management. Moreover, slurry produced in the digesters as a byproduct, which is a good organic/ bio-fertilizer.

The name 'Biogas' is commonly used to refer to a gas which has been produced by the biological degradation of organic matter. Anaerobic Digestion is a microbiological process for decomposition of organic matter, in the absence of oxygen, common to many natural environments and largely applied today to produce biogas in airproof reactor tanks, commonly named digesters. Biogas is a combustible gas consisting of methane, carbon dioxide and small amounts of other gases and trace elements. Residual substance is the decomposed substrate, rich in macro- and micro nutrients and therefore suitable to be used as fertilizer.

Cow dung has high nitrogen content and due to pre-fermentation in the stomach of ruminant, and has been observed to be most suitable material for high yield of biogas through the study made over the years. Traditional biogas plants have been based on cow manure from dairy farms. Cow dung demonstrated a potential for biogas generation. Purified biogas can be compressed at a standard pressure of 200bar. 1 cow will give about 10kg of dung per day, which will help to produce 1m³ of raw Biogas. $0.6\text{m}^3 \times 0.740\text{kg/m}^3 = 0.45\text{kg}$ of purified & compressed biogas. The manure produced by one cow in one year can be converted to methane, which is the equivalent of over 200 litres of gasoline.

Electricity production from biogas can be a very efficient method for producing electricity from a renewable energy source. However, this applies only if the emerging heat from the power generator can be used in an economically and ecologically sound way. The average calorific value of biogas is about 21-23.5 MJ/m³, meaning that 1 m³ of biogas corresponds to 0.5-0.6 l diesel fuel or an energy content of about 6 kWh. However, due to conversion losses, 1m³ of biogas can be converted only to around 1.7 kWh. Economically, electricity from biogas must compete with electricity generation from fossil fuels and other renewable energies such as hydro power.

This report represents the results of Dutch Dairy Limited (DDL) is located in a rural area of Satghoria, Halodia, Laohajung, Munshiganj, Bangladesh. The project will use cattle manure from existing dairy farm as feed material in the biogas digesters for gas production and the bio product will use as organic fertilizer. The proposed area of the plant is located inside the Dutch Dairy farm area.

The Environment and Social assessment are required to identify the major environmental and social impacts and formulate required environmental and social management measures. According to DoE guideline, the proposed project of a 400 KW Biogas Based Power Plant is considered as the "Orange B category". IDCOL, as well as all relevant development partners and stakeholders participating in REREDP II, have agreed the environmental and social requirements needed for processing the financing of each sub-component. The project is designated as environmental Category B (partial assessment) according to OP/BP of the World Bank and only

one environmental safeguard policy OP/BP 4.01, other Operational Procedures and EHS guideline need to be triggered.

The project components primarily deal with the anaerobic digestion systems to extract the biogas from the cow dung and generators to produce electricity. The Environment and Social assessment are required to identify the major environmental and social impacts and formulate required environmental and social management measures. IDCOL, as well as all relevant development partners and stakeholders participating in REREDP II, have agreed the environmental and social requirements needed for processing the financing of each sub-component. The project is designated as environmental Category B (partial assessment) according to OP/BP of the World Bank and only one environmental safeguard policy OP/BP 4.01, other Operational Procedures and EHS guideline need to be triggered.

Department of Environment (DoE), under the Ministry of Environment, Forests and Climate Change (MoEFCC) is the regulatory body responsible for enforcing the ECA'95 and ECR'97. It is the responsibility of the proponent to conduct an Environmental Assessment (EA) of development proposal and the responsibility to review EIAs for the purpose of issuing Environmental Clearance Certificate (ECC) from the DOE. According to the Gazette on 24th December 2017 under Environment Division-3 of Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, the proposed project of a 400 KW Biogas Based Power Plant is considered as the "Orange B category". According to the environmental categorization of ESMF of IDCOL, the project has been categorized as High-Risk project.

1.2 Energy Scenario in Bangladesh

Bangladesh situated in the north-eastern part of south Asia is among the world's most densely populated nations (1099 people/km² in 2010) with a population of 162.20 million in 2011 and about 72% of which live in the rural areas. Rural people meet up the energy needs mostly from traditional biomass fuels comprising of agricultural residues (45%), wood and wood wastes (35%), and animal dung (20%). Generally, biomass is estimated to account for over half (~62%) of the country's energy consumption. Bangladesh is in the midst of a severe and worsening energy crisis. With a population of about 160 million living in an area of 147,000 sq. km. it is one of the most densely populated countries too. Around 33% of the total population is covered by electricity network and 4% are covered under natural gas network. About 82% of total electricity comes from natural gas. As the demand is increasing and the reserve of the natural gas is decreasing, it is assumed that very early the supply of the natural gas will start to decline. The continuous depletion of fossil fuel is sticking the concern into the search for new energy source is mandatory.

The energy scenario of Bangladesh is dominated by traditional energy sources. They supply about 64 percent of the total energy consumption. These are based on agricultural residues (40.9%), animal dung (14.3%) and fuel-wood (8.7%). Unfortunately, the direct burning of cow dung causes a total loss of fertilizer and pollution of the atmosphere, whereas applying it directly to the field causes a total loss of fuel and pollution of the atmosphere. On the other hand, the production of biogas through anaerobic digestion would not only guarantee reliable and cleaner renewable energy sources but would also provide treated slurry as fertilizer.

Within this scenario, waste manure and other organic materials from livestock farms could be an important source of energy production. The livestock sector has expanded rapidly over recent years, especially in developing countries. Biogas and mineral production from animal waste and cow dung provide a pathway for recovering energy and improving waste management. This not only favors the livestock and energy sector, but also fosters sustainable development by addressing local energy needs of poor rural communities. Cow dung could be used as a suitable

substrate for biogas production.

Biogas in Bangladesh is considered highly feasible as the temperature is in favor of producing bacteria; feeding materials such as water, poultry liters, cattle dung and human wastage are available. In addition, required construction materials such as quality bricks, rods and cement are also available. Moreover, masons, technicians, experts and engineers on biogas plant construction are also available in Bangladesh. Looking into the above conditions, Bangladesh has higher prospects for the technology as it fulfils all of them.

1.3 Historical Context of Biogas Plant in Bangladesh

The first Indian KVIC model floating-drum biogas plant was constructed in 1972 at the premises of Bangladesh Agriculture University (BAU) for research and study purposes. Later BCSIR, DANIDA, LGED, DLS and Grameen Shakti involved in constructing biogas plants in Bangladesh. In 1992, the IFRD and Dhaka City Corporation jointly built an experimental large-size bio-digester having 85 m³ digester volumes at Dholpur. The digester was operated using municipal wastes. A wider dissemination of biogas took place while BCSIR implemented the “Biogas Pilot Plant (1st phase) Project” during the period of July 1995 to June 2000. During this period, as many as 4,664 fixed dome plants were put forth throughout the country.

Since there is no formal biogas programme is going on at this moment, some 200 plants were constructed by previously trained diploma engineers on individual basis. Out of this 200 plus plants, SEED Bangla Agro Limited constructed mostly the commercial biogas plants in the meantime and these ranges between 40 m³ to 500 m³ (gas production capacity) plant size with digester capacity to 80 m³ to 1,000 m³.

Later SEED Bangla Agro Limited focused specializing on large scale commercial biogas plant construction and so far, it has developed more than 1200 household and 700 commercial plants including the largest single digester of 500 m³ (gas production capacity).

1.4 Benefit & Uses of Biogas

Biogas can be used as primary source of energy to cater our ever-increasing energy needs in various sectors some of them can be described as following

Uses

Electric Power Generation

Biogas be used to generate electrical power as well as heat can be produced with the help of simple conventional gas fueled generator.

Bio-CNG (Vehicular Fuel)

Biogas can be upgraded to produce Bio-CNG so as to make it usable as vehicular fuel in transportation sector to replace the Mineral CNG.

Biogas in the gas network

As per recent developments in Govt. Policies Refined biogas (Bio-CNG) can be injected into existing gas (CNG or PNG) networks.

Biogas in Industry

Many industries such as Sugar Mills, Refineries, Distilleries, Dairies and paper mills generate processing Waste which can be used as a source of feed stock for AD plants and digested directly on site.

Benefits

Well-functioning biogas production and use can yield an entire range of benefits for its user, the society and the environment. In general, the following benefits are widely pronounced:

- It produces energy and works just like natural gas in producing electricity.
- It transforms waste to high quality organic fertilizer.
- It improves hygienic conditions by reducing pathogens, worm eggs and flies.
- It reduces hassle of collecting fire woods; instead be used at gas burners for cooking.
- It helps environment through protecting soil erosion, water and air pollution
- It ensures micro-economic benefits as a substitution of energy and fertilizer
- It generates additional income and increase return on animal husbandry, poultry and organic cultivation.

1.5 Necessity of the Project

Power source is one of the major assets for the overall development of a country. As for the electricity, its demand is increasing every moment and availability is still not enough. Waste like cow dung can be very promising for the generation of electricity that can be used to mitigate small scale demands. On the other hand, will be environmentally friendly as it will consider the waste management part, means no means will require to manage raw livestock waste. The proposed Project involves setting up of one (01) biogas-based electricity generation system for captive consumption.

Under the proposed project, cattle and goat manure generated inside the farm will be used as feed material in the biogas digesters for production of biogas which after purification will be used to run biogas generator. The slurry produced as byproduct from the biogas digesters will be filtered to separate solid content of the slurry. Retained solids will be sold out as organic fertilizer.

Biogas plants are very easy to set up because they do not require much space. Normally 10–15 days are required to construct a biogas plant. The first time the plants are charged, large amounts of raw material (cow dung) are required; 10–12 days are required to collect this. Since there is no formal biogas programme is going on at this moment, some 200 plants were constructed by previously trained diploma engineers on individual basis. Out of this 200 plus plants, SEED Bangla Agro Limited constructed mostly the commercial biogas plants in the meantime and these ranges between 40 m³ to 500 m³ (gas production capacity) plant size with digester capacity to 80 m³ to 1,000 m³. On the whole, there are tremendous opportunities for the development of small-scale biogas plants in Bangladesh but a number of other institutional and economic constraints need to be consistently addressed if a market has to develop for biogas using cow manure. A beginning has been made by the government in the National Livestock Development Policy (2007), by which support from the government has been committed for any institution or individual, who takes up initiatives for the safe and eco-friendly utilization of cattle manures. This policy commitment needs to be translated into sustainable action, such as improved information dissemination regarding the benefits of biogas plants, training based on the knowledge base and priorities of smallholder dairy rearers.

1.6 Objectives of the Report

The main objective of the Environmental and Social Impact Assessment (ESIA) study is to assess both positive and negative environmental and social impacts due to the project activities. Assess the impacts and recommend appropriate mitigation measures during preconstruction, construction, and operation phases to minimize negative impacts of the project to acceptable levels. Prepare the ESIA including Environmental and Social Management Plan (ESMP) for the

project in compliance with the Government and donor agencies requirements and obtain ECC from the DoE Bangladesh.

The ESIA will be used as a decision-making tool to ensure that the project design and implementation activities are environmentally sound and sustainable. During the implementation phase, the prepared ESMP shall serve as a framework for strengthening the mitigation, enhancement and environmental monitoring measures and system of the Biogas based project. The objectives of this ESIA are to:

- Facilitate an understanding of the elements of the existing baseline conditions that are relevant to resources/receptors that could be significantly impacted by the Project;
- Identify the aspects of the Project likely to result in significant impacts to resources/receptors;
- Predict and evaluate the significance of the impacts of the Project;
- To identify all potential significant adverse environmental and social impacts of the project and recommend measures for mitigation. In doing so, the ESIA will establish environmental and social baseline and identify any significant environmental, social and health safety issues.
- Identify potential areas of improvement/ capacity building for country institutions for management of environmental and social issues;

1.7 Scope of the ESIA Report

This ESIA report has been prepared keeping in view with the Term of Reference (ToR) as provided by the Client. The scope of the present ESIA report describes the following most important features:

- ❖ A review of the environmental legislative, regulatory and policy guidelines and considerations relating to the implementation of the project;
- ❖ A general description of the project and existing physical, biological and socio-economic conditions;
- ❖ Consultation with the locals/stakeholder involving concerned people in order to identify and act on any undocumented or perceived environmental issues;
- ❖ Identification and assessment of the potential impacts on the natural and human environment in the project area, from the construction of the biogas-based power plant.
- ❖ Identification of mitigation measures and monitoring actions in the form of an ESMP; and
- ❖ Recommendations and conclusions in order to operate the project works in an environmentally safe and sound manner.

1.8 Extent of the Study

This ESIA is carried out based on proposed development. The influence of impact has been defined as 1 Km on each side from the project location. However, the study area has been extended up to 1 Km area on each side of the project. Geographical Information System (GIS) techniques have also been used based on recent satellite imageries of the project area for above purposes. Assessment is carried out on the following environment components: terrestrial and aquatic ecology, soil, water, air, noise, and socio-economic aspects. The impacts on ecologically sensitive areas (e.g. wildlife sanctuaries, biosphere reserve, and protected places) within 1 Km of the project areas have also been assessed.

1.9 Need for ESIA study

According to the DoE Bangladesh - "if any cattle farm belongs to 10 cattle/heads or below in urban area or 25 cattle/heads or below in rural areas, the project has been categorized as Orange

A category”, meaning that it requires a brief Environmental Impact assessment Report (EIA). “If any cattle farm belongs above 10 numbers cattle in urban area and above 25 numbers cattle in rural areas, the project has been categorized as Orange B category”, Meaning that it requires Initial Environmental Examination (IEE) Report. For any commercially operated biogas project, there should be an environmental and social impact assessment by the project sponsor for any number of cattle’s/birds of any location (urban or rural). The environmental assessment report is to be submitted to IDCOL, which could be shared with stakeholders.

The proposed project component is classified under Orange B category as per Environment Conservation Rules, 1997. Industrial Estate is placed under “Orange B category” in Bangladesh Environment Conservation Rules, 1997 in Schedule 1 (D) Sl 39. Thus, it is required to carry out IEE study for the proposed project as per ECA, 1995 & ECR, 1997 and obtain approval (ECC) of DoE before taking up any construction activity for the project.

The applicable reference framework has been followed for the study is as follows:

- Applicable Bangladesh national and local regulatory requirement
- Applicable World Bank Operational Policies
- Environmental Assessment (OP 4.01),
- Involuntary
- The World Bank Group’s General EHS Guidelines (2007);
- The World Bank Group’s EHS Guidelines for Wind Energy (2015)

ESIA study was carried out considering present environmental and social setting, nature and extent of the proposed activities of the project site. Potential environmental impacts associated with the proposed project activities. Some of the important impacts associated with the proposed project were linked with land use, land stability (soil erosion), soil contamination, water availability, surface and ground water quality, water pollution, waste and wastewater disposal, ambient air quality, ambient noise levels, vegetation, fauna (terrestrial and aquatic), drainage pattern, hydrology, climate change, socio-economic, places of social/cultural importance (religious structures, community structures), construction and raw material sourcing and storing, and OHS. Adequate mitigation measures are needed to mitigate/minimize all likely environmental impacts and those have been discussed along with the impacts.

In terms of social assessment issues like disturbance of existing social infrastructures and services, local conflicts of interest, infectious diseases, work environment, accidents, disturbances to rights on water resource, disturbance to the existing social infrastructure and service, distribution of benefits and compensation, resettlement plan have been assessed.

During the field visit, discussions were also held with people in the locality including those presently living in and around the project areas, local people, nearby residents, etc. Outcome of these discussions were used in impact assessment and devising mitigation measures.

1.10 Contents of the Report

This report fulfils the requirements of the ESIA under the ECR and has been prepared in accordance with the DoE’s guidelines for “EIA Guidelines for Industries”. This ESIA identifies potential environmental impacts and issues associated with the undertaking of construction of Biogas Plant at Shatgharia under Lohajang Upazilla of Munshiganj District. It builds on the key identified impacts, management and mitigation measures identified and recommended in the study and provides a detailed assessment of the potential positive and negative impacts because of the Project and proposes appropriate mitigation and management measures.

The scope of this ESIA is specific to this Biogas Plant. Should any further construction and operation or development be planned as result of either this construction and operation Project

or other related work, additional environmental planning and assessment to the requirements of the Bangladesh Government must be carried out specifically in relation to that proposed development. DSCL does not endorse or take responsibility for any use of this report outside the scope of the Social and environmental impact assessment of the Biogas Plant Project.

The ESIA has been prepared to comply with the requirements set out in the ESIA Guidelines for Industries, Department of Environment, Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh, 1997, Section 4.

Chapter 1: Introduction: This chapter outlines the background of the Project, its context in relation to the Project outline.

Chapter 2: Legislative Regulations and Policy Consideration: This chapter addresses the legal requirements relevant to the Project implementation. It reviews the relevant environmental policies and legislation of the GoB and presents the relationship and requirements to the Project. It particularly focuses on compliance with DoE guidelines for the requirements of an ESIA and presents and addresses relevant Project specific conditions.

Chapter 3: Project Description: This chapter sets out the Project objectives, including location, phases, activities, equipment and the overall Project scope. Also presented is the delivery Program. The different components of the Project are presented in detail, which form the basis for the structured approach adopted for the identification of potential impacts and the undertaking of a risk-based methods of impact assessment.

Chapter 4: Analysis of Alternative: This chapter provides background as to the overall need for the Project. Also provided is an assessment of alternative Project Location, methodologies and the 'do nothing' option. These options were considered in the planning and development phase of this Project. The preferred and proposed Project options are presented.

Chapter 5: Baseline Environmental Condition: This chapter provides the definition and baseline conditions or attributes of the study area and its existing physical, biological and socio-economic environment. This section presents both environmental and socio-economic aspect and draws upon both secondary and primary data collection. Maps tables, figures and plates are used to present relevant data about the study area to provide a comprehensive picture of the existing environment prior to Project implementation. The study generally focuses on a 5km radius around the Project site.

Chapter 6: Description of the Socioeconomic Baseline: This chapter provides the definition and baseline conditions or attributes of the study area and its social and demographic structure.

Chapter 7: Anticipated Environmental & Social Impacts and Mitigation Measures: This chapter identifies the potential positive and negative environmental, physical and socio-economic impacts of the Project. Each key aspect is analysed and discussed in relation to the Project. For key aspects, the potential impacts are broken down into the different delivery stages of the Project. A risk prioritization matrix is presented which forms the guideline adopted for the undertaking of a risk assessment to identify the significance of potential impacts by way of likelihood and consequence. From this risk assessment, the identified potentially significant impacts are drawn out and presented as those that require most attention in the development of specific management and mitigation measures.

Chapter 8: Stakeholder Consultation and Disclosure: This chapter presents the

outcomes of the stakeholder engagement and consultation undertaken as part of the ESIA. Different types of engagement and consultation were undertaken with different stakeholder groups including local and divisional government administrations, the local community, business and social leaders, NGO's and individuals. These were largely undertaken by one-on-one meetings, small group interviews, household surveys with questionnaires and focus group discussions.

The opinions, concerns, comments, perceived benefits and suggestions from stakeholders in relation to the Project were recorded, summarized and analysed. Key concerns were identified and specific management and mitigation measures to address these are presented. This section also outlines the strategy for consultation activities in further Project phases.

Chapter 9: Environmental and Social Management Plan (ESMP): This chapter critically examines the potential positive and negative environmental and social impacts of the project and presents mitigation and management actions to reduce the risk of potential negative impacts. This involves actions to apply proposed management and mitigation measures on the ground, including some specific procedures and plans.

Chapter 10: Environmental and Social Benefit This chapter contains environmental and social benefit along the local economy and regional context.

Chapter 11: Conclusion and Recommendation: This chapter contains concluded project description and recommendation for further improvement of the project. This section summarizes the major ESIA findings, recommendations for a future course of action, and the overall conclusions of the report.

1.11 Approach and Methodology

1.11.1 Approach

The study has been conducted in accordance with Environment Conservation Rules, 1997, Government of Bangladesh (GoB) EIA Guidelines, 1997, and World Bank OP 4.01 (Environmental Assessment) guidelines. The route map of this ESIA preparation is given in Figure 1.1. The study is based on both primary and secondary data and information. The primary data includes data collected from field observations and secondary data includes review of the Bangladesh statistical and relevant information from government departments. The main purpose of this approach was to obtain a fair impression on the people's perceptions of the project and its environmental impacts.

1.11.2 Methodology

The following methodology was adopted for carrying out the ESIA of the proposed project:

(i) Orientation

Meetings and discussions were held among the members of the ESIA Team. This activity was aimed at achieving a common ground of understanding of various issues of the study.

(ii) Literature Review and Analysis of Previous Data

The ESIA uses the environmental data and social-economic data that have been collected from various primary and secondary sources. Field visits were made by specialists in order to proof secondary data and to develop a sound understanding of the interaction between environmental and social components and the Project activities. Other useful data included published and unpublished reports of similar development projects in the region that were obtained from sources such as DPHE, Department of Agriculture, DOE, DOF, the BBS and DOF(s).

The development of a sound information basis is critical to the understanding of the environmental, social and economic conditions at the Project site. It provides the necessary baseline by which inferences can be made about the potential for the Project to impact certain environmental or socio-economic aspects.

(iii) Data Collection Planning

Subsequent to the concept clarification and understanding obtained in the preceding step, a detailed data acquisition plan was developed for the internal use of the ESIA Team. The plan included identification of specific data requirements and their sources; determined time schedules and responsibilities for their collection; and indicated the logistics and other supporting needs for the execution of the data acquisition plan.

(iv) Data Collection

Site Reconnaissance In this step, primary and secondary data were collected through field observations, environmental monitoring in the field, concerned departments and published materials to establish baseline profile for physical, biological and socioeconomic environmental conditions. Following activities were performed for data collection:

- Analysis of Maps and Plans
- Literature Review
- Desk Research
- Field Observations and Studies
- Questionnaire Survey
- Public Consultations
- Laboratory Analysis

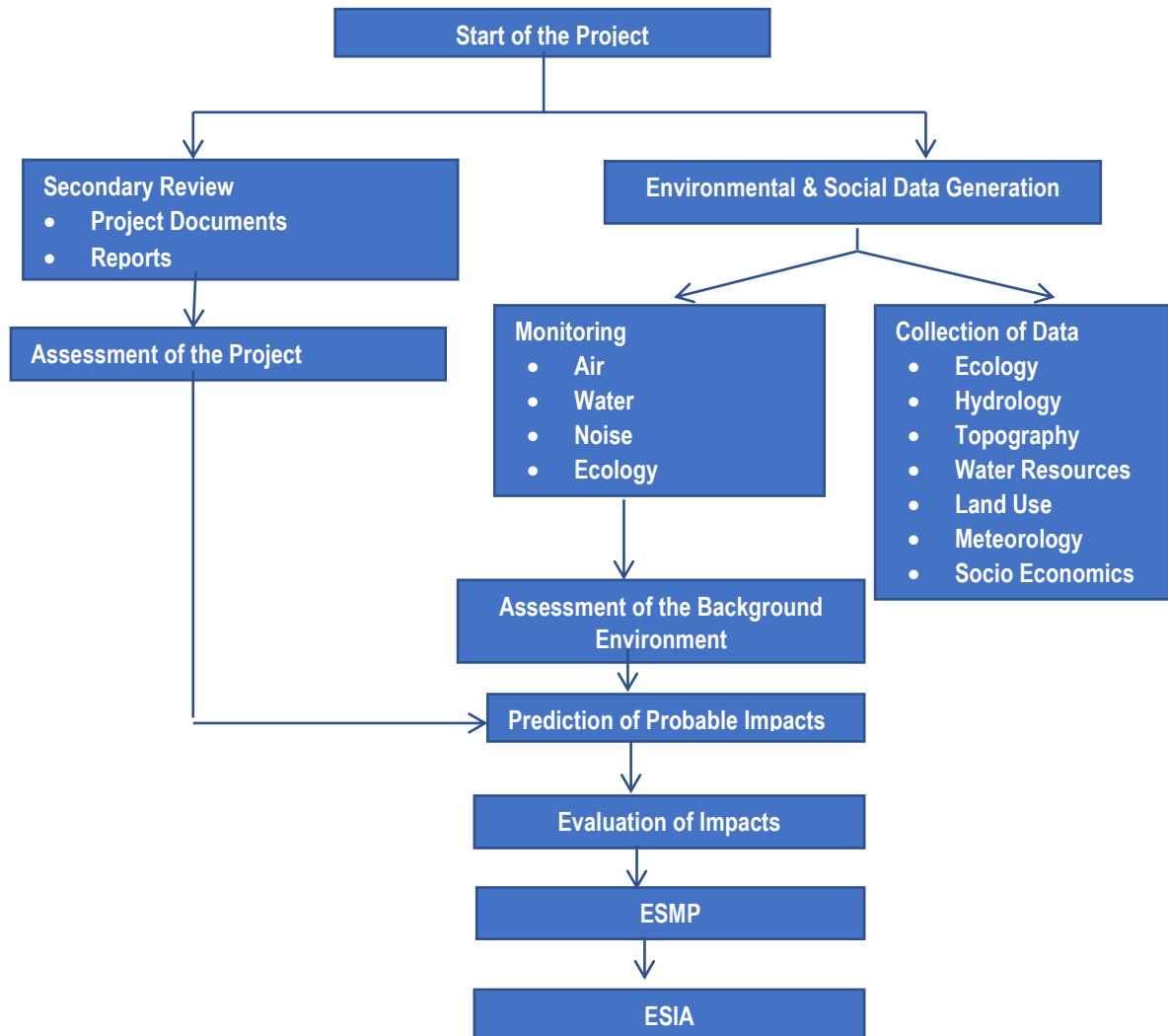


Figure 1.1: Route Map of ESIA

(v) Physical Environment

Information was collected on the existing physical environment, particularly as related to geology, topography, soils, hydrology and drainage, water quality, air quality and noise.

Geology, Topography, Soils

Data related to geology, topography and soil was collected to establish the baseline of the project area and further to find out the impacts of the Project during the construction and operational phases.

Hydrology and Drainage

Data related to hydrology and drainage was collected to identify the elements of the hydrological cycle that are likely to have impacts on the project and the possible impacts that the project could have on the hydrological regime. Field assessments included a determination and verification of all the existing inflows into the drain, assessment of drainage issues, interviews with local community members.

Environmental Quality

The existing environmental quality in the project influence area serves as the basis for identification, prediction and evaluation of potential environmental impacts of the proposed

project interventions. The baseline environmental quality was assessed through field studies on 18 May 2020 within the impact zone and analysis the information for various components of the environment, viz. air, noise, and water.

Ambient air quality measurements are essential to provide a description of the existing conditions, to provide a baseline against which changes can be measured and to assist in the determination of potential impacts of the proposed construction on air quality conditions. The noise monitoring was performed by a trained specialist, using a calibrated Sound Level Meter set to A-weighting, fast response and statistical analysis settings. The Sound Level Meter (SLM) was mounted on a tripod at a height of approximately 1.5m, facing in the direction of the apparent predominant noise source. The SLM was programmed to record statistical noise levels for 15 minutes. Sampling and analysis of surface water and groundwater quality was carried out from the project influenced location. Some of the water quality parameters are tested by on-site. Analysis of remaining parameters of water was performed by DPHE.

(vi) Biological Environment

The status of the flora and fauna of the project area were determined by an ecological survey, review of literature relevant to the area, and an assessment of terrestrial environment.

Flora

The vegetative communities were identified and classified into community types. Identification was carried out of dominant tree species, assessment of stage of growth (mature or sapling) and assessment of canopy cover.

Fauna

Information on fauna was gathered from existing literature on reported species as well as observations in the field.

(vii) Socio-Cultural Environment

The Consultants utilized a combination of desk research, field investigations, census data, structured interviews, maps, reports to generate the data required for description of the existing social environment and assessment of the potential impacts due to the construction of the project. Data was collected on the following aspects given below:

- Land use
- Transportation and access Roads
- Demographics
- Livelihoods
- Education
- Health
- Community facilities
- Recreational activities
- Archaeological and cultural heritage

(viii) Stakeholder Consultation

Stakeholder consultation is an important component of the ESIA preparation activities. Local knowledge about the ecosystem and problems associated with the project activities were carefully recorded and used in impact assessment and developing mitigation plan. Formal public consultation, in tandem with opportunistic informal ones involving local villagers, and people whose livelihood depends on these project areas, were executed.

(ix) Impact assessment and mitigation

Impact Assessment and Mitigations were undertaken in accordance with the ESIA objectives presented earlier. The general process includes:

- **Impact assessment:** Identification and assessment of potential environmental and social impacts with reference to applicable country and international regulations, standards and guidelines. Impact assessment also includes identifying opportunities to enhance beneficial impacts of the Project and to improve social development opportunities.
- **Mitigation Measures:** Mitigation measures have been developed with consideration of baseline conditions; identified constraints; concerns and suggestions raised by the community; GoM, WB, IFC and other relevant requirements, and the level of design information available at the time of preparation of this ESIA. Mitigation may include:
 - Environmental controls (e.g. measures for minimizing harmful noise, air, water and waste emissions);
 - Design optimization (e.g. relocation of dam wall to avoid graveyard);
 - Procedural measures (e.g. setting up catchment management committee);
 - Avoidance/reduction (e.g. waste minimization process management to conserve water);
 - Compensatory measures (e.g. biodiversity offsets); and
 - Timing measures (e.g. no construction at night).
- **Risk assessment:** Risk assessment has been undertaken to gauge the level of 'Residual' impact after mitigation and acceptability against international criteria and sustainability principles. Further opportunities for reducing identified 'high' risk residual impacts are then canvassed.

1.12 ESIA Study Team

The multidisciplinary team of ESIA experts having experience of conducting Environmental and Social Assessment of large scale industrial and infrastructural development projects. Table 1.1 presents the professionals' names with their positions.

Table 1.1 ESIA Study Team

Sl. No.	Name	Specialist/Responsibilities
1.	Md. Shafiqur Rahman	International Environmental Specialist, Overall Coordination / ESIA Team Leader
2.	Mafia Mostafa	Environmental Specialist, Assist to ESIA Report
3.	Tonmoy Pandit	Mid-Level Environmental Specialist, Data collection, environmental testing, field survey and analysis
4.	Md. Mashiur Rahman	Jr. Environmental Specialist, Data collection, environmental testing, field survey and analysis
5.	Saiful Islam Imran	Jr. Environmental Specialist, Data collection, environmental testing, field survey and analysis

2 POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

2.1 General

According to the national environmental legislation of Bangladesh all development projects are governed by some legal and institutional requirements. As such, assessment of relevant legal provisions, policies, strategies and institutional issues are very important for any project proponent or developer before execution of a program or plan. The proponent has to be well aware of these requirements and comply with the provisions as applicable and necessary. Before initiating any development project, it is hence required to obtain environmental clearance from DOE. Department of Environment (DoE), under the Ministry of Environment, Forests and Climate Change (MoEFCC) is the regulatory body responsible for enforcing the environmental laws and regulations like ECA'95 (amended in 2010) and ECR'97.

An ESIA is an effective planning and decision-making tool for the project proponent. It allows for the identification and management of environmental impacts/issues that may occur through the establishment and operation of such a facility. The need to comply with the requirements of the EIA Regulations ensures that decision makers are provided the opportunity to consider the potential environmental impacts of a project early in the project development process, and assess if environmental impacts can be avoided, minimized or mitigated to acceptable levels.

2.2 Applicable Policies

2.2.1 National Policies

2.2.1.1 Bangladesh Environmental Conservation Act (ECA) 1995, as amended in 2010

The Bangladesh Environment Conservation Act, 1995 (ECA 1995) is currently the main Act governing environmental protection in Bangladesh. The ECA 1995 replaced the earlier environment pollution control ordinance of 1992 and provides the legal basis for Environment Conservation Rules, 1997 (ECR 1997). The main objectives of ECA 1995 are: conservation of the natural environment and improvement of environmental standards, and control and mitigation of environmental pollution. The main strategies of the Act can be summarized as:

- Declaration of Ecologically Critical Areas (ECA), and restriction on the operation and process, which can be continued or cannot be initiated in the ecologically critical areas.
- Regulation in respect of vehicles emitting smoke harmful for the environment.
- Environmental clearance.
- Remedial measures for injury to ecosystem
- Regulation of the projects and other development activities - discharge permit.
- Promulgation of standards for quality of air, water, noise and soil for different areas for different purposes.
- Promulgation of standard limit for discharging and emitting waste.
- Formulation and declaration of environmental guidelines.

The Act was amended in 2010 on collection and recycling of used/non-functional batteries for conservation of environment, improving environmental standard and control and prevention of environmental pollution. According to this amendment, no biogas power plant will be permitted without environmental clearance of DOE. This also restricted the improper disposal of used fuel or any parts of used fuel/parts in open place, water bodies, waste bins, etc.

Relevance to the project - According to this legislation, no industrial unit or project shall be formed or conducted without obtaining the Environmental Clearance Certificate from the Director General in compliance with the regulations.

2.2.1.2 Bangladesh Environmental Conservation Rules, 1997

The Environmental Conservation Rules 1997 (ECR 1997) was enacted in exercise of the powers conferred by section 20 of the Bangladesh Environment Conservation Act 1995 (ECA 1995), to ensure its proper implementation and enforcement. The salient features of the ECR 1997 are;

- Categorization of the projects as green, orange (A and B) and red depending on the potential pollution's threats to environment,
- Procedure to take environmental clearance and the appeal process,
- Determination of ambient environmental standards with respect to water, air and noise, as well as permitted discharge/emission levels of water and air pollutants and noise pollution.

The ECR 1997 classifies projects by potential environmental impact and assigns different assessment and management requirements as follows:

- **Green projects** are those with positive environmental impacts or negligible negative impacts such as plantation and nursery. Clearance for these is obtained on the basis of project description, initial screening and No Objection Certificate (NOC) by the local authority.
- **Orange projects** fall into two categories i.e., Orange A and Orange B. Orange A projects are those with minor and mostly temporary environmental impacts for which there are standard mitigation measures, such as the installation of tube wells, pond sand filter, tank/reservoir, sanitary latrines etc. Application for DoE's environmental clearance requires general information, a feasibility report, a process flow diagram and schematic diagrams of facilities, environmental screening form, NOC from local authority. Orange B projects are those with moderately significant environmental impacts for which mitigation measures are easily identified, such as construction/re-construction of earthen roads, culverts, community centers, office buildings for general services, re-excavation of canals, repairing embankments, and school fields, etc. Such interventions require environmental clearance certificate from DoE, based on an Initial Environmental Examination report and an Environmental Management Plan, among others.
- **Red projects** are those which may cause 'significant adverse' environmental impacts such as the construction of bridges, industries, flood shelters, embankments, water control structures, etc. Projects under this category require IEE report to obtain the Site Clearance Certificate, and subsequently a full EIA report for environmental clearance certificate, along with the information required for other Categories. A number of sectoral EIA guidelines have been prepared to assist the EIA process.

Department of Environment (DoE), under the Ministry of Environment, Forests and Climate Change (MoEFCC) is the regulatory body responsible for enforcing the ECA'95 and ECR'97. It is the responsibility of the proponent to conduct an Environmental Assessment (EA) of development proposal and the responsibility to review EIAs for the purpose of issuing Environmental Clearance Certificate (ECC) from the DOE. According to the Gazette on 24th December 2017 under Environment Division-3 of Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, the proposed project of a 400 KW Biogas Based Power Plant is considered as the "Orange B category".

Relevance to the project - In accordance with the ECR of 1997, the Project is classified as an Orange B Category, requiring a complete Environmental Impact Assessment (EIA) to obtain clearance for construction.

2.2.1.3 The National Environmental Policy, 1992

The National Environment Policy 1992 sets out the basic framework for environmental action together with a set of broad sector guidelines. The Environment Policy provides the broader framework of sustainable development in the country. The core objective of the policy is to ensure the protection and improvement of the environment. It outlined actions that need to be pursued while planning development interventions by any sectors to facilitate long term sustainable use of all-natural resources.

It embraces 15 broad sectors including energy to deal with overall environmental issues. Under the energy sector in section 3.4 of the policy it articulated the following objectives:

- Reduce and discourage use of fuels that adversely impact the environment, and promote environment-friendly fuel use;
- Reduce use of wood and agricultural residues as fuel and encourage alternative sources;
- Adopt adequate precaution measures to safeguard environment while using nuclear energy;
- Promote innovation of fuel saving technologies and ensure dissemination of such technologies and knowledge for public uses;
- Ensure proper preservation of country's all energy resources; and
- Conduct comprehensive environmental impact assessment study before undertaking any intervention for exploitation of energy and other minerals in support of energy production.

The policy also gave the direction of amending the existing laws, formulating the new laws and implementing the same. To this effect, the policy assigned the Ministry of Environment and Forests to coordinate the implementation of the policy and to constitute a high level National Environmental Committee with the head of the Government as the Chairperson to give the direction, and ensure supervision and overseeing the implementation of the policy.

Relevance to the project - With regard to the transport sector, the environmental policy aims at prevention of pollution and degradation of resources caused by proposed project. The policy mentions that Environmental Impact Assessments (EIA) should be conducted before projects are undertaken.

2.2.1.4 The National Energy Policy, 1996 and 2004

The first National Energy Policy (NEP) of the country was formulated in 1996 "to ensure proper exploration, production, distribution and rational use of energy sources to meet the growing energy demand of different zones, consuming sectors and consumers groups on a sustainable basis" (GoB 2004:2). However, in recognition of the importance of energy in socio-economic development, the Government decided to update the NEP as an integral part of the overall development of the energy sector, and this was accomplished in May 2004. The NEP 2004 covers issues pertaining to "survey, exploration, exploitation and distribution of indigenous natural gas; establishment of petroleum refining facility and distribution systems; and establishment of power generation plants and networks for transmission and distribution of electricity" (GoB 2004:1).

The NEP 2004 recognized that "policy formulation is a continuing process for decision making at different levels by different institutions and individuals" and hence for operationalizing the NEP there is a need to ensure that these "decisions are taken in a synchronized manner at macro level, sectoral level as well as sub-sector (utility) level" to achieve the stated objectives (GoB 2004:17). The NEP also stated that implementation of the NEP "will necessitate introduction of new Acts and modifications of the relevant Acts and Ordinances in this regard and Environmental

issues to be considered under National Energy Policy are to be mandated under National Environment Policy and Environment Act” (ibid. 22, emphasis added).

The NEP 2004 devoted a section on Environment Policy, which deserves closer attention with reference to this project and hence we give an extensive quote as under. As regards to environment, the NEP 2004 (ibid. 27-28) outlined 10 policy measures and they include the following;

- Carrying out EIA (including a consideration of social impact) should be made mandatory and should constitute an integral part of any new energy development project;
- Use of economically viable environment friendly technology is to be promoted;
- Use of fuel wood is to be discouraged and replacement fuels are to be made available at an affordable price;
- Popular awareness to be promoted regarding environmental conservation;
- In case of coal-based power plants, disposal of ash and reduction of environmental emission are to be considered in technology selection;
- Use of lead-free petrol is mandatory;
- Use of low sulfur content diesel will be encouraged;
- Production of liquid fuels like petrol, kerosene, diesel oil from natural gas (NG) will be encouraged;
- Other technical options such as use of Catalytic Converter and Diesel Particulate Filter will be encouraged to reduce vehicular emissions;
- For improving the environment condition in the country, producing energy from wastes will be encouraged.

Relevance to the Project – This policy helps to define the necessary measures should be taken to implement the biogas project and to ensure the best possible usage.

2.2.1.5 Renewable Energy Policy of Bangladesh, 2008

The renewable energy policy of Bangladesh has been approved on December 18, 2008 with the target of developing renewable energy resources. This Policy laid out the target of meeting 5% of total power demand from renewable energy sources by 2015 and 10% by 2020. The policy provides an overall guidance of

- institutional arrangements
- resource, technology and program development
- investment and fiscal incentives
- regulatory policy

The policy promotes appropriate, efficient and environment friendly use of renewable energy. It also suggests that for large biomass electricity projects (i.e., greater than 1 MW) the project developer must demonstrate that the biomass is being sustainably harvested and that no adverse social impact will result from that development. It also restricted the larger scale production and use of bio-fuels which may jeopardize the existing crops.

Relevance to the project – According to this policy this project needs to be sustainably implemented and directed.

2.2.1.6 Bangladesh Labor Law, 2006

This Act pertains to the occupational rights and safety of factory workers and the provision of a comfortable work environment and reasonable working conditions. In the chapter VI of this law safety precaution regarding explosive or inflammable dust/ gas, protection of eyes, protection against fire, works with cranes and other lifting machinery, lifting of excessive weights are

described. And in the Chapter VIII provision safety measure like as appliances of first aid, maintenance of safety record book, rooms for children, housing facilities, medical care, group insurance, etc. are illustrated.

2.2.1.7 The National Livestock Development Policy, 2007

The National Livestock Development Policy, prepared by the Ministry of Fisheries and Livestock (MoFL), intends to provide the enabling environment, opening up opportunities, and reducing risks and vulnerability for harnessing the full potential of livestock sub-sector to accelerate economic growth for reduction of rural poverty. The private sector is expected to remain the main actor, while the public sector plays a facilitating and supportive role. The objectives of the policy are to promote sustainable enhancements in the productivity of livestock production including processing and value addition and also to promote sustained improvements in income, nutrition and employment for the landless, small and marginal farmers. It lays out the need to facilitate increased private sector participation and investments in livestock production, livestock services, market development and export of livestock products and by-products. The main objectives of this policy are given below-

- To promote sustainable improvements in productivity of milk, meat and egg production including processing and value addition;
- To promote sustained improvements in income, nutrition, and employment for the landless, small and marginal farmers; and
- To facilitate increased private sector participation and investments in livestock production, livestock services, market development and export of livestock products and by-products.

Relevance to the Project – This policy states the policy regarding usage of cow dung and also supports the viability of this project.

2.2.2 International Policies

2.2.2.1 World Bank's Guidelines on Environmental and Social Safeguards Policies

There are two types of safeguards requirement of the World Bank-environmental and social. Under these two safeguards there are a number of operational policies. Among them, the following operational policies could have relevance with the proposed Project:

OP 4.01 Environmental Assessment

The Bank requires environmental assessment (EA) of projects proposed to ensure that they are environmentally sustainable, and thus to improve decision making. EA is a process whose extent and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. EA evaluates a project's potential environmental impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimizing, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts; and includes the process of mitigating and managing adverse environmental impacts throughout project implementation. EA considers 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. The borrower is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements.

The Bank classifies the proposed project into three major categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts.

Category A: The proposed project is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.

Category B: The proposed project's potential adverse environmental impacts on human population or environmentally important areas-including wetlands, forests, grasslands, or 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 mitigation measures can be designed more readily than Category A projects.

Category C: The proposed project is likely to have minimal or no adverse environmental impacts.

2.2.2.2 Environmental and Social Management Framework (ESMF) of IDCOL

IDCOL has adopted an Environmental and Social Management Framework (ESMF) in 2011, which is to be complied with all infrastructure projects as are to be funded IDCOL. According to the environmental categorization of ESMF, the project has been categorized as High-Risk project requiring significant compliance safeguards including comprehensive environmental, social impact assessment, and regular monitoring. In consideration of social categorization, the project has been categorized as Low Risk project both for Indigenous People (IP) and for Involuntary Resettlement (IR) perspectives.

2.3 Environmental Clearance

Formal EIA guidelines in Bangladesh are set out in "Rules and Regulations under the 1995 Environmental Protection Acts" as published in the official Gazette on August 27, 1997. Any proponent planning an industrial project is currently required under Paragraph 12 of the Environmental Protection Acts, 1995 to obtain "environmental clearance letter:" from the Department of Environment. Steps to be followed for obtaining the Environmental Clearance Certificate for this power plant are shown in Figure 2.1, as the power plant is **Orange B** categorized by the DoE so they have circulated an amendment to prepare a full ESIA prior to implementation of such project for approval.

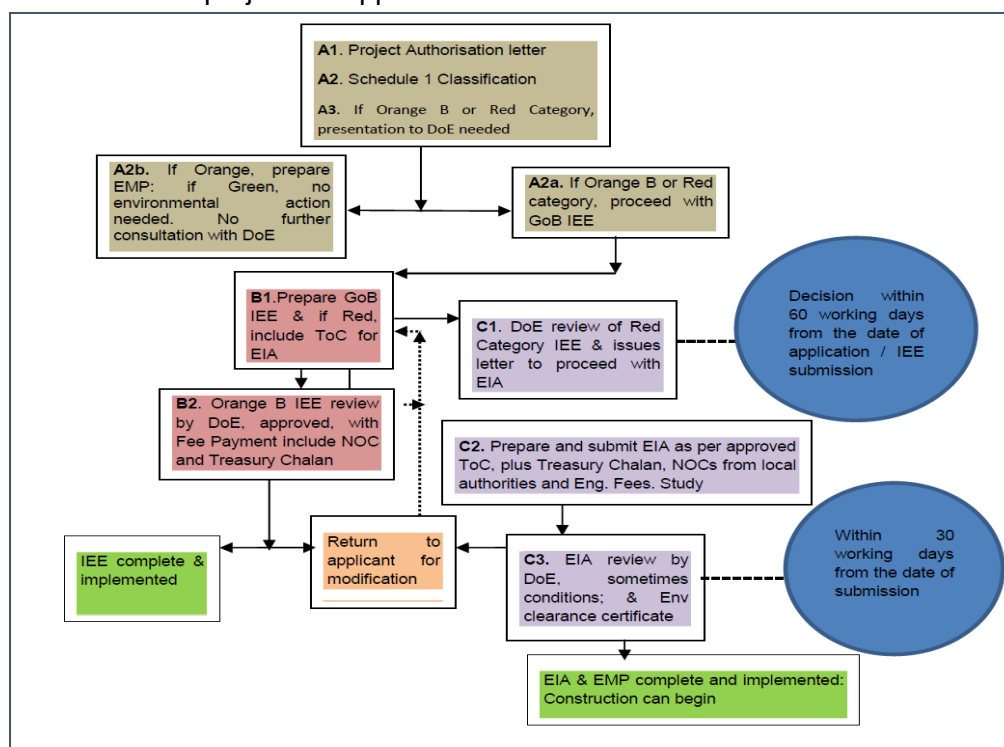


Figure 2.1: Government of Bangladesh Environmental Assessment Process

The first to obtain environmental clearance is for the project proponent to complete & submit an application form which may be obtained from the appropriate DoE regional offices as per the category. The application is accompanied by other supporting documents (i.e. project profile, layout plan, No Objection Certificate (NOC) from local authority, Government fees etc.) reviewed by the divisional and district offices of DoE who has the authority to request supporting documents as applicable. The divisional office has the power to take decision on Green and Amber-A & B category projects and the Red category projects are forwarded to head office for approval. The proposed project will receive an environmental site clearance at the beginning and the environmental clearance subject to the implementation of the project activities and all mitigation measures suggested in the ESIA report or in the application. Only an “environmental approval” will be required from IDCOL.

3 PROJECT DESCRIPTION

3.1 Introduction

The project description sets out the scope of the Project features and activities, with particular reference to the aspects, which can affect the environment. Details of the Project facilities' design characteristics, as well as planned and unplanned Project activities, are provided in the subsequent sections of this chapter.

3.2 Location of the Project

The proposed project involves construction and operation of a biogas-based power plant at Satghoria, Halodia, Lohajang, Munshiganj by DDL (Figure 3.1). The GPS location of the project site is 23.47803°N; 90.29655°E. The project will be located within the premise of the Dutch dairy farm limited. At present the number of cattle is 1000 whereas the total number of goats/ is 2000. The current manure production is 34,000 kg/day. The whole farm area is separated by a boundary wall which is owned by DDL. This project is intended to produce 3600 kWh of electricity per day for own consumption (captive) in the dairy farm using the cattle manure of 34,000 kg/day. Total land area is 100 decimals.



Figure 3.1: Photographs of Project Location

Munshiganj is located nearly South side to Dhaka. The bearing degree from Dhaka To Munshiganj is 180 degree. Project site can be accessed easily by bus, private car, or other means of road transports because it was beside the Dhaka- Mawa expressway which is now link with Padma multipurpose bridge. It takes around 1.5 - 2 hour to reach the project site from Dhaka city. Holdia bazar is located to the west side of the project area. The project area is surrounded by highly vegetation cover. The land is already owned and is part of the dairy farm from where raw material will be collected.

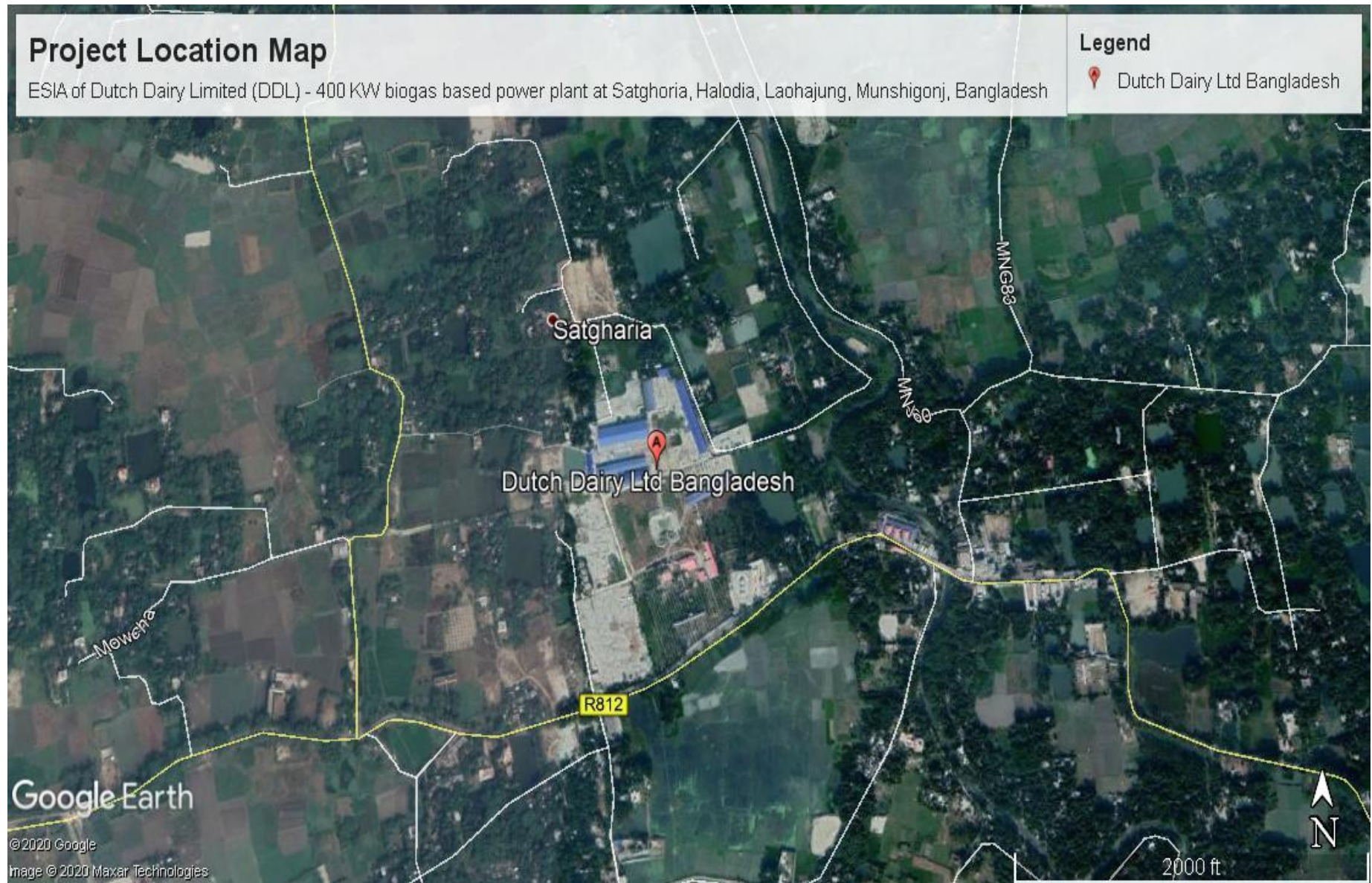


Figure 3.2: Project Location Map

3.3 Rationale of the Project

Bangladesh has favorable climate for biogas production. The ideal temperature for biogas is around 35 degree. The temperature in Bangladesh usually varies from 6 deg. to 40 deg. But the inside temperature of a biogas digester remains at 22 deg.-30 deg., which is very near to the optimum requirement.

Improper disposal of cattle manure results in environmental hazard, contamination in lands and water bodies, which through percolation, can contaminate groundwater and transfer up the food chain. Improper disposal of manure can contribute to water-quality problems especially in areas prone to flooding or where there is a shallow water table. The project will be able to produce bio slurry which can play vital role as the sources of organic matter and nutrients like N, P, K, Ca, Mg and S for quick growing vegetables. Due to the potential of bio-slurry in the agricultural field as fertilizer, this by-product of a biogas plant can get a higher value to the beneficiaries. This additive value may be motivational and co-advantageous to adopt such technology by the private sector investors.

In addition to that improper disposal of cattle litter in open environment can increase the production of flies and mosquitoes which can transmit diseases, such as cholera, dysentery, typhoid, malaria, filarial and dengue fever. Therefore, proper disposal of livestock waste is very important to contain the health as well as environmental hazard.

Besides, DDL must use organic fertilizer in order to produce grass in their own farm. DDL currently uses 2,130-ton organic fertilizer per year for cultivating grass, which is met bought from the other dealers. Dutch Dairy Ltd. will buy back the slurry from the proposed project for their existing contract farming.

Establishment of such projects will ensure reduced dependencies on low national grid. According to current load demand and estimated plant output, DDL will use about 1,284,800 kWh electricity per year from the project, allowing it to save 70,560-liter diesel and 1,073,120 kWh grid electricity per year.

3.4 Company Information

The company who is performing the project activity is described below-

Name of the company	Dutch Dairy Ltd.
Name of Contact person	Md. Zillur Rahman Mridha
Mailing Address	4/5, Block-C, Tajmahal Road, Mohammadpur, Dhaka. P.O.-1207
Year of establishment	2017
Registration information	Under the company act (Act XVIII) of 1994 C – 135418/2017
Registration From	Registrar of Joint Stock Companies & Firms, Bangladesh

The company has been formed and registered with the Registrar of the Joint Stock Companies and Firms, Govt. of Bangladesh as a Private Limited Company under the name and style “Dutch Dairy Ltd.”. Actual capital structure of the company will be evolved based on the sources of finance obtained from probable sources as loan and equity. The company documents are given in Appendix B of the report.

3.5 Project Details

The proposed plant consists of a single digester (of 2036 m³) providing a total daily production capacity of 1,800 m³ of biogas as fuel. Electricity will be generated by two biogas generators (each with a capacity of 200 kW). With 10 hours of daily operation, the project will generate approximately 3,600 kWh of electricity per day. Total land area of this project is 100 decimals.

Once completed, the project is expected to supply 1,168,000 kWh electricity per year, replacing 70,560-liter diesel per year and 956,320 kWh grid electricity. Besides, about 7 ton organic/ bio-fertilizer will be produced per day from the Project. 34,000 kg/day cattle manure will be used to produce biogas and bio-fertilizer. Dung from cattle, goats and sheep is the only major raw materials required for this project, which will be acquired from the owned cattle farm adjacent to the plant. Animal urine and cleaning water will also be used as raw material. Additional required water will be majorly sourced from recycled effluent by the ETP plant and some water will be sourced from deep tube well near the plant. Electricity required for the function of the plant will be generated through the process itself.

The proposed Project has four major sources of revenue:

- savings in diesel consumption
- savings in grid electricity consumption
- sale of slurry as a component of organic fertilizers
- savings in LPG.

3.5.1 Objectives of the Project

The proposed Project involves setting up of one (01) biogas-based electricity generation system for captive consumption.

Under the proposed project cattle manure generated inside the farm will be used as feed material in the biogas digesters for production of biogas which after purification will be used to run biogas generator. The slurry produced as byproduct from the biogas digesters will be filtered to separate solid content of the slurry. Retained solids will be sold out as organic fertilizer.

3.5.2 Technical Potential

Biogas in Bangladesh is considered highly feasible as the temperature is in favor of producing bacteria; feeding materials such as water, cattle dung and human wastage are available. In addition, required construction materials such as quality bricks, rods and cement are also available. Moreover, masons, technicians, experts and engineers on biogas plant construction are also available in Bangladesh. Looking into the above conditions, Bangladesh has higher prospects for the technology as it fulfils all of them. Detail design drawing of this particular project are given in Figure 3.3.



Figure 3.3: Detailed Design of the Biogas Based Power Plant at DDL

3.5.2.1 Composition and Properties of Biogas

The composition of biogas varies depending upon the substrate composition, as well as the conditions within the anaerobic reactor (temperature, pH, and substrate concentration). Landfill gas typically has methane concentrations around 50%. Advanced waste treatment technologies can produce biogas with 55%–75% methane, which for reactors with free liquids can be increased to 80%–90% methane using in-situ gas purification techniques. As produced, biogas contains water vapor. The fractional volume of water vapor is a function of biogas temperature; correction of measured gas volume for water vapor content and thermal expansion is easily done via simple mathematics which yields the standardized volume of dry biogas.

For 1000 kg (wet weight) of input to a typical bio digester, total solids may be 30% of the wet weight while volatile suspended solids may be 90% of the total solids. Protein would be 20% of the volatile solids, carbohydrates would be 70% of the volatile solids, and finally fats would be 10% of the volatile solids.

Table 3.1: Typical Composition of Biogas

Compound	Formula	%
Methane	CH ₄	50-75
Carbon dioxide	CO ₂	25-50
Nitrogen	N ₂	0-10
Hydrogen	H ₂	0-1
Hydrogen sulfide	H ₂ S	0.1-0.5
Oxygen	O ₂	0-0.5

It is found from a further study that, biogas production from cow dung yields bit different composition than usual (Diagi *et.al*, 2019).

Table 3.2: Typical Composition of Biogas

Component	Mole (%)	Wt. (%)
Methane	96.63	91.97
Carbon dioxide	0.81	1.35
Nitrogen	2.56	6.68
Total	100	100

3.6 Basic Elements of Bio-electricity Generation Plant

3.6.1 The Technology

Biogas is the gas resulting from an anaerobic digestion process. A biogas plant can convert animal manure, green plants, waste from agro industry and slaughterhouses into combustible gas. A positive contribution of biogas technology can only materialize, if the technology works. The development of biogas technology has passed the experimental stage. Trials with uncertain outcome can only be accepted if the costs of failure are not to be paid by the end-users. Whatever the chosen design of the biogas plant may be, those in charge for its dissemination bear the responsibility to deliver a reliable, durable and user-friendly product.

The daily amount of available dung (fresh weight) is known, gas production per day in warm tropical countries will approximately correspond to the following values:

- 1 kg cattle dung 40 liters biogas
- 1 kg buffalo dung 30-liter biogas

¹ Electricity Generation from Biogas - energypedia.info. (2020); https://energypedia.info/wiki/Electricity_Generation_from_Biogas

- 1 kg pig dung 60-liter biogas
- 1 kg chicken droppings 70-liter biogas

Biogas can be used in similar ways as natural gas in gas stoves, lamps or as fuel for engines. It consists of 50-75% methane, 25-45% carbon dioxide, 2-8% water vapor and traces of O_2 , N_2 , NH_3 , H_2 and H_2S . Compare this with natural gas, which contains 80 to 90% methane. The energy content of the gas depends mainly on its methane content. High methane content is therefore desirable. A certain carbon dioxide and water vapor content is unavoidable, but Sulphur content must be minimized - particularly for use in engines. The average calorific value of biogas is about 21-23.5 MJ/m³, so that 1 m³ of biogas corresponds to 0.5-0.6 l diesel fuel or about 6 kWh (FNR, 2009).

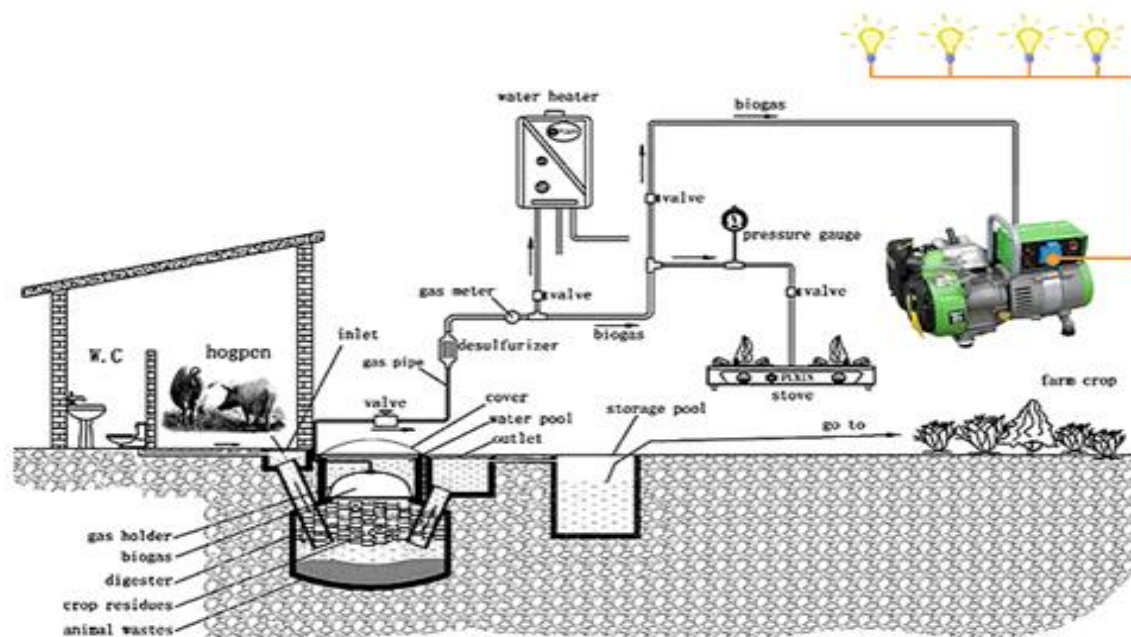


Figure 3.4: Schematic Diagram of a biogas plant used for power generation²

3.6.2 Types of Biogas Digester

Choosing a right biogas digester is a very important while constructing a biogas plant. From the standpoint of fluid dynamics and structural strength, an egg-shaped vessel is about the best possible solution. This type of construction, however, is comparatively expensive, therefore, its use is usually restricted to large-scale sewage treatment plants. There are some small-scale digester and also there are some digester which are used for industrial purposes. Small scale digester like Fixed Dome Biogas Plants, Floating Drum Plants, Low-Cost Polyethylene Tube Digester, Balloon Plants, Horizontal Plants, Earth-pit Plants, Ferro-cement Plants etc.

Industrial digester types are Continuous plants, Semi-batch basis etc. Continuous plants are suitable for rural households as the necessary work fits well into the daily routine. Gas production is constant, and higher than in batch plants. Today, nearly all biogas plants are operating on a continuous mode.

3.6.3 Continuous stirred-tank reactor (CSTR)

The continuous stirred-tank reactor (CSTR), also known as vat- or back mix reactor, mixed flow reactor (MFR), or a continuous-flow stirred-tank reactor (CFSTR), is a common model for a chemical reactor in chemical engineering and environmental engineering. A CSTR often refers

² Electricity Generation from Biogas - energypedia.info. (2020); https://energypedia.info/wiki/Electricity_Generation_from_Biogas

to a model used to estimate the key unit operation variables when using a continuous agitated-tank reactor to reach a specified output. The mathematical model works for all fluids: liquids, gases, and slurries. The behavior of a CSTR is often approximated or modeled by that of an ideal CSTR, which assumes perfect mixing.

3.6.3.1 Advantages of CSTR (Continuous Stirring Tank Reactor)

- It's suitable for anaerobic digestion of feedstock with high-concentration and high content of suspended solids; It can accept TS (Total Solids) content at 6~12%;
- It's outfitted with mechanical agitators for stirring of feedstock inside tank & breaking of shell that main forms at liquid surface;
- Resulting from the stirring made by mechanical agitators, formation of different layers is avoided effectively. Organic substrate is distributed evenly in tank, to contact with anaerobic microorganisms, so as to improve biogas production;
- Uniform heat distribution inside tank, to ensure the mesophilic anaerobic digestion process and biogas production;
- With perfect shock load resistance performance, any kind of inhibitory factors can be dispersed rapidly into every corner of tank and kept at a very low level;
- Small ratio of height to diameter to make the whole tank strong and firm.
- Appropriate design and configuration to make it has better performances of antiknock and anti-lightning than other kinds of anaerobic reactors, e.g., UASB, USR, IC;
- It can be designed as all-in-one solution to combine biogas production and gas storage with gas holder mounted on top of tank while final height is not high, so as to save investment;
- Perfect volumetric production rate: 0.8~1.5 Nm³(biogas)/day.m³(CSTR effective volume) and COD removal rate: 80~90%;
- Advanced design and outfitting to ensure no clogging of liquid & solid and smooth outlet of gas;
- Big processing ability that single maximum capacity can be 10,000 cubic meters.

3.6.4 Biogas Purification

Methods of Purification of Biogas Methane gas is the most useful and valuable gas produced for future applications. Although, there are impurities present in the biogas besides CO₂, these impurities can be removed by using methods such as:

- High Pressure Membrane Separation
- Gas Liquid Adsorption
- Adsorption by Iron Oxide
- Biological Filter

The biogas produced in the bio-digester is then passed through the purification unit which consists of three towers. Water, sulfur and moisture are removed from the biogas. The biogas produced in the digester contains 55-65 % Methane (CH₄), 35-45 % Carbon Dioxide (CO₂), 0.3-0.5 % Hydrogen Sulfide (H₂S), a good amount of moisture and loose water. The biogas is passed to the purification unit which consists of three towers fitted within a wheel mounted compact frame of stainless steel. At first, the raw biogas is fed in the first tower which is an impact type water separator to separate loose water from the biogas.



Figure 3.5: Biogas Purification Unit

Then the gas is fed to bottom of iron oxide tower wherein hydrogen sulfide reduction takes place and finally the gas is fed to a silica gel drying tower where the moisture is removed.

3.6.5 Bioelectricity Generation

Biogas can be converted directly into electricity by using a fuel cell. The conversion of biogas to electric power by a generator set is much more practical. In contrast to natural gas, biogas is characterized by a high knock resistance and hence can be used in combustion motors with high compression rates. The purified biogas is then passed to the engine-generator set with an air-fuel (biogas) ratio of 11:1 through biogas-air mixing device and electricity is thus generated.

3.6.6 Organic Fertilizer from Biogas

While there are suitable inorganic substitutes for the nutrient's nitrogen, potassium and phosphorous from organic fertilizer, there is no artificial substitute for other substances such as protein, cellulose, lignin, etc. They all contribute to increasing a soil's permeability and hygroscopicity while preventing erosion and improving agricultural conditions in general. Organic substances also constitute the basis for the development of the microorganisms responsible for converting soil nutrients into a form that can be readily incorporated by plants. Bio fertilizer is a locally produced alternative to mineral or chemical fertilizers. The farmers collect the manure on our facility to spread out on the fields again.

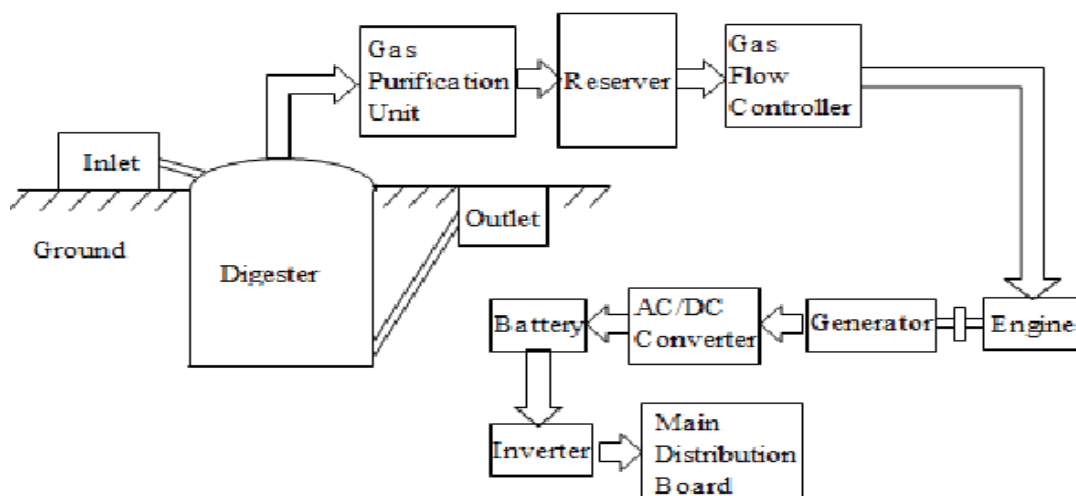


Figure 3.6: Bio-electricity & Solid Bio-slurry Generation Plant

3.7 Proposed CSTR Digester Technology and Process

3.7.1 CSTR Design

The main features of the complete mix or CSTR design include the tanks, mixers, covers and heating systems. Some CSTR designs use a single mix tank where all phases of treatment (hydrolysis, methanisation etc.) happen in a single tank. This tank would sometimes have a flexible membrane cover to store resulting biogas and would utilize mixers that mount on the side of the tank and penetrate into the tank generally with a propeller or mixing jets to mix the tank's contents. Some CSTR systems will split treatment into two tanks running in series. This style accomplishes hydrolysis and acidification in the first tank and the methanisation in the second tank. This style is commonly noted by a first stage with a fixed roof with a roof mounted, high torque, slow speed propeller style mixer mounted from the top. The second stage methanation tank will be noticeable by its domed shape flexible gas cover.

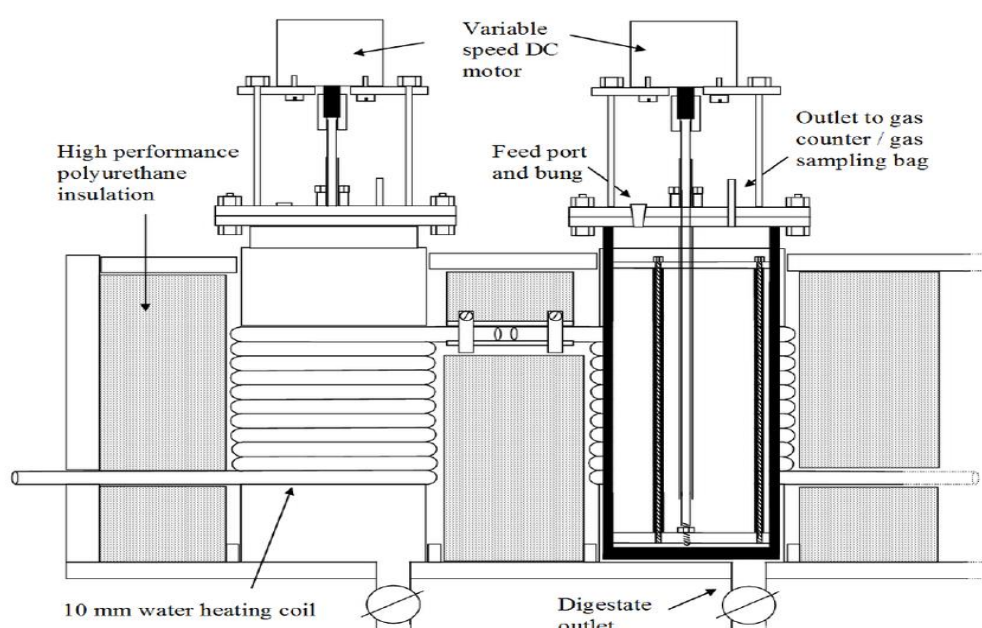


Figure 3.7: Schematic Model of a Typical CSTR Digester

3.7.2 Raw Material

All the dairy farms under the Project will follow automatic collection procedure to procure cow manure to be fed into the first inlet. The sheds will be connected to the mixing chamber through a sloppy drain. Water will be flown into the sheds so as to pass the manure through the drain into the mixing chamber. Cow dung is the only raw materials required for this project, which will be procured from the owned dairy farm adjacent to the plant.

Key Input of the Project

The main key input of the project is given below:

Cattle	1,000 nos.
Goats/Sheep	2,000 nos.
Usable manure	34,000 kg/day
Proposed size of biogas plant	1,800 m ³ /day (gas production capacity)
Electricity generation potential	3,600 kWh / day
Raw Organic Fertilizer	6,000 kg / day
Number of Generator	200 kW x 2 (in operation 9 hours a day)
Anaerobic reactors	One (01) units of 3600 m ³ capacity

3.7.3 CSTR Mixing System

There are three chief means of mixing a CSTR digester; by gas, mechanical or hydraulic mixing techniques. Gas mixing systems operate by compressing biogas and injecting it into the tank contents. Resulting rising gas bubbles dislodge the contents either in the bottom or top of the digester and keep them stirred.

There are two types of mechanical mixing systems, those with their moving parts in the basin and those with their moving parts outside the basin. The former commonly use either side mounted propeller style mixer and a hoist mechanism to facilitate easy motor maintenance or a roof mounted propeller. The latter will commonly employ mixing jets where tank contents are first pulled out of the basin by a motive pump and reintroduced at a high velocity back to the tank through a jet nozzle to keep contents stirred and agitated.

Properly designed mixing systems will commonly “spin” the tanks contents on a vertical axis. Common design consideration and operational issues to watch are the potential for grit accumulation on the tank bottom and the possible accumulation of a floating fat or scum layer on the top of the tank.

Well-designed mixing systems will be able to keep bottom solids agitated and top floating layers “folded in” to the mixed digester contents. It is common to design a CSTR where the mixing system is not operated continuously. Many mixer suppliers will have their systems operate for just 30-70% of the running time. The anaerobic treatment process continues despite the fact that the contents are not actively being stirred constantly.

Design Parameters:

Slurry output	72m³ per day
Fermentation Temperature	Mesophilic 35°-38° c.
Hydraulic Retention Time	25 days
Volumetric gas production rate	0.8-1.5 Nm³ / (m³.d)
Removal of organic biomass	85% - 90%
Estimated biogas yield	1800 Nm³ /day
Digestate production	approx.. 65.5 m³ /day

3.7.4 CSTR Tank Selection

CSTR systems have been installed using a variety of tank materials including both concrete and steel. Each style has proven to provide years of robust service. The most common CSTR configuration is a round tank. The roofs on CSTR tanks can either be fixed concrete, fixed steel, floating or a flexible membrane.

Steel tanks can be installed using either stainless steel or carbon steel. Internal coatings on the tanks include glass linings or painted epoxy coatings to prevent corrosion. Steel tanks incorporate panels that are either welded or bolted together.

Great care should be taken to be sure that aggressive tank contents do not harm tank internals. Corrosive conditions are common inside digesters especially in the gas/ water head space intersection. Grit laden digester contents can abrade digester tanks and equipment. Any sealant, gasket or fastener used in tank construction needs to be properly evaluated to ensure long service life.

Concrete tanks can be implemented by either poured-in-place methods or by use of precast and pre-stressed panels. The same methods can be used on concrete tank roofs. Precast panels require proper care be taken to join the panels in a way that ensures gas tightness. Both concrete

and steel tanks can be insulated for use colder climates from a wide variety of insulation types including spray-on or rigid insulation board.

Tanks are found that are both short and wide or taller and narrower in design. Either configuration can work well. For any given application there will be an optimum design that provides the best cost and the best functionality to maximize gas yield and minimize service and maintenance.

3.7.5 Digester Tank Covers

There are several styles of cover for a wet digester tank. Covers can be either fixed or floating. They can be made of a rigid material, like steel or concrete, or they can be made of a flexible material such as a canvas membrane. Flexible membrane covers generally have an inner cover that is able to flex as gas pressure changes and an outer membrane that is kept fully inflated by a small fan.

Tanks that have a rooftop mixer will require a rigid roof structure to support the mixer.

Digesters can also be implemented as earthen, lined lagoons. Lagoons have the benefit of being very inexpensive to install. They are more commonly applied in warmer climates as systems in colder climates require a more engineered approach to control temperature, mixing and gas collection. Lagoons are most commonly applied in animal manure projects or in wastewater treatment where waste volumes are large and land is plentiful.

3.7.6 Heating System

Digesters need to be kept at a steady, warm temperature for optimum gas yield and stable system operation. Ideally digester heat requirements can be met by capturing waste heat from other facility unit operations, such as a Combined Heat & Power (CHP) system. Sometimes, such as during start up, supplemental heat from a gas boiler is required to get a system up to operating temperature. Heat can be applied internally to the tank through a series of hot water pipes that are either embedded in concrete tank walls or supported on the inside tank walls.

Heat can also be applied externally to the tank from an external heat exchanger where contents from the tank are heated in either a shell-in-tube or plate heat exchanger using a heat transfer fluid, usually water, that pulls heat from the CHP process that has waste heat and moves heat to the tank contents.

3.7.7 Bottom Grit Removal (BGR) Systems

The ideal digester scenario is one that never needs to be taken out of service during their long, useful life. It is therefore important to be able to remove settled grit that can accumulate over time. Systems that employ a rotating scraper arm across the tank bottom, for one, can be used to force contents to the tank wall where they can be properly removed. Tanks can also be installed with sloped bottoms that force contents to the sidewall or tank middle for removal. The optimum pre-treatment system will keep as much grit as possible out of the tank ahead of time but there's no way to keep it all out so it is important to remove grit to keep 100% of the tank's usable digestion volume functioning. Unfortunately, applications where there are heavy loads of grit or inerts in the feedstock can require the tank be taken out of service every few years if the level of inerts are allowed to build up on the tank bottom.

3.7.8 Automatic Dung Scraper

Dung from 1000 cattle will be collected from 4 (four) cattle sheds with the help of automatic dung scraper. Manure from 2000 goats and sheep will be manually collected from the separate goat shed and carried to the first waste collection tank using small hand trolley. Water jets will be used

to clean the dung drains and the animal shed. Animal dung, urine and cleaning water will flow through a channel into the first waste collection tank.

3.7.9 Separation of straw, sand and other non-biodegradable debris

Water mixed animal excreta will be retained and allowed to rest for sometimes inside the first separation tank. The lighter debris like straw, hay, dry grass etc. will naturally float on to the surface and manually removed from the tank. Heavier sand and soil (collected from the hooves and skin of animals by free movement) will settle in a pit below inside the mixing tank by natural gravity. After certain intervals mixing tank pit will be cleaned and remove the settled limestone using manual labor.

3.7.10 Biogas Slurry Feeding Screw Pump

Thick and abrasive Biogas liquid flow rate more slowly than other types of liquid and also create a higher degree of resistance. Positive displacement pumps are often the preferred choice to move these liquids at a consistent speed, because of their efficiency in operating at lower speeds. These machines work mechanically, by expansion and contraction of the space in between elements of the pump. Because each motion displaces the same volume of liquid, this ensures an even rate of flow.

3.7.11 Mechanical Agitators/ Mixer

Mechanical agitators/mixers are specially designed to work in the aggressive/ harsh environment inside the Digester, with the propellers manufactured with the help of special tools that ensure millimeter angle accuracy blade after blade. Electric motor-driven mixers are designed for work in the explosion hazard environments.

All components, including the sealing membrane (Gastight) for drive Shaft, are UV-resistant. The propeller mixer is fitted from the outside. Propeller mixer is supported by two top links or optionally by rack-and-pinion jack and can be set stepless to any angle of inclination. Drive shaft, propeller and sealing plate are made of stainless steel.

Mechanical Agitators/Mixers are specially designed to optimize the biological process in Digester and after fermenters with almost constant substrate levels. One advantage of the design is that almost all of maintenance duties can be carried out from the outside, which means that opening the Digester or dismounting the unit is not necessary.

The drive side with the electric motor and transmission is accessible from the outside, only the shaft and propeller are within the fermenter and in an optimal position for thorough mixing.

3.7.12 Biogas Balloon/Biogas Holder

The bio gas generated in the reactor is primarily stored in the gas holder mounted on top of the reactor tank. Later, Bio gas will be transmitted through the transmission pipeline and will be primarily stored in the biogas storage bag.

Biogas Balloon / Biogas holder material (special PVC Coated) is high voltage and fire resistant, resistant to damage by sharpened steel even when red-hot. The Biogas holder is installed in a special ventilated shed. The Biogas holder is designed to collect and store Biogas under pressure 0.005-0.01 Bar. Biogas supply to the Gas holder is done by means of special branch pipes made of HDPE. Biogas holders are equipped with a safety valve in order to avoid overpressure.

3.7.13 Biogas Storage bag

Red mud- soft reinforced Material used by the fabric and the coating of two parts. Fabric mainly uses high-strength industrial polyester mesh folder and glass fiber materials; coating materials are mainly PVC and Teflon. Polyester cover membrane is used polyvinyl chloride (PVC) and polyethylene coated glass fiber PTFE (Teflon). For containing red mud ingredients, made into main characteristics of the material pull good elasticity, anti-aging, good folding properties. To increase its performance, can be coated on the surface of Teflon coating to improve its anti-aging and self-cleaning ability, its life can reach 15 years.

Specifications

Thickness	12 mm
Substrate	1000D x 20 x 20
Weight (+/- 3%)	1775 gm
Tensile Strength (kgf/3cm)	3120 x 2800
Tar Strength (kgf)	200/250
Pressure capacity	105 KPA
Puncture Resistance	950 (N)
Flame Resistance	M1
Temp Resistance	-30° ~ 70° C



Figure 3.8: Red Mud Biogas Storage Bag

3.7.14 Horizontal Solid Liquid Separator

The Horizontal Separator is utilized for separation of digested processed biomass into solid and liquid parts included into the basic equipment of the Biogas plant. Separator parts are made of corrosion- and abrasion-resistant steel. The digestate is either gravity fed or is fed to the loading chamber by means of pumps through a supply branch pipe. From the loading chamber Digestate is fed to the separator by the use of a varied pitch auger made of abrasion-resistant steel. Fluid and strong divisions are isolated by methods for weight and filtration in the separator. Liquid and solid fractions are separated by means of pressure and filtration in the separator. Liquid fraction is poured out through an emptying fixture secured to the accumulator tank. Solid fraction with the help of an unloaded leaves the separator and is accumulated in a bin.

3.7.15 Heating System

Digesters need to be kept at a steady, warm temperature for optimum gas yield and stable system operation. Ideally Digester heat requirements can be met by capturing waste heat from other facility unit operations, such as a Combined Heat & Power (CHP) system. Therefore, desired fixed temperature range is constantly maintained inside the Biogas Digester in order to achieve optimal bacterial action.

The temperature inside of the biogas reactor is mesophilic, which is about 37°C. Reactor heating is done using the heating system. Inlet temperature of heating water is 80°C and the outlet temperature is 55°C. The heating system is a network of pipes placed inside the digester chamber or on the inner wall surface. If the biogas plant is equipped with a co-generator the hot heating medium is supplied from the cooling system of the engine. Boilers fueled by biogas, natural gas or their mixture can be also used as heat power source for the biogas plant.

Sometimes, such as during start up, supplemental heat from a gas boiler is required to get a system up to operating temperature. Heat can be applied internally to the tank through a series of hot water pipes that are either embedded in concrete tank walls or supported on the inside tank walls.

3.7.16 Biogas Desulphurization Technology

Biogas from the storage bag will be transmitted to the generator through the desulphurization /biogas purification system when needed. Desulphurization system will remove H₂S and water from the gas and will make adjustment in the gas pressure before feeding into generator.

Biological removal of hydrogen sulfide from Biogas or Biological Scrubber utilizing conventional biological H₂S removal system has been a demonstrated strategy for many years to remove high to very high H₂S (hydrogen sulphide) content from Biogas, sewage gas, natural gas and landfill gas. The issue of many biological desulphurization plants is the blockage of the filling material which must be removed and renewed. The proposed Biogas Desulphurization Technology fundamentally different from competitive systems, therefore, blockage is technically nearly impossible.

3.7.17 Biogas to Electric Power Generation

Biogas is used to generate electrical power as well as heat can be produced with the help of simple conventional gas fueled generator. The proportions of heat and power generated depend of course on the design of the plant but generally the chemical bond energy present in Biogas can be converted into 35 percent electricity and rest of 65 percent into heat.

The disposal and treatment of biological & natural waste are significant difficulties for many industries. Anaerobic fermentation-a better option to composting—provides a unique solution for the management of a wide range of organic substances. Created during anaerobic Digestion, biogas serves as a more energy, renewable fuel that can be used as a substitute for fossil fuels. Biogas engine not only improve waste management, but also generate an economical energy supply.

With a combined heat and power (CHP) system, electricity and thermal energy are efficiently produced onsite for captive utilization. The system is further enhanced by avoiding the electricity losses that occur in the transport, transmission and distribution processes from the point of power generation to your facility. CHP produces electrical and add up to (electrical + warm) efficiencies. Thermal energy is released in the combustion process and can be utilized for preheating or producing steam, as well as a variety of process heating or cooling systems. Also, surplus power can be sent out to the power grid, regularly giving extra income. The outcome is a system that

can provide significant efficiency, profitability and environmental advantages over separately creating heat and power for your facility.

After clean biogas is achieved the power generation will be done simply by connecting a dedicated biogas-based generator. In this project the generator unit will be procured from CAMDA Generator Work Co. Ltd.

CAMDA Generator Work Co. Limited is primarily a manufacturer of diesel, gas and heavy fuel generator sets and was registered in Dong Guan City, Guangdong Province, China in 1998. CAMDA has 12 share-holding companies, including Woomi Power (China & Korean), Asia Energy-saving, SUGIYAMA (China & Japan) etc. Their products and services cover power supply, environmental protection, purifying and energy saving equipment.



Figure 3.9: CAMDA Gas Generator

3.7.18 Effluent Treatment Plant (ETP)

Effluent Treatment Plant (ETP) is most cost Effective & technically proven system to remove the unwanted, hazardous chemicals from the wastewater to meets the statutory pollution control requirements. Water from the separator unit will flow into the ETP. 70% treated water will be reused in the second Mixing tank and the remaining 30% will be safely released in the environment.

Liquid dung and washing water from cattle house enter into the bio gas digester, bio slurry and residue mixture discharge from the bio gas digester, and get into collection basin. Separator machine will pump liquid part into the FABR Basin for treatment and filtering of sedimentation, the liquid supernatant will get into 4WR pool to remove COD, BOD, and SS, then enter into the DT reaction pool again to remove Nitrogen and Potassium, residual COD, BOD, and SS. The effluent enters into decolorizing settling tank for further decolorization and sedimentation. The effluent from the decolorizing settling tank flow into HSFV for further removal of Nitrogen and Potassium. The effluent will automatically flow into disinfectant tank for disinfection and then enter into fresh water tank. Disinfected water is partially (30%) discharged safely into the natural stream of water (in nearby pond, lake or river) and a part (70%) is entered into the water supply system for dilution and reuse of fresh faces. a process flow diagram of the sewage treatment station is given below;

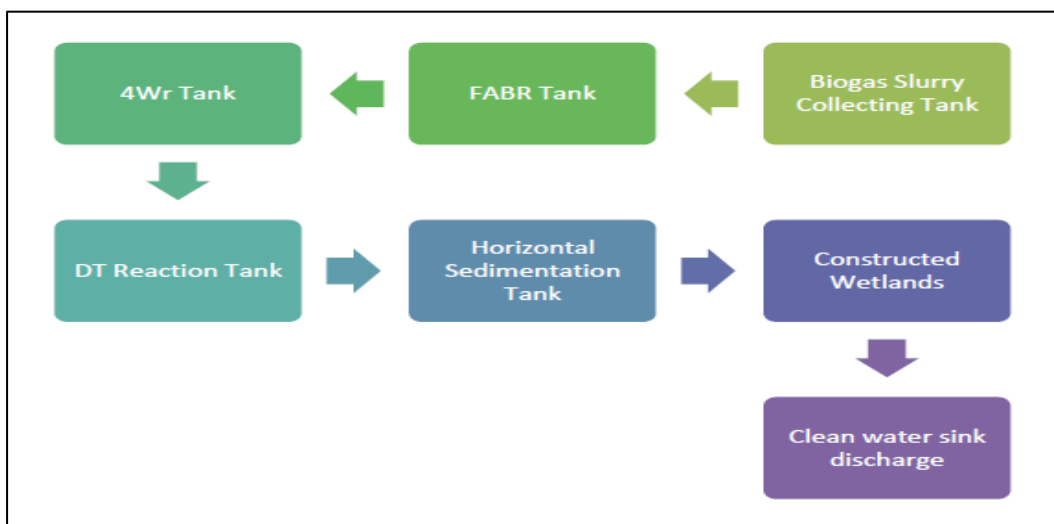


Figure 3.10: Process Flow Diagram: Sewage Treatment Station

3.7.19 Activities under the Project

Activities to be carried out under the project are pretty straight forward and can be divided into 10 main activity phases. A schematic diagram is given below and also a process flow diagram of the sewage treatment station is given below;

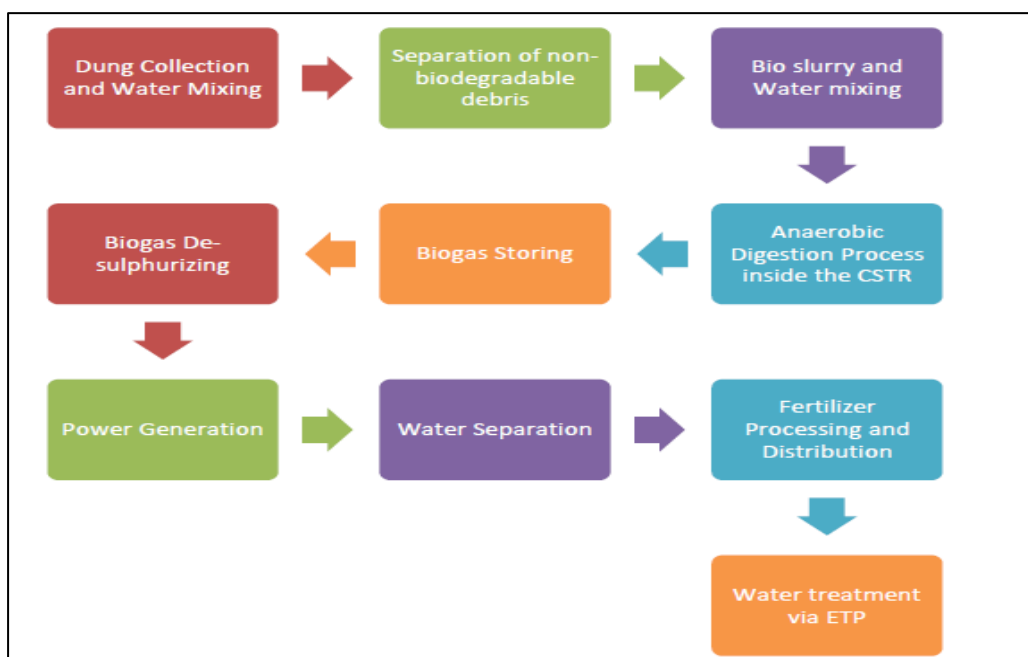


Figure 3.11: Activities under the project

3.7.20 Energy Consumption

Electricity

The project has total installed load of 255 kW which includes four (4) mechanical agitator motors, delivery pump, feed pump, reflux pump, hot water pump, air blower and gasholder.

Water

Considering 1:1 dung to water ratio the plant will require approximately 34 of water per day. The project proposes to obtain 70% (approx. 24 tons) this water from its own ETP operation cycle (from ETP) and the remaining 30% (approx. 10 tons) from deep tube-well at the project site.

3.7.21 Product, Capacity, Project Cost

The Product The project is going to produce electricity as main product and raw organic fertilizer as by product. Following are the products which will be produced in the project –



Figure 3.12: Product of the Proposed Project

General Production Capacity

Product	Production peryear	days in production per year
Electricity	12,60,000.00KwH	350 days
Organic Fertilizer	21,00,000Kgs	350 days

It has been assumed that the factory will produce the products as per following schedule –

Product Mix	
Electricity per Day	3600 KwH
Electricity per Year	1,260,000.00 KwH
Raw Organic Fertilizer per Day	6000 Kg
Raw Organic Fertilizer per Year	2,100,000.00Kg

Following are the parameters and assumptions which are the basis of calculations of the project-

Head	Parameter	Unit
Number of Cattle	1,000	nos
Number of Goat and Sheep	2,000	nos
Dung per Cattle per day	30.00	kg
Dung per Sheep per day	3.00	kg
Total Available Dung	36,000.00	kg
Dung Fluctuation Consideration	2,000.00	
Total Workable Dung per day	34,000.00	
Biogas Production Factor	1.8696	cft/kg dung
Total Biogas production Potential per day	63566.40	cft
Total Biogas production Potential per day	18,00.00	m ³
Generator Biogas (Fuel) Consumption	0.51	m ³ /kw generation
Total Electricity Generation Potential per day	3,600	kwh
Generator standby capacity considered	200.00	kw
Gross Total Running hours per day	9.00	hrs
Number of standby generators	1.00	units
Relative Running Hrs of 2 Generators	18.00	hrs
Raw Bio-Fertilizer per day	6,000.00	kg
Electricity Unit Understood in	KW	
Raw Fertilizer	KG	
Currency	Taka	
Workday per month	30.00	days
Workday per year	350.00	days
# of Days Electricity Production / Yr	350.00	days
# of Days Raw Fertilizer Production / Yr	350.00	days
Total Capacity of Electricity / Day	3,600	KwH
Total Capacity of Electricity / Year	1,260,000.00	KwH
Total Capacity of Raw Fertilizer / Day	6,000	Kg
Total Capacity of Raw Fertilizer / Year	2,100,000.00	Kg

3.8 Safety Considerations

In accordance with the requirement of DoE, proposed project must have a plan to take adequate measures against accidents and to meet the emergency. Construction workers may be affected adversely due to hazardous working environments where high noise, dust, unsafe movement of machinery etc. may be present. Prior to the blasting the elementary precautions shall be undertaken. Also, safety equipment, such as helmets, masks, ear muffs, safety gloves and boots shall be used. All vehicles should observe speed limits and load restriction. Safety at the many work sites with the provision of signs and notices, warning flags, safety barriers and fences, shoring of excavations and general safe working practices is also an area that requires continual attention with regular maintenance. The Contractor instructed his workers in health and safety matters, and requires the workers to use the provided safety equipment. Arranging for provision of first aid facilities, emergency transport to near accident and transport to hospital and emergency facilities. Operation and Maintenance Arrangements

As a general rule, maintenance of agitation, pumping and flushing equipment should always be performed above ground level. If this is not possible, a forced ventilation system must be permanently installed in order to counteract the risk of asphyxiation and poisoning in the event of an escape of gas. The operation of the plant includes proper feeding of dungs in the plants, the daily cleaning of stones of pit and proper switching of main valve of digester. To strive and

perform optimal, “life support systems” must work at all times, and “living conditions” shall be kept stable and in harmony with process requirements. General good practice of Operation and maintenance procedures can be defined, but also a “feeling” for the individual plants requirements is needed by the O&M staffs. The maintenance of the generator includes cleaning and refilling of the silica gel tower after every six months, changing of engine oil after every 250 hours and changing of spark plug after every 500 hours. If the plants are operated properly, then there is no significant maintenance required for the biogas plants. According to information supplied by the manufacturers, the equipment is of low-maintenance design. It should be possible to carry out maintenance during the breaks in feeding.

4 ANALYSIS OF ALTERNATIVES

4.1 General

An ESIA report portrays a scope of sensible options in contrast to the proposed venture or to the area of the proposed venture site that could possibly keep away from or diminish any huge ecological effects of the proposed venture while accomplishing the greater part of the undertaking's essential targets. An ESIA likewise should look at and assess the ecological impacts and relative benefits of the other options. This section portrays options considered however disposed of from further thought (counting the purposes behind end) and looks at the ecological effects of a few options held with those of the proposed venture.

The alternative consists of the proponent's final proposal with the inclusion of the DOE guidelines and regulations and procedures. This is as stipulated in the Environment Conservation Rule (ECR) of 1997, which aims at reducing environmental impacts to minimum extent practicable.

The proposed project has the potential to have significant adverse effects on visual amenity; air quality; noise; biological resources; cultural resources; geology/soils; GHG emission; hazards and hazardous materials; hydrology and water quality; land use and planning; noise; public services; transportation and traffic; and utilities and service systems within the County. Even with the mitigation, measures described in Chapter 6 of this ESIA impacts in some of these issue areas would be significant and unavoidable.

4.2 Project Objectives

The following objectives have been established for the proposed project and will aid decision makers in the review of the project and associated environmental impacts:

The objectives for the proposed project are to:

- Cow manure will be used as feed material in the biogas digesters for production of biogas which after purification will be used to run biogas generator.
- The slurry produced as byproduct from the biogas digesters will be filtered to separate solid content of the slurry.
- 3,600KwH/day bio electricity generation from biogas
- Retained solids will be sold out as raw material for 6,000Kg organic fertilizer.
- Make positive impact on the livelihood of the local people.
- Improve the socio-economic status of the area.

4.3 Technology Alternatives

The site wherein biogas plant is built up is fundamentally possessed by Dutch Dairy Limited. The treatment innovation and treatment plot for this undertaking has been concluded based on detail information assortment on quality and amount of the dairy animals' fertilizer delivered by the farm. The site in which biogas plant is established is owned by Dutch Dairy Limited.

Heaters have to be cleaned regularly in order to ensure that heat transfer remains effective, because running a gas-fired boiler is an inexpensive and efficient method to use biogas. The deterrent will discover utilizes for the warmth, particularly in the summer. Assimilation (heat-initiated) cooling frameworks are a promising innovation for utilizing abundance heat, however right now have a high beginning expense. Another option is to remove carbon dioxide and hydrogen sulfide from the biogas and sell it as natural gas. The deterrent will discover utilizes for the warmth, particularly in the late spring. Assimilation (heat-initiated) cooling frameworks are a promising innovation for utilizing abundance heat, however right now have a high beginning expense. Scrubbing the gas, finding a market, providing the buyer with a dependable supply of gas, and maintaining the distribution equipment require money, time, maintenance, and

management. Although other options are available for biogas utilization; electricity is the most versatile and valuable energy product from biogas.

4.4 Site Alternatives

Currently the proposed project will be within an existing and relocation option to a different site is an option available for the project implementation. There are no houses and other structures as well as utilities are located within the project boundary. The dairy farm is located in rural areas and there are many residential & other houses. So, all the sites are suitable in social consideration as per Social Study. At the moment, there are no alternative sites for the proposed development. This implies the defender needs to search for the land if movement is proposed and land isn't accessible and if accessible it will be unreasonably costly for the advocate to understand his dream.

Looking for the land to accommodate the scale and size of the project and completing official transaction on it may take a long period. In addition, it is not a guarantee that such land would be available. It's also worth noting that the said project is already underway in terms of seeking development approvals in various government departments.

No trees are affected around the project. Some trees need to be planted around the project Corridor which will act as green fence. No cultural sites and water bodies are located in the project sites. Considering the environmental point of view, these sites are suitable for further construction or renovation of existing buildings. Assuming the project will be given a positive response (after relocation) by the relevant authorities including DOE, it (project) would have been delayed for a long period before implementation. This would also lead to a situation like No Action Alternative. In consideration of the above concerns and assessment of the current proposed site, relocation is not a viable option.

4.5 The No Action Alternative

The No Action Alternative in respect to the proposed project implies that the status quo is maintained. This option is most suitable alternative from an extreme environmental perspective as it ensures non-interference with the existing conditions. However, the project activities have already been started. This option will however, involve several losses both to the project proponent and the donor organization. The property will remain under-utilized. The No Project Option is the least preferred from the socio-economic and partly environmental since if the project is not done.

- The economic benefits especially during construction i.e. provision of jobs for skilled and non-skilled workers will not be realized.
- There will be no generation of income by the developer to the Government.
- The local skills would remain under-utilized so that No employment opportunities will be created who will work in the project area.

From the analysis above, it becomes apparent that the No Project Alternative is not the appropriate alternative to the company, Bangladeshi, and the Government of Bangladesh.

5 BASELINE ENVIRONMENTAL CONDITION

5.1 General

Development of a detailed and comprehensive description of the existing environment is a critical step in impact assessment. The description of the existing environment provides the baseline case for the environmental, social and economic aspects that could be influenced by the Project. Without a reliable and detailed baseline, any determination of impacts becomes difficult or unjustifiable.

The following section describes the baseline environment into three broad categories:

- Physical Environment: factors such geology, climate, topography and hydrology;
- Biological Environment: factors related to life such as flora, fauna and ecosystem;

5.2 Project Influence Area

The Area of Influence (AOI) of the Project comprises of the Project Site and the surrounding area, where influence of the Project activities is anticipated. According to DoE, the AOI shall be acknowledged as 1km, 5km and 10km. The areas likely to be affected by the Project and its associated activities may include:

- impacts from unplanned but predictable developments caused by the project that may occur later or at a related location such as increase in traffic on the approach road;
- impacts on biodiversity or on ecosystem services upon which affected communities' livelihoods are dependent;
- associated facilities, that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable;

In this study, considering all the above-mentioned criteria, 1Km buffer areas were selected as the AOI, in which, all the baseline information was collected and described in the following sections.

Overview and Environmental Setting

An overview of the Project area is provided in Map. These maps show geo-referenced photographs of features and landforms nearby the Project site and provide a general description of the existing environments in the Project area.



Figure 5.1: Satellite View of the project area

The distinct physical and geological features of the Upazila is the key to the ecological assessment done in this report. The main features of the Upazila is outlined below:

Lohajang Thana was formed in 1916 and it was turned into an Upazila in 1983. It is one of the oldest small business hubs in the area. It became an Upazila at 1983. The Upazila consists of 10 union parishads, 115 mouzas and 110 villages. Annual average temperature is between 28.5 °C (83.3 °F) and 13.5 °C (56 °F), with an annual rainfall of 2,687 millimeters (106 in). (*Banglapedia, 2015*).

It is one of the fastest growing basic industrial area of Bangladesh. Lohajang has a total area of 131.10 km². It is bounded by Sreenagar and Serajdikhan upazilas on the north, Zanjira upazila on the south, tongibari upazila on the east and Shibchar upazila on the west. The main river is Padma.

An overview of the Project area is provided in following Map (Figure 5.1). These maps show geo-referenced photographs of features and landforms nearby the Project site and provide a general description of the existing environments in the Project area.

Table 5.1 Detailed Description of Environmental Setting

Particulars	Detail Description
Location	Shatgharia, Halodia, Lohajang Upazilla, Munshiganj
Nearby villages	Kanaksar Village
Site elevation	Undulating, elevation variation of 3-8 m amsl
Nearest Airport	Dhaka / Hazrat Shahjalal International Airport (DAC) (55.2 km)
Nearest Railway Station	Dhaka Railway Station
Climatic conditions	Average Temperature is 28.5 °C 83.3 °F Average wind speed 6.3 miles per hour

5.3 Physical Environment

Physical environment denotes the physical features that occur naturally (air, water, soil, atmosphere, etc.). In order to depict the existing physical environment in the project area, a few

of the major parameters are considered like geology & soil, ambient air, noise, surface & ground water, etc.

5.3.1 Climate

Although less than half of Bangladesh lies within the tropics, the presence of the Himalaya mountain range has created a tropical macroclimate across most of the east Bengal land mass. Bangladesh can be divided into seven climatic zones (Rashid 1991). According to the classification, the project area is located in the South-central region climatic zone (Figure 5.2).

- **South-central zone:** In this zone rainfall is abundant, being above 1,900 mm. The range of temperature is, as can be expected, much less than to the west, but somewhat more than in South-eastern zone (maximum 32°C and minimum 13°C). This is a transitory zone between the South-eastern, North-western and South-western zones and most of the severe hail storms, north-western and tornadoes are recorded in this area.

Like other parts of the country, the project area is heavily influenced by the Asiatic monsoon and it has these three distinct seasons:

- Pre-monsoon hot season (from March to May),
- Rainy monsoon season (from June to October), and
- Cool dry winter season (from November to February)

The pre-monsoon hot season is characterized by high temperatures and thunderstorms. April is the hottest month in the country with mean temperatures ranging from 27°C in the east and south, to 31°C in the west-central part of the country. After April, increasing cloud-cover reduces the temperature. Wind direction is variable during this season, especially during the early part. Rainfall, mostly caused by thunderstorms, at this time can account for 10 to 25 percent of the annual total.

The rainy monsoon season is characterized by southerly or south-westerly winds, very high humidity, heavy rainfall and long periods of consecutive days of rainfall. The monsoon rain is caused by a tropical depression that enters the country from the Bay of Bengal. About 80% of the annual precipitation occurs during the five-month monsoon season from May to September.

The cool dry season is characterized by low temperatures, cool air blowing from the west or northwest, clear skies and meager rainfall. The average temperature in January varies from 17°C in the northwest and north-eastern parts of the country to 20°C to 21°C in the coastal areas. Minimum temperatures in the extreme northwest in late December and early January reach between 3°C to 4°C. There is no meteorological station available in Munshiganj district, for that reason we can use Dhaka BMD station data as a climatic data for this proposed project because project district is within Dhaka division and BMD station is approximately 41 km distance from the project location.

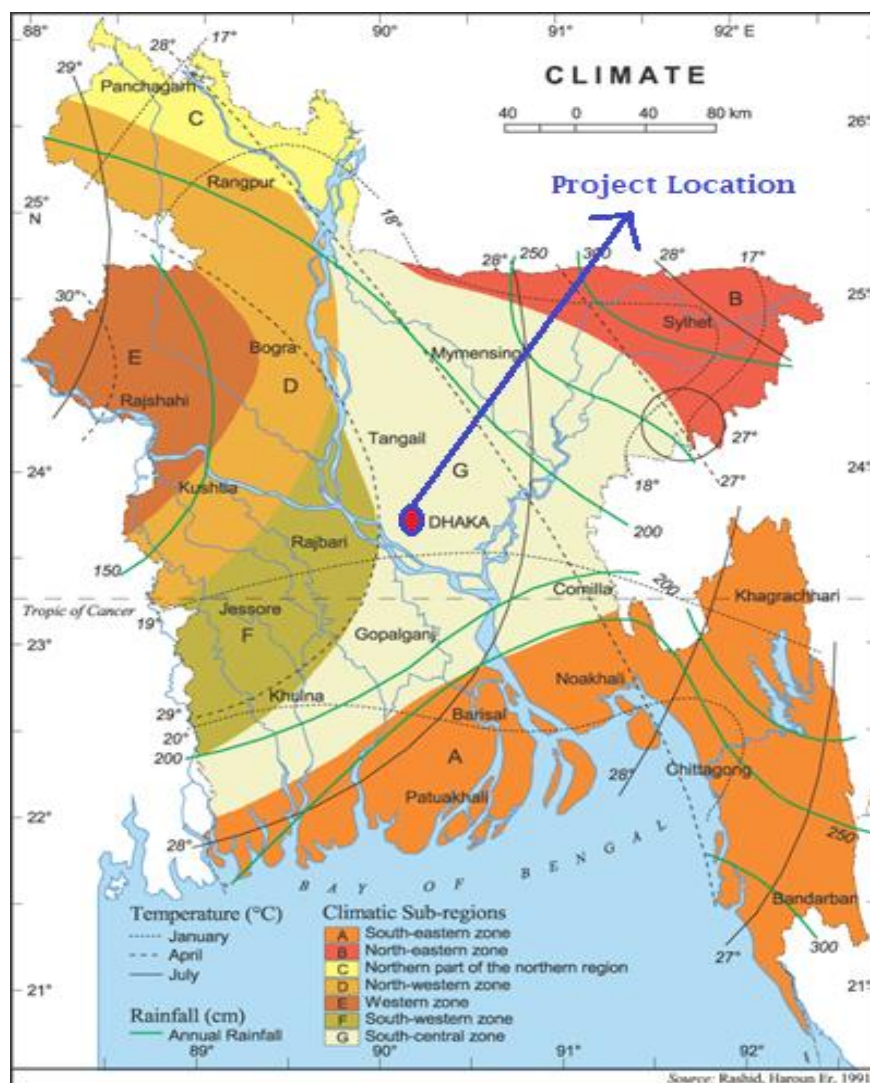


Figure 5.2: Climatic sub-regions of Bangladesh

Temperature: Long-term average monthly temperature data (1991-2017) collected at Dhaka weather station of Bangladesh Meteorological Department. The highest average recorded temperature in this weather station was 28.30°C in June. The lowest average recorded temperature was found in the month of January which was 18.2°C. The average monthly temperature graph (Figure 5.3) shows that this area faces high temperature from March to June and lowest temperature during winter remains from December to February in the year.

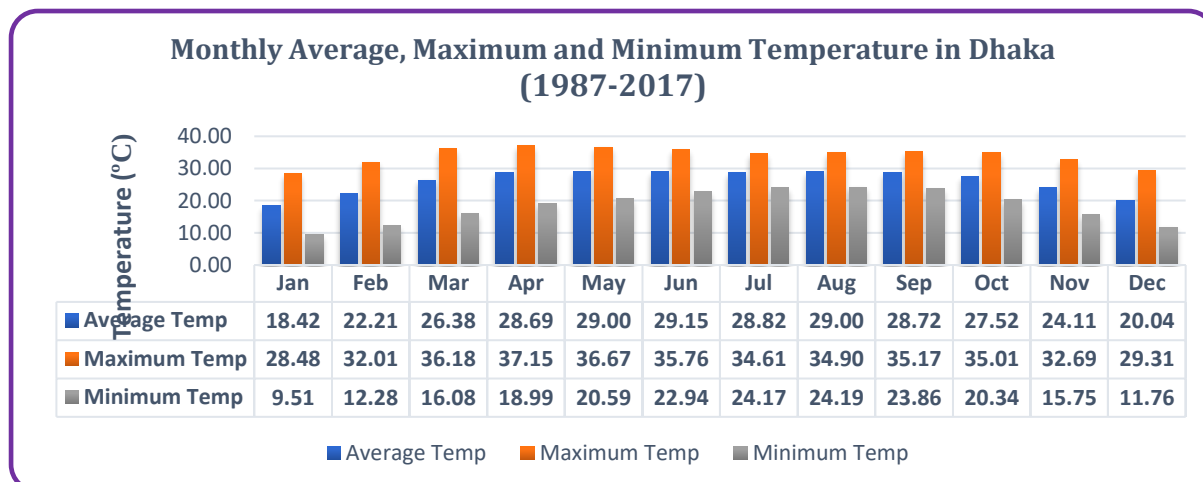


Figure 5.3: Average, Monthly Maximum and Minimum Temperature of Dhaka Weather Station

Rainfall: In Dhaka City rainfall is not abundant, being above 1890 mm. The range of temperature is, as can be expected, much less than to the west, but somewhat more than in South-western zone. This is a transitory zone between the, North-eastern, South-western and western zones. The rainfall data collected from the above stated station represents that maximum rainfall occurs during June to September and the lowest rainfall occurs in November to February during winter season. Statistical data of 1987 to 2017 shows that Dhaka experience more than 300 mm rainfall during monsoon. In the month of December and January of winter season around 10 mm rainfall occurred in the region of Dhaka weather station.

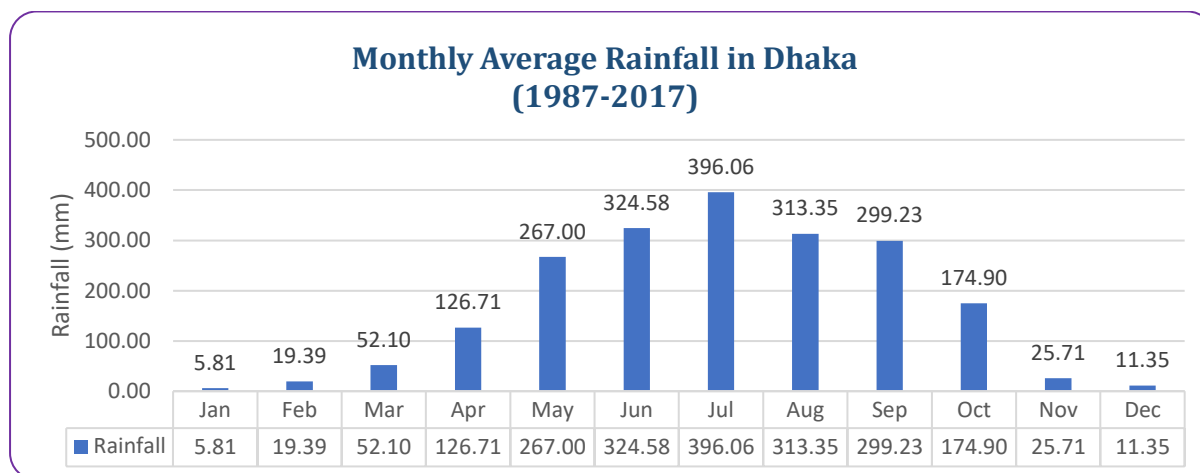


Figure 5.4: Average Monthly Rainfall of Dhaka Weather Station

Humidity: Humidity remains high in summer and comparatively low in winter season. The statistical data of humidity from 1987 to 2017 indicates that humidity in the Dhaka Station area maximized in June to September in the year which is ranges from 80% to 82%. On the other hand, humidity falls around 60% in February, March and April during the winter season in the considered station area (Figure 5.5).

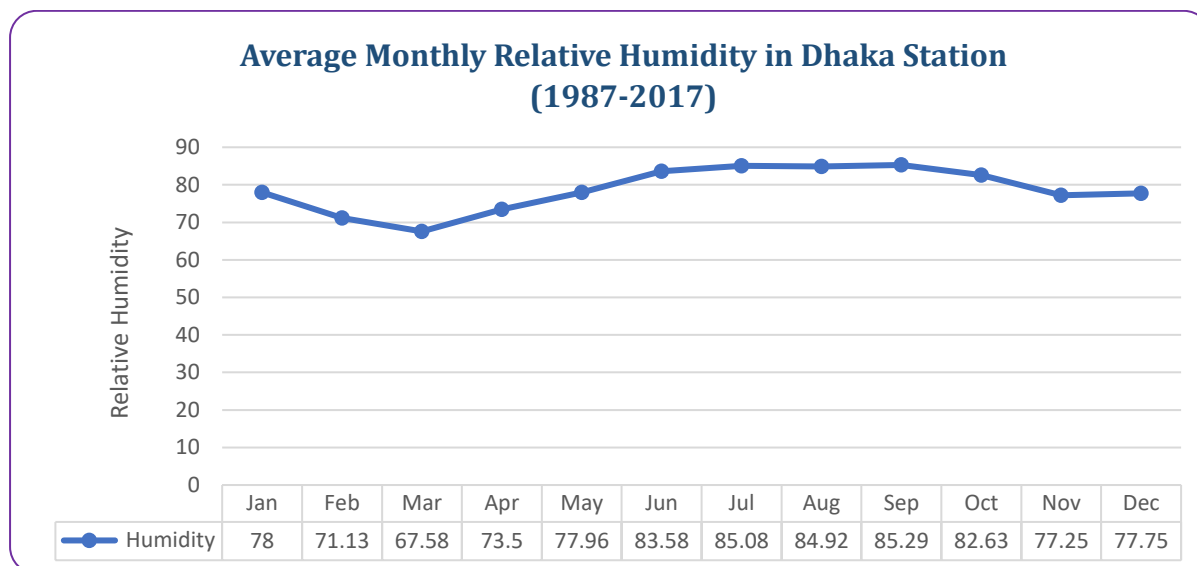


Figure 5.5: Average Monthly Relative Humidity of Dhaka Weather Station

Wind Speed & Wind Direction: The statistical wind speed data (Figure 5.6) shows that average wind speed maximum value was 3.28 knots in April. The minimum wind speed value was 2.01 knots in the month of December in the area of Dhaka station. In the project areas the predominant wind flows from the northwest but with a high frequency of calm situations.

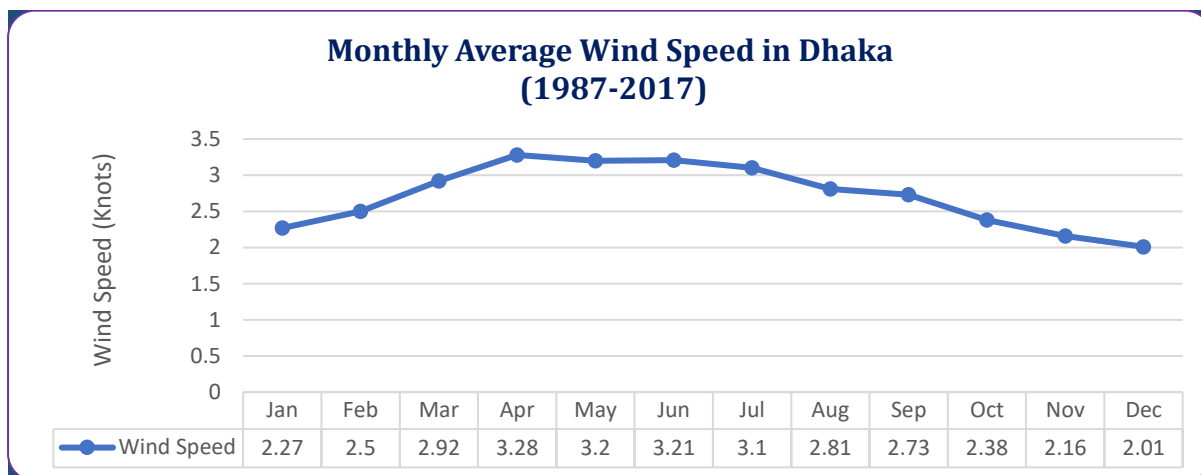


Figure 5.6: Average Monthly Wind Speed of Dhaka

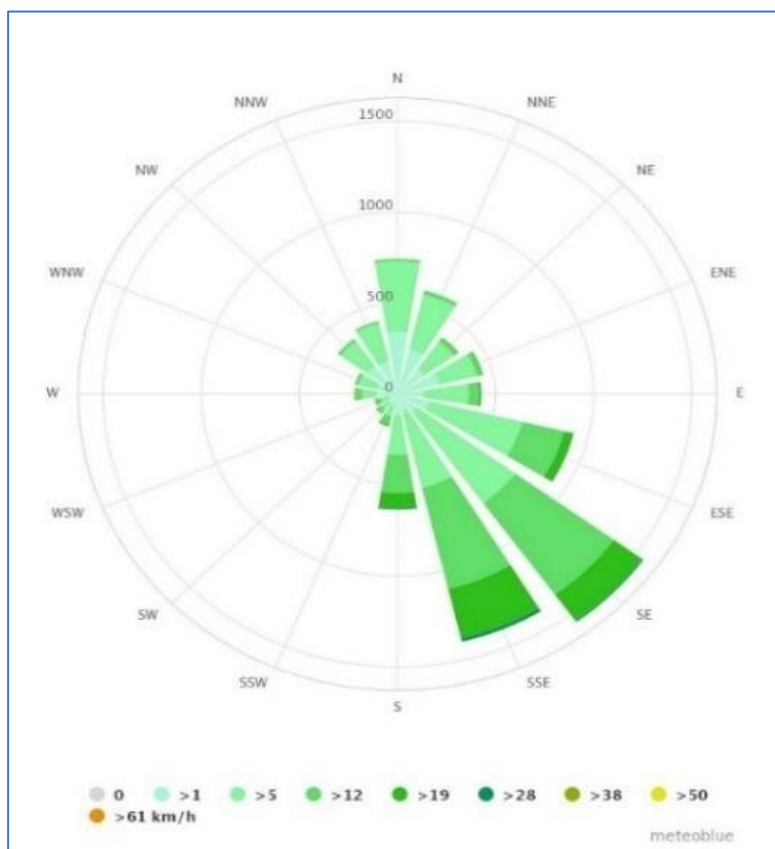


Figure 5.7: Wind Direction of Dhaka

Sunshine: The statistical sunshine data from 1987 to 2017 (Figure 5.8) shows that average sunshine remained maximum with 7.91 hours in the month of March. The minimum sunshine was 4.23 hours in the month of July in the area of Dhaka weather station.

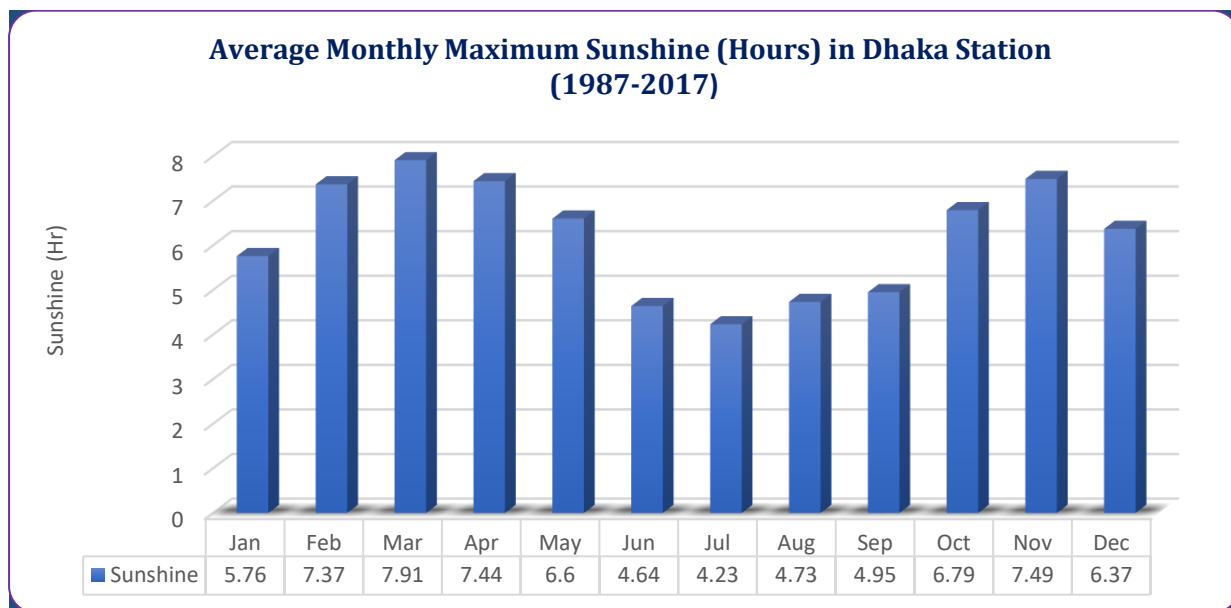


Figure 5.8: Average Monthly Sunshine of Dhaka Weather Station

Cloud Coverage: The statistical cloud coverage data from 1987 to 2017 (Figure 5.9) shows that average cloud coverage remained maximum from 5.33 octas to 6.13 octas during June to September. The minimum cloud coverage was 1.11 octas in the month of December in the area of Dhaka weather station.

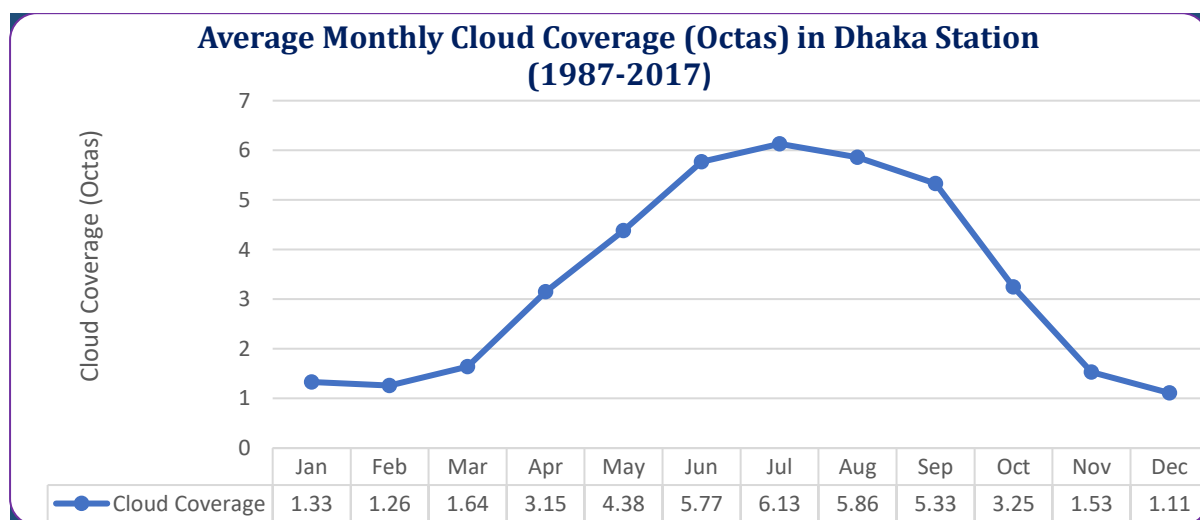


Figure 5.9: Average Monthly Cloud Coverage of Dhaka Weather Station

5.3.2 Topography

Topography is the configuration of a land surface including its relief and contours, the distribution of mountains and valleys, the patterns of rivers, and all other features, natural and artificial, that produce the landscape. Although Bangladesh is a small country, it has considerable topographic diversity. It has three distinctive features: (i) a broad alluvial plain subject to frequent flooding, (ii) a slightly elevated relatively older plain, and (iii) a small hill region drained by flashy rivers.

The general topography of the project area is relatively flat. The topography of the specific project location is 8 m a.m.s.l Topographically the cluster of the project location is almost flat, with many depressions, natural water bodies, bounded by the Major Padma Rivers.

5.3.3 Ambient Air Quality

Ambient air quality refers to the background air quality levels in a region, characterized by concentrations of various pollutants in the atmosphere. The presence of air pollutants and their concentrations depends on the type of polluting sources, and other factors that influence their flow and dispersion. In most cases vehicular emissions are the predominant source of air pollution.

Based on the physical observation during field visit it can be said the ambient air quality in the project area is comparatively good except some anthropogenic sources of dust flow and pollutants from the farm vehicles. The proposed project area is located beside the local road hence emission from the vehicles and dust flow on the road are main sources of air pollution. There are no other anthropogenic sources (e.g. industry, brickfield etc.) for air pollution in the area of 1 km buffer zone.

Ambient air quality testing was carried out to establish the baseline ambient air quality condition in the study area and to compare the data during project construction activities to check if there is any high air pollution level and to design adequate mitigation measures, as applicable. Dispersal of pollutants depends upon factors like prevailing wind direction and other weather conditions, atmospheric stability, height of the source. The air quality testing was performed at two locations around the project location on 18 May 2020 (Figure 5.10). All the locations of sample collection are showed in a map (Figure 5.11). Results of the air quality monitored at the project location have been showed in Table 5.2.



Figure 5.10: Ambient Air Quality Monitoring in Project Location

Table 5.2: Ambient Air Quality Test Result

Parameter	Unit	DDL_AAQ_01	DDL_AAQ_02	Bangladesh Standard	Weather Condition	Method of Analysis
		Beside Biogas Plant Area	Beside Water Reserve Tank Area			
		23.47803° N 90.29655° E	23.47982° N 90.29455° E			
SPM	µg/m ³	101	98.3	200	Sunny	Gravimetric
PM _{2.5}	µg/m ³	27.5	22.6	65		Gravimetric
PM ₁₀	µg/m ³	75.5	48.5	150		Gravimetric
SO ₂	µg/m ³	12.2	9.5	365		West- Geake
NO _x	µg/m ³	24.8	30.0	100		Jacob and Hochheiser
CO*	ppm	0.2	0.2	9		CO Meter

Note: * CO concentrations and standards are 8-hourly only.

DSCL Laboratory, June 2020**

The Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19 July 2005 vide S.R.O. No. 220-Law/2005. NYS: Not Yet Standardized

The measurement results showed achievement of all air quality standards. Based on the ambient air quality standard of DoE, air quality in the project site can be stated as in good condition. Particulate matter PM_{2.5} value was 49.75 and PM₁₀ value was 100.2 for DDL_AAQ_01. Also, for DDL_AAQ_02 PM_{2.5} value was 40.2 and PM₁₀ value was 87.6 which are far below the DoE standard.

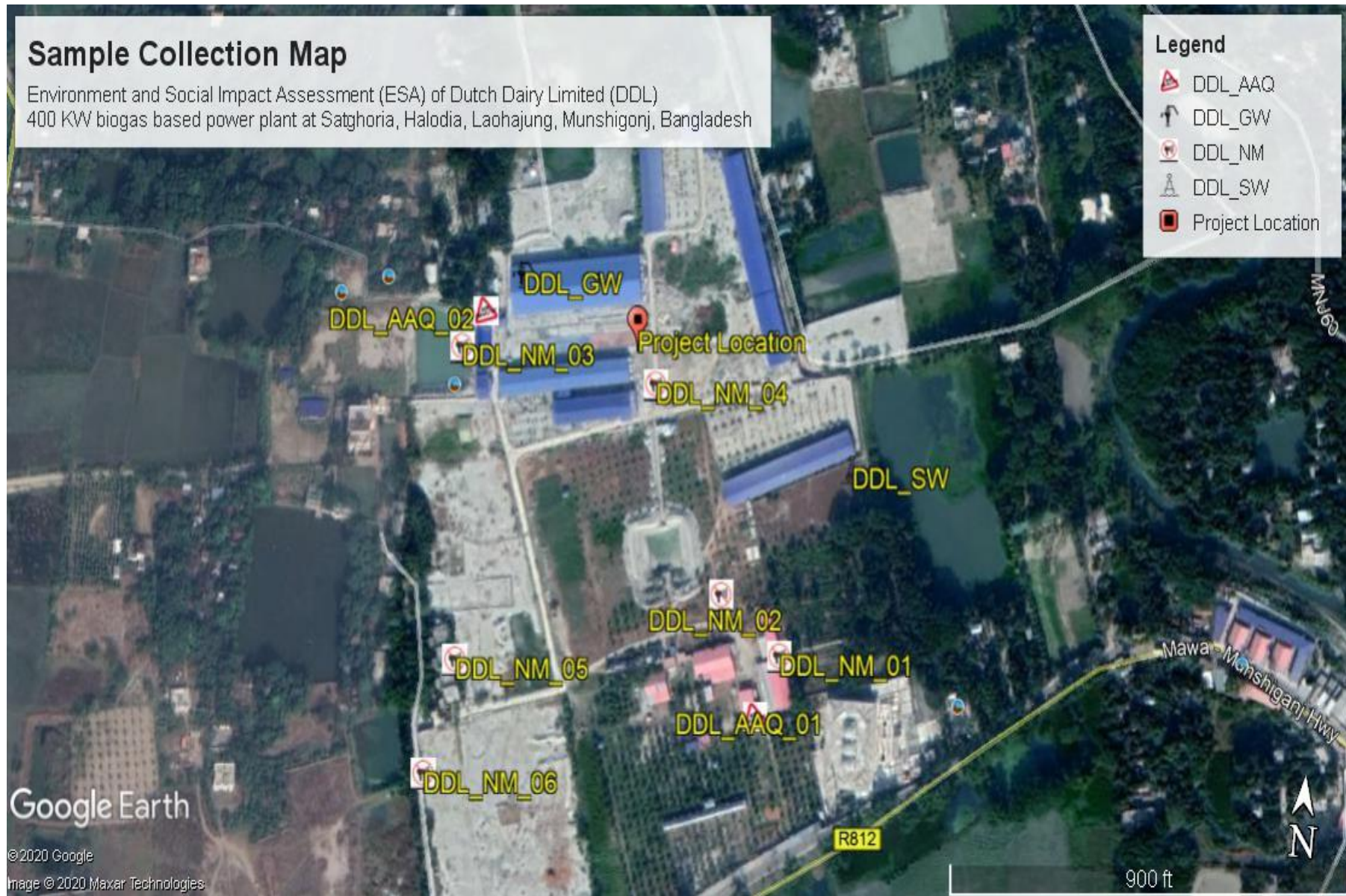


Figure 5.11: Locations of Sample Collection

5.3.4 Noise Level

Excessive noise is a potential issue for both human and biological receivers and can potentially cause a range of negative issues, from mild annoyance and moderately elevated levels of aggression to significant disturbance of behavioral patterns and in severe cases temporary or permanent hearing loss. According to World Health Organization's Guidelines for Community Noise (1999), daily sound pressure levels of 50 decibels (dB) or above can create discomfort amongst humans, while ongoing exposure to sound pressure levels over 85 dB is usually considered the critical level for temporary hearing damage.

The proposed project is inside of dairy farm premises. Some Noise are generating from running of fan within the cow shed in the farm premises. There are some refreshment areas where always significant number of people gather and makes chaos continuously. This is another source of noise pollution.

Ambient noise level measurement was carried out to determine sound intensity at the monitoring locations during the baseline condition. Noise Level Measurement was analyzed at project influenced locations day time at 18 May 2020 (Figure 5.12). Noise level data were taken during day time are summarized in Table 5.3. Noise measurement at each location was done continuously for 30 minutes at day time.



Figure 5.12: Noise Level Monitoring from Project Location

Table 5.3: Noise Level Monitoring Test Result

Location	Sample ID	GPS Location	Land Use Category	Time	Noise Level (dBA)
Beside Biogas Plant Area	DDL_NM_01	23.47803° N, 90.29655° E	Residential	9:00 am -9:30am	54.4
Beside Cow's Resting Area	DDL_NM_02	23.47845° N 90.29624° E	Residential	9:45 am -10:15 am	52.1
Beside Water Reserve Tank Area	DDL_NM_03	23.47982° N 90.29455° E	Residential	10:20am – 10:50am	57.8
Beside Office Area	DDL_NM_04	23.47957° N 90.29557° E	Residential	11:00 am -11:30am	51.23
Entrance of Biogas Plant	DDL_NM_05	23.47788° N 90.29448° E	Residential	11:40 am -12:10pm	50.5
Beside the new cattle shed, under-construction	DDL_NM_06	23.477524°N, 90.294377°E	Residential	12:15 am -12:45pm	53.4
Notes: - Land use category is based on the classification provided in the Noise Pollution Control Rules (2006) - The sound level standards for residential area at day and night are 55 dBA and 45 dBA respectively. - Noise Level is the average noise recorded over the duration of the monitoring period. Abbreviation: NM- Noise Measurement, dB- decibel					

The result shows that time weighted average value of the sound monitored inside the project are within the standard set for residential and commercial area at day time.

5.3.5 Seismicity

Bangladesh is situated in one of the most tectonically active regions in the world. Here are where three major plates meet (the Indian Plate, the Tibet Sub-Plate, and the Burmese Sub-Plate). The project area is located over the Indian Plate, which is moving north. However due to the location of relevant plates, fault lines and hinge zones, Bangladesh itself is divided into three seismic zones (Table 5.12), based on the ranges of the seismic coefficient (note: the seismic coefficient is a measure of how strong an earthquake has the potential to be based on a combination of the mass of the plate and the seismic forces acting on it, as well as how frequently these quakes are likely to occur). As per the seismic zone map (Figure 5.13), project area falls in the Zone-II. The Zone II consists of the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur and the western extension of the folded belt and the Bask coefficient for this zone is 0.05. Ground condition (firm or soft) has not been taken into consideration during the seismic zonation of Bangladesh.

Table 5.4: Seismic Zonation of Bangladesh

Zoning	Area Mercalli Scale	Bask Seismic Coefficient
I	North and eastern regions of Bangladesh (Seismically most active)	0.08
II	Lalmai, Barind, Madhupur Tracts, Dhaka, Comilla, Noakhali and western part of Chittagong Folded belt.	0.05
III	Khulna division S-E Bangladesh (Seismically relatively quiet)	0.04

During the design of the project structure the historical information of earthquake should be taken care of. A recent historical earthquake statistic is shown in Appendix E (Source: Bangladesh Meteorological Department).

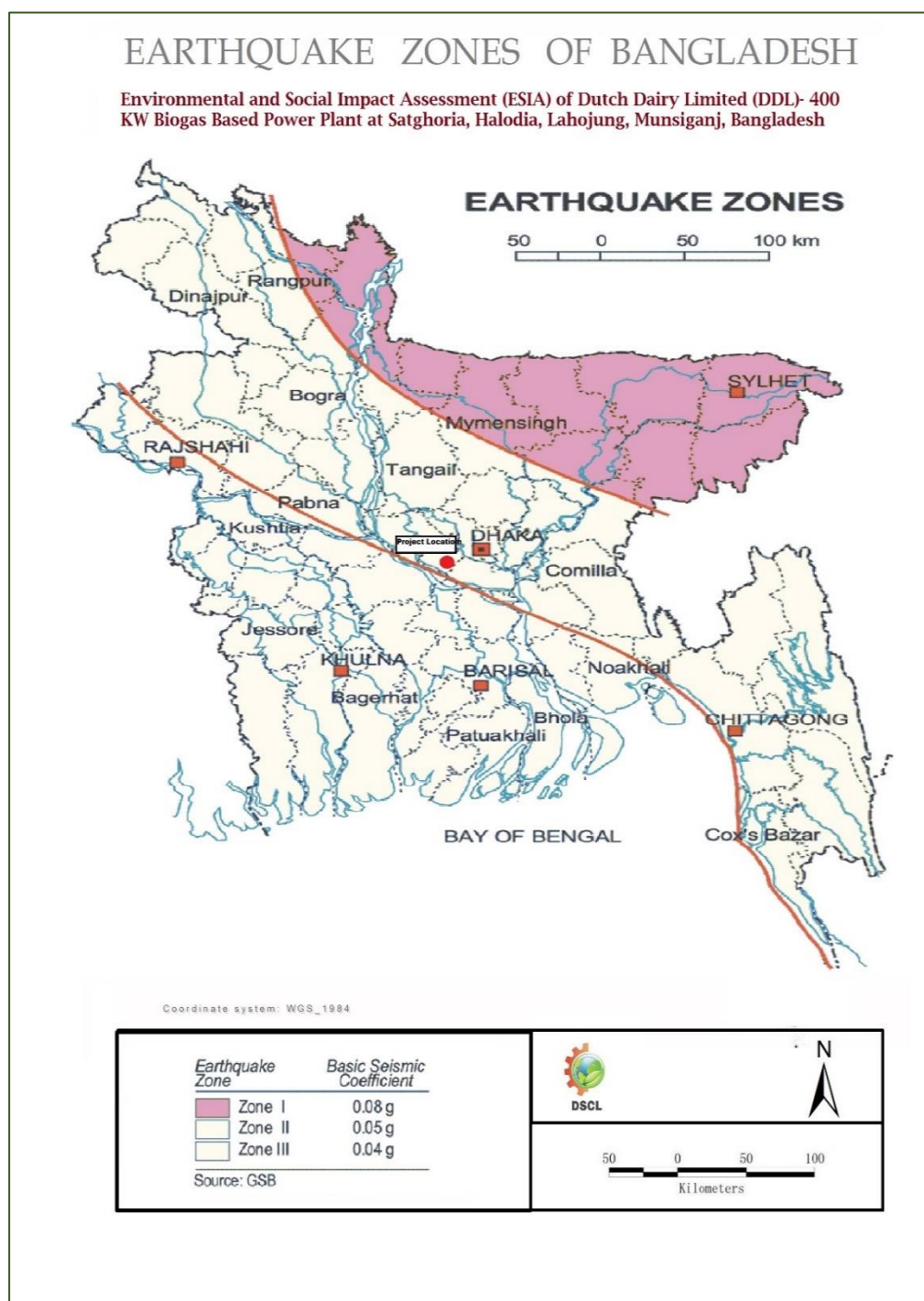


Figure 5.13: Earthquake zones of Bangladesh

5.3.6 Physiography

The project area falls in Ganges river floodplain physiographic unit. The Ganges channel is constantly shifting within its active floodplain, eroding and depositing large areas of new char land each flood season, but it is less braided than that of the Brahmaputra-Jamuna. Ganges alluvium is calcareous when deposited, but most basin clays and some older ridge soils have been decalcified and acidified in their upper layers; lime is found only in the subsoil or substratum of such soils. Clay soils predominate in basins and on the middle parts of most ridges, with loamy soils (and occasionally sands) occurring mainly on ridge crests. Flooding is mainly by accumulated rainwater and the raised groundwater table, except on the active Ganges floodplain and close to distributary channels which cross the meander floodplain.

5.3.7 Geology

Bangladesh is situated to the east of the Indian sub-continental plate. The geosynclinal basin in the southeast is characterized by the huge thickness (maximum of about 20 km near the basin centre) of clastic sedimentary rocks, mostly sandstone and shale of Tertiary age. It occupies areas of greater Dhaka, Faridpur, Noakhali, Sylhet, Cumilla and Chattogram and the Bay of Bengal.

Bengal Foredeep occupies the vast area between Hinge Line and Arakan Yoma Folded System and plays the most important role in the tectonic history of Bengal Basin. Tectonically, Bengal Foredeep can be divided into two major regions- (a) Western Platform Flank and (b) Eastern Folded Flank. The Western Platform flank is further subdivided into (a) Faridpur Trough (b) Barisal-Chandpur High (c) Hatiya Trough (d) Madhupur High and (e) Sylhet Trough. The project area is situated in the Faridpur Trough (Figure 5.14).

- **Faridpur Trough:** Faridpur Trough situated adjacent to Hinge Zone is characterized by a general gravity low with development of Neogene sequence. Sylhet Limestone is 6500 m deep in area south of the confluence of the Padma and the Jamuna. Chalna and Bagerhat are the notable structural highs of very low amplitude.

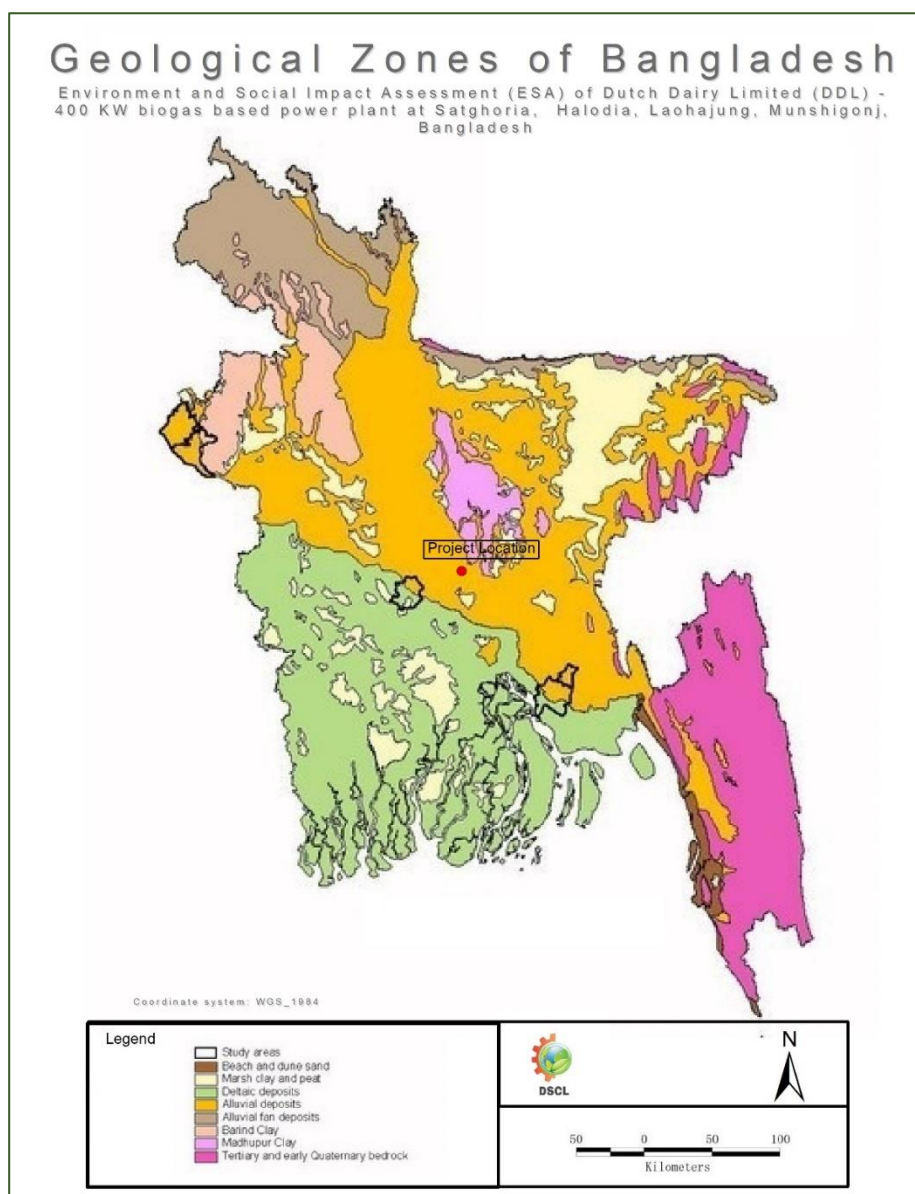


Figure 5.14: Geological Zones of Bangladesh

5.3.8 Water Resources and Hydrology

▪ Surface Water

The overall quality of surface water around the project site and its surroundings varies throughout the year. Typically, water quality improves during the monsoon due to the influx of fresh rainwater, and worsens during the dry season as water evaporates and the concentration of contaminants increases. Padma river is covering the Louhajong upazilla of Munshiganj district which is within the project area.

Surface water sample were collected from project influenced location on 18 May 2020. The locations along with GPS coordinates are summarized with results in Table 5.5. The sample were collected with Kemmerer Bottle and then transferred in 1-liter plastic sampling bottles. The water is being dialyzed with the help of distilled water during sampling. The sampling bottles were then kept in an ice cooler. Vest and helmets were used during the sample collection. The samples were sent to Department of Public Health Engineering (DPHE). For Total Coliform (TC) and Faecal Coliform (FC), the samples were sent to DPHE within 12 hours of collection.

Table 5.5: Test Result of Surface Water Quality

Parameters	Unit	Concentration Present	Standards for Inland Surface Water from Industrial Unit*	Analysis Method
		DDL SW		
		23.479435°N 90.297030°E		
Temperature*	°C	27.1	40	Multimeter
Turbidity	NTU	1935	NYS	Turbidity Meter
pH*	-	8.2	6-9	Multimeter
Total Dissolved Solids (TDS)*	mg/L	1893	2100	Multimeter
Total Suspended Solids (TSS)	mg/L	223	200	Gravity Multimeter
Chemical Oxygen Demand (COD)	mg/L	432	400	CRM
Biochemical Oxygen Demand (BOD ₅)	mg/L	164	100	5 days Incubation
Total Coliform (TC)	N/100ml	470	NYS	MFM
Ammonia (Nitrogen)	mg/L	97	75	UVS
Nitrogen (Nitrate)	mg/L	14	15	UVS
Phosphate (PO ₄)	mg/L	7.87	NYS	UVS
Cadmium (Cd)	mg/L	0.00032	0.5	AAS
Iron (Fe)	mg/L	2.61	2	AAS
Lead (Pb)	mg/L	0.004	0.1	AAS
Calcium (Ca)	mg/L	77	NYS	AAS

Source: Lab Analysis by DPHE

*Standards for Inland Surface Water is followed Environmental Conservation Rule (ECR)'97

* On-site Test Result; NYS = Not Yet Standardized

The test result shows that some of the parameters are within the national standard according to ECR, 97 and some of the remaining parameters are NYS according to DoE (ECR, 1997).

▪ Groundwater

Arsenic is a problem in large part of Bangladesh ground water. The acceptable quantity of arsenic in potable water is 0.05 mg per liter under the Department of Environment standard and 0.01 mg per liter under the WHO standards.

Based on field observations and interviews with local residents it was found that groundwater in the area is used as a drinking water source in many instances, as well as for irrigation purposes. Water is generally extracted via hand pump (tube wells) from the shallow regions of the composite aquifer, and via machine-driven pumps (deep tube wells) which draw from the deeper main

aquifers. The ground water reservoir usually recharges from rainfall, floods and river. In summer season, the water table slightly goes down and goes up in rainy season.

Groundwater is collected from water reserve tank area inside the project location which is used for drinking and bathing purposed by the workers and personnel of the project area. Water is generally extracted from the shallow regions of the composite aquifer which draw from the deeper main aquifers. It was generally tap water which is distribute across the project site. One sample were collected with purified and filtered 1-liter plastic sampling bottle (figure 5.15). The sampling bottles were then kept in an ice cooler. Vest and helmets were used during the sample collection. The parameters measured were pH, Temperature, Electric Conductivity (EC), Turbidity, Total Coliform (TC), Fecal Coliform (FC), Total Suspended Solids (TSS), Total Dissolved Solid (TDS), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD₅), Dissolve Oxygen (DO), Total Coliform (TC), Iron (Fe) and Calcium (Ca). All samples were collected in 1-liter plastic sampling bottles and then kept in an ice cooler. EZDO 8200 Multimeter was used to conduct the on-site test of pH, TDS, EC and Salinity. The samples were sent to DPHE within 72 hours of being collected.



Figure 5.15: Groundwater Sample Collection from Project Area

Table 5.6: Test Result of Groundwater Quality

Parameters	Unit	Concentration Present	Standards for Potable Water**	Analysis Method
		DDL_GW		
		23.47982° N 90.29455° E		
Temperature*	°C	31.1	NYS	Multimeter
Dissolve Oxygen (DO)*	mg/L	6.7	6 or more	DO Meter
pH*	-	8.32	6.5-8.5	Multimeter
Total Dissolved Solids (TDS)*	mg/L	488	1000	Multimeter
Turbidity	NTU	5	10	Turbidity Meter
Total Suspended Solids (TSS)	mg/L	9	10	Gravity Multimeter
Chemical Oxygen Demand (COD)	mg/L	3.7	4.0	CRM
Biochemical Oxygen Demand (BOD ₅)	mg/L	0.19	0.2	5 days Incubation
Total Coliform (TC)	N/100ml	0	0	MFM
Iron (Fe)	mg/L	0.94	0.3-1	AAS
Calcium (Ca)	mg/L	63	75	AAS

Source: DPHE, 2020

* On-site Test Result; NYS = Not Yet Standardized

The test result shows that almost all of the parameters tested are within the national standard for potable water according to ECR, 97.

5.3.9 Soil

The soil of the project area falls in Non-Calcareous and Calcareous Brown Floodplain category of Bangladesh soil types (Figure 5.16). Non-calcareous Brown Floodplain soils occur largely on the Old Himalayan Piedmont Plain, mostly on the ridges. They also occupy minor areas in the Tista, Karatoya-Bengali, Jamuna and Old Brahmaputra floodplains, and in some western parts of the Ganges floodplain. Calcareous Brown Floodplain soils have cambic B-horizon that is predominantly oxidized, containing lime in the profiles. They comprise pale brown to olive brown, friable, loamy and clay soils occurring on the upper parts of ridges on the Ganges river floodplain and on the river bank of the Ganges tidal floodplain. Most of these soils belong to Calcic Gleysols.

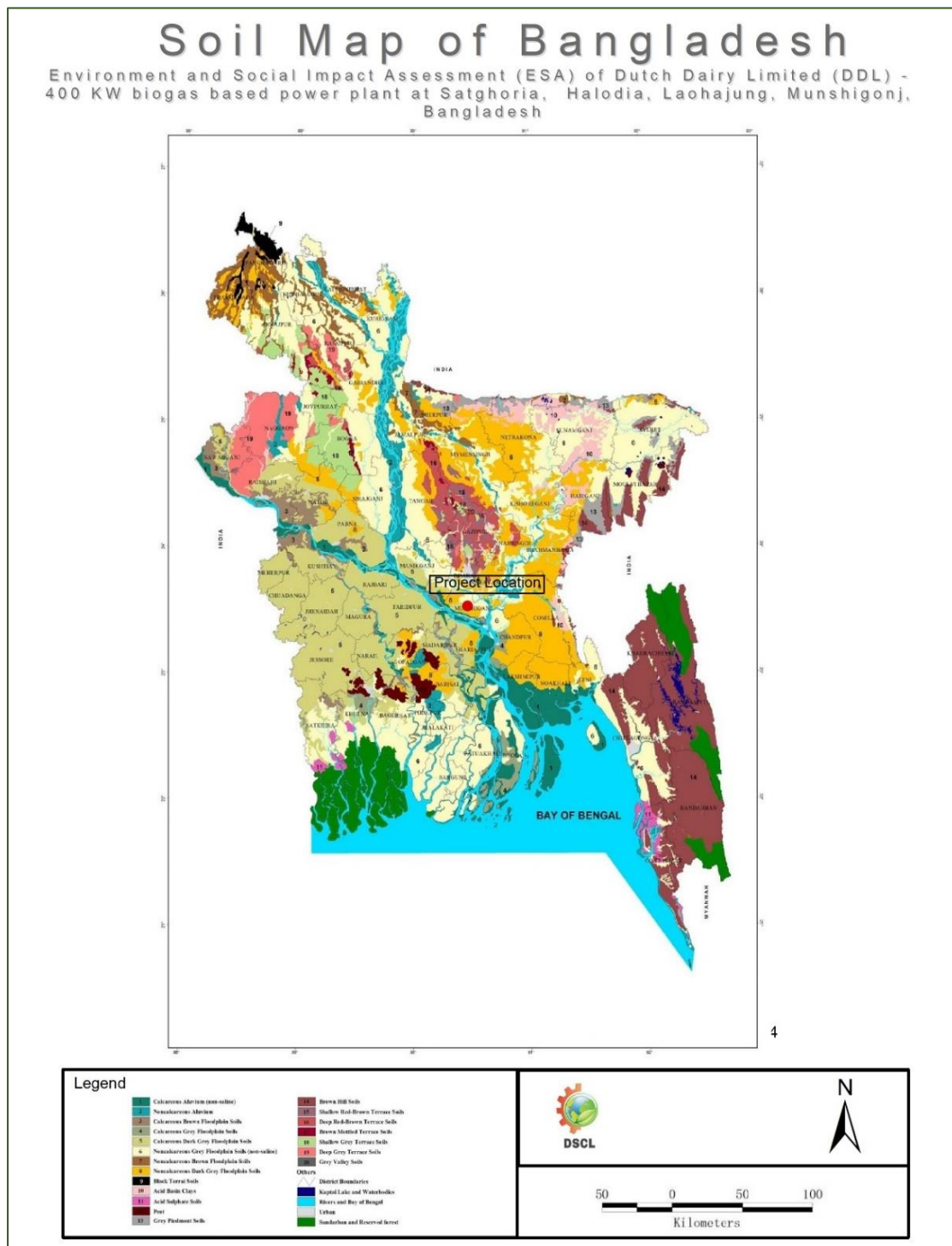


Figure 5.16: Soil Types of Bangladesh

5.3.10 Agroecological Zone

The project area contains the Middle Meghna River Floodplain. (1,555 sq. km) This region occupies an abandoned channel of the Brahmaputra River on the border between the greater Dhaka and Comilla districts. The region includes areas of old Brahmaputra chars within the Meghna River as well as adjoining parts of the mainland. Soils of the area are grey loam on the ridges and grey to dark grey clays in the basins. The dominant general soil type is non-calcareous grey floodplain soil. Topsoils are strongly acidic and subsoils slightly acidic to slightly alkaline. General fertility level is medium with low Nitrogen and organic matter (Banglapedia, 2014). The nature and soil characteristics of this zone influence the crops and cropping patterns within the region.

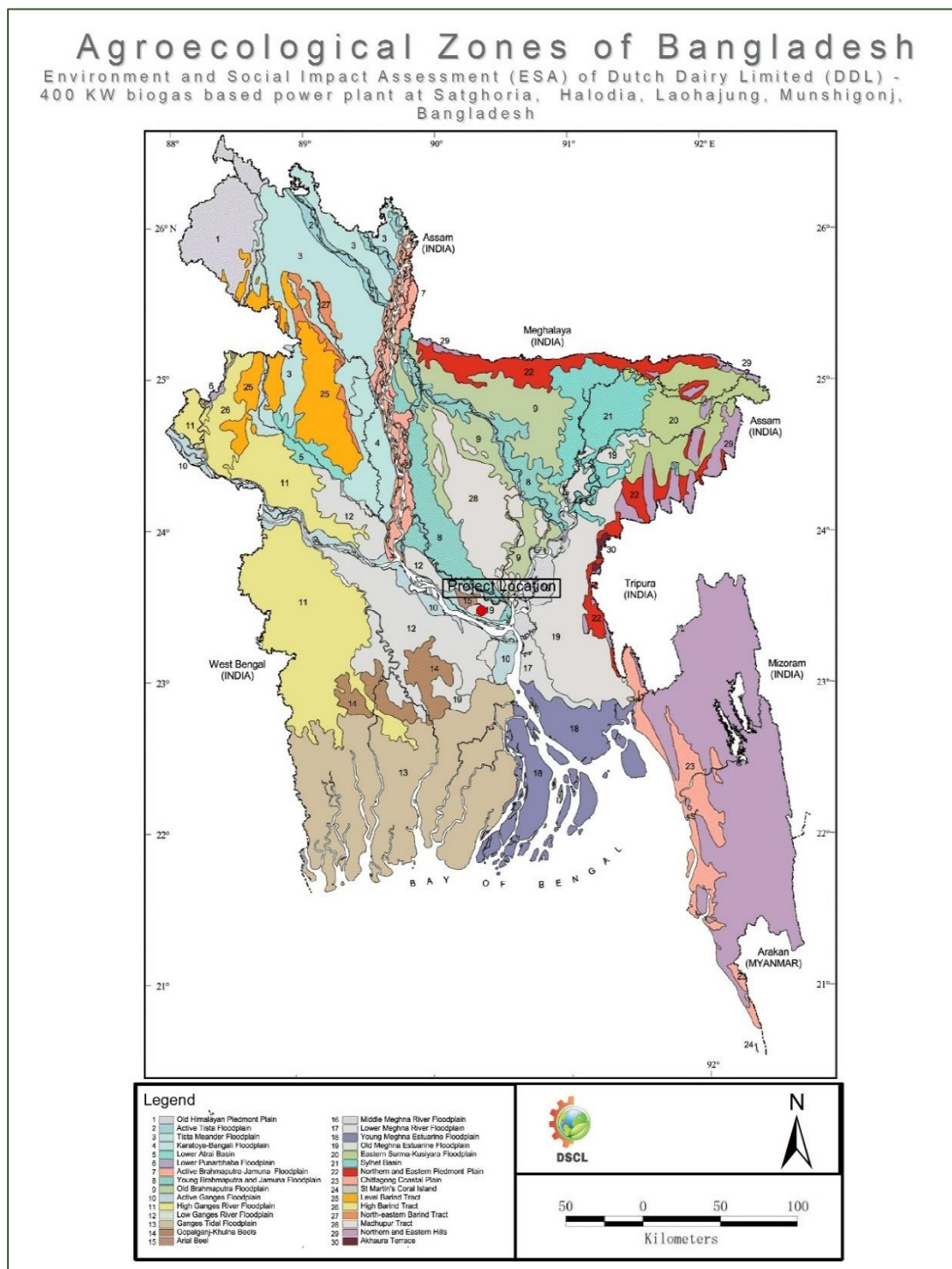


Figure 5.17: Agroecological Zone of Bangladesh

5.3.11 Climate Change and Natural Disaster

The impacts consideration assessed the hydro-meteorological parameters that are directly and indirectly exposed to climate change phenomenon for facilitating the detail design and environmental impact assessment process. Projecting the impact of global climate change on any infrastructure/related natural resources requires representation of climate processes on a variety of spatial scales, from global down to local level. In this regard, under the current scope of works, neither any GCM or RCM climatic models nor any hydro-dynamic simulation was newly conducted; rather raw data available from different existing climate and hydro-metric observations and regional projections from different sources were used. The assessment provides some recommendation/potential solutions/mitigation for climate resilient structures based on the findings of the literature review.

5.3.11.1 Climate Projections: Temperature

The IPCC 5th assessment report (AR5) indicates that the global mean temperatures will continue to rise over the 21st century if greenhouse gas (GHG) emissions continue unabated. Global surface temperature change for the end of the 21st century is likely to exceed 2.5°C relative to 1986 to 2005 for all RCP (Representative Concentration Pathway) scenarios except RCP2.6, and warming will continue beyond 2100 under all RCP scenarios except RCP2.6. Table 5.7 shows the projected change in global mean surface air temperature.

Table 5.7: Projected Surface Change in Global Mean Air Temperature (likely range)

Time Period (base year - 1986 to 2005)	Temperature (°C)			
	RCP 2.6	RCP 4.5	RCP 6.0	RCP 8.5
2046-2065	0.4 to 1.6	0.9 to 2.0	0.8 to 1.8	1.4 to 2.6
2081-2100	0.3 to 1.7	1.1 to 2.6	1.4 to 3.1	2.6 to 4.8

On the other hand, for South Asia the report projections indicate that, compared to the average in the 20th century, average annual temperatures could rise by more than 2°C over land in most of South Asia by the mid-21st century and exceed 3°C, up to more than 6°C over high latitudes, by the late 21st century under a high-emissions scenario (RCP8.5); while under a low-emissions scenario (RCP 2.6) average temperatures could rise by less than 2°C in the 21st century, except at higher latitudes, which could be up to 3°C warmer.

Table 5.8: Projected Temperature Change for Bangladesh under CC Scenario

Time Period	Temperature (°C)		
	Annual	Monsoon (Jun-Sep)	Winter (Dec-Feb)
(base year - 1986 to 2005)	24.6	31.83	16.2
2071-2100	4.34	3.43	5.37
2011-2041	1.49	1.50	1.80

Even though, IPCC assessment report does not provide any country level projections, under the Comprehensive Disaster Management Programme (CDMP II) of Department of Disaster Management (Ministry of Disaster Management & Relief) acclimate model PRECIS (Providing Regional Climates for Impacts Studies) is used to get climate change scenario for Bangladesh.

5.3.11.2 Climate Projections: Precipitation

AR5 reports that, in the long term, global precipitation will increase with increased global mean surface temperature. Global mean precipitation will increase at a rate per degree Celsius smaller than that of atmospheric water vapor. It is likely to increase by 1 to 3% / °C for scenarios other than RCP2.6, for RCP2.6 the range increase will be 0.5 to 4% / °C at the end of the 21st century.

In the South Asian region AR5 projections indicate that under a high-emissions scenario more rainfall will be very likely at higher latitudes by the mid-21st century and over southern areas of the late 21st century. Under a low-emissions scenario, more rainfall at higher latitudes is likely by mid-century but no likely substantial changes in rainfall patterns at low latitudes. More frequent and heavy rainfall days are projected over parts of South Asia (IPCC, 2007).

Table 5.9: Projected Precipitation Change for Bangladesh under CC Scenario

Time Period	Precipitation (mm/day)		
	Annual	Monsoon (Jun-Sep)	Winter (Dec-Feb)
(base year - 1961 to 1990)	3.5	7.24	0.59
2071-2100	0.90	1.43	0.03
2011-2041	0.64	1.40	-0.05

Analysis of past trend of rainfall by (CDMP II, 2013) study reveals that all-Bangladesh annual normal rainfall has not changed much in Bangladesh. For a period of 30 years (1980-2009), the annual normal rainfall is found to be 2,306 mm, such rainfalls were 2,298 and 2,314 mm during 1960-1989 and 1970-1999, respectively. On the other hand, Bangladesh normal rainfalls in different seasons show some mixed trend. Pre-monsoon (March-May) and post-monsoonal (October-November) normal rainfalls have increased and the monsoonal (June- September) normal rainfall has decreased over the three time periods (1960-89, 1970-99 & 1980-2009). The winter (December-February) normal rainfall has increased in the last two periods compared to the first period. The change in projected precipitation for Bangladesh, as found by PRECIS run (CDMP II report) is presented in the Table 5.9.

5.3.11.3 Climate Projections: Wind Speed/Cyclone

As predicted by AR5, globally, it is likely that the area encompassed by monsoon systems will increase over the 21st century. While monsoon precipitation is likely to intensify due to the increase in atmospheric moisture, monsoon winds are likely to weaken. However, based on process understanding and agreement in 21st century projections, it is likely that the global frequency of occurrence of tropical cyclones will either decrease or remain essentially unchanged, concurrent with a likely increase in both global mean tropical cyclone maximum wind speed and precipitation rates.

The future influence of climate change on tropical cyclones is likely to vary by region, but there is low confidence in region-specific projections of frequency and intensity. In fourth assessment report of IPCC (AR4, 2007), an increase of 10% to 20% in tropical cyclone intensities (wind speed) for a rise in sea-surface temperature of 2°C to 4°C relative to the current threshold temperature is likewise projected in East Asia, South-East Asia and South Asia.

For Bangladesh, based on the above analysis, 20% increase of wind speed (cyclone prone area) is assumed for the current assessment considering year 2100. Considering the maximum wind speed (260 km/h) of the most recent cyclone, the projected highest wind speed is calculated as 310 km/h (projection year 2100).

5.3.11.4 Climate Projections: Sea Level Rise

AR5 predicted, it is very likely that the rate of global mean sea level rise during the 21st century will exceed the rate observed during 1971–2010 for all Representative Concentration Pathway (RCP) scenarios due to increases in ocean warming and loss of mass from glaciers and ice sheets (Table 5.10).

Table 5.10: Global Mean Sea Level Rise (values shown as median and likely range)

Time Period (base year - 1986 to 2005)	Sea Level Rise (m)			
	RCP 2.6	RCP 4.5	RCP 6.0	RCP 8.5
2020	0.08 [0.06 to 0.10]	0.08 [0.06 to 0.10]	0.08 [0.06 to 0.10]	0.08 [0.06 to 0.11]
2050	0.22 [0.16 to 0.28]	0.23 [0.17 to 0.29]	0.22 [0.16 to 0.28]	0.25 [0.19 to 0.32]
2080	0.35 [0.24 to 0.48]	0.41 [0.28 to 0.54]	0.40 [0.28 to 0.53]	0.51 [0.37 to 0.67]
2100	0.44 [0.28 to 0.61]	0.53 [0.36 to 0.71]	0.55 [0.38 to 0.73]	0.74 [0.53 to 0.98]

It is very likely that in the 21st century and beyond, sea level change will have a strong regional pattern, with some places experiencing significant deviations of local and regional sea level change from the global mean change. However, no local level SLR data could be found for Bangladesh based on the AR5 by the current assessment. The potential impact of SLR on the infrastructures of the proposed project described in the following section based on available literatures.

5.3.11.5 Flood Flow

Bangladesh is located at the confluence of three major river basins: The Ganges, Brahmaputra and Meghna (GBM) basins. In order to understand the future impacts on water resources in Bangladesh, it is necessary to investigate these trans-boundary rivers (only 5% of the Ganges catchment and 7% of the Brahmaputra catchment lie in Bangladesh) (Faifung, Franchis, & Jahir, 2006).

The previous phenomena related with flooding illustrates that, the magnitudes of water level of peak flows at Bahdurabad in the Brahmaputra in 2007, 2004, 1998, 1988 were found 0.88m, 0.68m, 0.87m and 1.12 mPWD above danger level respectively. At Hardinge Bridge of the Ganges River, the magnitudes of water level during floods in 2007, and 2004 were always below the danger level. During 1998 and 1988, magnitudes of the peak flow were found 0.94m and 0.62 mPWD above danger level respectively. In terms of the magnitudes of peak flows in the Meghna River at Bhairab Bazar point in 2007, 2004, 1998, 1988 were found 0.69m, 1.53m, 1.08m and 1.41 mPWD above danger level respectively (Islam, Haque, & Bala, May 2008).

The impact of climate change on a river, mainly on its flood flow may be viewed as a complex interaction between climate, hydrology, hydraulics and morphology of the river system. In order to assess such complex hydraulic and morphologic response of a river to climate change, application of mathematical modelling is essential (Kamal, 2011-12). At present, regional estimates of SLR are scarce, therefore in few instances SLR estimation was conducted through expert consultations. In the absence of a scientific SLR, local climate change scientists used an estimate of between 27 and 32cm global SLR by 2050 for the Bay of Bengal (Dasgupta, Kamal, Haque, Sharifuzzaman, & Nishat, March, 2014).

A recent study conducted by CEGIS an effort was made to investigate flood flow changes of the Meghna River due to climate change and sea level rise with the application of different mathematical models. The GCM precipitation projections along with the sea level rise scenarios given by IPCC have been used to construct different climate change scenarios namely A1B and A2 for the periods of 2030s, 2050s and 2080s. The study indicated that annual flow of Meghna River decreases 4% by 2030, 6% by 2050 and 6% by 2080 for A1B scenario. For A2 scenario, the changes are 14% decreases (2030), 4% decrease (2050) and 11% increase (2080) (Hossain, et al., 2015).

The average annual flow volume of Ganges for three time slices in two different SRES scenarios shows that annual flow volume increases 22% by 2030, 26% by 2050 and 19% by 2080 for A1B scenario. A similar situation is observed for A2 also. So, there is increasing flow which reaches the peak by 2050 and then reduces during 2080 (Ahmed, et al., 2015).

A study on projected flow of Brahmaputra River on the basis of future impacts on water resource due to climate change, conducted by IWFM, BUET reveals that, the change of monthly flow for monsoon seasons is predicted to increase 7-12%, 4-13% and 4-13% for 2020s, 2050s and 2080s respectively. The change of monthly flow for Pre-monsoon seasons is predicted to increase 28-56%, 23-60% and 17-92% for 2020s, 2050s and 2080s respectively (Paul, Islam, Hasan, & Rahman, 2015).

On a different study, Climate Change Cell of DoE with technical support from Institute of Water Modelling (IWM) conducted a study to assess the impact of Climate Change and Sea Level Rise on Monsoon Flooding. The study followed a projection of 23 cm rise of sea level above 2000 level and increase of precipitation by 13%. (Haque, Hassan, Masud, & Tarun Kanti Magumder, 2009).

5.3.11.6 Storm-surge Inundation

World Bank conducted a GIS-based research in Bangladesh to delineate vulnerable zone in coastal areas to larger storm-surges and sea-level rise in a changing climate by 2050 during 2010 (Figure 5.18). The project developed inundation risk map due to SLR under climate change condition following IPCC AR4 (IPCC, 2007).

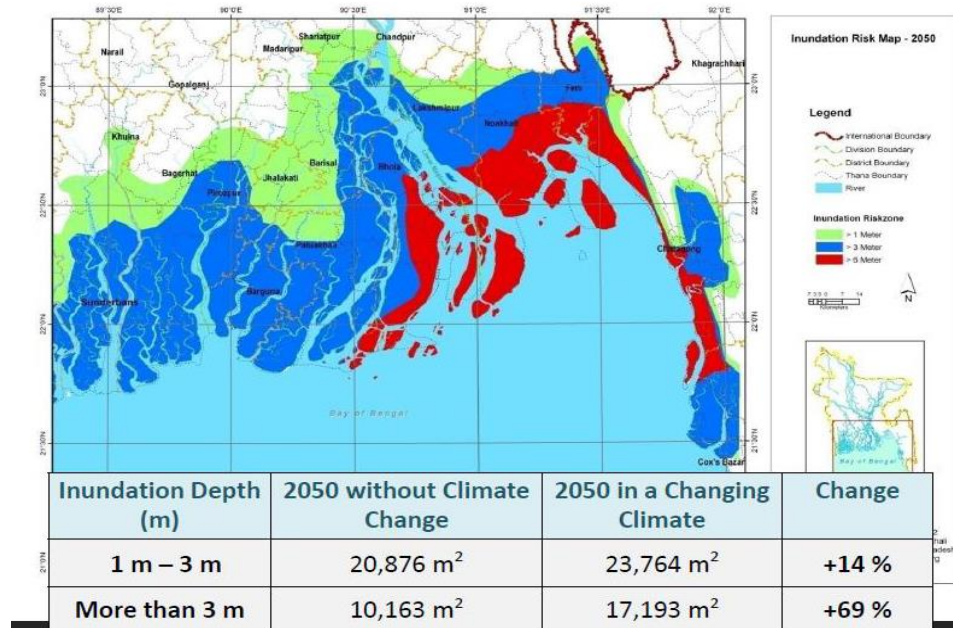


Figure 5.18: Storm Surge Inundation Area (2050 in a changing Climate)

5.4 Biological Environment

5.4.1 Bioecological Zone

The project area falls Major Rivers Bioecological zone (Figure 5.19). Bangladesh consists mainly of riverine and deltaic deposits of three large and extremely dynamic rivers entering the country: the Brahmaputra, Ganges and Meghna rivers. Newly accreted land, if it does not erode quickly, is initially colonized by grass, particularly catkin grass for example). Dense growth of catkin grass can accelerate silt deposition on chars. Many of the species' natural distribution, migration and storage are primarily functioned via these rivers into other wetland ecosystems (GoB-IUCN, 1992). A diverse range of waterfowls are directly or ecologically dependent on these rivers and

its associated ecosystems. However, it is quit alarming that, with the exception of few species of turtles, all other river biodiversity is threatened with extinction (IUCN, 2002f).

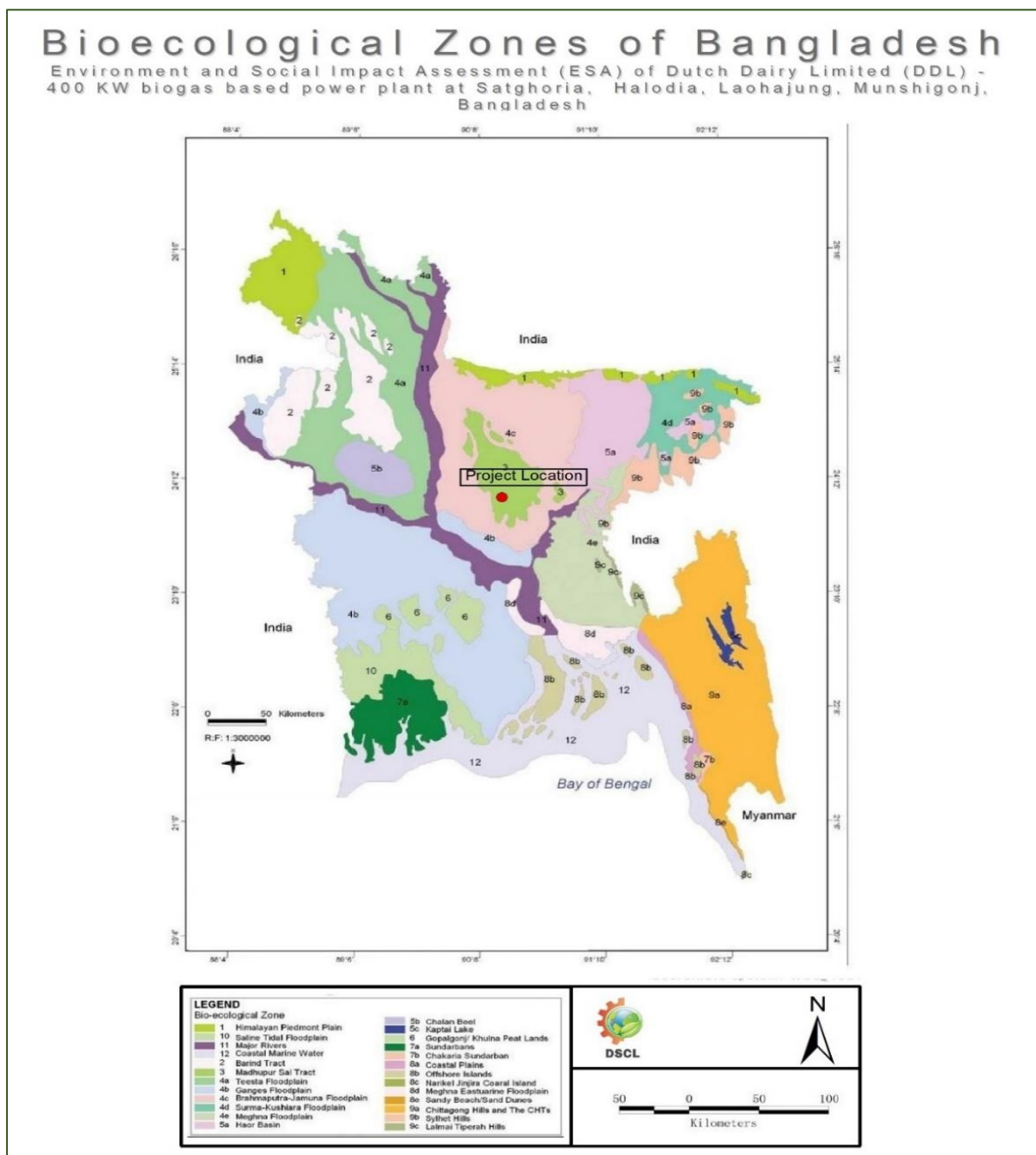


Figure 5.19: Bioecological Zone of Bangladesh

5.4.2 Terrestrial Ecosystem

The status of terrestrial floras and faunas at the project site were assessed from visual observations, review of literature, and information documented by other agencies. The project area consists of several ecological subsystems e.g. open agricultural land, homesteads, and roadside vegetation. The open agriculture land ecosystem dominates the area providing widespread habitat types for various species of flora and fauna under flooded and non-flooded conditions. The vegetation covers of agricultural lands are different crop species, weeds and other herbaceous plants species.

The faunal species in the agriculture land and roadside bush ecosystems include birds, amphibians, fishes, snakes, rodents and few mammals. The homestead ecosystem provides the

main tree covered areas within rural Bangladesh including the project site. The homesteads are covered by fruit, timber, fuel wood, medicinal plants and various multipurpose tree species. The wildlife species in homestead ecosystem include the birds, amphibians, reptiles, rodents and mammals like mongoose, jackal, cats, monkey, etc. Many of the species including mammals are vulnerable or/and endangered in Bangladesh due to habitat loss, over exploitation, natural calamities and lacking of management. The project command area is not the specific habitat for any particular species of flora and fauna hence none such species will be specifically affected due to project implementation.



Figure 5.20: Flora and Fauna in the Project Area

5.4.2.1 Flora

The project influence area (PIA) has mixed vegetation. Besides some fruit trees were also observed. The data collected from the field survey and suggests that the predominant species are those of cultivated vegetables and trees. A detailed list of terrestrial floral species found in the project area is shown in Table 5.11.

The project area is similar to the character to many areas of alluvial delta in Bangladesh with mixed crop vegetation. Rice, other grains and seasonal vegetables are the main crops in this area. Other than monoculture tree plantations, no forestland is involved in this area. Terrestrial plants are now mainly limited to trees, shrubs and flowers grown alongside roads and in parks and gardens, and the crops and fruit trees planted in agricultural areas. The composition of plant community includes low growing grasses and herbaceous vegetation as well as other flora.

Table 5.11: List of Flora in the Project Influenced Area

Species Name	Local Name	Family
<i>Annona reticulata</i>	Bullocks heart/Sharifa	Annonaceae
<i>Atstonia scholaris</i>	Chettim	Apocynaceae
<i>Averrhoa carambala</i>	Kamranga	Averrhoaceae

Species Name	Local Name	Family
<i>Artocarpus heterophyllus</i>	Kanthal	Moraceae
<i>Albizia lebbeck</i>	Koroi	Fabaceae
<i>Amaranthus spinosus</i>	Kantanotey	Amaraanthaceae
<i>Abroma augusta</i>	Ulat kambal	Malvaceae
<i>Acacia moniliformes</i>	Akashmoni	Leguminosae
<i>Areca catechu</i>	Supari	Palmae
<i>Azadirachta indica</i>	Neem	Meliaceae
<i>Borassus flabellifer</i>	Taal	Arecaceae
<i>Bambusa vulgaris</i>	Bansh	Poaceae
<i>Cocos nucifera</i>	Narikel	Palmae
<i>Codiaeum vareigatum</i>	Patabahar	Patabahar
<i>Carica papaya</i>	Pepe	Caricaceae
<i>Delonix regia</i>	Krisnochura	Leguminosae
<i>Delonix regia</i>	Krishnachura	Fabaceae
<i>Dalbergia sissoo</i>	Sheeshu	Fabaceae
<i>Ficus benghalensis</i>	Bot	Moraceae
<i>Ficus religiosa</i>	Oshwoth	Moraceae
<i>Heliotropium indicum</i>	Hatisur	Boraginaceae
<i>Luffaae gypticea</i>	Dhundul	Cucurbitaceae
<i>Lagerstroemia speciosa</i>	Jarul	Lythraceae
<i>Litchi sinensis</i>	Lichu	Sapindaceae
<i>Mangifera indica</i>	Aam	Anacardiaceae
<i>Musa</i>	Kola	Musaceae
<i>Phoenix sylvestris</i>	Khejur	Palmae
<i>Psidium guajava</i>	Peyara	Myrtaceae
<i>Polyalthia longifolia</i>	Debdaru	Annonaceae
<i>Shorea robusta</i>	Shal	Dipteocarpaceae
<i>Salmaliama labarica</i>	Shimul	Malvaceae
<i>Syzygium cumini</i>	Jaam	Myrtaceae
<i>Streblus asper</i>	Shewra	Moraceae
<i>Swietenia macrophylla</i>	Mahogany	Meliaceae
<i>Tamarindusindica</i>	Tentul	Leguminosae
<i>Terminalia arjuna</i>	Arjun	Combretaceae
<i>Tectonia grandis</i>	Shegun	Lamiaceae

5.4.2.2 Fauna

The diversified habitat and ecosystem in the project area support various types of animals as given in Table 5.12. Primary and secondary mode was adopted for identification of fauna. Most of the birds are identified through direct observation rather than from people. Most of the amphibians, reptiles and mammals were identified by using books and description of the local people during the field survey.

Table 5.12: List of Fauna in the Project Influenced Area

Scientific Name	English Name	Local Name
Class: Amphibia		
<i>Bufo melanostictus</i>	Common toad	Kuno bang
<i>Lemnonectes limnocharis</i>	Crickit frog	Gecho bang
<i>Rana tigrina</i>	Indian bull frog	Kula bang

Scientific Name	English Name	Local Name
Class: Amphibia		
Class: Reptilia		
<i>Gecko gecko</i>	Wall lizard	Tokkhok
<i>Hemidactylus brooki</i>	Common House Lizard	
<i>Naja Naja</i>	Indian cobra	Gokhra
<i>Varanus bengalensis</i>	Bengal monitor	Guishap
Class: Aves		
<i>Spilopelia chinensis</i>	Spotted dove	Tilaghughu
<i>Passer domesticus</i>	House sparrow	Charui
<i>Milvus migrans</i>	Black kite	Cheel
<i>Amaurornis phoenicurus</i>	Water fowl	Dahuk
<i>Anatidae anatidae</i>	Duck	Hash
<i>Picononotus barbatus</i>	Common bulbul	Bulbuli
<i>Acrida theerestrictis</i>	Common myna	Shalik
<i>Copsychus saularis</i>	Magpie robin	Doyel
<i>Eudynamis scolopacea</i>	Asian cuckoo	Kokil
<i>Egretta garzetta</i>	Little egret	Bok
<i>Corvus splendens</i>	Crow	Kaak
<i>Tyto alba</i>	Barn owl	Pecha
<i>Gallus gallus</i>	Wild cock	Murgi
<i>Melopsittacus undulatus</i>	Budgerigar	Tia pakhi
<i>Orthotomus moustulius</i>	Common tailorbird	Tuntuni
Class: Mammalia		
<i>Mus musculus</i>	Mouse	Nengtiindur
<i>Capra aegagrus hircus</i>	Goat	Chagol
<i>Canis lupus familiaris</i>	Dog	Kukur
<i>Ovis aries</i>	Sheep	Bhera
<i>Bos taurus</i>	Cow	Goru
<i>Bubalus bubalis</i>	Wild buffalo	Mohish
<i>Herpestes erpessii</i>	Mongoose	Beji
<i>Sciurus carolinensis</i>	Grey Squirrel	Kath birali
<i>Canis aureus</i>	Jackal	Sheyal
<i>Macaca fascicularis</i>	Monkey	Banor
<i>Rattus rattus</i>	Rat	Indur
<i>Viverra zibetha</i>	Large Indian Civet	Khatash
<i>Felis chaus</i>	Jungle cat	Bon biral

5.4.3 Aquatic Flora and Fauna

Some aquatic plant species exist in the canal nearby the industry. The species commonly found are Kochuripana, Dholkalmi, Sheola, Malanchi, Kalmi, Helencha etc. The species of fish found in the area are Mrigel, Rui, Katla, Grass Carp, Silver Carp, Mirror Carp, Big Head, Koi, Tengra, Taki, Singh, Chingri, etc.

It is observed from the field visit/consultations that no endangered/ rare fish species were identified. No anticipated impact on aquatic species as well as fish species due to the project activities.

5.4.4 Protected Areas and Red Book Species

In and around the project no environmentally protected areas were found. Construction impacts on the rate of deforestation, loss of habitat, habitat fragmentation, and interruption of wildlife migration patterns are not anticipated. Figure 5.21 shows that no environmental sensitive area is present around the project region.

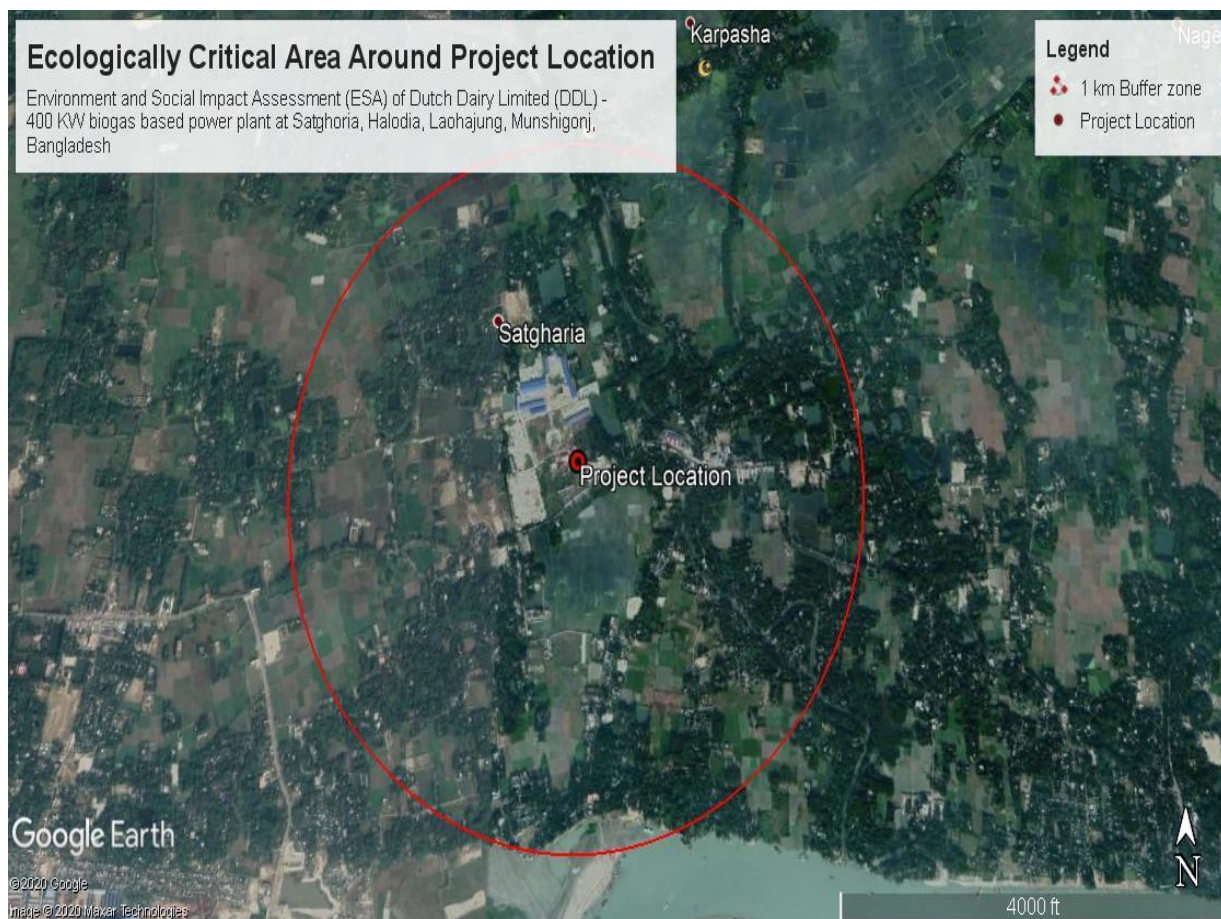


Figure 5.21: Environmental Protected Areas of Bangladesh

5.5 Important Environmental and Social Features

The socio-cultural aspects include the educational institutions, hospitals/health centers, religious structures, cultural structures, burial grounds, market places, water bodies, etc., few of which would be affected directly and indirectly through implementation of the project. Surrounding the proposed project there are least environmentally and socially hotspot areas in accordance with the project activities. These areas include cultural & community infrastructure (e.g. market, eidgah and mosque). All of those environmentally and socially critical areas have been showed in Figure 5.22.

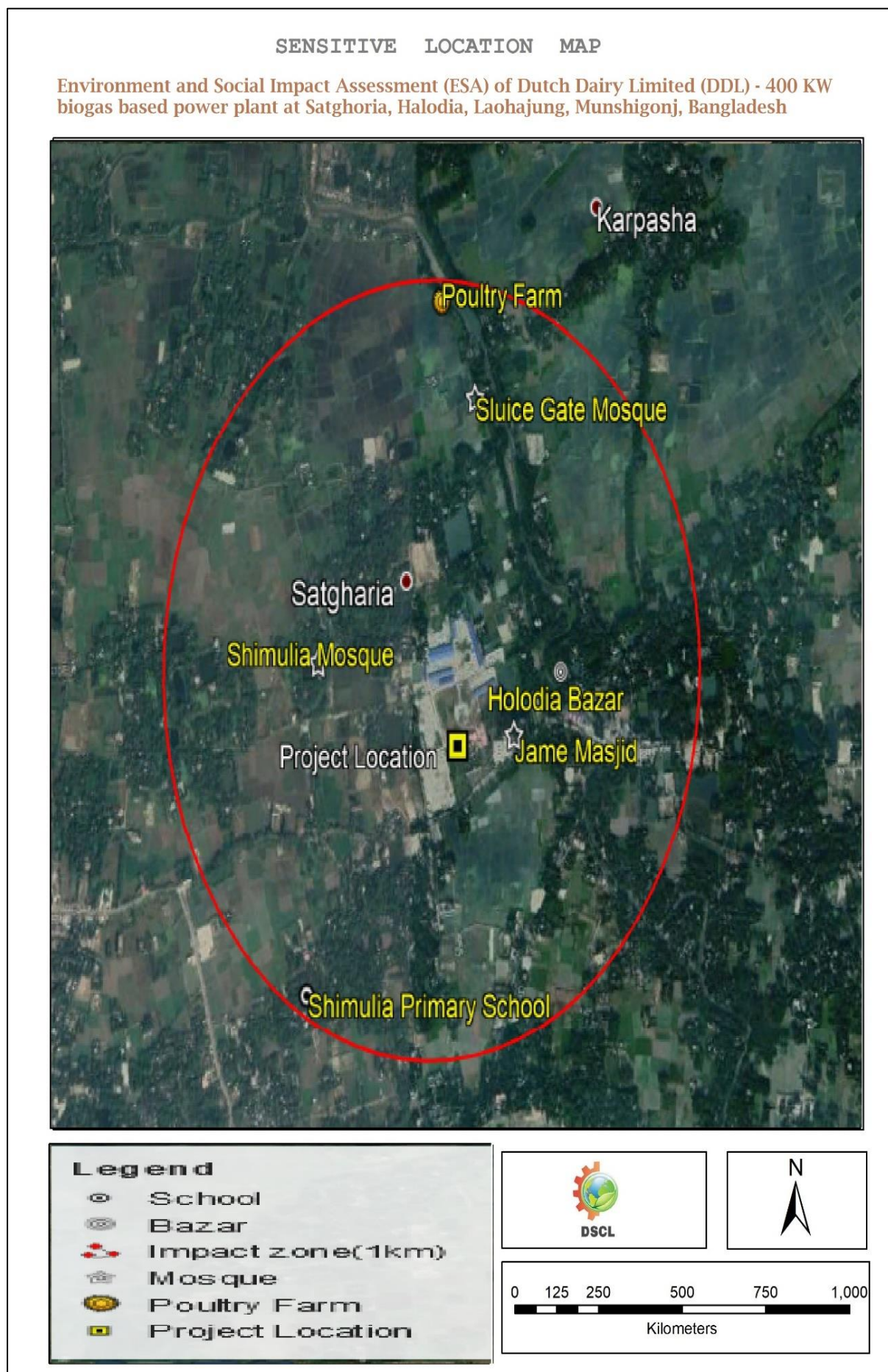


Figure 5.22: Environmental and Social Hotspot of the Project Area

6 DESCRIPTION OF THE SOCIOECONOMIC BASELINE

6.1 Socioeconomic Conditions

This section provides a profile and analysis of the socio-economic characteristics and practices that currently exist within the Project Area. Socio-economic baseline data has been collected in order to achieve a number of outcomes, namely to:

- Assess potential impacts that may arise as a result of the Project;
- Provide a basis for the effective monitoring of the Project during construction and operation; and to
- Allow for the evaluation of any social, economic and demographic changes in the Project Area that could be attributable to the Project.

It is essential for every development project, whether small or large, to understand the social, human and economic aspects of the primary stakeholders, i.e., people living in and around the project site. The following tools and techniques were used to collect the relevant data/information on the social and economic aspects of affected people:

- Literature review;

In addition, data obtained from secondary sources were compared with the primary data/information gathered during the study. Data on population, age/sex composition, household patterns, and sources of drinking water, sanitation facility, and ownership of agricultural land were enumerated from the latest community series census published by the Bangladesh Bureau of Statistics (BBS). Banglapedia etc.

6.2 National Context

Bangladesh has experienced steady economic growth and improvement in macroeconomic stability during recent years, particularly in the past decade. This has been despite numerous natural disasters and external forces such as the global economic crisis. Rates of poverty have fallen from 57% in 1990 to 40% in 2005. The average growth of gross domestic product (GDP) between 2001 and 2007 was over 6 percent (World Bank, 2007). In addition, Bangladesh has made great strides towards achieving many of the Millennium Development Goals (MDGs), including meeting the MDGs for gender parity in education and universal primary enrolment ahead of time.

Despite the improving track record, around 56 million people remain living below the poverty line. As such Bangladesh faces considerable challenges, including from ongoing natural disasters such as cyclones and floods, and from the potential impacts from climate change. Development of socio-economic indicators for Bangladesh are provided in Table 6.1.

Table 6.1: Key Socio-economic indicators for Bangladesh

Key Indicator	Value
GDP (US\$ billions), 2008	79.0
GDP per capita (US\$), 2002	351
Exports of goods and services (% of GDP), 2002	14.3%
Imports of goods and services (% of GDP), 2002	19%
Agriculture (% of GDP), 2007	18.9%
Industry (% of GDP), 2003	28.5%
Services (% of GDP), 2003	52.6%
Population living below national poverty line, UNDP (2005)	40.0%
Life expectancy (2006)	
- Male	65.6

Key Indicator	Value
- Female	70.0
Total fertility rate (births per woman ages 15-49), 2007	2.39
Adult literacy rate (% age 7 and above), 2007	
- Male	59.4%
- Female	52.7%
Population with sustainable access to improved sanitation (%), 2000	48%
Population with sustainable access to water source (%), 2000	97%

(Sources: United Nations Development Program, 2004; Bangladesh Bureau of Statistics, 2008; Bangladesh Bureau of Statistics, 2009)

6.3 Administrative Information

It is important to highlight the administrative setup as framed by District and union boundaries of the Project area, as those will be referred to many times throughout the ESIA document. The project is located at Shatgharia, Halodia Union of Lohajang Upazila under Munshiganj district. The total area of the Lohajang Upazila (Munshiganj district) area 130.12 sq km, located in between 23°24' and 24°32' north latitudes and in between 90°01' and 90°15' east longitudes. It is bounded by Sreenagar and Serajdikhan upazilas on the north, Zanjira upazila on the south, Tongibari upazila on the east and Shibchar upazila on the west. However, the total area of the Haldia union is 2192 acre. Number of populations is 17452. The literacy rate of this is 55.5 % for both male and female (Banglapedia, 2015).

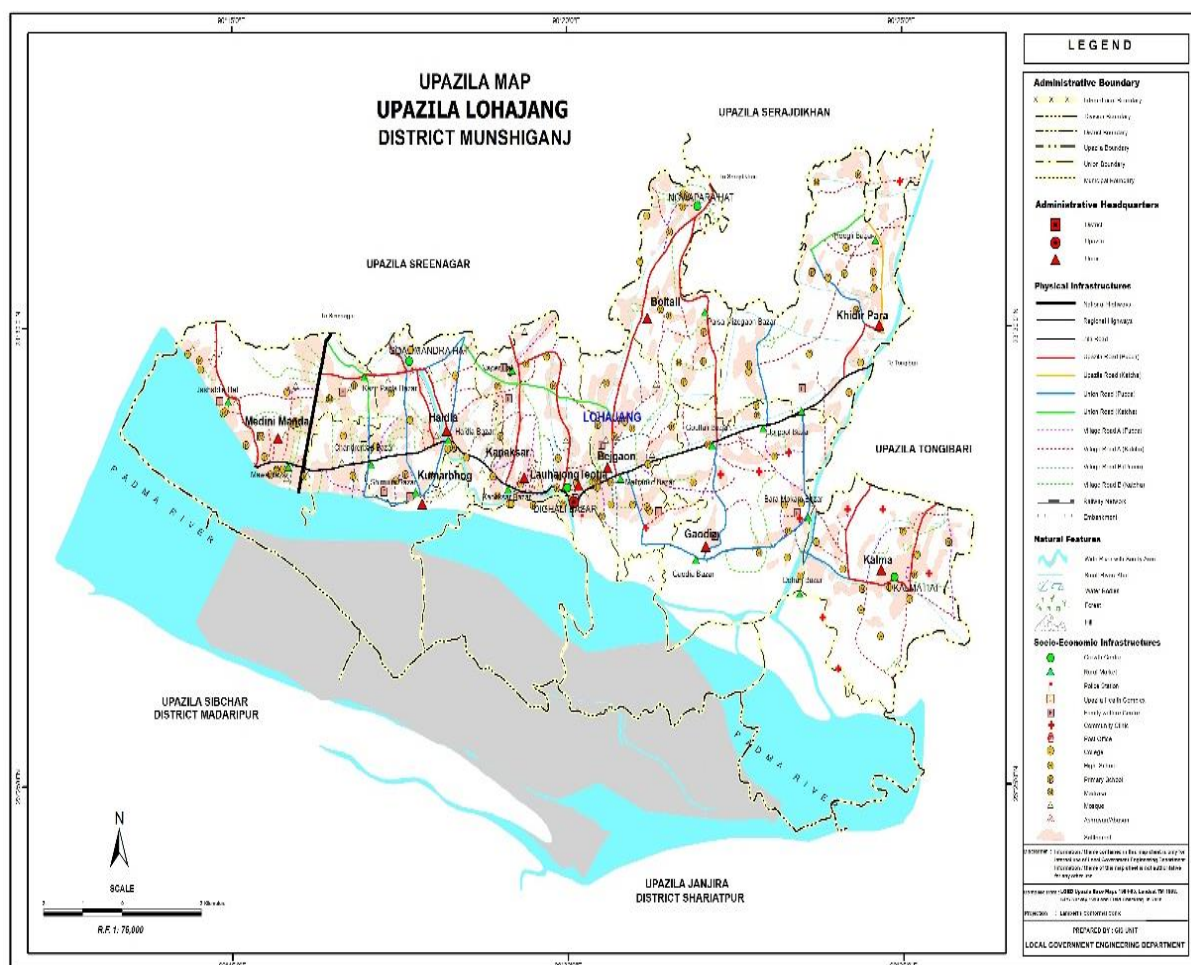


Figure 6.1: Administrative Map of the Project Upazila (Source: LGED)

6.4 Demographic Information

With an estimated 164.4 million inhabitants and an annual population growth rate of 1.4%, Bangladesh is considered to be one of the most densely populated countries in the world (UNFPA, 2010). The detail of demographic profile of the project area is presented below (Table 6.2). The demographic information is collected from Population Census, 2011 by Bangladesh Bureau of Statistics (BBS, 2011).

Table 6.2: Demographic Profile of the Project Area

Upazila/Union	District	Area (In Acre)	Population		Literacy Rate	Population Density
			Male	Female		
Lohajang Upazila	Munshiganj	32396	79247	79995	56.2	1289
Halodia Union	Munshiganj	2192	8496	8956	55.5	225

Source: BBS, 2011

6.4.1 Gender Distribution

The sex ratio of the population is defined as the number of males per 100 females. In the country as a whole the sex ratio has remained fairly constant at around 106 since 1981, with the reported ratio for 2001 being 106.6. However, there is a significant urban-rural difference in sex ratios; 117.2 for the urban areas as opposed to 103.6 for rural areas. This difference can mainly be attributed to male labor migration to urban areas, specifically in the 20-29 age brackets and to a lesser degree in the 30-34 age bracket (BBS 2003).

6.4.2 Religion Status of the project Area

Bangladesh is a predominantly Muslim nation, with nearly 90 percent of the population recorded as Muslim in the 2001 Population Census (BBS, 2006). The predominance of the Muslim faith was reflected in the results of the household survey, with 95.4 percent of persons recorded as Muslim, 3.2 percent of person was recorder as Hindu and the remaining 1.4 percent being Buddhist, Christen and Others etc. In Lohajang Upazila there are Mosque 220, temple 10, tomb 4. Noted religious institutions: Ghordaur Jami Mosque, Shatgharia Mosque, Society Jami Mosque, Hat Bhogdia Jami Mosque, Malir Anka Jami Mosque, Bejgaon Kali Mandir, Kanaksar Durga Mandir, tomb of Kadam Shah.

6.4.3 Ethnicity

Bangladesh is noted for the linguistic homogeneity of its population, with over 98 percent of the population classified as Bengali or Bangla-speaking. According to the 1991 Population Census (BBS, 2006), Bangladesh has 29 indigenous groups, who together constitute some 1.1% of the total population. These groups have traditionally inhabited the Chittagong Hill Tracts area, and the border and forest areas of north-western, north-central and north-eastern Bangladesh. No ethnicity belongs to this Upazila.

6.5 Land Use and Cropping Pattern

With the increasing population (growth rate of population is 1.3 per annum, 2011 Population Census), land use patterns are undergoing a qualitative change in which the areas under the net cropped land is gradually shrinking to meet various needs of people. Two-thirds of the population in Bangladesh depends directly or indirectly upon agriculture, while nearly 25% of the gross national product comes from this sector. Agriculture is the major food supplier for the people of the project area. The major portion of the amazingly fertile agricultural land occurs on the immense floodplains was formed by the deposition of sediments from the river Meghna.

The Project area is located beside the Padma River and floodplain and therefore rice paddy is a substantial crop. The main paddy grown in the Project Area is AUS (cultivated from February to June), Aman (cultivated from mid-July to mid-December) and Boro (irrigated and cultivated in the winter). Wheat, jute, wheat, mustard, sugarcane, potato, maize, vegetables, betel leaf, betel nut, are also grown within the Project area. Fruits like jackfruit, litchi, banana, lemon, black berry and guava are often grown in smaller amounts and in close proximity to dwellings.

6.6 Occupational Patterns

Livelihoods encompass systems of accommodation and settlement, income-generation and resource use, as well as systems of social interaction, cooperation and mutual support. Recent reports on socio-economic development in Bangladesh refer to the changing nature of rural livelihoods with most households being shown to be pursuing a diversified range of activities for their livelihoods. Therefore, information provided below on occupational status collected through household surveys provides more of a broad insight into livelihood strategies in the Project area.

Table 6.3: Percentage of Income Source of Lohajang Upazila

Income Source	Percentage (%)
Agriculture	32.16
Non-Agricultural Laborer	1.96
Industry	0.96
Commerce	31.05
Transport & Communication	4.53
Service	9.94
Construction	2.27
Religious Service	0.21
Rent & Remittance	5.61
Others	11.31

Source: Banglapedia, 2015

6.7 Livelihood

Livelihoods allow people to secure the basic necessities of life, such as food, water, shelter and clothing. Engaging in livelihoods activities involves acquiring the knowledge, skills, social network, raw materials, and other resources to meet individual or collective needs on a sustainable basis. The rural people are typically involved in activities such as agriculture, livestock breeding, fishing and trade. Income provides the basis for food security and self-reliance, contributing towards general stability, prosperity and peace.

Commercial energy consumption in Bangladesh is approximately 71 percent based on natural gas, with the remainder almost entirely oil (and limited amounts of hydropower and coal). Whilst electricity consumption is on the increase, this is mostly apparent in urban areas with rural areas remaining reliant on non-commercial forms of energy such as wood, animal wastes, and crop residues. Results from household surveys found that no households in the Project area had access to electricity in terms of actual energy or fuel usage, and 100 percent of households surveyed used leaves and straw as the primary energy source.

6.8 Settlement Pattern and Housing

The settlement patterns observed during field visits reflected the rural nature of the Project area, with scattered villages surrounded by agricultural fields and seasonally surrounded by floodplain. In the villages, a homestead is often occupied by an extended family and typically consists of a few houses and outbuildings, surrounded by fruit trees.

The majority of households surveyed within the Project Area owned their own home. Of those not owning their own home, alternative arrangement included living in a house owned by relatives or being a tenant.

6.9 Transport and Communication

The project area is connected with Bus, Truck and other transportation system. The modes of transport in the area are motorbike, van etc. People of this area are connected with mobile network for regular communication.

6.10 Poverty

Almost all the families of Shatgharia Village are engaged with some earning activities. Almost all the families of the area are engaged with some earning activities. During the field visit it was observed that people usually go to the town or further for better income. Female usually remain at home and do the household work. Among the employed people most are working in agricultural field, some work in industry outside char and rest are doing service.

6.11 Health Status

The health facilities of this area are not satisfactory. There is only four non-government satellite clinics was found in the project influence area. Health centers Upazila health complex 1, satellite health centre 4, family planning centre 8, diagnostic centre 2, clinic 1.

6.12 Income Status

Main sources of income Agriculture 32.16%, non-agricultural labourer 1.96%, industry 0.96%, commerce 31.05%, transport and communication 4.53%, service 9.94%, construction 2.27%, religious service 0.21%, rent and remittance 5.61% and others 11.31%.

6.13 Recreational Activities

The social need for recreation has been identified as compulsory. The upazila have very limited access to recreational activities. There is no such dedicated place or regular activities as recreational purpose. Mawa Ferry Ghat and resort are the recreational center for the local people. Archaeological heritage and relics Alamnida Jami Mosque, Sujanagar Jami Mosque. However, there are some houses have bought television but all the people do not have ability to buy the valuable means of recreation. Additionally, without having access to electricity the available television is not worthy at all in some times. Because of the lacking of electricity people in this area are not interested to establish any recreational center at all. However, there are some houses have bought television but all the people do not have ability to buy the valuable means of recreation.

7 ANTICIPATED IMPACTS AND MITIGATION MEASURES

7.1 General

This section evaluates the identified impacts on different environmental parameters due to construction and operation of the proposed plant. After studying the existing baseline environmental scenario, monitoring environmental parameters, reviewing the process and related statutory norms, detailing the waste management measures, the major impacts can be identified during construction and operation phase. Relevant important aspects of environment are therefore selected which may have significant impacts due to project activities.

7.2 Environmental and Social Consideration

A project aiming for economic and social development may nevertheless entail a risk of having negative impacts on the environment or society, such as pollution, loss of natural habitat, involuntary resettlement, and infringement of people's rights. Avoidance or minimization of such risks must be realized as an integral part of the project itself, with its cost included into the development cost.

7.3 Corridor of Impact (Col)

The corridor of the proposed Impact (Col) was delineated as the extent, which has direct or indirect impact of project. All direct impacts are constrained within the project boundary. Indirect impacts could be beyond the project boundary. According to the Department of Environment (DoE) guideline the project impact area is divided into two sections. One, those related to the project. Another section is those related to the background environmental features of the project site. This should cover not only the project site in proper, but generally an area of 1km radius around the site. In this project area has been considered as core impact zone and 1km as buffer zone for better understanding.

7.4 Anticipated Impacts and Measures

Environmental impacts are the results of identified project activities and are strictly related to the project implementation cycle. An impact on the surrounding and socio-economic environment may be the result of any identified aspects of the project (of the interaction activity – receptor respectively). The impact may be direct or indirect. The direct impact is produced quite often outside the project area, as a result of a complex propagation path. The impact level is evaluated considering the diminish or normal control of the impact that is inherent to construction and biogas plant operation (for example it must be taken into account the impact of vehicles and machineries emissions on the air quality, assuming the use of new, modern transportation equipment). The impacts on the above parameters have been identified, analyzed and classified as adverse.

7.4.1 Pre-Construction Phase

The concepts considered in design of the sub-project are: (i) prioritizing rehabilitation/maintenance over new construction; (ii) taking all possible measures in design and selection of sites to avoid resettlement impacts (if any); (iv) avoiding where possible locations that will result in destruction/disturbance to historical and cultural places/values (if any); Following is the brief description of impacts envisaged during the Pre-construction/Design Phase:

7.4.1.1 Land Use

Impact

No land acquisition is to be required for the project improvement. In addition, no structures and utilities are located within the selected areas as the project initiator will implement the project in

their own dairy farm premises. Therefore, there are no anticipated impacts during the planning phase of the Project.

Mitigation

The project initiator is to take responsibility of minimizing environmental impact on the surroundings by following the project's ESMP. Since these activities are to be performed temporarily the minimum impact is expected to be acceptable.

7.4.1.2 Permit from Respective Department

Impacts

During the planning and designing phase, a permit or clearance should be taken from the respected department.

Mitigation

The clearance from DoE and Halodia Union Parishad/Local Authority has already been taken. The copies of the clearances are attached in Appendix H respectively.

7.4.1.3 Design Considerations

The plan and design of the project have been carefully reviewed with respect to project objectives. There will be no relocation for public properties, houses, shops, or businesses. The project will yield significant positive changes once implemented.

7.4.2 Construction Phase

The impact during construction will be localized and short term with permanent changes in profile of the project site as compared to the current conditions. Impact will be primarily related to the civil works and less intensive impact is expected during erection of the equipment and trial operation. Except for change in land use all other environment impacts will be temporary in nature.

7.4.2.1 Visual Amenity

Impact

The construction activities of the power plant that are likely to create a visual intrusion and a disruption to aesthetics include: materials lay down, backfilling, and spoil. The project site is inside the dairy farm premises. There are some close communities such as some residence that would be within the visual radius of the project. Therefore, visual intrusions are anticipated to be limited to employees. Hence, the visual effects of the construction will be of low significance within the project area and largely limited to effect only employees living in the company's temporary camp facilities during construction (if any).

Mitigation

The project initiator must be careful while doing construction works as though the adjacent sites and communities do not hamper.

7.4.2.2 Air Quality

Impacts

Air pollution status at the project site, except the specific proposed plant vicinity seems to be normal. Air quality may be affected for short duration in and around the construction site due to various construction activities and construction vehicular movement. Another source of air

pollution is the open drains surrounding the farm area which creates bad odor in the project vicinity. Certain amount of dust and gaseous emissions will be generated from vehicle movements.

- Increase in gaseous emissions by heavy construction equipment and vehicles.
- Increase in dust by construction activities. Earth excavation work, material storage, transportation and handling of construction materials, and wind erosion are the major factors that would produce a temporary, localized increase in SPM levels.
- The increased movement of heavy vehicles carrying construction Material.
- Operation of generator sets as standby power back up system would generate gaseous emissions. The degree of dust generated will be depending on the soil compaction and moisture content of the ground surface during construction.
- Dust and exhaust particulate emissions from heavy equipment operations will be temporarily degrade air quality in the immediate construction zone.

Mitigation Measures

In order to keep the pollution level within acceptable limit, construction related emissions should be regulated. Regular maintenance of machinery and equipment shall be made mandatory. Ambient air quality monitoring should be carried in all phases of the project. If monitored quality seems to above the acceptable limit then the air quality should be tested to keep it DOE standard. All discharge drains should be covered to suppress odor pollution. Dust mask will be provided to the workers.

- A dust control plan is implemented viz. regular daily spraying of water on the roads and dust emission area in the project site.
- Regular maintenance of vehicles and equipment is carried out. The vehicles having PUC is used during the construction period and an agreement with the contractor for water spraying and use of vehicles with PUC as well as use of environment friendly methods during construction phase is made.
- GI sheets are provided to a height of 5 m all around the project site to control dust;
- Water is sprinkled at regular intervals;
- SO₂ emissions from diesel generators are expected to be low because of usage of low sulfur content diesel;
- Use of efficient machinery and schedule maintenance of the Construction vehicles and equipment.
- If dust or pollutant emissions were found to be excessive, construction activities should be stopped until the source of such emissions have been identified and adequate control measures are implemented;
- Proper planning of dust causing activities to take place simultaneously in order to reduce the dust incidents over the construction period.

7.4.2.3 Noise

Impact

During construction of biogas-based power plant noise might be generated from construction work. Movement of construction materials, handling of equipment, concrete mixer, generator running can cause significant noise which has impact on environment. There are no closest sensitive locations around the project area. Hence, the project site could not be a potential source of noise. However, some reptiles and mammals, within the project area can potentially be driven away from the site due to the sound levels.

Mitigation

Measures to control noise pollution during construction stage should be undertaken to maintain Bangladesh standard noise level. The work should adopt optimum site activities and site layout not to exacerbate existing noise levels at sensitive sites, e.g., mosque, school, populated area, market, etc.

- No noise polluting work in night shifts
- Acoustic enclosures will be provided as per DoE guidelines
- Enclosure in acoustic screen, allowing for engine cooling and exhaust, use of anti-vibration mounting, flexible couplings of hoses, maintaining adequate inlet pressure
- Provision of Intake mufflers, unidirectional fan for Cooling and enclosures for electrical motors
- Provision of ear plugs for labor in high noise area
- Provision of barricades along the periphery of the site
- All contractors and subcontractors involved in the construction phase shall comply with the DoE noise standards
- Activities that take place near sensitive receptors to be carefully planned (restricted to daytime, considering weather conditions etc.)
- Vehicles and generator set to be serviced regularly and maintained properly to avoid any unwanted generation of noise or vibration from them
- Use of suitable muffler systems/ enclosures/ sound proof glass paneling on heavy equipment/ pumps/ blowers

Comply with the Occupational Safety and Health Administration (OSHA) requirements and the Bangladesh Codes to ensure that for activities associated with high noise levels, workers are equipped with proper Personal Protective Equipment (e.g. Earmuffs).

7.4.2.4 Loss of Top Soil

Impact

During project construction activities, earth will be required and contractor will collect this earth from nearest agricultural lands. As a result, top soils of the agricultural lands will be affected and ultimately will reduce crop production. Soil characteristics may be deteriorated at project site due to accidental spillage of chemicals, and contamination from cow manure and ill planned disposal of solid wastes and effluents at project site.

Mitigation

Handling, operation and storage of noxious chemicals, and other hazardous materials, etc., should be done cautiously and carefully avoiding accidental spillage. Waste and effluents from project site should be disposed of cautiously in pits dug for the purpose at service areas or elsewhere properly. Prior to start construction, top clay soils should be excavated at 0.5m depth and stored for using on the sandy ground surface and slopes.

7.4.2.5 Soil

Impact

Soil characteristics may be deteriorated at project site due to accidental spillage of chemicals, and contamination from manure and ill planned disposal of solid wastes and effluents at project site.

Mitigation

Handling, operation and storage of noxious chemicals, and other hazardous materials, etc., should be done cautiously and carefully avoiding accidental spillage. Waste and effluents from project site should be disposed of cautiously in pits dug for the purpose at service areas or elsewhere properly.

7.4.2.6 Surface Water

Impact

Surface water quality at project site might degrade due to disposal of solid waste, sewage effluents to nearby ponds and ditches spillage of litters and noxious chemicals during different stages.

Mitigation

Surface water pollution due to disposal of waste and effluents, spillage of litter and other contaminants can be reduced/mitigated through planned disposal, storage, handling and transportation of these materials. Surface water quality will require to be monitored periodically during every stage of project implementation.

7.4.2.7 Terrestrial Ecology

Impact

The activities anticipated during the construction phase for biogas-based power plant will include earthworks, site leveling, and the operation of construction machinery and equipment. However, according to the baseline description, the project area does not encompass natural systems, which means that no significant flora and fauna are present. As a result, construction activities are not anticipated to pose any risks on the terrestrial ecology within or in the vicinity of the project site.

Mitigation

Implement proper management measures to prevent damage to the natural vegetation of the site (if any). This could include establishing a proper code of conduct and awareness raising / training of personnel and good housekeeping which include the following:

- Restrict activities to allocated construction areas only, including movement of workers and vehicles to allocated roads within the site and prohibit off roading to minimize disturbances
- Prohibit hunting at any time and under any condition by construction workers onsite
- Avoid unnecessary elevated noise levels at all times. In addition, apply adequate general noise suppressing measures Ensure proper storage, collection, and disposal of waste streams generated

7.4.2.8 Wildlife and Habitat

Impacts

During the construction phase and onwards, the change in land use will occur at the site of plant extension. The construction activities of the project will result in loss of wildlife habitat. The construction activity disturbs the wild life by noise, traffic and different activities at the site, especially by generators and compressors. Disturbance to wildlife is likely to arise during construction phases due to increased vehicular traffic, noise and movement of people and machinery. This activity may cause temporary disturbance to nocturnal animals not normally

exposed to such levels of noise and light, although it is likely that the reaction of the animals will simply be to stay away from the works area.

Mitigations

Hunting, fishing or capturing wildlife, or otherwise discharging firearms will be prohibited. Harassment or pursuit of wildlife will be prohibited. Dens of large mammals and colonies of small mammals and reptiles will be given appropriate offset from project activities. Construction of new tracks will be minimized. Project crew will not buy wild birds from local trappers. Movement of project personnel will be restricted to work areas only.

7.4.2.9 Waste Management

Impact

Improper management of non-hazardous and hazardous waste generated during construction may lead to impacts on soil, water, visual environment, in addition to health and safety of workers. Non-hazardous waste includes paper, wood, plastic, scrap metals, glass and mud. Hazardous waste includes absorbent material, metal drums, empty chemical containers, waste oil from machinery lubricants, etc.

Mitigation

A Waste Management Plan of proper design were prepared (Appendix I). Solid wastes collection system will be essential, which should include separation and collection of solid wastes in the dustbins/ waste containers throughout the project site. A log of the disposal of toxic and other waste materials is to be kept by the project proponent. Waste water from should be disposed through sewerage pipeline. Prior to transport, container of all liquid materials should be checked by experienced persons properly. Domestic wastewater generated at site will be collected in septic tanks.

7.4.2.10 Employment and Income Generation

Impact

Positive benefits of the project may arise either from short-term job opportunities during construction, or long-term job opportunities during operation. It is important that construction and operation jobs to be targeted to the local people within *Banani* where feasible.

Recommendation

Contractor as far as practicable will recruit construction workers from amongst the locals where possible and shall maintain gender equity while employing the locals. Additional benefits will be derived by setting aside-areas within contractor camps/labor shed for local people to sell their products or to provide additional services to the workers. Replacement on a suitable location in a better form will be done with the help and consent of the local community.

7.4.2.11 Health & Safety

Impact

The construction activities include site preparation, infrastructure utilities installation, building structures. Therefore, there will be potential impacts on workers' health and safety due to exposure to risks through construction activities that lead to accidents causing injuries and death. Construction works and activities bear frequent accident and health risks for both the laborers and the public general, with varying direct and indirect consequences. Therefore, the project authority needs to make provision for specific medical services, workers insurance policies and indemnities, emergency provisions and a rescue/evacuation plans in case of major accidents.

Mitigation

- The Contractor, under the supervision of project initiator, will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events. The contractor shall ensure all prospect risks during construction phase are assessed and all prevention and mitigation measures are in place accordingly. The contractor shall ensure all workers during construction comply with safety producers through training, awareness and supervising. Moreover, the contractor shall provide all appropriate resources (Personnel Protective Equipment) onsite to ensure providing first aid for personnel in case of occurrence emergencies.
- The project authority will be requested to prepare an approved Construction Environmental Action Plan (CEAP), which will, among others, delineate all work safety aspects he intends to apply. Focal points of the CEAP will relate to means, type and number of protective clothing, safety precautions at specific work sites, first aid, rescue plans, work hours, and all intended measures for avoiding or proper clearance of hazardous substances, including fueling operations, transport and handling of hazardous materials and explosives, securing measures etc. The CEAP will further explain methods and volumes for using any local resource, and how to address common risks associated with public safety. The project authority will disclose the CEAP with the local stakeholders for further developments on the health and safety issue.
- Health and Safety Manager (H&SM) should be engaged for the implementation period of the project. Proper H&S signboards and appropriate information to the local people about the project activities should be provided.

The health and safety requirements of any construction activity must not be compromised at this time. If an activity cannot be undertaken safely, it should not take place. Construction sites operation during the Coronavirus (Covid-19) pandemic, the contractors need to ensure they are protecting their workforce and minimizing the risk of spread of infection.

Due to pandemic COVID-19 there are few instructions for worker and engineers to safe and avoid the effect of Novel coronavirus (COVID-19) at their workplace. These are given below:

- ✓ Sites and work need to be planned and organized to avoid crowding and minimize the risk of spread of infection by following the proper control measures of safe work procedures. Sites should remind the workforce (e.g. at daily briefings) of the specific control measures necessary to protect them, their colleagues, families and others.
- ✓ Social distancing level: social distancing is very effective to stop the spread of the disease, but several reasons that various groups might show dissimilar levels of social distancing:
- ✓ Construction Sites workers need to wear mandatory PPE and maintain 2-meter social distancing.
- ✓ It is mandatory to do thermal screening of everyone entering and existing the work site. People with temperature above 37.3 °C or 99.14 °F, should not be allowed or asked to work either separately or in group.
- ✓ In Office, an Isolation room shall be created so that anyone with cough cold sneeze, can work in isolation
- ✓ Provide additional hand washing facilities (e.g. pop ups) to the usual welfare facilities, particularly on a large spread out site or where there are significant numbers of personnel on site, including plant operators. Provide hand sanitizer (minimum 70% alcohol based) where hand washing facilities are unavailable

- ✓ People who have had medical problems of diabetes, chronic respiratory disease, cardiovascular disease, or even high blood pressure and cancer are at higher risk from coronavirus.
- ✓ Mental Health: Management will promote mental health & wellbeing awareness to staff during the Coronavirus outbreak and will offer whatever support they can be help.

7.4.2.12 Traffic

Impact

During the construction phase traffic is expected to increase to a certain degree due to the nature of activities that will take place such as the transport of equipment and materials to and from the site through the surrounding road network. Additional traffic load will be evident at certain times during the day, especially if there are slow moving heavy vehicles transporting material to and from the site.

The above potential traffic impacts can possibly occur during the construction, especially during working hours. However, this is considered a short-term impact. This impact is likely to happen but is not anticipated to cause any permanent effect on the receiving environment.

Mitigation

Proper Traffic Management Plan (TMP) should be prepared by the contractor during starting of construction and follow it strictly. However, minimum numbers of vehicles will be used for carrying construction materials. Hence, the accidental loss is expected at the lowest. Moreover, the project authority will try to carry the construction materials during off peak hours when the traffic volume is the minimum.

7.4.3 Operation Phase

Operational impacts continue during the life of the project after the completion of construction phase and these impacts are long lasting and, in some cases, permanent. Following sub-sections provide the following potential impacts along with mitigation measures.

Due to increased activities and efficient operational systems, there will be some impacts on the environmental set-up in the project area, which are discussed hereunder. In order to achieve sustainability of the development works, it is necessary to ensure the effectiveness of mitigation measures even after construction, as some adverse environmental impacts may result from the operation of the project facilities. Therefore, in order to reap the full environmental benefits of the activities and ensure environmental enhancement it would be necessary to implement the following, which are beyond the purview of this project.

7.4.3.1 Air Quality

Impact

Project being biogas plant, there will not be any need of combustion process except occasional operation of digester set in case of failure of power. Hence there will be not any regular and continuous point source of flue gas emission.

Mitigation

The generator will be operated only during emergencies when there is failure of power supply. The anaerobic digestion and continuously stirred reactor technology for processing of dung will not generate odor. The project emphasizes on resource recovery i.e. the biogas extracted from the litters is sent for the fuel usage as a substitute to LPG. The slurry will be sent to polyhouse to extract out moisture and use it as manure. Thus, the major cause of foul smell has been

eliminated. The project developer shall be committed to control emitted dust and gaseous pollutant from such operations through the proposed emission control procedures described in the environmental management plan (EMP) included in this report.

7.4.3.2 Noise

Impact

The bioelectricity as a facility is not considered to exhibit any significant noisy operations, although the facility's inverters and transformers may produce noise, but this is not considered a serious issue, since they will not generate any significant noise. In addition, there are no close sensitive receptors within the project site. In addition, noise generated from plant equipment is only heard when distance is close (i.e. within 1-2 m, however, as distance increases, noise will be greatly reduced, not to mention that they do not generate noise during night time. During the discontinuation of electricity supply the generator has to run for power production. However, the diesel generator creates severe noise but the gas generator yet makes significant level of noise to disturb ambient quiet environment.

Mitigation

These noise impacts are not considered to significantly harm animals nor cause impacts on a population level. The increased noise levels are considered occupational noises that require occupational health and safety measures. The worker inside the project area should use earmuffs during the operation of diesel generator. The project proponent should use canopy or silencer to mitigate the noise pollution during the operation stage of this project. The generator room would be constructed by insulated casing and vibration pad will be used beneath the engine pad since the high capacity project makes some vibration.

7.4.3.3 Water Resources

During the operation phase, wastewater will be generated from the Septic tank and leachate will be generated from the process. The plant has proper system for the collection of waste water generated from all sources. Wastewater generated due to operation & maintenance staff will be treated in ETP. Rain water harvesting will be practiced at the plant site.

Hence, no negative impact on surface and ground water environment quality is expected due to the proposed project activities.

7.4.3.4 Terrestrial Ecology

Impact

The probability and consequences of significant ecological impacts occurring as a result of the operation of the Mounded Bullets/facility are considered to be almost negligible. The risk of any leakage is almost negligible owing to stringent leak prevention technologies.

Mitigation

The anticipated impacts on terrestrial ecology are considered low and hence no particular mitigation measure should be followed. However, the vehicular movement should be very limited and proper attention should be given to minimize the disturbance on surrounding ecological environment.

7.4.3.5 Aquatic Ecology

There will be no effluent discharge in the water body. Thus, there is no impact on the aquatic biota present in vicinity of proposed project.

7.4.3.6 Soil

Impact

Soil impacts during operation phase are limited to accidental spillage of lubricant, fuel and other chemicals that may potentially cause soil degradation. Soil contamination from cow manure and ill planned disposal of solid wastes and effluents at project site. These contents are may be harmful for soil quality.

Mitigation

Through implanting spill response procedures, and proper storage and handling of any chemicals on site, the impact probability will be reduced. The project proponent should check these devices regularly and have to replace the damaged and expired or bad devices. However, if possible, the damaged and expired devices should be maintained properly and recycled. Waste and effluents from project site should be disposed of cautiously in pits dug for the purpose at service areas or elsewhere properly.

7.4.3.7 Solid Waste Management

Impacts

The operation of the proposed plant will generate a relatively minor volume of solid wastes. The waste generated during the operation phase of the project will include the domestic waste from the dairy farm staff which will include, waste from kitchen and general rubbish, recyclable waste such as empty containers, paper, plastics bottles etc.

Mitigation

Key elements of the waste management system will be the following:

- Separate waste bins will be placed for different type of wastes - plastic, paper, metal, glass, wood, and cotton.
 - Recyclable material will be separated at source. The recyclable waste will be sold to waste contractors for recycling.
 - Non-hazardous non-recyclable wastes such as construction camp kitchen wastes will be disposed off in an onsite landfill.
 - No waste will be dumped at any location outside the plant boundary.
 - Surplus materials including partially filled chemical and paint containers will be returned to suppliers. Inert wastes will be disposed off onsite as fill material.
 - Records of all waste generated will be maintained. Quantities of waste disposed, recycled, or reused will be logged on a Waste Tracking Register.
- Training will be provided to personnel for identification, segregation, and management of waste.

7.4.3.8 Emissions of Gases

Impact

It is worth mentioning that biogas power plants have very low air emissions of air pollutants such as sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, and the greenhouse gas carbon dioxide during operations. Anaerobic digestion is associated to the production of several greenhouse gases, namely carbon dioxide, methane and nitrous oxide. Though there are some GHG emissions due to the cow manures. The projections are given

Table 7.1: Projections of Manure and GHG Emissions per Year

	2005	2010	2015	2020
Manure (75% moisture) (million tons)	2.26	2.88	3.50	4.06
CH ₄ Emission (tons)	10200	13000	15750	18300
CO ₂ eq. Emission (tons)	214000	273000	331000	384000

Mitigation

- Biogas plant will have beneficial effect on the environment due to reduced pollution load
- The immediate effect of biogas plant would be reduced dumping of biodegradable organic food waste on the landfill and reducing the emission of GHGs.
- The excess wastewater discharged would comply with the norms aimed; with the stipulated norms of Ministry of Environment, Forest and Climate Change (MoEFCC) and will not be harmful to the receiving body.
- No biological sensitive area is present within 10 km radial area.
- All the activities related to construction work shall be confined to the project site only; hence no adverse social impacts are envisaged in the surrounding area due to the project.

7.4.3.9 Waste Management**Impact**

Waste generated during operation phase will be limited to wastewater from maintenance and cleaning activities in addition to domestic waste (due to workers domestic activities). Waste generation during the operation phase is considered part of daily operations, therefore, it is not considered to have any significant impacts to the environment or health of personnel present on site.

Mitigation

Followed the proper waste management plan. A log of the disposal of toxic and other waste materials is to be kept by the project proponent. Waste water from should be disposed through sewerage pipeline. Prior to transport, container of all liquid materials should be checked by experienced persons properly. Domestic wastewater generated at site will be collected in septic tanks.

7.4.3.10 Odor**Impact**

The anaerobic digestion process is not able to produce completely odor less biogas and other byproducts. There are some low-odor wastes will be produced.

Mitigation

The project should include an air ionization system which is incorporated inside the segregation shed which will help keep air odor under control. Also auto sprays with de-odorants are installed. Outside the shed near the hopper the odor absorbing cakes will be installed and replaced at periodical intervals. The plant varieties such as citronella grass, jasmine plants, lemon grass, vetiver will be planted as these plants are known for odor absorption. Plants act as filters because they absorb the toxins through their leaves, especially those with the largest leaves. Sight barrier trees and tall grass such as Bamboo and Ashoka (also works as a lightning arrester) will be planted at the compound wall. Other species of odor absorbent plants can also be selected such as Areca palm, Citronella, and Rubber plant - good for filtering a range of nasties, such as formaldehyde, benzene and ammonia.

7.4.3.11 Impact of Digested Storage and Treatment

Impact

There are several styles of cover for a wet digester tank. Covers can be either fixed or floating. They can be made of a rigid material, like steel or concrete, or they can be made of a flexible material such as a canvas membrane. Flexible membrane covers generally have an inner cover that is able to flex as gas pressure changes and an outer membrane that is kept fully inflated by a small fan. Digesters can also be implemented as earthen, lined lagoons. Lagoons have the benefit of being very inexpensive to install. They are more commonly applied in warmer climates as systems in colder climates require a more engineered approach to control temperature, mixing and gas collection. Lagoons are most commonly applied in animal manure projects or in wastewater treatment where waste volumes are large and land is plentiful.

Mitigation

A proper design and management of feedstock and digestate storage units looks also important in order to mitigate the odour impact of the plant.

7.4.3.12 Organic Fertilizer

Process

While there are suitable inorganic substitutes for the nutrient's nitrogen, potassium and phosphorous from organic fertilizer, there is no artificial substitute for other substances such as protein, cellulose, lignin, etc. They all contribute to increasing a soil's permeability and hygroscopicity while preventing erosion and improving agricultural conditions in general. Organic substances also constitute the basis for the development of the microorganisms responsible for converting soil nutrients into a form that can be readily incorporated by plants. Bio fertilizer is a locally produced alternative to mineral or chemical fertilizers. The farmers collect the manure on our facility to spread out on the fields again.

A fermented slurry with a lower C/N ratio has better fertilizing characteristics. Compared with fresh manure, increases in yield of 5 - 15 % are possible. Particularly good harvests are obtained from the combined use of compost and fermentation slurry.

Impact

The fertilization effect depends on the type of crop and on the soil. When fermentation slurry (called bio fertilizer) is used as fertilizer for years, the soil structure is improved. The proportion of organic materials in the soil is increased, enabling the soil to store more water. If fermentation slurry is to be stored before spreading on the field, it should be covered with earth in layers. This reduces evaporative nitrogen losses even further.

7.4.3.13 Biogas Balloon/Biogas Holder

Process

The bio gas generated in the reactor is primarily stored in the gas holder mounted on top of the reactor tank. Later, Bio gas will be transmitted through the transmission pipeline and will be primarily stored in the biogas storage bag.

Biogas Balloon / Biogas holder material (special PVC Coated) is high voltage and fire resistant, resistant to damage by sharpened steel even when red-hot. The Biogas holder is installed in a special ventilated shed. The Biogas holder is designed to collect and store Biogas under pressure 0.005-0.01 Bar. Biogas supply to the Gas holder is done by means of special branch pipes made of HDPE. Biogas holders are equipped with a safety valve in order to avoid overpressure.

Impact

The advantages of biogas holder are Low cost, ease of transportation, low construction (important if the water table is high), high digester temperatures, uncomplicated cleaning, emptying and maintenance.

7.4.3.14 Employment Opportunities

Impact

During the operation phase job opportunities will be created for executing the project activities. Local people can be involved in the project activities as per their skill and talent.

Mitigation

During the recruitment of workers and other professionals, local poor and distressed people followed by project affected people and poor women should be given priority as per their competence and skill. While recruiting and giving wage gender equity must be maintained.

7.4.3.15 Security and ATEX Zone

Impact

Biogas plants process large quantities of combustible and toxic gases which pose increased fire, explosion or suffocation hazards in case of faults in design, materials or control. In the event of an incident at the plant, people may be injured, property damaged and the environment (air and water) polluted. Operators violating these duties risk that the operation of their plants is no longer in compliance with the law, which may result in a shutdown of the plant and in restriction or even loss of insurance coverage. Health risks due to unsafe working conditions. Safety risks due to construction and operation works.

Mitigation

The operators of biogas plants have a high level of responsibility. Their duties include conducting the necessary inspections, ensuring safety and health documentation of sufficient explosion protection and expert training of employees.

There are many security hidden dangers existing in the engineering construction, the contractor will comply with the contract as well as internationally accepted safety and security standards to take measures in accordance with the characteristics of engineering, and formulate corresponding safety operation specifications and safety precautions for construction, to ensure the safety of the project:

- Safe condition signs are used to indicate escape routes, emergency exists and operation of devices related to escape routes or emergency door operations etc.;
- General Fire Action Notices with specific local information for raising the alarm and evacuating the building;
- Fire exit signs to direct occupants to escape routes;
- Internal fire-resisting doors with 'Fire Door-Keep Shut' or similar notices;
- Internal fire-resisting doors to cupboards/service risers with 'Fire Door – Keep Locked Shut' signs;
- Fire Doors held open with devices interfaced to the alarm 'Automatic Fire Door – Keep Clear' signs;
- Fire exists are provided with 'Fire Escape – Keep Clear' or similar notices;
- Firefighting equipment / fire brigade facilities, where necessary;

- General signs indicating how to use door mechanism i.e. 'Push Bar to Open' where necessary;
- Disabled Refuge locations / keep clear signs; and
- Secure door 'green box' emergency release units.

There are several security zone signs are given in below:



7.4.3.16 Health and Safety

Impact

Improper health and safety (H&S) policy maintained at the site may lead to outbreak of different diseases to the surrounding communities through the sick farm workers. Farm workers may face occupational health hazards such as minor or major injuries due to lack of general safety requirements and precautions applicable for such sites, malfunctioning equipment, careless use of equipment and vehicles, etc. Poorly designed camp and sanitation facilities may pose a health threat and nuisance to the workers. Uncontrolled vending of food and drinking water on the work site may also pose a risk with respect to the transmission of contagious diseases like Typhoid, Diarrhea, Malaria, Dengue, etc. Farm workers will be required to handle hazardous materials therefore increasing health risks of workers.

Biogas plants are complex process engineering systems in which a range of different hazards can occur. The impact origins are in the following sectors:

Environmental Hazard: Essentially the environment is only exposed to danger if biogas escapes into the atmosphere or working materials in the plant (e.g. digestion substrate, silage effluent, oils or fuels) enter nearby bodies of water. An accident of this type may be caused by structural faults or operating errors. Environmental hazards from biogas plants can be divided into emissions into air and emissions into soil and water.

Emergency Fire Hazard: Since this is a power plant, the plant has always some risks of fire hazards. Electrical equipment is the main source of a potential fire hazard. In the event of fire catching a module, it is theoretically possible for hazardous fumes to be released and inhalation of these fumes could pose a risk to human health.

Health Hazard: In light of the potential sources of danger above it is impossible to completely rule out health hazards for operators, employees and third parties. These health hazards can be divided into four categories: hazardous substances, electrical hazards, mechanical hazards, and explosion and fire hazards. Hazardous substances that are particularly likely to be present at biogas plants are biogas, processing aids, oils, activated carbon, silage effluent, slurry, wastes and biological agents. Accident blackspots in this connection include work on the silo or other workplaces at a height, work in the vicinity of rotating parts (e.g. feeding systems) or work in the vicinity of moving vehicles (risk of being run over). Accidents are particularly likely to occur during maintenance and repair work if inadequate protective measures have been taken. Danger of electric shock or arc caused by an electric shock through an individual's body or by an arc flash. Danger from static electricity caused by an electric shock from the discharge of static electricity.

Gas Hazard: Biogas is a mixture of different gases, the concentration of which may vary depending on the plant in question. The workplace exposure limit or occupational exposure limit (OEL) is the time weighted average concentration of a substance in air at the workplace over a specified reference period at which no acute or chronic harm to the health of employees is expected to be caused. As a rule, the limit is set on the assumption that the exposure is for eight hours a day, five days a week over a working lifetime.

Explosion and Fire Hazard: An explosion is defined as the sudden chemical reaction of a flammable substance with oxygen, releasing large amounts of energy. There is a sudden expansion in the volume of gases as the energy is released. This can be brought about by an explosive atmosphere. Flammable substances may be present in the form of gases, vapors, mists or dusts.

Biogas Storage Bag: A biogas storage bag consists of a heat-sealed plastic or rubber bag (balloon), combining digester and gas-holder. The gas is stored in the upper part of the balloon. The inlet and outlet are attached directly to the skin of the balloon. Gas pressure can be increased by placing weights on the balloon. If the gas pressure exceeds a limit that the balloon can withstand, it may damage the skin.

Mitigation

The project developer shall ensure all risks from operation activities to be assessed and to establish specific work procedures for tasks during operation phase including all safety prevention and mitigation measures to avoid non-conformance events.

The Contractor, under the supervision of developer, will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events. The contractor shall ensure all prospect risks during construction phase are assessed and all prevention and mitigation measures are in place accordingly. The contractor shall ensure all workers during construction comply with safety producers through training, awareness and supervising. Moreover, the contractor shall provide all appropriate resources

(Personnel Protective Equipment) onsite to ensure providing first aid for personnel in case of occurrence emergencies.

For gas storage bag safety valves are required. If higher gas pressures are needed, a gas pump is required. Since the material has to be weather- and UV resistant, specially stabilized, reinforced plastic or synthetic caoutchouc is given preference. Other materials which have been used successfully include RMP (red mud plastic), Trevira and butyl. The useful life-span does usually not exceed 2-5 years.

A proper Occupational Health and Safety (H&S) Plan should be prepared and follow it to avoid health hazard of the workers. First Aid Box and Personnel Protective Equipment (PPE) such as hand gloves, safety shoes, goggles, raincoats (during rains) etc. are provided for the workers. In case of major accident, transport should be made available to take the patient to the nearest hospital. Health and Safety Manager (H&SM) should be engaged for the implementation period of the project. Proper H&S signboards and appropriate information to the local people about the project activities should be provided.

Due to pandemic COVID-19 there will be few instructions for worker and engineers to safe and avoid the effect of Novel coronavirus (COVID-19) at their workplace and project site. These are given below:

- ✓ Sites should remind the workforce (e.g. at daily briefings) of the specific control measures necessary to protect them, their colleagues, families and others.
- ✓ Social distancing level: social distancing is very effective to stop the spread of the disease, but several reasons that various groups might show dissimilar levels of social distancing:
- ✓ Construction Sites workers must be need to wear mandatory PPE's maintaining 2-meter social distancing.
- ✓ It is mandatory to do thermal screening of everyone entering and existing the work site. People with temperature above 37.3C or 99.14 F, should not be allowed or asked to work either separately or in group.
- ✓ In Office, an Isolation room shall be created so that anyone with cough cold sneeze, can work in isolation
- ✓ Provide additional hand washing facilities (e.g. pop ups) to the usual welfare facilities, particularly on a large spread out site or where there are significant numbers of personnel on site, including plant operators. Provide hand sanitizer (minimum 70% alcohol based) where hand washing facilities are unavailable
- ✓ Mental Health: Management will promote mental health & wellbeing awareness to staff during the Coronavirus outbreak and will offer whatever support they can be help.

7.4.4 Decommissioning Phase

The main mitigation and monitoring measures to minimize or reduce the environmental and social impacts during decommissioning are anticipated to be similar to those identified for the construction phase. However, some of the major impacts are described below.

7.4.4.1 Visual Amenity

Impact

During the dismantling of the biogas plant system, removal of ancillary facilities visual intrusions will be likely.

Mitigation

Their consequence will be negligible due to fact that such impact would be temporary (over a short period).

7.4.4.2 Air Quality

Impact

Similar to construction, the decommissioning phase is anticipated to generate dust and exhaust emissions. Decommissioning activities will involve site preparation, dismantling and disassembling of the components of the biogas plant facility, clearance of the site etc.

Mitigation

The project developer shall be committed to control emitted dust and gaseous pollutant from such operations through the proposed emission control procedures described in the environmental management plan (EMP) included in this report.

7.4.4.3 Noise

Impact

The decommissioning activities of dismantling the biogas plant and removing the ancillary facilities are associated with potential increased noise levels. The receptors of the increased noise level will be only the workers of decommissioning activities.

Mitigation

As the only receptors will be the workers at the site and within the proposed facilities within the vicinity of biogas power plant, these increased noise levels are considered occupational noises that require occupational health and safety measures.

7.4.4.4 Terrestrial Ecology

Impact

The activities associated with decommissioning will involve dismantling of the power plant and removal its facilities. This is a temporary phase that could result in some additional noise and dust disturbances. These activities are not anticipated to harm any flora elements due to absence or scarcity of vegetative cover within and around project area, provided dust suppression measures and other procedures are followed. On the other hand, decommissioning activities may cause disturbance to bird species.

Mitigation

The mitigation measures should be the same as it was considered during the construction phase since the decommissioning activities will be same as construction phase.

7.4.4.5 Employment Opportunities

Impact

Short-term job opportunities may be arising during decommissioning; however, this can negatively impact permanent personnel at the biogas power plant since the facility will cease its operations, therefore permanent staff may lose their jobs.

Although this impact is very unlikely given that fact that an upgrade is expected for the facility during its post-design life, however, the consequence is considered critical to permanent personnel if the facility underwent decommissioning, yielding a low impact significance.

Recommendation

Preference should be given to employing the local communities in various positions.

7.4.4.6 Soil

Impact

During the decommissioning phase, the decommissioning activities are anticipated to have an impact of medium significance to soil. This is due to possible accidental leakage of fuel, oil, or chemicals during demolition activities.

Mitigation

Proper environmental protection measures should be followed to prevent or control the occurrence of such incidences.

7.4.4.7 Health and Safety

Impact

The decommissioning activities will include equipment dismantling and demolishing facilities at project site. As all project components will be recycled after decommissioning, the prospect risks from decommissioning phase will be limited to dismantling and demolishing activities including moving all recyclable components to their final destination. There will be potential impacts on workers' health and safety due to exposure to risks through decommissioning activities.

Mitigation

The project developer will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events. The developer shall ensure all prospect risks during decommissioning phase are assessed and all prevention and mitigations measures are in place accordingly.

7.5 Summary of the Anticipated Impacts

Table 7.2 below present a summary of the anticipated impacts during the planning and construction, operation, and decommissioning phase of the Project.

Table 7.2: Summary of the Anticipated Impacts During the Planning, Construction, Operation Phase and Decommissioning Phase

Environmental Attribute	Impact Assessment							
	Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
Planning & Construction Phase								
Landscape and Visual	Short term	Local	Reversible	Certain	Medium	Mild	Low Negative	Low Negative
Air Quality	Long term	Local	Reversible	Certain	Medium	Mild	Low Negative	High Positive
Biodiversity	Long term	Local	Irreversible	Certain	Minor	Mild	Low Negative	Moderate Positive
Noise	Long term	Local	Reversible	Certain	Medium	Mild	Moderate Negative	Low Negative
Geology and Hydrology	Long term	Local	Irreversible	Likely	Medium	Mild	Moderate Negative	High Positive
	Could be long term	Local	Could be irreversible	Likely	Medium	Mild	Low Negative	High Positive
Health and Safety	Short term	Local	Could be irreversible	Likely	Medium	Mild	Moderate Negative	Low Negative
Operation Phase								
Air Quality	Long term	Local	Could be irreversible	Likely	Minor	Low	Low Negative	Moderate Positive
Backup Generator	Long term	Local	Reversible	Certain	Medium	Mild	Moderate Negative	Low Negative
Biofertilizer	Long term	Local	Could be irreversible	Likely	Medium	Mild	Low Negative	Moderate Positive
Geology and Hydrology	Long term	Local	Could be irreversible	Likely	Minor	Low	Low Negative	Moderate Positive
Noise	Long term	Local	Reversible	Likely	Medium	Mild	Moderate Negative	Low Negative
Occupation and Community Health & Safety	Long term	Local	Could be irreversible	Likely	Medium	Mild	Low Negative	Moderate Positive
	Long term	Local	Could be irreversible	Likely	Medium	Mild	Low Negative	Moderate Positive
Decommissioning Phase								
Geology and Hydrology	Short term	Local	Could be irreversible	Likely	Medium	Low	Moderate Negative	Low Positive
Air Quality	Short term	Local	Reversible	Certain	Medium	Low	Moderate Negative	Low Negative
Noise	Short term	Local	Reversible	Likely	Medium	Mild	Moderate Negative	Low Negative
Health and Safety	Short term	Local	Could be irreversible	Likely	Medium	Mild	Moderate Negative	Low Negative

8 STAKEHOLDER CONSULTATION AND DISCLOSURE

8.1 Introduction

Stakeholder Consultation is both an essential criteria and important strategy for an integrated environmental and social analysis process, the project design and its implementation. Its goal is to improve decision-making and build understanding by actively involving individuals, groups and organizations with a stake in the project. This involvement will increase a project's long-term viability and enhance its benefits to locally affected people and other stakeholders. Stakeholder Consultations such as Focus Group Discussions (FGDs) have been conducted during the ESIA study in conformity with the DOE guidelines to achieve the following objectives:

- To enhance the sustainability of project by ensuring that interventions are relevant to the objectives of the project and will be beneficial to the people of the area.
- To determine potential environmental, social, economic, cultural impacts and develop their mitigation plans including potential negative impacts along with mitigation and positive impacts along with enhancement.

FGDs have been carried out with the group of people such as:

- Dairy farm workers
- People living near the project

These stakeholder consultations have been provided key inputs for the identification of the potential impacts (site specific) along with possible mitigation and enhancement measures of the project.

8.2 Consultation with Various Stakeholders

A stakeholder is defined as any individual or group who is potentially affected by the proposed Project or can they affect the proposed Project directly or indirectly. Stakeholder consultation is an inclusive process for sharing information that enables stakeholders to understand the risks, impacts, and opportunities of a development or project, allowing them to express their views and articulate their perceptions towards it. The participants will be invited to attend at a certain place and time to discuss with the project design team to discuss on the environmental and social issues.

Through the project preparation stage FGD have been arranged during the conduct of the ESIA survey. The details of FGD are given in Appendix J.

Table 8.1: Details of Stakeholder Consultation

Sl. No.	Location	Date	Time	Comments/Suggestions
01	Proposed Project Area (Vill: Shatgharia Uni: Holdia, Upz: Lohajong Dist: Munshiganj)	03.02.2020	12.30am to 01.20 pm	▪ This is generally excellent activity. A fruitful usage of this project will rouse others to take this sort of venture for their own farm. ▪ Incompetent and poor ladies can build up their abilities. They will help their family by acquiring money just as help to national economy. ▪ The project ought to be built in an environmentally friendly way. ▪ The open drain needs to be covered. ▪ There should be proper noise barrier or boundary wall at the noise source.

Sl. No.	Location	Date	Time	Comments/Suggestions
				- More electricity will help to improve the farm overall condition and productivity. - The project proponent should take all action to confirm no accidental hazards because of gas generation. - To use proper biogas utilization equipment's and also to concentrate on odorless biogas production.



Figure 8.1: Photos of Stakeholder Consultation

8.3 Identification of Issues

The consultation process identified a number of key issues and themes associated with the Project. Overall, the attitude to the Project appeared to be positive, though many questions and concerns were raised about the potential for negative impacts of the Project, including the potential for loss of livelihood and environmental damage. The results of consultation have been categorized into the following issues:

8.3.1 Land, Livelihood and Employment Opportunities

This project will be resulted in local people's employment opportunities. In several sections as per their skills, the project management unit through the contractor can appoint them. The employment opportunities will create newer path to earn their livelihood and also to maintain their status. The land selected for the project is within the project boundary of DDL which indicates that no further land acquisition will be needed.

8.3.2 Project Scope and Awareness

The introduction of this project and its usefulness should be understandable by the people near the project area. From the consultation it will be clearer about this project's viability and also the scope of using the cow manures turning into energy. The sustainability of this project also will be recognized through these consultations.

8.3.3 Environmental Management

There are several environmental impacts of the project in the pre-construction phase also true for both construction and decommissioning phases. The outcome of these consultations will also provide local knowledge regarding the biogas production technic and also include the alternative technology if plausible.

8.3.4 Bio fertilizer

A bio fertilizer is not just any organic fertilizer or manure. It consists of a carrier medium rich in live microorganisms. When applied to seed, soil or living plants, it increases soil nutrients or makes them biologically available. The improvement in soil texture and quality helps plants grow better during periods of drought. Bio fertilizers help plants develop stronger root systems and grow better. Bio fertilizers also reduce the effects of harmful organisms in the soil, such as fungi and nematodes. Plants resist stress better and live longer.

8.3.5 Waste Management

Currently the generated wastes are being dumped in an open space inside the firm but it is not environment friendly and also hazardous for both human and animal. But proper implementation and utilization of this project will definitely be fruitful as the wastes will be properly managed and also will cut the extra maintenance cost needed due to manage the waste.

Table 8.2: Summary of the Stakeholder Consultation

Questions to the Groups	Participants opinion, comments and suggestions
Are you aware about the activities of the Biogas Based Power Plant project? If yes, what are they?	Yes, Dutch Dairy Limited (DDL) will establish Biogas Based Power plant for his farm. It is a good initiative.
How the project will impact on surrounding environment? Please mention both positive and negative sites.	The project will give less environmental impact because the project area is surrounded by boundary wall.
What do you think of choosing biogas over other sources?	It is obvious that it is a renewable energy source also the raw materials will be collected from the farm which will be both cost effective and environment friendly. Besides its a comparatively lesser pollution generating energy and Biogas plants significantly lower the greenhouse effects on the earth 's atmosphere. The plants lower methane emissions by entrapping the harmful gas and using it as fuel. Also, the solid left overs also will be useful as bio fertilizers.
Any air pollution in the area due to the project area due to the project activities? If yes, how to mitigate?	The air quality will not decrease significantly because of construction activities. Through more traffic will run to carry construction materials which will increase dust around the roadside but this would not be harmful to local people. Construction of building for workers shed and other facilities will decrease the local air quality temporarily. As the project site far from the residence so there is less possibility of health impact. No need to take any serious attention to reduce this impact but the proponent should be careful about this issue.
Any noise- impact of the project during construction and operation at the locality? If yes how to mitigate?	The noise level will increase because of running construction machineries and movement of workers. The effect will be temporary. After the construction is finished, the noise level will return to the previous limit. Still, there should be proper noise barrier or boundary wall at the noise source to minimize the minor possibility of the anticipated impact. The proponent needs to take some attention to reduce this impact.
Any impact on local soil due to the project activities? If yes, how to mitigate?	Agricultural land will decrease because of the implementation of this project. The implementation of this project will hamper the nearest agricultural practices of the proposed plant area. Any spillage of chemicals and toxic materials will degrade the soil quality of the project site. The project proponent should take proper attention regarding this accident. The waste materials should be maintained properly and it should not be kept at open place.
Any impact on ground/ drinking water quality due to the project? If yes, how to mitigate?	There is no problem with the groundwater quality because of the Power Plant construction. However, the project proponent should confirm that no accidental spillage or washout of hazardous/waste material to

Questions to the Groups	Participants opinion, comments and suggestions
	surrounding water bodies during construction; particularly in the monsoon.
Any impact on the surface water body (river, pond, khal, beel, canal etc.)? If yes, how to mitigate?	There is no problem with the surface water quality because of the Power Plant construction. However, the project proponent should confirm that no accidental spillage or washout of hazardous/waste material to surrounding water bodies during construction; particularly in the monsoon.
Is the proposed area inundated during flood? If yes, how much?	The project site is a flood prone area. The project proponent should develop the land prior the start the construction works.
Is wildlife (birds, snakes, crabs, fox etc.) available in the area? If yes, mention their name. Among them which are endangered?	The availability of the wildlife (birds, snakes, crabs, fox etc.) is low in this area. No endangered species are found.
Are any Environmental Protected Area (EPA) / Environmental Sensitive Area located nearby the project? If yes, where & how far from the project?	No.
Is there any particular sensitive area nearby the project that you think should be protected? If yes, where & how far from the project location?	No particular sensitive area nearby the project area. But there are schools, mosques and bazar within 1 km radius.
Will the project impact on your social and economic sector? If yes, how?	Yes, due to the implementation of this project unskilled and poor women can develop their skills. They will help their family by earning money which in the long run will contribute to the national economy.
Are you in favor of this project? Why?	Yes, we appreciate the initiative. This project in the long run will help to develop the economic and social condition in this area.

9 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

9.1 General

The ESMP provides an essential link between predicted impacts and mitigation measures during implementation and operational activities. The ESMP aims to ensure the compliance of all activities undertaken during the implementation and the operation of the proposed project with the environmental and social safeguard requirements of the Donor and Government of Bangladesh. Furthermore, it aims at integrating the environmental and social components of the project with existing initiatives and programs in these fields. The plan consists of mitigation, monitoring and institutional measures to be taken during implementation and operation to eliminate adverse environmental impacts, offset them, or reduce them to acceptable levels. The plan also includes the actions needed to implement these measures. For each attribute, or operation, which could otherwise give rise to impact, the following information is presented:

- A comprehensive listing of the mitigation measures
- Parameters that will be monitored to ensure effective implementation of the action
- Timing for implementation of the action to ensure that the objectives of mitigation are fully met

9.2 Objectives

The basic objective of the ESMP is to manage adverse impacts of the Project interventions in a way, which minimizes the impacts of the environmental, social and people of the Project area. The specific objectives of the ESMP are to:

- Minimizing any adverse environmental, social and health impacts resulting from the project activities;
- Conducting all project activities in accordance with relevant Bangladesh Legislation and applicable World Bank guidelines.
- Implementation of on-going environmental monitoring programs;
- Periodic review of the environmental management programs to allow for iterative improvement;
- Ensure that all stakeholder concerns are addressed.

Overall, this ESMP aims at ensuring the application of the mitigation and monitoring measures needed to reduce and control the various environmental and social impacts associated with the implementation of the proposed project.

9.3 Environmental and Social Management Plan (ESMP)

On the basis of identification of the environmental impacts and recommended mitigation measures linked with the project activities, an ESMP has been prepared which will be followed at the construction and operation stages. While preparing the ESMP, medium and significant impacts are taken into consideration to recommend possible mitigation measures. A mitigation measure will be considered as successful when it complies with the Environmental Quality Standards (EQS), policies, legal requirements set by World Bank Safeguard Policies, and DoE environmental guidelines & other relevant GoB legal requirements. In absence of DoE's EQS, other relevant international or other recognized organization's quality standard will be applied.

Table 9.1: Environmental Management Plan-Mitigation Measures

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Pre-construction Phase						
Permit from Respective Department	A permit or clearance should be taken from the department of Environment, Union Parishad, etc. Without the clearance, no construction works can be started.	The clearance from DoE and the union parishad has already been taken. The copies of the clearances are attached in Annex K and Annex L respectively.	N/A	Copy of permit	N/A	Environmental Conservation Rules (ECR), 1997
Land Use	The proposed project will be built by the initiator in their own dairy farm premises. Therefore, there are no anticipated impacts about land use during the planning phase of the Project.	The project initiator is to take responsibility of minimizing environmental impact on the surroundings by following the project's ESMP. Since these activities are to be performed temporarily the minimum impact is expected to be acceptable.	N/A	Land Document	N/A	National Land use Policy, 2001
Construction Phase						
Visual Amenity	Visual impacts from construction activities such as materials lay down, infrastructure development etc.	The contractor shall ensure general cleanliness and good housekeeping practice at the project site at all times.	Daily	Good housekeeping and tidiness of work areas within the project site.	Contractor /DDL	- National Land use Policy, 2001 - National Environmental Policy, 1992 - National Environmental Management Action Plan, 1995
Noise	Increased noise levels during to construction & machinery.	- The contractor shall use heavy equipment, machinery, and fuels in compliance with national regulations. The contractor shall perform regular maintenance on all equipment, vehicle and machinery to prevent noise emissions. - The contractor shall limit idling of engines when not in use to reduce its contribution to noise emissions.	Every week and after receiving any complaints from worker or third parties.	Compliance with DoE and National guideline limits for Environmental noise at sensitive receptors.	Contractor /DDL	- Environmental Pollution Control Ordinance, 1977 - Noise Pollution Control Rules (2006)
Air Quality	- Dust generation due to construction activities. Exhaust Emissions due to operation of construction plant and machinery. - Operation of generator sets as standby power	- Train workers to handle construction materials and debris during construction to reduce fugitive emissions. - Ensure adequate maintenance and inspection of vehicles to minimize exhaust emissions. Not running engines for longer than is necessary.	Daily	- No visible dust plumes originating From construction sites. - Regular machineries maintenance records.	Contractor /DDL	- Environmental Pollution Control Ordinance, 1977 - Environmental Conservation Rules (ECR), 1997 - Environment Court Act, 2000 - Bangladesh Climate Change Strategy and Action Plan (2008)

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	back up system would generate gaseous emissions. The degree of dust generated will be depending on the soil compaction and moisture content of the ground surface during construction.	- Proper planning of dust causing activities to take place simultaneously in order to reduce the dust incidents over the construction period. - GI sheets are provided to a height of 5 m all around the project site to control dust; - Water is sprinkled at regular intervals; - SO₂ emissions from diesel generators are expected to be low because of usage of low sulfur content diesel; - Use of efficient machinery and schedule maintenance of the Construction vehicles and equipment.				
Soil	- Soil characteristics may be deteriorated at project site due to accidental spillage of chemicals, and contamination from cow manure and ill planned disposal of solid wastes and effluents at project site. - Soil disturbance due to removal of top soil, potential accidental spillage	- Handling, operation and storage of noxious chemicals, and other hazardous materials, etc., should be done cautiously and carefully avoiding accidental spillage. Waste and effluents from project site should be disposed of cautiously in pits dug for the purpose at service areas or elsewhere properly. - Any spilled chemical shall be immediately collected and disposed of in accordance with Spill Prevention and Response Plan and MSDS. - Contractor shall ensure that a spill kit and adequate PPE is available at the site for emergency cleanup activities in case of chemical/oil spillage.	Weekly	- Number of spills or incidents to be recorded during onsite audits. - Training records of Personnel trained in spill response procedures must be filed	Contractor /DDL	- Environmental Pollution Control Ordinance, 1977 - The Environment (Pollution Control) Act, 1995
Terrestrial Ecology	Potential disturbance to birds	- Minimize human and vehicular contact with fauna, including their burrows / nests and feeding grounds. - Waste shall be stored on site within closed container, especially food remnants to avoid attracting birds on site.	Daily	N/A	Contractor /DDL	- Bangladesh Wildlife Preservation Order 1973 and Revision 2008 (Draft) - National Forest Policy and Forest Sector Review (1994, 2005) - The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry) - National Biodiversity Strategy and Action Plan (2004)

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Health and Safety risks	- Potential of exposure to safety events such as tripping, working activities, - Exposure to health events during construction activities such as manual handling and musculoskeletal disorders, hand-arm vibration, temporary or permanent hearing loss, heat stress, and dermatitis.	- All construction equipment used for the execution of the project works shall be fit for purpose and carry valid inspection certificates and insurance requirements. - Provide walkways that are clearly designated as a walkway; all walkways shall be provided with good conditions underfoot; signposted and with adequate lighting. - Signpost any slippery areas, ensure proper footwear with a good grip is worn for personnel working within slippery areas. - Avoid work at height where it reasonably practicable to do so, e.g. by assembly at ground level. - Prevent any person falling a distance liable to cause personal injury e.g. by using a scaffold platform with double guard-rail and toe boards; - Arrest a fall with equipment to minimize the distance and consequences of a fall, e.g. safety nets, where work at height cannot be avoided or the fall prevented. - Set up a system to alert workers on site. This may be temporary or permanent mains operated fire alarm. - Fire extinguishers should be located at identified fire points around the site. The extinguishers shall be appropriate to the nature of the potential fire. - Establish and communicate emergency response plan (ERP) with all parties, the ERP to consider such things as specific foreseeable emergency situations, organizational roles and authorities, responsibilities and expertise, emergency response and evacuation procedure, in addition to training for personnel and drills to test the plan - Ensure all plant machines and vehicles are regularly inspected, serviced and maintained; ensure all staff assigned is trained and	Continuously	- Total Recordable - Incidence Rate (TRIR) - Lost Time Incidence Frequency - Fatal Accident - Rate - Number of safety Training performed - Number of nonconformance events Reports. - Medical Treatment Case (MTC)		Bangladesh Labour Law, 2006

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		competent to operate plant machines and vehicles. ▪ Electrical equipment must be safe and properly maintained; works shall not be carried out on live systems. ▪ Only competent authorized persons shall carry out maintenance on electrical equipment, adequate Personal Protective Equipment (PPE) for electrical works must be provided to all personnel involved in the tasks. ▪ Adequate number of staff and first aiders shall be on site in accordance with Bangladesh Labor Law requirements. ▪ First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors, thermometer, etc. shall be made available by the contractor on site. ▪ Emergency evacuation response shall be prepared by the contractor and relevant staff shall be trained through mock-up drills. ▪ Ensure all equipment is suitable for jobs (safety, size, power, efficiency, ergonomics, cost, user acceptability etc.), provide the lowest vibration tools that are suitable and can do the works. ▪ Ensure all tools and other work equipment are serviced and maintained in accordance with maintenance schedules and manufacturer's instructions. ▪ Regular noise exposure assessments and noise level surveys of noisy areas, processes and equipment shall be carried out in order to form basis for remedial actions when necessary. ▪ As far as reasonably practical, all steps to reduce noise exposure levels of employees by means other than that of personal protective equipment shall be taken, such as reducing exposure times, enclosures, silencers, machine covers, etc.				

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		- Awareness training sessions should be established and provided to all personnel involved during the construction phase in order to highlight the heat related illnesses of working in hot conditions such as heat cramps, heat exhaustion, heat stroke, dehydration. - Ensure adequate quantities of drinking water are available at different locations within the site, - Provision of sun shades at different locations within the site. - Eliminate the risk of exposure whenever possible, provide proper PPE wherever necessary and to ensure that there are satisfactory washing and changing facilities. - Ensure that all workers exposed to a risk are aware of the possible dangers. They should be given thorough training in how to protect themselves and there should be effective supervision to ensure that the correct methods are being used.				
Water Resources	- Increased water demand during construction phase for site preparation, dust spraying, construction activities, curing, domestic and other water requirements for labour and staff onsite - Increase in site runoff and sedimentation. Run-off after a storm from the site may contain oil and silt that may pollute the surrounding land. Earthworks may also alter the drainage pattern and affect the storm water flow.	- The impact would be restricted within the plant boundary. Thus, the impacts of construction activities will be marginal in scale. - However, for major part of the year during construction phase, no detectable impact is expected because water quality will not change significantly. Hence, no tangible impact on the aquatic eco-system is anticipated.	Daily	No visible pollutants originating from construction sites.	Contractor /DDL	- Environmental Pollution Control Ordinance, 1977 - Environmental Conservation Rules (ECR), 1997 - Environment Court Act, 2000 - Bangladesh Climate Change Strategy and Action Plan (2008)

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Waste Generation	Improper management and handling of hazardous and non-hazardous waste during construction.	- The contractor shall segregate storage for different types of wastes, such as hazardous, non-hazardous recyclable construction material, plastic, paper, etc. to facilitate proper disposal. - The contractor shall provide a separate storage area for hazardous materials. The hazardous materials/products must be labeled with proper identification of its hazardous properties. - Chemical waste shall be stored in accordance with the provisions of Material Safety Data Sheets (MSDS). The contractor shall keep MSDS onsite. - The contractor shall establish regular intervals for waste collection and disposal as per contractor's waste management procedures. - The sanitary and organic wastes shall be collected in a septic tank to be installed on site and disposed of regularly.	Daily	- Compliance with Waste management procedures. - Current and Complete records of regular waste pickup and disposal.	Contractor /DDL	- Environmental Pollution Control Ordinance, 1977 - The Environment (Pollution Control) Act, 1995 - Environmental Conservation Rules (ECR), 1997
Archaeological and Cultural Resources	No known sites of archeological or cultural value are known to exist near the proposed well site or along the access road. The project is therefore not expected to have any impact on archeological or cultural resources of the area.	Appropriate project staff will be trained to identifying items of archaeological importance so that no artifact is inadvertently destroyed during the project construction activities.	Weekly	N/A	Contractor /DDL	The Antiquities Act, 1968
Operation Phase						
Noise	Significant sound pollution from backup generator	- Establish the generator inside an insulated room and use noise reduction canopy to keep the environment free from sound pollution. - Noise barrier should also be given around the generator room. - The worker inside the project area should use earmuffs during the operation of diesel generator.	Every week and after receiving any complaints from worker or third parties.	Compliance with DoE and National guideline limits for Environmental noise at sensitive receptors.	Contractor /DDL	- Environmental Pollution Control Ordinance, 1977 - Noise Pollution Control Rules, 2006

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Backup Generator	The most significant noise source of this power plant is from the 150 KW backup diesel generator. To ensure smooth electric supply the project proponent will run diesel generator in case of any disharmony. The diesel generator will create discomfort sound level around the project area which may affect to the surrounding inhabitants.	However, the noise from diesel generator needs to act for mitigation. The project proponent should establish the generator inside an insulated room to keep the environment free from sound pollution. Additionally, the generator should be upwardly enclosed with the noise reduction canopy. Noise barrier should also be given around the generator room as a mitigation measure from noise pollution. The increased noise levels are considered occupational noises that require occupational health and safety measures. The worker inside the project area should use earmuffs during the operation of diesel generator.	Continuously	Compliance with DoE Regular machineries maintenance records.	Project Developer	- Environmental Pollution Control Ordinance, 1977 - Environmental Conservation Rules (ECR), 1997 - Environment Court Act, 2000
Terrestrial Ecology	Potential disturbance and harm to birds	- Minimize human and vehicular contact with resident birds including their burrows / nests and feeding grounds. - Ground nests found on site shall be translocated outside the project boundary. - Waste shall be stored on site within closed container, especially food remnants to avoid attracting birds on site.	Weekly	No reported harm to birds.	Project Developer	- Bangladesh Wildlife Preservation Order 1973 and Revision 2008 (Draft) - National Forest Policy and Forest Sector Review (1994, 2005) - The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry) - National Biodiversity Strategy and Action Plan, 2004
Soil	Potential spillage of stored oil and chemicals	- Specific procedures shall be developed for the removal of waste or spilled fuel, oil and contaminated soil at approved disposal facilities. - Proper storage for chemicals and fuel within confined areas on site and adopting proper safety measures when handling those chemicals to prevent their leakage and infiltration into the soil.	Post rainfall Event Weekly	Maintain readily available records of all workers training on spill response procedures.	Project Developer	- Environmental Pollution Control Ordinance, 1977 - The Environment (Pollution Control) Act, 1995
Bio fertilizer	During the digestion process, gaseous nitrogen (N) is converted to ammonia (NH₃). In this water-soluble form the nitrogen is available to the plants as a nutrient. A	The fertilization effect depends on the type of crop and on the soil. When fermentation slurry is used as fertilizer for years, the soil structure is improved. The proportion of organic materials in the soil is increased, enabling the soil to store more water. If fermentation slurry is to be stored before spreading on the field, it should be	Daily	Increase soil fertility	IDCOL	-

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	particularly nutrient-rich fertilizer is obtained if not only dung but also urine is digested. Compared with solid sludge from fermented straw and grass, the liquid slurry is rich in nitrogen and potassium. The solid fermentation sludge, on the other hand, is relatively richer in phosphorus. A mixture of solid and liquid fermented material gives the best yields. The nutrient ratio is then approximately N: P2O5:K2O=1:0.5:1.	covered with earth in layers. This reduces evaporative nitrogen losses even further.				
Waste Generation	Waste generated during operation phase will be limited to wastewater from maintenance and cleaning activities in addition to domestic waste (due to workers domestic activities). Waste generation during the operation phase is considered part of daily operations, therefore, it is not considered to have any significant impacts to the environment or health of personnel present on site.	Followed the proper waste management plan. A log of the disposal of toxic and other waste materials is to be kept by the project proponent. Waste water from should be disposed through sewerage pipeline. Prior to transport, container of all liquid materials should be checked by experienced persons properly. Domestic wastewater generated at site will be collected in septic tanks.	Continuously	- Compliance with Waste management procedures. - Current and Complete records of regular waste pickup and disposal.	IDCOL	- Environmental Pollution Control Ordinance, 1977 - The Environment (Pollution Control) Act, 1995
Odor Management	Generation of flies, worms, insects and mosquitoes due to improper handling of	- The workers of the farm will be given training by the PMU to properly operate and maintain the biogas plant. - In order to mitigate odor problem, the leakage from biogas digester, piping and stoves should	Daily	Hygiene at Biogas plant site	IDCOL	Environmental Pollution Control Ordinance, 1977

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	cattle slurry and digested sludge Odor problem from biogas plant	not be there. For this effective maintenance of biogas plants is needed.				
Terrestrial Ecology	The project area does not encompass any natural systems. The anticipated impacts on terrestrial ecology is considered low, however, activities such as vehicular movement, may cause disturbance to resident birds and their ground nests.	The anticipated impacts on terrestrial ecology are considered low and hence no particular mitigation measure should be followed. However, the vehicular movement should be very limited and proper attention should be given to minimize the disturbance on surrounding ecological environment.	Weekly	No reported harm to birds.	IDCOL	- Bangladesh Wildlife Preservation Order 1973 and Revision 2008 (Draft) - National Forest Policy and Forest Sector Review (1994, 2005) - The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry) - National Biodiversity Strategy and Action Plan, 2004
Sign and Security	Biogas plants process large quantities of combustible and toxic gases which pose increased fire, explosion or suffocation hazards in case of faults in design, materials or control. In the event of an incident at the plant, people may be injured, property damaged and the environment (air and water) polluted.	There are many security hidden dangers existing in the engineering construction, the contractor will comply with the contract as well as internationally accepted safety and security standards to take measures in accordance with the characteristics of engineering, and formulate corresponding safety operation specifications and safety precautions for construction, to ensure the safety of the project	Daily	Increase safety and security	IDCOL	-
Health and Safety	- Biogas plants are complex process engineering systems in which a range of different hazards can occur - Environmental hazards from biogas plants can be divided into emissions into air and emissions into soil and water. - Emergency Fire Hazard	- Ensure all works and storage areas are tidy, all material deliveries shall be planned to minimize accumulated materials at project site. - Signpost any slippery areas, provide proper footwear during working within slippery areas. - Set up a system to alert workers on site. This may be temporary or permanent mains operated fire alarm. - Fire extinguishers should be located at identified fire points around the site. The	Continuously	- Number of safeties Training performed - Number of nonconformance events.	IDCOL	Bangladesh Labour Law, 2006

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	▪ Accident blackspots in this connection include work on the silo or other workplaces at a height, work in the vicinity of rotating parts (e.g. feeding systems) or work in the vicinity of moving vehicles (risk of being run over). Accidents are particularly likely to occur during maintenance and repair work if inadequate protective measures have been taken. Danger of electric shock or arc caused by an electric shock through an individual's body or by an arc flash. Danger from static electricity caused by an electric shock from the discharge of static electricity. ▪ Slipping and tripping, working at height activities ▪ As a power plant, the plant has always some risks of fire hazards. Electrical equipment is the main source of a potential fire hazard. ▪ The workplace exposure limit (TRGS 900, 2016) or occupational exposure limit (OEL) is the time weighted average concentration of a substance in air at the	extinguishers shall be appropriate to the nature of the potential fire. ▪ Establish and communicate emergency response plan with all parties, the ERP to consider such things as specific foreseeable emergency situations, organizational roles and authorities, responsibilities and expertise, emergency response and evacuation procedure, in addition to training for personnel. ▪ Adequate first aiders shall be on site in accordance with Bangladesh Labour Law requirements. ▪ First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors, thermometer, etc. shall be made available by the contractor on site.				

Aspect	Key Potential Impact/Issue	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	workplace over a specified reference period at which no acute or chronic harm to the health of employees is expected to be caused Gas pressure can be increased by placing weights on the balloon. If the gas pressure exceeds a limit that the balloon can withstand, it may damage the skin.					
Decommissioning Phase						
- The biogas power plant facility is viewed as an enormous scope long haul venture that will add to monetary advantages to the nation through arrangement of bioelectric flexibly structured as per best work on, considering all important national and inner codes and enactment. - Risk of soil and groundwater contamination during the various decommissioning activities from improper housekeeping activities, random discharge of waste and wastewater. - The main mitigation and monitoring measures to minimize or reduce the environmental and social impacts during decommissioning are anticipated to be similar to those identified for the construction phase. - Therefore, to avoid repetition, please refer to Table for detailed mitigation measures that are overlap with decommissioning as well. - Proper decommissioning and recycling of power plants instruments both ensures that potentially harmful materials are not released into the environment and reduces the need for virgin raw materials.						

9.4 Environmental and Social Monitoring Plan (ESMP)

9.4.1 General

An Environmental and Social Monitoring Plan will be prepared to provide guidelines for environmental management plan during the construction and operation phases of the biogas-based power plant. The environmental components that will be monitored are those that will be positively or negatively affected, or expected to be affected, by construction activities. Environmental management is a sustainable way of planning, arranging, supervising, organizing, and developing the environment for the maintenance of the preservation of natural resources and the prevention or reduction of damage to the environment. Environmental management is a sustainable way of planning, arranging, supervising, organizing, and developing the environment for the maintenance of the preservation of natural resources and the prevention or reduction of damage to the environment. The major environmental impact, monitoring method, responsible organization, and expense for each environmental item in the construction and operation phases for the proposed development are listed in Table 9.2

9.4.2 Objectives

The objective of environmental monitoring during the construction and operation phases is to compare the monitored data against the baseline condition collected during the study period to assess the effectiveness of the mitigation measures and the protection of the ambient environment based on national standards. The main objectives of the pre-construction, construction and operation phase monitoring plans will be to:

- Monitor the actual impact of the works on physical, biological and socioeconomic receptors within the project area for indicating the adequacy of the ESIA;
- Recommend mitigation measures for any unexpected impact or where the impact level exceeds that anticipated in the ESIA;
- Ensure compliance with legal and community obligations including safety on construction sites;
- Ensure the safe disposal of excess construction materials.
- Appraise the adequacy of the ESIA with respect to the project's predicted long-term impacts on the physical, biological and socio-economic environment;
- Evaluate the effectiveness of the mitigation measures proposed in the ESMP and recommend improvements, if and when necessary;

Table 9.2: Environmental and Social Monitoring Plan

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
				Implementation	Supervision
Pre-Construction Stage					
Permit from respective department	No Objection Certificate (NOC) from respective departments, authorities and institutes.	N/A	Prior to construction	DDL	DDL
Air Quality	SO ₂ , NO _x , CO, SPM, PM _{2.5} , PM ₁₀	Air quality standard by DoE, Bangladesh	Once	Contractor	DDL
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	Once	Contractor	DDL
Water Quality	Groundwater: pH, Alkalinity, Fe, Cl ⁻ , TDS, As	Groundwater quality standard by DoE, Bangladesh	Once	Contractor	DDL
	Surface water: pH, TDS, DO, COD, BOD ₅	Surface Water quality standard by DoE, Bangladesh	Once	Contractor	DDL
Construction Stage					
Air Quality	SO ₂ , NO _x , CO, SPM, PM _{2.5} , PM ₁₀	Air quality standard by DoE, Bangladesh	Once	Contractor	DDL
Dust	Dust control	Air quality standard by DoE, Bangladesh	Once	Contractor	DDL
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	Once	Contractor	DDL
Water Quality	Groundwater: pH, Alkalinity, Fe, Cl ⁻ , TDS, As	Groundwater quality standard by DOE, Bangladesh	Once	Contractor	DDL
	Surface water: pH, TDS, DO, COD, BOD ₅	Surface Water quality standard by DoE, Bangladesh	Once	Contractor	DDL
	Wastewater: pH, alkalinity, Fe, Cl ⁻ , TDS, As	Waste Water quality standard by DOE, Bangladesh	Once	Contractor	DDL
Soil Pollution	▪ Check liquid waste is carried out by experienced personnel and in proper way	Monitoring	Regularly	Contractor	DDL
Waste	▪ Waste and effluents to be collected and disposed safely from camp. ▪ Wastes and garbage from construction sites to be disposed safely	Monitoring	Weekly	Contractor	DDL
Health and Safety	▪ Check quality of food and accommodation at construction camp; ▪ Check safe water supply, hygienic toilet at camp, construction of drain at camp site; Check toilets are close to construction site; ▪ First Aid Box with required tools and medicines; ▪ The heavy construction material to handled and stored safely putting due care on public safety; ▪ Check of personal protective equipment (PPE) for worker at the sites	Bangladesh Labour Law 2006/ Monitoring	Regularly	Contractor	DDL
Operation Stage					
Air Quality	SO ₂ , NO _x , CO, SPM, PM _{2.5} , PM ₁₀	Air quality standard by DOE, Bangladesh	1/year (5 year)	DDL	DOE/IDCOL
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	1/year (5 year)	DDL	DOE/IDCOL

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
				Implementation	Supervision
Water quality	Groundwater: pH, Alkalinity, Fe, Cl ⁻ , TDS, As	Groundwater quality standard by DOE, Bangladesh	1/year (5 year)	DDL	DOE/IDCOL
	Surface water: pH, TDS, DO, COD, BOD ₅	Surface Water quality standard by DoE, Bangladesh			
	Wastewater: pH, alkalinity, Fe, Cl ⁻ , TDS, As	Waste Water quality standard by DOE, Bangladesh	1/year (5 year)	DDL	DOE/IDCOL
Accident and Public Safety	Record of accidents, different level of disabilities/fatalities.	None Specific	-----	DDL	DOE/IDCOL
Occupational Safety					

9.5 Environmental Budget

The estimated budget for implementation of the mitigation and monitoring measures proposed in the ESMP is presented in Table 9.3. The overall costs of the ESMP will comprise:

- Environmental monitoring through sample collection and analysis;
- Any remedial measures necessary to reduce or avoid environmental damage;
- Designing and implementing all mitigating and enhancement measures;

The total budget is estimated as BDT. 3,39,900. This budget does not include the decommissioning stage since the minimum operation period is 20 year and the rate will vary largely from the present cost.

Table 9.3: Environmental and Social Monitoring Budget for the Proposed Project

Component	Item	Unit	Quantity	Rate (in BDT)	Amount (BDT)
PRE-CONSTRUCTION STAGE					
Air Quality	Measuring air quality	No.	1	25,000	25,000
Noise	Measuring ambient noise level	No.	5	8,000	40,000
Water Quality	Surface water quality measurement	No.	1	9,000	9,000
	Groundwater quality measurement	No.	1	9,000	9,000
SUB TOTAL (PRE-CONSTRUCTION STAGE)					83,000
CONSTRUCTION STAGE					
Air Quality	Measuring air quality	No.	2	25,000	50,000
Noise	Measuring ambient noise level	No.	6	8,000	48,000
Water Quality	Wastewater quality measurement	No.	1	7,000	7,000
	Surface water quality measurement			9,000	9,000
	Groundwater quality measurement	No.	1	9,000	9,000
Soil	Maintenance cost in soil conservation	Lump sum			10,000
Dust Management	Water sprayer / watering	Covered in Engineering Cost			
Waste disposal and management	Disposal and management of construction waste	Lump sum			5,000
Construction Safety	General Safety (provision of PPE like ear muffs, gloves etc.)	Lump sum			5,000
Health	Health check-up camps for construction workers	Camp	-	5,000	5,000
SUB TOTAL (CONSTRUCTION STAGE)					1,48,000
OPERATION STAGE					
Air Quality	Monitoring air quality	No.	1 (1/year)	25,000	25,000
Noise	Monitoring ambient noise level	No.	1 (1/year)	8,000	8,000
Water	Monitoring wastewater quality	No.	1 (1/year)	7,000	7,000
	Monitoring surface water quality	No.	1 (1/year)	7,000	9,000
	Monitoring ground water quality	No.	1 (1/year)	9,000	9,000
SUB TOTAL (OPERATION STAGE)					58,000
ESTABLISHMENT AND TRAINING					
Training	Environmental training and awareness	Lump sum	As per training details	10,000	10,000
Management Information System		Lump sum	-	10,000	10,000
SUBTOTAL (ESTABLISHMENT AND TRAINING)					20,000
SUB TOTAL (Pre-construction, Construction, Operation, Training)					309,000
CONTINGENCIES @ 10 % on total Environmental Costs					30,900
GRAND TOTAL (in BDT)					3,39,900

10 ENVIRONMENTAL AND SOCIAL BENEFIT

10.1 Introduction

Renewable energy is recognized internationally as a major contributor in protecting our climate, nature, and the environment as well as providing a wide range of environmental, economic, and social benefits that will contribute towards long-term global sustainability.

Biogas based power plant are an ideal alternative to grid electricity. And biogas power plant are independent entities, they can also be controlled and managed without presenting threats to the conventional grid. Such distributed energy systems also provide more reliable electricity, as any outages or interruptions to electricity supply can be quickly identified and corrected. One of our most effective power generation solutions is the power plant. It is a very reliable, independent, cost effective solution with low operation and maintenance costs.

It is also a centralized solution, which means it acts like a small power plant, utilizing a local electricity distribution network and saving the hassle of installing and maintaining hundreds of small consumer systems. This makes it a very efficient and convenient solution for municipalities, governments, NGOs and investors who want to transform the lives of people in remote communities.

It is a particularly beneficial solution for areas lacking access to national grid electricity or where chances of connecting to the grid are low. Indeed, a biogas power plant power system functioning as an autonomous entity can provide almost the same quality and services as the electricity.

Increasing the supply of renewable energy would allow replacing carbon-intensive energy sources and significantly reducing global warming emissions. Generating electricity from renewable energy offers significant public health benefits. The air and water pollution emitted by coal and natural gas plants is linked to breathing problems, neurological damage, heart attacks, and cancer.

Biogas based power plants generate electricity with no associated air pollution emissions. In addition, biogas-based power plant requires essentially no water to operate and thus do not pollute water resources or strain supply by competing with agriculture, drinking water systems, or other important water needs.

10.2 Energy and Climate Concern

Biogas is a Renewable Energy Resource: Biogas is a renewable source of energy. The carbon dioxide that is released when biogas is combusted and mixed with the oxygen in the air does not contribute to the greenhouse effect. The carbon in the methane molecule produced by the biogas process originates from carbon dioxide in the air that growing plants have previously taken up by photosynthesis. The use of biogas is thus an important step in climate change mitigation.

The development of biogas represents a strategically important step away from oil dependency that will contribute to a sustainable energy supply in the long-term. Renewable means that there will be no “peak biogas”; biogas will be continuously available and thus offers improved energy security. Biogas is also produced locally meaning that it is not dependent on trade relationships. This also contributes to improved energy security.

Biogas as a Bio Fuel: Biogas is a high-quality bio fuel. As any fuel it can be used to produce electricity (up to 40% of the total energy content) and heat, or both in a combined heat and power (CHP) equipment. As it consists of methane it is easily adaptable to existing processes where natural gas, also methane, is used.

Methane is a fuel in demand by industry, partly because it is a gas, which gives a high-quality combustion that can be precisely controlled. Methane burns with a clean and pure flame, which

means that boilers and other equipment are not clogged by soot and cinders. This leads to a cleaner workplace environment and less wear and tear on the plant.

Biogas is the most environmentally-friendly vehicle fuel on the market today. Biogas gives the smallest emissions of carbon dioxide and particulate matter of all vehicle fuels on the market. Emissions of carbon monoxide, hydrocarbons, sulphur compounds and nitrogen oxides are less than when petrol or diesel is used as fuel. A gas engine is quieter and vibrates less than a diesel engine, which means a better working environment for professional drivers.

Calculations show that replacing fossil vehicle fuels by biogas reduces the carbon dioxide emission per unit of energy by 90%. The benefits can be doubled if biogas is produced from manure, since this decreases emissions of both methane and fossil carbon dioxide. The reduction, measured in carbon dioxide equivalents, can then be as large as 180% per unit of energy. Biogas is lighter than air. If a leakage should occur, methane rises through the surrounding air. Biogas has a higher temperature of ignition than petrol and diesel, which reduces the risk of fires and explosions at accidents.

10.3 Energy and Nutrients –Manure Management

All kinds of agricultural production with animals' cattle, pig, chicken etc. produce manure. Too often the manure is seen as a waste to get rid of in the cheapest possible way. When biogas is produced from organic waste, manure or food waste, the residue, digestate, contains all the nutrients in the original substrate (e.g. nitrogen, phosphorous, potassium, calcium and magnesium). These are retained in soluble and plant-available forms in the residue, and cannot be lost by leaching, since the digestion takes place in closed containers. Using the digestion residue as a bio fertilizer reduces the need for mineral fertilizers. The return of the bio fertilizer to arable land constitutes an excellent case of recycling of a natural resource. This is important contribution to a better environment, since nitrogen fertilizers are produced using large amounts of fossil fuels, and phosphorus is a nonrenewable resource.

Biogas is also produced with organic waste as substrate. This is a great advantage in waste management; the waste does not need to be landfilled or just incinerated for recovery of its heat content. When fermenting organic waste, the two important resources are recovered, the biogas and the nutrients in the residue. A concern is that this residue needs to have a low content of heavy metals and organic pollutants to be used on agricultural land as bio fertilizer. The use of food waste for biogas production and bio fertilizer is now steeply increasing in many cities.

Manure is a managed resource both when it comes to energy production and for application of nutrients and organic matter on farmed fields. Biogas production economy must include the position: greenhouse gas emissions from manure are greatly reduced in the biogas production process (which is needed to tackle climate change). Furthermore, biogas production is economically a good investment but one has to remember that investment costs may be rather large. The digestate can be used as manure but is not allowed to be applied on farm fields during winter time since then runoff containing high amounts of N, P and organic compounds would pollute water bodies.

10.4 Energy and Economy Concern

Energy is a foundation stone of the modern industrial economy. Energy provides an essential ingredient for almost all human activities: it provides services for cooking and space/water heating, lighting, health, food production and storage, education, mineral extraction, industrial production and transportation. Modern energy services are a powerful engine of economic and social development, and no country has managed to develop much beyond a subsistence economy without ensuring at least minimum access to energy services for a broad section of its

population. Throughout the world, the energy resources available to them and their ability to pay largely determine the way in which people live their lives. Nevertheless, it is critical to recognize that what people want are the services that energy provides, not fuel or electricity per se. Many factors play a role in influencing energy supply, not least of which is its availability, price and accessibility. The regional endowment of energy sources and the pace at which they are developed and distributed are not uniform around the world.

The last two centuries have seen massive growth in the exploitation and development of energy sources, and the world has gained many benefits from these activities. The magnitude of energy consumed per capita has become one of the indicators of development progress of a country, and as a result, energy issues and policies have been mainly concerned with increasing the supply of energy. This approach is now seen as a vision that needs challenging.

11 CONCLUSION & RECOMMENDATION

11.1 Conclusion

According to the above analysis, we can conclude that, if the recommended mitigation measures and environmental management processes are adopted properly, the project will be environmentally sound and sustainable.

During the construction stage, there will be some negative impacts of the project. There are no significant cumulative adverse impacts during operation that are identifiable at this stage. The construction impacts should be very predictable and manageable, and with appropriate mitigation, few residual impacts are likely. Additional human and financial resources will be required to improve environmental capability, and to progress and achieve necessary statutory compliance and environmental clearance certification for the project or associated activities that also require environmental assessment and environmental permits under the environmental laws of Bangladesh.

The project is expected to have a small "environmental footprint". No endangered or protected species of flora or fauna are reported at the project site. The proposed project activities have no significant adverse environmental impact so far as a time bound execution program with application of advanced construction technology is ensured. The mitigation measures are well within such codes and practices of construction and operation of the proposed project.

11.2 Recommendations

Adequate provisions have been made for the environmental mitigation and monitoring of predicted impacts, along with their associated costs. Adverse impacts if noticed during implementation will be mitigated using appropriate design and management measures. The potential cumulative and residual impacts of the project classify as not a highly sensitive or complex.

The ESMP, its mitigation and monitoring programs, contained herewith shall be included within the Bidding documents for project works. The Bid documents state that the contractor shall be responsible for the implementation of the requirements of the ESMP through his own Site-Specific Environmental Management Plan, which will adopt all of the conditions of the ESMP. This ensures that all potential bidders are aware of the environmental requirements of the project and its associated environmental costs.

The ESMP and all its requirements shall then be added to the contractor's contract, thereby making implementation of the ESMP a legal requirement according to the contract. To ensure compliance with the ESMP the contractor should employ an environmental specialist to monitor and report project activities throughout the project construction phase. There are specific issues can be recommended-

- Proposed environment management plan should be implemented strictly both during operation and construction phase of the project
- Proper training of maintaining environment, health and safety should be given to Project management unit in both construction an operation phase
- Rain water harvesting should be carried out to reduce the pressure on surface and ground water resources during both construction and operation phase
- Environmental monitoring should be conducted as proposed in environment management plan

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APPENDIX

Appendix A: Environmental Screening Checklist

Screening questions	Yes	No	Scale of impact			Remarks
			High	Medium	Low	
A. Project sitting						
Is the project area adjacent to or within any of the following environmentally sensitive areas?						
▪ Cultural heritage site		✓				However, there are several mosques, and school within the project influence area.
▪ Buffer zone of protected area		✓				There is no protected area in the buffer zone of the project area.
▪ Special area for protecting biodiversity		✓				None
▪ Wetland	✓					There is a pond behind the Dutch dairy firm limited. .
▪ Mangrove		✓				None
▪ Land acquisition for the project		✓				No Land acquisition is needed for the project. The project will be developed within the premise of the dairy farm of DDL. The whole farm area is separated by a boundary wall which is owned by DDL.
B. Potential environmental impacts						
Will the project cause....						
▪ Noise and vibration due to civil works?	✓					Construction work Movement of construction materials, handling of equipment, concrete mixer, CSTR digester, generator causes some noise & vibration
▪ Impairment of historical/cultural monuments and other areas, and loss/damage to these sites?		✓				None
▪ Encroachment into precious ecosystem (e.g. Sensitive habitats like protected forest areas or terrestrial wildlife habitats)?		✓				None
▪ Dislocation or involuntary resettlement of people?		✓				The project will be located within the premise of the dairy farm of DDL.
▪ Is there any tree clearing required in the project site?		✓				No tree cutting is needed for the project. Might be some trees needs to be trimmed for this project activities.

Screening questions	Yes	No	Scale of impact			Remarks
			High	Medium	Low	
▪ Is there any negative effect on wildlife habitat, populations, corridors or movement?		✓				The anticipated impacts on terrestrial ecology is considered very low, however, activities such as vehicular movement, may cause disturbance to resident birds and their ground nests.
▪ Any obstruction of natural connection between river and wetlands inside project area?		✓				No connection of river.
▪ Is there negative effect on surface water quality?	✓				✓	There is a surface water body like pond into surrounding the project. Surface water pollution due to disposal of waste and effluents. Surface water quality will require to be monitored periodically during every stage of project implementation.
▪ Is there negative effect on groundwater quality, quantity or movement?	✓				✓	There is minor possibility of groundwater pollution. As the raw material and manure is storing in the tank and chance of leaching into the groundwater table.
▪ Is there any loss of existing buildings, property, and economic livelihood?		✓				None
C. Social impacts						
▪ Is there any minorities / indigenous communities live near the project site?		✓				No indigenous people are living beside the project site.
▪ Any local conflicts of interest?		✓				Though the project creates bad odor but the residential houses are located far from the project. Thus, there is not any conflict because of this activity.
▪ Does the water usage in the project might affect the surround communities?		✓				None
▪ Disproportionate impacts on the poor, women and children, indigenous peoples or other vulnerable groups?		✓				None
▪ Aesthetic degradation and property value loss due to establishment of plant and ancillary facilities?		✓				None
▪ Risks community safety due to the transport, storage, and use and/or disposal of materials such as raw		✓				Can be reduced the risk through proper mitigation measures

Screening questions	Yes	No	Scale of impact			Remarks
			High	Medium	Low	
materials, fuel and other chemicals during construction and operation?						
D. Environmental & social benefits from the proposed project						
▪ Environmental benefits	✓		✓			Noise pollution will be reduced by using better technology. Bad odor/air pollution will be reduced by using the waste to produce fertilizer and by covering the existing open drains.
▪ Social benefits	✓		✓			Will create more local employment. Will have the access of electricity and will reduce the cost. It will help to confirm local food balance with having strong infrastructural support.

Appendix B: Legal Documents of Dutch Dairy Limited (DDL)

Issue No. 40623 Date:22/01/2017

Form XII

Particulars of Directors, Manager and Managing Agents and of any change therein
The Companies Act, 1994 (See Section 115)Name of the Company: **Dutch Dairy Limited**, Reg. No. C-135418, Reg. Date: 18-JAN-17

Entity Address: 4/5, Block-C, Tajmahal Road, Mohammadpur, Dhaka

Presented for filing by: **MD. ZILLUR RAHMAN MRIDHA**

Sl.	The Present Name (a) or Names and Surnames (d)	Nationality	Nationality of Origin (other than the present nationality)	Usual Residential Address	Other Business, Occupation and Directorship, if any, if none, state so (b)	Date of Appointment or Change	Changes
1	MD. SAJJADUR RAHMAN MRIDHA	Bangladeshi		4/5, Block-C, Tajmahal Road, Mohammadpur, Dhaka, Phone :9812626, email: sajjad@abagroupbd.com, National ID: 5914439562845, TIN: 470281407803	Business	Date of Incorporation	
2	MD. ZILLUR RAHMAN MRIDHA	Bangladeshi		4/5, Block-C, Tajmahal Road, Mohammadpur, Dhaka, Phone :9812626, email: ripon@abagroupbd.com, National ID: 5914439562844, TIN: 227117489431	Business	-do-	
3	MD. SHAYDUR RAHMAN MRIDHA	Bangladeshi		4/5, Block-C, Tajmahal Road, Mohammadpur, Dhaka, Phone :9812626, email: ripon@abagroupbd.com, National ID: 2695045923572, TIN: 135359314560	Business	-do-	
4	MD. GIASUDDIN AHAMAD	Bangladeshi		W-20, Noorjahan Road, Mohammadpur, Dhaka, Phone :01751012255, email: g.ahamad@winningagro.com, National ID: 19642695031000017, TIN: 526745804047	Business	-do-	
5	MS. MALAIKA AHMED	Bangladeshi		House No. 253, Road No. 19, Dhanmondi, Dhaka, Phone :01611537476, email: taslim666@gmail.com, National ID: AG5093980, TIN: 467536288805	Business	-do-	

(Signature)

MD. ZILLUR RAHMAN MRIDHA

Managing Director

Dated: 16-Jan-2017

(State whether Director, Manager or Managing Agents)

(a) In the case of a Corporation its corporate name and registered or principal office shall be shown;

This document is digitally signed. Please find the soft copy to verify the signature.

Form XII

Particulars of Directors, Manager and Managing Agents and of any change therein
The Companies Act, 1994 (See Section 115)Name of the Company: **Dutch Dairy Limited**, Reg. No. C-135418, Reg. Date: 18-JAN-17

(b) In the case of an individual who has no business occupation but any other directorship or directorships, particular of the directorship or some of these directorships must be entered. A complete list of directors, manager, managing agents shown as existing in the last particulars delivered shall always be given;

(c) A note of the changes of the last list shall be made in this columns by placing against new directors name the words in place of by writing against a new directors, name the words "deed" resigned to as the case may be;

(d) In case of a firm the full name, address and nationality of each partner, and the date on which each became a partner.

(e) In case of multiple representatives, use comma(,) to separate names.

This document is digitally signed. Please find the soft copy to verify the signature.

FORM IX

Consent of Directors to Act

The Companies ACT, 1994

(See Section 92)

Filling Fee Tk. 200/-

Name of Company Dutch Dairy LimitedConsent to act as Director/Directors of the... Dutch Dairy Limited.
to be signed and filed pursuant to section 92 (1)(Ka).Presented for filing by Md. Zillur Rahman Mridha

To the Registrar of Joint Stock Companies & Firms,

Dhaka, BangladeshI/We, undersigned, hereby testify my/our consent to act as Director/Directors of the Dutch Dairy Limited
pursuant to section 92 (1)(Ka) of the Companies ACT, 1994.

SL	SIGNATURE	ADDRESS	DESCRIPTION
1.	 (MD. SAJJADUR RAHMAN MRIDHA)	4/5, Block-C, Tajmahal Road, Mohammadpur, Dhaka	Business Bangladeshi
2.	 (MD. ZILLUR RAHMAN MRIDHA)	4/5, Block-C, Tajmahal Road, Mohammadpur, Dhaka	Business Bangladeshi
3.	 (MD. SHAYDUR RAHMAN MRIDHA)	4/5, Block-C, Tajmahal Road, Mohammadpur, Dhaka	Business Bangladeshi
4.	 (MD. GIASUDDIN AHAMAD)	W-20, Noorjahan Road, Mohammadpur, Dhaka-1207	Business Bangladeshi
5.	 (MS. MALAIKA AHMED)	House No. 253, Road No. 19, Dhanmondi, Dhaka	Business Bangladeshi

Dated this _____ day of _____ 2017

NOTES — If a Director signs by "his agent authorised writing" the authority must be Produced and a copy attached.

Appendix C: NOC Letter & DoE Final letter on issuance of Environmental Certificate

বিশ্ববিদ্যমান স্বাস্থ্যকর পরিবেশ

হলদিয়া ইউনিয়ন পরিষদ

হাজী মোঃ মোজাম্মেল হক
চেয়ারম্যান

ডাকঘর : হলদিয়া, উপজেলা : লৌহজং, জেলা : মুন্সীগঞ্জ, বাংলাদেশ।
মোবাইল : ০১৭১১৪৯২৩৬১

সূত্র : হাঃ ইউপিঃ ১০১/১১
তারিখ : ০৯/১১/২০১৭

অবস্থানগত/পরিবেশগত ছাড়পত্রের জন্য স্থানীয় কর্তৃপক্ষ কর্তৃক প্রদেয় অনাপত্তিপত্রের সনদ

১। অবস্থানকারীর নাম : মোঃ মিল্লুর রহমান মৃধা
২। পিতার নাম : মৃত খলিলুর রহমান মৃধা
৩। অবস্থানকারীর ঠিকানা : গ্রাম: সাতঘড়িয়া, পো: হলদিয়া, থানা: ০৭, লৌহজং, মুন্সীগঞ্জ।
৪। ডেইরী ফার্ম অবস্থানগত ঠিকানা : সাতঘড়িয়া কনস্ট্রাকশন সংলগ্ন, হলদিয়া, লৌহজং, মুন্সীগঞ্জ।
৫। ডেইরী ফার্মের তফসিল : সাতঘড়িয়া, হলদিয়া, লৌহজং, মুন্সীগঞ্জ।

জেলার নাম	থানার নাম	মৌজার নাম	খতিয়ান নং	দখল নং	জমির ধরন	মোট জমির পরিমাণ
মুন্সীগঞ্জ	লৌহজং	সাতঘড়িয়া	৭০.৩১৪, ২১৮, ১৯৫ ৮২, ৫৭, ৩২, ৬৪, ২৩৫, ১২৪	৪১৬, ৩৯৪, ৩৮৫, ৪২৪, ৪১৫, ৪২২, ৫১৫, ৩৯৮, ৪০৩, ৩৮৮, ৩৮৭, ৩৮৩, ৪০৮	ভরাটি জমি	৩০ বিঘা

৬। ডেইরী ফার্ম উল্লিখিত দ্রব্য পণ্যের নামঃ দুগ্ধ উৎপাদন

উপরোক্ত তথ্যাদি আদৌকে ডাচ ডেইরী লিঃ ফার্ম নিম্নবর্ণিত শর্ত সাপেক্ষে অনাপত্তিপত্র প্রদান করা হলো।

শর্তাবলী :

- ১। ডেইরী ফার্ম স্থাপন ও পরিচালনার ক্ষেত্রে পরিবেশ সংরক্ষন আইন ও বিধি যথাযথভাবে অনুসরণ করতে হবে।
- ২। পরিবেশ অধিদপ্তর হতে বিধি বাস্তবায়িত পদ্ধতিতে ছাড়পত্র গ্রহণ করতে হবে।
- ৩। কর্মরত শ্রমিকদের পেশাগত স্বাস্থ্য ও নিরাপত্তা নিশ্চিত করতে হবে।
- ৪। উপযুক্ত অগ্নি নির্বাপক ব্যবস্থা রাখতে হবে এবং অগ্নিকাতা কিংবা অন্য কোন দুর্ঘটনা সময় জরুরী নির্গমন ব্যবস্থা থাকতে হবে।
- ৫। বায়ু ও শব্দ দূষণ করা যাবে না।
- ৬। ডেইরী ফার্ম প্রকল্প স্ট্রট তরঙ্গ বর্জ্য অপরিশোধিত অবস্থায় বাইরে নির্গমন করা যাবে না।

উল্লেখিত যে কোন শর্ত লঙ্ঘন করলে যথোপযুক্ত কর্তৃপক্ষ কর্তৃক ডেইরী ফার্ম বিরুদ্ধে আইনানুগ ব্যবস্থা নেওয়া যাবে।

মোঃ মিল্লুর রহমান মৃধা
হাজী মোঃ মোজাম্মেল হক
চেয়ারম্যান
হলদিয়া ইউনিয়ন পরিষদ
লৌহজং, মুন্সীগঞ্জ।

বেশী করে গাছ লাগান, পরিবেশ বাঁচান

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিবেশ অধিদপ্তর
মুন্সীগঞ্জ জেলা কার্যালয়
সদর হাসপাতাল রোড, পঞ্চসার, মুন্সীগঞ্জ
www.doe.munshiganj.gov.bd

স্মারক নং- ২২.০২.৫৯৪৪.১৪৪.৭১.৪৪২.১৭. প্রশা:- ১৭২

২১/০৫/১৪২৬ বঙ্গাব্দ

তারিখ:-----

০৫/০৮/২০১৯ খ্রিঃ

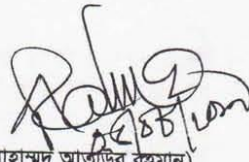
জনাব জিল্লুর রহমান মুখা
ব্যবস্থাপনা পরিচালক
ডাচ ডেইরি লিমিটেড
সাতঘড়িয়া, হলদিয়া, লৌহজং, মুন্সীগঞ্জ।

বিষয়ঃ পরিবেশগত ছাড়পত্র প্রসংগে।

সূত্রঃ ক) ঢাকা অঞ্চল কার্যালয়ের পরিবেশগত ছাড়পত্র বিষয়ক কমিটির ৩৩০ তম সভায় গৃহীত সিদ্ধান্ত নং গ-১।

উপর্যুক্ত বিষয় ও সূত্রের প্রেক্ষিতে জানানো যাচ্ছে যে, পরিবেশ অধিদপ্তর, ঢাকা অঞ্চল কার্যালয়ের পরিবেশগত ছাড়পত্র বিষয়ক কমিটির ৩৩০ তম সভায় আলোচ্য ফার্মটির অবস্থান ও সার্বিক পরিবেশগত দিক বিবেচনায় ফার্মটিতে বায়োগ্যাস প্লান্ট স্থাপন করে স্থিতিচিহ্ন দাখিল করতে হবে মর্মে সুপারিশ গৃহীত হয়।

০২। এমতপ্রেক্ষিতে সাতঘড়িয়া, হলদিয়া, লৌহজং, মুন্সীগঞ্জ জেলায় অবস্থিত ডাচ ডেইরি লিমিটেড নামক ফার্মটিতে বায়োগ্যাস প্লান্ট স্থাপন করে স্থিতিচিহ্ন দাখিল করার জন্য অনুরোধ জানানো হলো।


(মোহাম্মদ আজাদুর রহমান)
উপপরিচালক
ফোনঃ ০২-৭৬২০৭৪২

সদয় জ্ঞাতার্থেঃ

১। পরিচালক(ঢাকা অঞ্চল, পরিবেশ অধিদপ্তর, ঢাকা অঞ্চল কার্যালয়, ঢাকা।

Appendix D: Waste Management Plan

1. General

Considerable quantities of wastes will be generated due to the construction and operational of the project road. Below types of wastes will be generated during construction and operation:

- a. General Waste:
 - Organic waste (foods, fruits, tree leaves etc.);
- b. Construction Waste
 - Construction wastes are: construction materials such as sand, bricks, remaining concrete & other waste.
- c. Non-Hazardous Waste:
 - paper, wood, plastic, scrap metals, glass and mud etc.
- d. Hazardous Waste:
 - absorbent material, metal drums, empty chemical containers, waste oil from machinery lubricants, etc.

2. Objectives

The main objective of the Waste Management Plan (WMP) is to organize disposal of all wastes generated during construction and operation in an environmentally acceptable manner specially consider the following:

- ❖ Health hazards of the project personnel as well as community people should not be occurred;
- ❖ Manage the wastes in such a way that environment (specially air, soil, water etc.) will not be polluted;
- ❖ Odor means bad smell should not be generated;
- ❖ Always friendly environment at the construction sites and construction camps;
- ❖ Any waste should not be disposed into the river and any water bodies to avoid water pollution;
- ❖ Any waste should not be burnt; and
- ❖ Any waste should not be placed in earth holes/chambers.

3. Potential Environmental Impacts

Major potential environmental impacts due to the lack of waste management are:

- All types of environmental pollutions such as air, soils, water (surface & ground) pollutions;
- Generation of odor;
- Increase of flies, mosquitoes, insects etc.,
- Health hazards; and
- Environmental nuisance at the project sites

4. Strategies to Adopt

The following strategies need to be adopted for appropriate waste collection system to be functioned properly:

- a. Setting waste collection bins (not permanent structure, movable high-quality movable plastic bins; See Figure 1) in strategic points of the work sites.
- b. Introduce solid waste bins for Hazardous and Non-Hazardous waste.
- c. Coordinate with the respective authority's waste collection system so that the waste can be collected the waste.

- d. Wash liquids needs to be drained out though the functioning drains. The liquid waste needs to be treated with bleaching power every evening before draining so that the waste water cannot create nuisance and local pollution.



Figure 1: High quality plastic bins for waste collection

5. Method of Disposal of Wastes

The project proponent will collect the general wastes in separate waste bin at sources (means hazardous waste in one bin & non-hazardous waste in another bin) and dumped at the designated waste disposal site. The project proponent will construct concrete waste disposal site; means concrete floor and wall and covered by shed to avoid, air, bad smell, soil and ground water pollutions.

Just after filling one chamber (say after 6 months) by nonhazardous waste through pocket gate, it should be covered by earth (soils) properly & keeps it for about 6 months for converting organic fertilizer for the agricultural lands.

The hazardous waste will be collected in the waste collection bins. Just after filling, these hazardous wastes can be given to the vender free of cost.

The project proponent will collect construction waste as mentioned above separately and dump in to the designated room at the construction camp. Just after filling the room, project proponent will sale these waste to the vender for re-cyclic. The project proponent will maintain log book for the measurement of quantity of the wastes (especially hazardous wastes) disposed every day.

Appendix E: Focus Group Discussion on the Project Site.**Site: Project Location (Shatgharia, Halodia, Lohajang, Munshiganj)****GPS Coordination: 23.47803° N, 90.29655° E****Date: 18 May, 2020****Time: 09.00 AM TO 10:15 AM****Outcome of the Consultation**

All the participants were associates of the firm or the proposed project. Total 10 (ten) people participated in the meeting. In consultation meeting; environmental and social issues were examined. The main focus was to dig out information on how indiscriminate use of natural resources causes social and environmental degradation or benefit by implementing the proposed project with using several natural resources. The issue on potential impact of construction works has also been raised.

The project will increase and improve the quality of their life. No major impact will take place due to the implementation of this project. Most of the people argued that they are willing to endure the negative impact to some extent for the sake of this project which they believe will improve their livelihood.

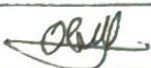
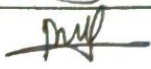
Suggestions:

- Air pollution from the constructional materials and hardware will make minor issue. Temporary worker should shower water during material transportation and use spread for air pollution sources if conceivable.
- Groundwater and soil contamination ought to be constrained by checking the overflow of unsafe or compound waste materials to the environmental factors.
- There should be powerful relief quantifies so as to noise pollution. Improved innovation may moderate the noise pollution. Waste management because of the project implementation should be monitored and the proponent has to take responsibility of this management.
- More local employment needs to be created in the future project construction and operation phases which can be a decent choice for occupation improvement.

Some Specific Question and Comments from the Stakeholder are given below-

Questions to the Groups	Participants opinion, comments and suggestions
Are you aware about the activities of the proposed Project? If yes, how do you?	K. M. Osman (Project Engineer): Without a doubt, the project authority has conferred this information to us. The project proponent will establish a biogas-based power plant for bioelectricity production.
How The project will impact on surrounding environment? Please mention both positive and negative sides	Dr. Md. Mustafa Kamal (Veterinary In charge): Improvement of this proposed undertaking, the incorporating condition may influence yet concise. Air contamination and soil contamination will effect on incorporating condition. The project proponent should take genuine thought to reduce these impacts. The waste materials should be kept up fittingly and it should not be kept at the open spot.
Do you have any recommendation before the implementation of this project?	Md. Shaiful Islam (Shopkeeper) We are really happy to understand that biogas-based power plant that produce bioelectricity and biofertilizer. Local labors should be given priority during advancement work.

List of Participants for Focused Group Discussion (FGD)Address Beside Biogas Plant Area, Dutch Dairy Ltd.GPS: 23.47803° N; 90.20655° EDate 18-05-2020Time 09.00 Am.

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
01	K. M. Osmane	37	Project Engineer	01752-118012	
02	Dr. Md. Mostafa Kamal	30	Vet. Incharge	01736-111216	
03	Md. Akram	27	Farmer	01521-116302	Akram
04	Md. Robin	25	Labour	01012-224335	রবিন
05	Md. Abdur Razzak	23	Farmer	01821-126464	আব্দুর
06	Md. Shasidul Islam	28	Shopkeeper	01623-113021	
07	Md. Mozidul Islam	24	Farmer	01731-136521	মজিদুল
08	Md. Rafiqul	10	Labour	01612-103651	রাফিক
09	Rajib Ahmed	23	Farmer	01651-121321	রাজিব
10	Kh. Ramim	25	Shopkeeper	01721-132251	খান্না

Facilitated By DSELSignature 

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Appendix F: HSE Guidelines during COVID-19

Health and Safety Guideline

for

400 KW Biogas Based Power Plant at Satghoria, Halodia, Laohajung, Munshiganj, Bangladesh Project



**What to Do"s and "What Not to Do"s when You're
at the Site!**

July 2020

What is COVID-19

In January 2020 the World Health Organization (WHO) declared the outbreak of a new coronavirus disease in Hubei Province, China to be a Public Health Emergency of International Concern. WHO stated there is a high risk of the 2019 coronavirus disease (COVID-19) spreading to other countries around the world.

WHO and public health authorities around the world are taking action to contain the COVID-19 pandemic. However, long term success cannot be taken for granted. All sections of our society - including businesses and employers - must play a role if we are

COVID-19

Disease caused by the SARS-CoV-2 virus

Novel coronavirus

Coronaviruses are viruses that circulate among animals but some of them are also known to affect humans.

The 2019 novel coronavirus was identified in China at the end of 2019 and is a new strain that has not previously been seen in humans.

Prevention

When visiting affected areas

Avoid contact with sick people

Wash your hands with soap and water

If you develop cough, use a medical face mask

Wherever you travel apply general hygiene rules

Symptoms

FEVER

COUGH

DIFFICULTY BREATHING

MUSCLE PAIN

TIREDDNESS

Transmission

VIA RESPIRATORY DROPLETS

2-14 days
estimated incubation period

How it spreads...

- ✚ When someone who has COVID-19 coughs or exhales they release droplets of infected fluid. Most of these droplets fall on nearby surfaces and objects - such as desks, tables or telephones.
- ✚ People could catch COVID-19 by touching contaminated surfaces or objects - and then touching their eyes, nose or mouth.
- ✚ If they are standing within one meter of a person with COVID-19 they can catch it by breathing in droplets coughed out or exhaled by them.
- ✚ In other words, COVID-19 spreads in a similar way to flu. Most persons infected with COVID-19 experience mild symptoms and recover.
- ✚ However, some go on to experience more serious illness and may require hospital care. Risk of serious illness rises with age: people over 40 seem to be more vulnerable than those under 40.
- ✚ People with weakened immune systems and people with conditions such as diabetes, heart and lung disease are also more vulnerable to serious illness.

Symptoms

The following symptoms may develop in the 14 days after exposure to someone who has COVID-19 infection:

- ✚ dry cough
- ✚ sore throat
- ✚ difficulty in breathing
- ✚ tiredness
- ✚ fever

Generally, these infections can cause more severe symptoms in people with weakened immune systems, older people, and those with long-term conditions like diabetes, cancer and chronic lung disease.



Getting workplaces ready

Dutch Dairy Limited (DDL) shall:

- ✚ Develop a plan of what to do if someone becomes ill with suspected COVID-19 at one of your workplaces
- ✚ Consider how to identify persons who may be at risk, and support them, without inviting stigma and discrimination into workplace.
- ✚ Promote regular teleworking across our organization.
- ✚ Pay attention to the workers at the project sites (Dutch Dairy Limited) who are at high risk and be prepared to protect the most vulnerable including the older ones and those with chronic condition.
- ✚ Consider putting in place support for workers who may be suffering from anxiety or stress. This could range from managers asking workers more often how they are, facilitating exchanges or buddying between colleagues.
- ✚ Communicate to field site employees, Contractors and sub-contractors about the plan and make sure they are aware of what they need to do - or not do - under the plan.
- ✚ Emphasize key points such as the importance of staying away from work even if they have only mild symptoms or have had to take simple medications

Dutch Dairy Limited Safety Measures...

- ✚ Practice social distancing by maintaining a minimum 6-foot distance from others.
- ✚ Preclude gatherings of any size, and anytime two or more people must meet, ensure minimum 6-foot separation
- ✚ Provide PPE at the project sites such as gloves, goggles, face shields, face coverings, and face masks as appropriate for the activity being performed
- ✚ A designated COVID-19 Supervisor should be present on the construction site at all times during construction activities. The COVID-19 Supervisor can be an onsite worker who is designated to carry this role.
- ✚ Identify "choke points" and "high-risk areas" where workers are forced to stand together.
- ✚ Strictly instructed the workers not to spit anywhere either offices or worksite.
- ✚ During Covid-19 period traveling should be avoided. If necessary, 1 or maximum 2 persons can travel with the driver.
- ✚ Routinely cleaning shall be maintained to all frequently touched surfaces in the project sites workstation, such as offices, labor camps, doorknobs, keyboards, remote controls, desks and door handles.
- ✚ Minimize interactions when picking up or delivering equipment or materials to ensure minimum 6- foot separation.
- ✚ Discourage workers from using other workers' phones, desks, offices, tools, and equipment. If necessary, clean and disinfect them before and after use.
- ✚ At the project sites place wash stations (Soap and water) in multiple locations to encourage hand hygiene; wash hands often with soap and water for at least 20 seconds; use hand sanitizer with at least 60% alcohol.
- ✚ Require anyone on the project to stay home if they are sick, except to get medical care.
- ✚ DDL's all employees inform their supervisor if they have a sick family member at home with COVID-19
- ✚ Maintain a daily attendance log of all workers and visitors.

WASTE DISPOSAL

Waste Disposal...

Gloves, rags, or wipes used to disinfect during routine cleaning can be disposed in regular trash.

If possible, dedicate a lined trash can for disposal of cleaning supplies used to disinfect an area used by a possible or confirmed case. Use gloves when removing garbage bags, and handling and disposing of trash. Wash hands after handling or disposing of trash.



If there's a meeting...

Before the meeting-

- ✓ Is the meeting necessary? Or can it be postponed?
- ✓ If not, then pre-order sufficient supplies like hand sanitizers, masks, gloves and keep soap and water in a suitable place for hand washing
- ✓ Keep contact details of all participants, check medical histories if required
- ✓ Check if online meeting can be held

During the Meeting-

- ✓ Start with a briefing about how safety can be ensured amid COVID-19 situation; avoid handshaking!
- ✓ Minimum safety space must be arranged
- ✓ Make sure everyone is using face masks; keep tissue boxes nearby
- ✓ Make sure there are sufficient numbers of disposal bins

After the Meeting-

- ✓ Make sure everyone disposes tissues, gloves into the disposal bins
- ✓ Clean the whole space with disinfectors
- ✓ Keep record of the participants; check at least for 14 days if anyone shows

If there's a suspected case in the Dutch Dairy Limited project site...

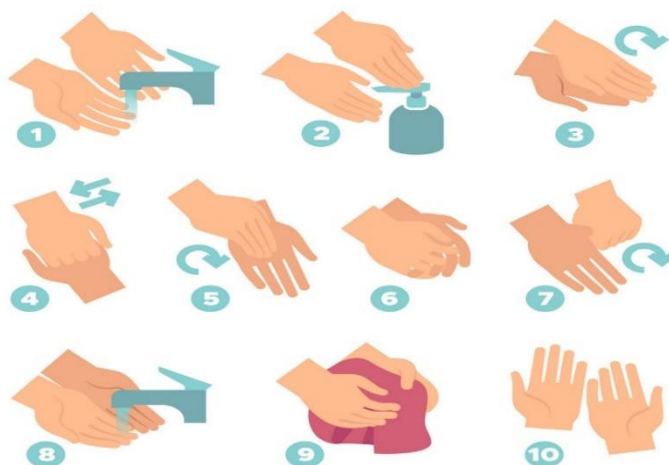
- ❖ **DO NOT PANIC!!!** Inform the consortiums designated HSE expert, Office Manager and local health department
- ❖ Identify the people who had direct contact with the person and send them to self-isolation; designated health advisor should follow up on a regular basis
- ❖ If the suspected case gets confirmed to be COVID positive, seek help from the local health department to take necessary actions
- ❖ Make sure all the surfaces the suspect had contact with are disinfected properly
- ❖ Talk with the individuals and others; make sure they don't get stressed out
- ❖ Provide healthy food, disinfectants, sanitizers, antiseptic soaps and anything required to keep up the morale of the individuals

Hospitals Offering Treatment to the COVID-19 Patients-

Division wise COVID 19 dedicated hospital

22 25 L	Nam/ e of Division	Name of District	COVID Hospitals			Contact Number
			Name of Dedicated Hospital/Facility	Beds for COVID- 19	ICU Beds	
1	Dhaka	Gopalgonj	250 beded Sadar Hospital new building (100)	100	8	01711973037
2		Faridpur	Medical College Hospital (250) Separate building	250	10	01715646362
3		Manikgonj	250 beded Sadar hospital (100)	100	0	01716069175
4		Shariatpur	Sadar hospital (20)	20	0	
5		Dhaka	Zinzira 20 bed hospital (20),	20	0	01717019338
6		Gazipur	Ma Oh Shishu kollan Kendro, Meghdubi (20), Shaïd Tajuddin medical college hospital(100+07 ICU)	120	07	
7		Tangail	Trauma centre(50)	50	0	
8		Narshingdi	100 Bed zilla hospital (80)	80	0	
9		Rajbari	sadar hospital	10	0	
10		Narayanganj	300 beded hospital (40+ 10 ICU)	40	10	
11		Munshiganj	Sadar Hospital new building (50), United Hospital (14+ 2 ICU)	64	2	
12		Kishorganj	Sayed nazrul islam MCH(200 bed+10 ICU)	500	10	
13		Madaripur	250 beded District Hospital new(42)	42	0	
Total in Dhaka Division				1396	47	
14	Chattogr am	Chattogram	250 beded general hospital (100+10 ICU),	160	10	01711971512
			BITID (Infectious Disease Hospital) (30),			01952050753
			Lohagara Trauma Centre (20)			01817311591
			Park View Pvt hospital (10),			
15		Khagrachori	Sadar Hospital (Old building) (50)	50	0	01926005043
16		Rangamati	FWVTI hostel (50), Govt College (New Buildins) (50)	100	0	01520080654
17		Cumilla	Sadar Dhakhin (50), Fortis pvt heart centre (38 + 12 ICU), Cumilla Medical College Hospital-(100 bed + 12 ICU)	188	24	01712566590
18		Feni	Mohipal trauma centre (30)	50	0	01731554088
			Mongol kandi hospital (20)			01711396759
19		Chandpur	BNSB Mazharul Haque Eye Hospital (30), 250 Bedded Sadar Hospital (25)	55	0	01711355988
20		Bramanbaria	Chest Disease Hospital (25) Nursing Institute (50) Brahmmanbaria MCH (Pvt) (100)	175	0	01716264295 01761607544
21		Cox's bazar	Ramu UHC (New building) (50),	100	0	01791303215
			Chokoria UHC (New building)(50)			01769957416
22		Bandarban	Bandarban Nursing College (New building (100)	100	0	01859674465
23		Laksmipur	Sadar Hospital Old Building (30)	30	0	01822120667
24		Noakhali	Chor Algi 20 beded hospital (20), Sahid vulu Stadium (80)(Proposed) Sonamuri Andha kallayan Eye Hospital-30	130	0	01711963538 01817096167
Total in Chittagong Division				1138	34	

Attention!



STAY SAFE, STAY HEALTHY! DON'T PANIC, KEEP CLEAN!

