

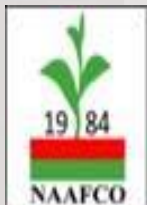
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

of

*1.494 MWp Industrial Rooftop Solar Project of
NAAFCO Pharma Limited, Bhaluka, Mymensingh*

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ABBREVIATIONS

ADB	Asian Development Bank
AEZs	Agro-ecological Zones
BBS	Bangladesh Bureau of Statistics
BMD	Bangladesh Meteorological Department
CITES	Convention on International Trade in Endangered Species
DoD	Depth of Discharge
DoE	Department of Environment
DPHE	Department of Public Health Engineering
ECA	Ecologically Critical Area
ECA'95	Environment Conservation Act, 1995
ECC	Environmental Clearance Certificate
ECR	Environment Conservation Rules
ESIA	Environmental & Social Impact Assessment
ESMP	Environmental & Social Management Plan
EQS	Environmental Quality Standards
FGD	Focus Group Discussion
GHGs	Greenhouse Gases
GIS	Geographical Information System
GPS	Global Positioning System
IDCOL	Infrastructure Development Company Limited
IEE	Initial Environmental Examination
IP	Indigenous People
IPCC	Inter-government Panel on Climate Change
IUCN	International Union for Conservation of Nature
LEED	Leadership in Energy and Environmental Design
MFF	Multitranche financing facility
MoEFCC	Ministry of Environment, Forest and Climate Change
MSDS	Material Safety Data Sheet
NPL	NAAFCO Pharma Limited
NAPA	National Adaptation Programme on Action
OSHA	Occupational Safety and Health Administration
PSMP	Power Sector Master Plan
PV	Photovoltaic
SLM	Sound Level Meter
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

NAAFCO Pharma Limited, one of Bangladesh's major integrated medicine manufacturing companies, proposed a project of 1.494 MWp rooftop solar PV systems on the roofs of different sheds and buildings of NAAFCO Pharma Limited.

Basically, this part provides the Project background, the aim and scope of the study, and the approach and methodology of the proposed project.

This paper contains the findings of an Environmental and Social Impact Assessment (ESIA) of the project titled "1.494 MWp Industrial Rooftop Solar Project of NAAFCO Pharma Limited, Bhaluka, Mymensingh." The main purpose of the ESIA study is to identify, evaluate and manage environmental and social impacts that may arise due to implementation and operation of the project. The site visit for the ESIA study has been undertaken to assess any potential impacts (both negative and positive) that may arise from the construction, operation and decommissioning of the rooftop solar plant. The goal of the ESIA is to enhance sustainability of vital ecosystem, to improve or restore ecosystem health and biodiversity. The document has been made to comply with the requirements of World Bank Group's EHS Guidelines and applicable sector guidelines, as well as applicable local and national regulations.

This study relied on both primary and secondary data and information. The primary data includes data collected from field observations and secondary data includes review of the statistical and relevant information from Government Departments. Discussions were held with stakeholders including community representatives and a wide range of project areas.

POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

This ESIA report was developed in accordance with the procedures outlined in the DoE's ESIA guidelines for industries, ECA'95, and ECR'97, which are the primary legal texts governing environmental protection in Bangladesh. The report is also compliant with development partner's operational policies and guidelines. Steps to consult potentially affected people by the project and to disclose the ESIA report to the public have been taken for compliance with the Bank's policies of the ESIA preparation, although these are non-mandatory as per national legislations. According to the Gazette on 24th, December 2017 under Environment Division-3 of Ministry of Environment, Forest and Climate change, Government of the Peoples Republic of Bangladesh, the 1.494 MWp Rooftop Solar PV Systems project is considered as the "**Orange B category**".

DESCRIPTION OF THE PROPOSED PROJECT

NAAFCO Pharma Limited was founded in 2015 in Bandia, Meduary, Bhaluka, Mymensingh, Bangladesh (24.443865°N, 90.346420°E). NAAFCO Pharma Limited proposed a project of a 1.494 MWp rooftop solar PV system on the roofs of different sheds and buildings.

The project will be implemented in Rooftops of NAAFCO which is steel structured, and rooftop is corrugated sheet-based shed. Total available space are 160,000 square feet. Plant capacity of a roof-top solar power project mainly depends on available space and load while other factors to be taken into consideration being shading effect, orientation of the building, tilt angle of the building, load bearing capacity and backup generator capacity.

The project will be executed on the roofs of different sheds and buildings of NAAFCO Pharma Limited. Sheds were established around 5-6 years ago and rooftop are made of corrugated sheet-based sheds. The purlin spacing is different in each shade and is around 1.2m-1.33m. The sheds are having a tilt angle of around 6-7 degrees. In case of RCC roof, a hot deep galvanized MS structure will be installed with a tilt angle of 20°.

TECHNOLOGICAL ASPECTS

In the proposed system two main equipment will be used which are solar panels and inverters. Sun shines on the solar panels to generate DC electricity. The DC electricity produced from the solar panel will be converted to 415V 3-phase AC using the inverters. Then the energy will be fed into the bus bars of industry. A zero-export controller will be used to ensure “net zero export”. The aggregated installed capacity of the project will be 1.494 MWp.

ANALYSIS OF ALTERNATIVES

The environmental consequences and comparative advantages of the alternatives need to be compared and evaluated in an ESIA. This chapter describes alternatives considered but eliminated from further consideration (including the reasons for elimination) and compares the environmental impacts of several alternatives retained with those of the proposed project.

A variety of viable choices is chosen and discussed in a way that encourages meaningful public participation and informed decision-making. Among the factors that may be taken into account when addressing the feasibility of alternatives are environmental impacts, site suitability, economic viability, social and political acceptability, technological capacity, availability of infrastructure, general plan consistency, regulatory limitations, jurisdictional boundaries, and whether the proponent could reasonably acquire, control, or otherwise have access to an alternative site.

The proposed project might have a severe negative impact 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. Therefore, alternatives that are capable of avoiding or substantially lessening effects on these resources were assessed.

DESCRIPTION OF ENVIRONMENT AND SOCIAL BASELINE

The compilation of baseline data is an essential component of the ESIA study and aids in evaluating the projected consequences on the different environmental and social features in the study region using

scientifically developed and widely recognized environmental and social impact assessment procedures.

This section describes the environmental baseline status of 1.494 MWp Solar PV Project study area, covering both the natural and social environments. The baseline environmental quality is assessed through field studies within and around the project site zone for various components of the environment viz. air, water, noise, land and socio-economy etc. The primary objective was to identify and describe existing environmental conditions and to provide an understanding of the baseline conditions prior to undertaking any development activities. Information was gathered on the existing physical environment related to Physiography, geology, topography, climate, soils, surface water and groundwater quality, air quality and noise level, etc.

Bhaluka is an Upazila, or sub-district, of the Mymensingh District in Mymensingh Division of Bangladesh. It is the 1st Model Thana of Bangladesh. The project area of Influence (Aoi) is located within Bandia, Meduary, Bhaluka, Mymensingh District.

Bangladesh can be divided into seven climatic zones (Rashid 1991). According to the classification, the project area is located in South-central climatic zone. The general topography of the project area is relatively flat. The topography of the project location is 18.83 – 35 m a.m.s.l. This project area falls in the seismic zone-4 comprising the central part of Bangladesh represents the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur Tracts, and the western extension of the folded belt. Arsenic contamination in drinking water is a problem in large part of Bangladesh ground water. The project area also has acceptable limit of Arsenic levels in ground water. No endangered or protected species of flora or fauna are reported at the project site.

The baseline environmental quality has been assessed through field studies on 27 October 2021 within the impact zone and analysis the information for various components of the environment, viz. air, noise, water, etc. The measurement results showed measurement of all air and noise quality are within national standards. The test result shows that almost all of the parameters are within the national standard except for BOD5 in SW_NPL_02 location, according to ECR, 97 and some of the remaining parameters are not yet standardized according to DoE (ECR, 1997). For drinking water, the test result shows that almost all of the parameters are within the national standard except for total coliform (TC), according to ECR, 97.

Data on socio-economic conditions, i.e., 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, 2011). According to the population and housing census (2011), the literacy rate for the population 7 years and above in the project area is 65.8% which is lower than the national literacy rate of 58.77%. Lands at the project area are used for

agriculture, fisheries, agro-forestry, homestead, homestead forestry and vegetation, animal husbandry, etc.

**ANTICIPATED
IMPACTS AND
MITIGATION
MEASURES**

This chapter describes on the Project's different interactions with the physical, biological, or social surroundings, resulting in possible repercussions to resources/receptors. It has been organized as per the various phases of the Project life cycle to understand the risks and impacts associated with each phase. The scope of the assessment captures the understanding on the envisaged risks and impacts assessed during the scoping exercise of this impact assessment study as well as the risks identified during subsequent physical baseline assessment and impact evaluation process.

The determination of effects was based on a review of existing project material, consultations with members of the local community, representatives of the project proponents, and other sector-specific specialists. Potential environmental impacts associated with the proposed project activities of both the projects are classified as: (i) Impacts during pre-construction/design phase; (ii) Impacts during construction phase; (iii) Impacts during operation phase; and (iv) Impacts during decommissioning phase.

For determining direct and indirect impacts, qualitative and quantitative methodologies were used. Some of the important impacts of the proposed project will be associated with land use, land stability, soil compaction and contamination, water availability, water quality of river/stream/canal, groundwater contamination, 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 structure), construction material sourcing and occupational health and safety. Adequate mitigation measures are devised to mitigate/minimize all likely environmental impacts.

**STAKEHOLDER
CONSULTATIONS &
INFORMATION
DISCLOSURE**

This section will show the process followed during project design and planning for involving stakeholders, including information disclosure and consultation with impacted persons and other stakeholders. It also summarized comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of the project affected peoples.

The purpose of public consultation is to make sure that a participation methodology is used, which in turn documents the concerns of all stakeholder groups and ensures that such concerns are considered, addressed, and incorporated into the development's decision-making process. Stakeholders were identified through systematic consultation with project beneficiaries, project affected people, women, vulnerable and poor members of the community, and other stakeholders who may have an influence over the project, in order to prepare a Stakeholder Engagement Plan.

Two (02) stakeholder consultations were conducted on 27 December 2021- one with respective authority representatives, one with the people living beside the factory. The primary objective of these discussions was to gain a comprehensive understanding of project issues and concerns from a diverse group of participants, including those who may be impacted by rising unemployment. The focus of the consultations was on community members' willingness to participate, as well as their perceptions and concerns about the project's positive and negative social impacts, including impacts on livelihoods. The feedback received from the consultation meeting will be used by the project executing agencies to carry out necessary revisions to the technical designs in order to minimize the impacts.

**ENVIRONMENTAL
AND SOCIAL
MANAGEMENT PLAN
(ESMP)**

The Environmental and Social Management Plan (ESMP) is concerned with the implementation of the actions necessary to avoid and offset detrimental consequences while enhancing beneficial outcomes in the context of a project. Unless the mitigation and benefit enhancement measures are identified in ESIA and fully implemented, the prime function of the ESIA cannot be achieved. Thus, the objectives of ESMP for the present project are: (i) Identification of Monitoring requirements and Monitoring indicators; (ii) Mitigation measures to reduce or eliminate negative impacts; and (iii) Enhancement measures to maximize positive impacts. Environmental management plan has to be considered as part of the plant's overall management and it would be part of the plant operational manual. The estimated budget for implementation of the environmental and social mitigation and monitoring measures proposed in the ESMP is BDT 5,15,500.

**RISK ASSESSMENT
AND EMERGENCY
RESPONSE**

The risks affecting solar projects appear throughout the entire project lifetime. Some examples are the risk of environmental damage, hand injury, fatigue and ergonomics, the collapse of scaffold or ladder, falls, electrocution, and fire. In managing the risks associated with the rooftop solar project it is important to carry out a risk assessment and follow-up the mitigation measures. Without fulfilling the health and safety requirements of the project sites; construction activity must not be compromised. If an activity cannot be undertaken safely, it should not take place. The PIU & Contractors need to take into consideration in the planning of work activities, first aid, fire and emergency responses.

**GRIEVANCE
REDRESS
MECHANISM**

The Project Management has created a system to respond to project-related questions and complaints, as well as to resolve any inconsistencies in the execution of the standards specified for environmental protection impact assessment and mitigation. The complaints related to plant operation that may create inconveniences to agency/individual should be addressed based on consensus, the procedure will help to resolve issues/conflicts amicably and quickly without resorting to expensive, time-consuming legal actions. To ensure impartiality and transparency, hearings on complaints will remain open to the public. The GRC will record the details of the complaints and the reasons that led to acceptance or rejection of the

particular cases. The GRC will keep records of all resolved and unresolved complaints and grievances and make them available for review as and when asked for by appropriate authorities and any organizations known to be working with urban development issues. However, it should be noted that the GRC process will not pre-empt and aggrieved person's right to seek redress in the courts of law.

**ENVIRONMENTAL
AND SOCIAL
BENEFIT**

Solar power facilities do not pollute the air or emit greenhouse gases. Using solar energy can have a positive, indirect effect on the environment when solar energy replaces or reduces the use of other energy sources that have larger effects on the environment. The electricity produced by solar panels is clean, renewable and emission free. Whereas most of the electricity generated is produced by burning fossil fuels like coal and natural gas, generating electricity with solar power and other renewable resources—such as wind and hydropower—does not result in any emissions of carbon dioxide or local air pollutants. And while extracting and using fossil fuels is expensive and harmful to the environment, solar energy is free and readily abundant – if we could capture all of the sun's energy shining on the Earth for just one hour, we could power the entire world for one year. Furthermore, community-based solar initiatives can have positive social impacts, from decreased heating bills for low-income individuals, decreased dependency on public utilities, an improved environment from reduced pollution.

**CONCLUSIONS AND
RECOMMENDATIONS**

According to the former study, we can conclude that the project will be environmentally sound and sustainable if the proposed mitigation measures and environmental management practices are appropriately implemented.

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.

1 INTRODUCTION

1.1 PROJECT BACKGROUND & RATIONALE

A sustainable, affordable, and secure energy supply is necessary for socio-economic development. People all around the world are turning to renewable energy sources including solar, wind, bioenergy, hydropower, geothermal, and marine energy to ensure green economy, as renewable energy is both environmentally good and cost effective. Renewable energy consumption has increased dramatically in recent years, both in developed and developing countries. Solar PV and wind are expected to account for two-thirds of future renewable energy growth.

Bangladesh is a heavily populated nation with a population of 160 million people. To satisfy the needs of an ever-increasing population, electricity is not being generated at the required rate. Despite its large population, Bangladesh has achieved substantial economic growth over the last 15 years. Deficient infrastructure prevents the country from achieving its full growth potential. This situation is particularly evident in the economically disadvantaged remote and rural areas. Whereas access to energy is a priority in the development framework, much work needs to be done on basic infrastructure for rural electrification. Remote and dispersed areas are currently adopting off-grid electrification as a viable alternative to the national grid service. Whereas access to energy is a priority in the development framework, much work needs to be done on basic infrastructure for rural electrification. Renewable energy is a key component for the development of a country and Bangladesh has already made significant strides in reaching most of the country's population; both in Urban and Rural areas. The renewable energy projects initiated by the Government are helping Private sector, Non-Government Organizations (NGOs), and Micro-Finance institutions expand the solar energy program, in terms of both Sustainability and Commercial viability. These projects are increasing awareness among consumers and suppliers of the benefits and the correct use of solar home systems.

Rapid urbanization, fueled by consistent economic expansion, has resulted in a massive increase in energy consumption in Bangladesh. It is well known that energy plays a vital role in poverty eradication, economic growth, sustainable infrastructure development, and ensuring security of a country. In Bangladesh, electricity is the most widely used form of energy. Future economic growth significantly depends on the availability of electricity. At present, about 72% of the total population has access to electricity, and electricity supply is not adequately reliable.

Bangladesh has been suffering from energy shortages for decades, owing to its reliance on imported fossil fuels and natural gas for electricity generation. The present government has successfully increased electricity generation, but due to the lack of infrastructure and longstanding distribution facilities, yet grid electricity is not reachable in the remote areas of the country.

Bangladesh has implemented several initiatives, both commercial and public, to progress toward renewable electricity production in order to protect the environment and improve living conditions as a vulnerable country. The government has established SREDA to provide policy support and guidelines for sustainable growth of renewable energy.

Bangladesh is blessed with year-round sunlight (more than 300 days a year) and has huge solar energy potential. We have been utilizing solar power wisely and using its experience towards diversifying renewable energy (RE) for maximum use. Bangladesh receives an

average daily solar radiation in the range of 4-5 kWh/m². Encouraged by the availability of solar radiation, Power Division has initiated a programme to generate 500 MW of solar-based electricity. Under this programme, projects for electrification of rural health centers, educational institutions, E-centers at union levels, religious establishments and remote railway stations are required to be implemented by authorities concerned. Private sector is expected to implement commercial projects like Solar Irrigation, Solar Mini Grid, Solar Park and Solar Rooftop applications.

The vision of the Government of Bangladesh is to provide quality electricity to all by 2021. To fulfill the GOB's vision and objectives of electrification, development of renewable energy resources will play a vital role. The government has responded appropriately for generating environment-friendly electricity from renewable energy sources. The Renewable Energy Policy has already been adopted with the target to produce 10% of the total power generation by 2021 from renewable energy sources. In absolute numbers, this means that at least 2000 MW power has to be generated from renewable sources by 2021. The Infrastructure Development Company Limited (IDCOL) is working with objective to promote, develop and co-ordinate renewable energy & energy efficiency activities in the country.

Bangladesh receives a daily average of 4-5 KWh/m² of solar radiation. With the advent of solar based technologies and the current global trend of reduction in solar panel costs, electricity generated using solar based technologies is expected to become cheaper than electricity generated from traditional sources. Thus, different industries are being encouraged to install solar PV based power plants to save electricity expenses in future.

Current electricity cost from solar plant is almost similar to grid tariff which is expected to be cheaper than grid tariff in future due to the constant fall in price of solar based technologies vs. expected rise in grid tariff to minimize gap between generation cost and tariff. Thus, financing such kind of projects makes financial sense apart from achieving country's target to promote renewable energy-based technologies in the country to ensure access to electricity for all. Solar power is the key to a clean energy future. That is why, NAAFCO Pharma Limited has taken initiative to install rooftop solar plant in their factory's rooftop located in Bhaluka, Mymensingh.

Department of Environment (DoE), under the Ministry of Environment, Forest 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 & Social Impact Assessment (ESIA) of development proposal and the responsibility to review ESIA 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 Peoples Republic of Bangladesh, the 1.494 MWp industrial rooftop solar system project (>1MWp) is considered as the **"Orange B Category"**.

1.2 PROJECT OBJECTIVES AND BENEFITS

The main objectives of the Environmental and Social Impact Assessment (ESIA) study are to assess both positive and negative environmental impacts due to the project (Industry and rooftop solar project) activities. Assess the impacts and recommendations appropriate mitigation measures during preconstruction, construction and operational phases to minimize negative impacts of the project to acceptable levels. The ESIA will be used as a decision-making tool to ensure that the project design and implementation activities are environmental and social Management Plan (ESMP) shall serve as a framework for strengthening the

mitigation, enhancement and environmental monitoring measures and system of the rooftop solar project. In the preparation Phases, the ESIA shall achieve the following objectives.

- To establish the environmental and social baseline in the study area, and to identify any significant environmental issues.
- To assess these impacts and provide for measures to address the adverse impacts by the provision of the requisite avoidance, mitigation and compensation measures;
- To integrate the environmental and social issues in the project planning and design.
- To develop appropriate management plans for implementing, monitoring and reporting of the environmental and social mitigation and enhancement measures suggested.

Some of the benefits of the project include:

- Energy security against gas shortage.
- Buyer's attraction.
- Upgrade LEED status.
- Lower carbon footprint by 35%.
- Additional source of energy with full control and predictable cost.
- Contribution to social responsibility to mitigation of climate change.

1.3 THE SCOPE OF THE ESIA REPORT

This ESIA report has been prepared keeping in view the Terms 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 roof top solar system.
- Identification of mitigation measures and monitoring actions in the form of an environmental & social management plan (ESMP); and
- Recommendations and conclusions in order to operate the project works in an environmentally safe and sound manner.

1.4 EXTENT OF THE STUDY

This ESIA is carried out based on proposed development. The influence of impact has been defined as 1 Km around the 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 areas) within 1 Km of the project areas have also been assessed.

1.5 APPROACH AND METHODOLOGY

1.5.1 Approach

The study has been conducted in accordance with Environment Conservation Rules, 1997, Government of Bangladesh (GoB) EIA Guidelines, 1997, and World Bank Environmental & Social Standard (ESS, 1-10). 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. Discussions were held with stakeholders including project representatives and a wide range of community people. The main purpose of this approach was to obtain a fair impression on the people's perceptions of the project and its environmental impacts.

1.5.2 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) 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.

(iii) Data Collection

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. A map in Figure 6.18 is showing the data collection spots of several environmental features in the project area. Following activities were performed for data collection:

- Site Reconnaissance
- Analysis of Maps and Plans
- Literature Review
- Desk Research
- Field Observations and Studies
- Laboratory Analysis

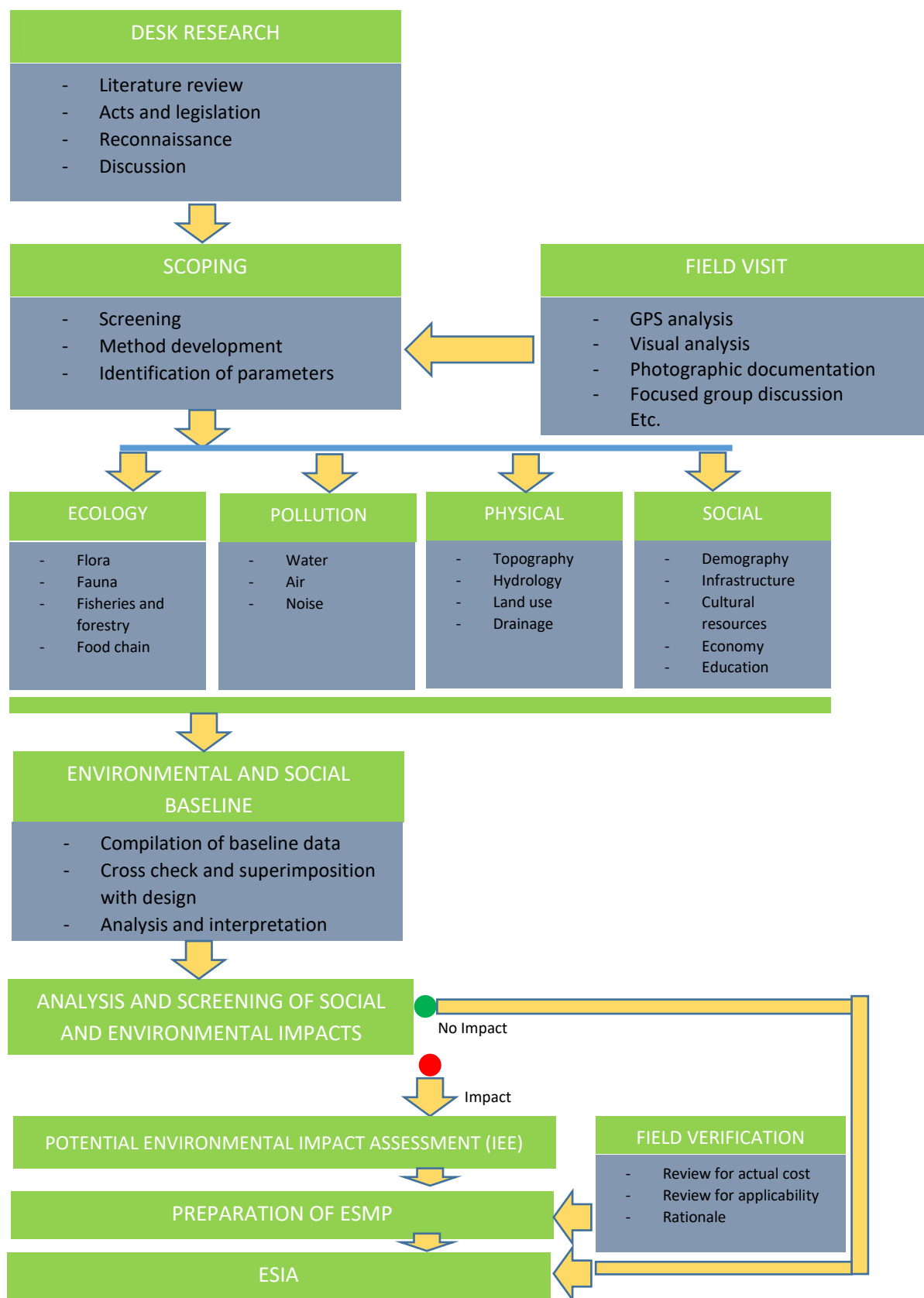


Figure 1.1: Route Map of Environmental and Social Impact Assessment (ESIA)

(iv) Physical Environment

Information was collected about the existing physical environment, particularly as related to existing soil and geology, landscape, aesthetic values and hydrology, with special emphasis on storm water run-off, drainage patterns, topography, water quality, noise and air quality.

Geology, Topography, Soils

Data related to geology of the proposed site, the distribution of soil types in the proposed study areas and topography data 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.

Air Quality

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. To monitor ambient air quality, carbon monoxide (CO), Sulphur dioxide (SO₂), Nitrogen dioxide (NO₂), particulate matter (PM₁₀), particulate matter (PM_{2.5}), Ozone (O₃), etc. have been included for ambient air quality monitoring.

Noise

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 30 minutes at each location and was calibrated before and after the survey; no significant drift was detected.

Surface Water Quality

Sampling and analysis of surface water quality has been carried out for the following parameters: Temperature, Turbidity, pH, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Dissolve Oxygen (DO), Total Suspended Solids (TSS), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD₅), Total Coliform (TC), Ammonia (Nitrogen), Chloride (Cl⁻), and Chromium (Cr).

Drinking Water Quality

Sampling and analysis of drinking water has been carried for the following parameters: Temperature, Turbidity, pH, Total Dissolved Solids (TDS), Electrical Conductivity (EC), salinity, Total Coliform (TC), Faecal Coliform (FC), Biochemical Oxygen Demand (BOD₅), Alkalinity, Iron (Fe), Chloride (Cl⁻), Manganese (Mg), Arsenic (As), Chromium (Cr), and Total hardness (as CaCO₃).

(v) 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.

(vi) 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

(vii) 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.

(viii) Impact assessment and mitigation

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

1. **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; GoB, IDCOL, 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 Solar PV System);
- ✓ Procedural measures (e.g., setting up management committee);
- ✓ Avoidance/reduction (e.g., waste minimization process management);
- ✓ Compensatory measures (e.g., biodiversity offsets); and
- ✓ Timing measures (e.g., no construction at night).

1.6 REVIEW AND ANALYSIS OF PREVIOUS DATA AND LITERATURE

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, and the BBS.

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.

1.7 CONTENTS OF THE REPORT

The report fulfills the requirements of ESIA under ECR, 1997 and has been prepared in accordance with the ToR. This ESIA report is also consistent with the Government of Bangladesh guidelines, IDCOL Guidelines and development partner's Environmental & Social Standards (ESS).

The scope of this ESIA is specific to this industrial rooftop solar system project. 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. The ESIA has been prepared to comply with the requirements set out in the EIA Guidelines for Industries, Department of Environment, Ministry of Environment, Forest and Climate Change, Government of the People's Republic of Bangladesh, 1997, Section 4. The report contains 11 chapters and the chapters are:

- **Chapter 1: Introduction:** This section outlines the background of the Project, its context in relation to the Project outline.
- **Chapter 2: Policy, Legal and Administrative Framework:** This section 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 section 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.
- **Chapter 4: Technological Aspects:** This section sets out the proposed process

and technology, plant capacity, solar irradiation, generator size, energy storage etc.

- **Chapter 5: Analysis of Alternatives:** This section provides background as to the overall need for the Project. Also provided is an assessment of alternative Project Location, methodologies, technological alternatives 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 6 & 7: Description of Environmental and Social Baseline:** This section 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.
- **Chapter 8: Anticipated Environmental Impacts and Mitigation Measures:** This section identifies the potential positive and negative environmental, physical and socio-economic impacts of the Project. Each key aspect is analyzed 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 9: Stakeholder Consultations & Information Disclosure:** This chapter will describe the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders.
- **Chapter 10: Environmental and Social Management Plan (ESMP):** This section 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 11: Grievance Redress Mechanism:** This section contains public participation, consultation and information disclosure activities in the project area.
- **Chapter 12: Environmental and Social Benefit:** This section contains environmental and social benefit along the local economy and regional context.
- **Chapter 13: Conclusion & Recommendation:** This section 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.

1.8 ENVIRONMENTAL AND SOCIAL ASSESSMENT (ESIA) TEAM

The multidisciplinary team of ESIA experts having experience of conducting Environmental and Social Assessment of large scale industrial and infrastructural development projects are engaged for the study. 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.	Md. Mashiur Rahman	Jr. Environmental Specialist, Data collection, environmental testing, field survey and analysis
3.	Saiful Islam Imran	Jr. Environmental Specialist, Data collection, environmental testing, field survey and analysis
4.	Rajib Roy	Jr. Environmental Specialist, Data collection, environmental testing, field survey and analysis
5.	Muhammad Anwar Iqbal	Jr. Environmental Specialist, Data collection, environmental testing, field survey and analysis

2 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 GENERAL

According to DoE ECR 1997 (Addendum December 24, 2017), Solar subprojects of more than 1MW fall into the Orange B Category. For Orange B Category projects, ECC from DOE is mandatory for that particular sub-project.

All development initiatives in Bangladesh are governed by some legal and institutional restrictions, according to the country's national environmental legislation. As a result, any project proponent or developer must analyze relevant legal laws, policies, tactics, and institutional issues before implementing 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, Forest and Climate Change (MoEFCC) is the regulatory body responsible for enforcing environmental laws and regulations like ECA'95 (amended in 2010) and ECR'97.

Rooftop solar project operations have less environmental and social impact due to their inherent nature and adaptability. Due to both local requirements and international responsibilities, Bangladesh's environmental and social regulations have been improved in the previous decade. All project initiatives must comply with these laws, taking into account necessary international treaties, regulations, and recommendations relating to environmental and social considerations of funding agencies.

The proposed project will be implemented in compliance with the applicable environmental and social laws and regulations of Bangladesh and other development partners. Bangladesh has environmental and social law frameworks that promotes environmental protection as well as the conservation of natural resources and social considerations of project implementation. This legislative framework for the environmental and social issues applied to the proposed project. In addition, there are several environmental and social laws and regulations in Bangladesh.

An ESIA is an effective planning and decision-making tool for the project proponent. It enables the identification and management of environmental impacts/issues that may arise as a result of the facility's construction and operation. An ESIA also provides for the remediation of the issue(s) raised in the Scoping and ESIA Reports, as well as interaction with parties involved.

The obligation to comply with the ESIA Regulations guarantees that decision-makers have the chance to analyze a project's possible environmental consequences early in the project development process and to determine whether those impacts may be avoided, minimized, or mitigated to acceptable levels. According to the ESIA Regulations, comprehensive, independent environmental studies must be conducted to give the responsible authority sufficient information to make a more informed decision. The following activities have been carried out under the ESIA study:

- Exploration of environmental and social legislation laws and policy guidelines at the national level.
- Identifying national legal duties in connection to the actions that will be examined as part of the proposed project's ESIA study.
- Identifying international legal obligations and relevant sections of multilateral environmental treaties and agreements that apply to the renewable energy project.
- Exploration of national and international legal provisions on energy sector; and

- Identification of the standard guidelines at the regional and international level related to the project.

2.2 APPLICABLE POLICIES

2.2.1 National Environmental Policies

2.2.1.1 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 sector 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 the 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 precautionary measures to safeguard the 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 a 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.

2.2.1.2 National Environmental Policy, 2018

The national environmental policy has been updated in 2018 based on NEP, 1992. The environmental policy is a comprehensive framework of environmental action, together with a set of broad sectoral action guidelines. The objective of the updated environmental policy as follows:

- a. Natural equilibrium provision and overall development of the country through environmental protection and sustainable management
- b. The spread of adaptation programs to reduce the adverse effects of climate change in the country
- c. Encourage collection and promotion of low carbon emission technology in the country
- d. Identifying and controlling all types of environmental pollution and degradation activities
- e. Ensure environmental development in all fields
- f. Ensure sustainable, long term, and environmentally friendly use of all-natural resources

- g. Exploring and expanding the areas of cooperation in regional and international arenas for the development of the global environment
- h. Built-up the environment education, capacity building, public awareness, and public opinion to protect the environment
- i. To take Public Private Partnership (PPP) for the development of the environment
- j. Maintain and streamline the environmental policies and strategies among other policy strategies in the interest of sustainable development
- k. Creating a population capable of dealing with all kinds of environmental and environmental issues, including climate change
- l. Ensure the Environmental Impact Assessment and Strategic Environmental Assessment in all necessary sectors
- m. To discourage the introduction of foreign and invasive species of animals and plants, if necessary, make decisions through adequate research
- n. Actively involved as possible with all international environmental initiatives and take necessary actions at local and national levels
- o. Take action to reduce poverty through environmental protection
- p. Strengthen observations on proper compliance with environmental laws and regulations

The updated environmental policy includes a total of twenty-four sectors and areas. The policy includes an outline of organizational set-up and national environmental policy compliance for different sectors.

2.2.1.3 National Environmental Management Action Plan (NEMAP), 1995

The National Environmental Management Action Plan (NEMAP) builds on the NEP and was developed to address specific issues and management requirements during the period 1995-2005. The plan includes a framework within which the recommendations of a National Conservation Strategy (NCS) are to be implemented. The NEMAP was developed with the following objectives:

- To identify key environmental issues affecting Bangladesh;
- To identify actions to halt or reduce the rate of environmental degradation;
- To improve management of the natural environment;
- To conserve and protect habitats and biodiversity;
- To promote sustainable development; and
- To improve the quality of life.

According to this policy, the project proponent should identify the key environmental issues as well as identify the actions to reduce or halt environmental degradation.

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 about “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 the 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 the 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 regarding this project and hence we give an extensive quote as under. As regards the 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 fuelwood 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 the case of coal-based power plants, disposal of ash and reduction of environmental emission is 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 the use of a Catalytic Converter and Diesel Particulate Filter will be encouraged to reduce vehicular emissions;
- For improving the environmental condition in the country, producing energy from wastes will be encouraged.

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 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 biofuels which may jeopardize the existing crops.

2.2.1.6 Guidelines for the Implementation of Solar Power Development Program, 2013

It is mentioned in section 3.8 of guidelines for the implementation of the Solar Power Development Program (2013) that according to the Renewable Energy Policy, to establish a solar mini-grid project with a capacity of up to 5 MW, the entrepreneur will be exempted to get a waiver certificate. Mini-grid projects with a capacity up to 250 MW will not be required any waiver certificate/license, but the entrepreneur will have to inform the Commission by sending a letter. For the implementation and operation of solar mini-grid projects, a license for a period of a minimum of 20 years may be issued with a condition to renew every year.

2.2.1.7 Remote Area Power Supply Systems (RAPSS) Guideline of 2007

The Remote Area Power Supply Systems (RAPSS) guideline of 2007 allows for private sector participation in the development, operation, and maintenance of electricity generation systems and distribution networks in remote rural areas including isolated islands to supplement GoB efforts at achieving universal access by 2020. However, there has not been much progress in implementing the RAPSS schemes. GoB is in the process to establish the Sustainable and Renewable Energy Development Agency (SREDA) as an autonomous body to lead its efforts in promoting renewable energy and energy efficiency in the country.

2.2.1.8 National Land Use Policy, 2001

Bangladesh government in 2001 adopted the National Land Use Policy, setting out guidelines for improved land-use and zoning regulations. The main objectives of this policy are to ensure criteria-based uses of land and to provide guidelines for usage of land for agriculture, housing, afforestation, commercial and industrial establishments, rail and highway, and tea and rubber gardens. Overall, this policy promotes a sustainable and planned utilization of land.

The main contents of this policy are:

- Stopping the high conversion rate of agricultural land to non-agricultural purposes;
- Utilizing agro-ecological zones to determine maximum land-use efficiency;
- Adopting measures to discourage the conversion of agricultural land for urban or development purposes;
- Improving the environmental sustainability of land-use practices.

The proposed project must adhere to this policy so that the environmental sustainability of land-use practices is assured.

2.2.1.9 National Agriculture Policy, 1999

This policy aims to make the nation self-sufficient in food through increasing production of all crops including cereals and ensure a dependable and secure food system for all. One of the objectives of this Act is to preserve and develop land productivity. The policy particularly stresses on research and development of improved varieties and technologies for cultivation in waterlogged and salinity-affected areas. The policy also recognizes that adequate measures should be taken to reduce waterlogging and salinity and provide irrigation facilities for crop production.

Adequate measures should be taken to reduce waterlogging and hamper irrigation systems due to the construction of the transmission lines and substations.

2.2.2 National Social Policies

2.2.2.1 Labor Legislations

Standards for labor and working conditions are defined in Bangladesh Labor Act, 2006 (amendments in 2013 and 2018) and Bangladesh Labor Rules 2015 and Occupational Health and Safety Policies 2013. Bangladesh Labor Act, 2006 is a comprehensive legislation. The Act addresses three areas: (i) Conditions of service and employment including wages and payment, establishment of Wages Boards, employment of young people, maternity benefits, working hours and leave; (ii) health, safety, hygiene, and welfare, and compensation for injury; and, (iii) trade unions and industrial relations. Beside this, due to ongoing pandemic of COVID-19 World Health Organization (WHO) and Directorate General of Health Services (DGHS), under the Ministry of Health and Family Welfare, provided guideline for infection prevention and control. The government has incorporated the life-threatening novel corona virus (COVID-19) in 'The Communicable Diseases (Prevention, Control and Eradication) Act, 2018. With the issuance of the gazette the government has got a legal power to take action against the people not following the government's direction that relates to COVID-19. The health and safety issues relevant to COVID-19 should be addressed with reference to ILO Occupational Safety and Health Convention, 1981 (No. 155), ILO Occupational Health Services Convention, 1985 (No. 161), ILO Safety and Health in Construction Convention, 1988 (No. 167), WHO International Health Regulations, 2005, WHO Emergency Response Framework, 2017.

2.2.2.2 Gender-based Violence (GBV) related Legislations

In Bangladesh, several legislations developed to ensure women's right. The government of Bangladesh additionally enacted the Citizens Act, which permits women to transfer citizenship to their children. Besides, the government enacted the following laws and ordinances to ensure women's and girls' rights and to protect them from violence, harassment, and discrimination. The Prevention of Women and Children Repression Act, 2000; The Acid Crime Control Act, 2002; The Dowry Prohibition Act, 1980; National Human Rights Act, 2009; Domestic violence (prevention and protection) act, 2010; The Child Marriage Restraint Act, 1929; The Dowry Prohibition Act, 1980; The Family Court's Ordinance, 1985; The Muslim Family Law's Ordinance, 1961; The Muslim Marriages and Divorces (Registration) Act, 1974; The Dissolution of Muslim Marriages Act, 1939; The Special Marriage Act, 1872; The Hindu marriage registration act, 2012; The Christian Marriage Act, 1872; The Married Women's Property Act, 1874; The Succession Act, 1925; The maintenance of parents act, 2013; and The Child Marriage Restraint Act, 2017 (Judicial Portal Bangladesh, 2022).¹

The main focusing area of the acts is the enhancement of punishments rather than prevention for the protection of women and girls' rights strategies. Most of these laws and ordinances discriminate against women in marriage, separation, maintenance, and child custody. The legal protections for women and girls are harmonious to other parts of the world as weak application and biases of law enforcing agencies are seen over the country. Policymakers claimed that weak application of existing laws, delay in judicial procedure, lack of women's rights consciousness, sensitivity, and fragile infrastructures are the major reasons for discrimination and violence in the society of Bangladesh.

2.2.2.1 OSH Policy-2013

In the context of global, ethical and legal obligations to ensure a safe and healthy working environment for all, the National Policy on Occupational Health and Safety was formulated

¹ <https://www.judiciary.org.bd/en>

and adopted on 5th November 2013, with the understanding that the implementation of such a National Policy would firstly ensure the safety of workers and secondly, help increase industrial productivity. The Policy applies to all workplaces in Bangladesh, including formal and informal sectors of industries, factories, enterprises, business and commercial entities and farms. The ultimate goal of the Policy is the nationwide understanding and acceptance of OSH for all women and men who are working in both the formal and informal sectors in Bangladesh. A robust national OSH framework will significantly help reduce the number of deaths, injuries and occupation-related diseases, thereby fulfilling the constitutional and legal obligations of the state.

2.2.2.1 Community Safety and Health (CSH) Legislations

There is no specific legislative framework for community health and safety aspect of industry or projects but under the government of Bangladesh there are specific laws and acts enacted by various ministries. The project proponent conducting the EIA may consult ongoing community-based programs and policies of the Ministry of Health to help improve assessment and mitigation planning on community health and safety impacts and risks. Table 2.1 below provides some of the relevant legislations and policy issuances that have relevant provisions on community health and safety of industry projects.

Table 2.1: Legislations and policy issuances related to safety in the workplace

Legislations and Issuances	Key Provisions
National Occupational Health and Safety Policy, 2013	Specifies the obligations of all relevant stakeholders and organizations in promoting and enforcing occupational health and safety
Labour Act 2006 as amended, 2013 Labour Rules (2015)	Imposes obligations on the part of the employer on the conditions of service and employment including wages and payment, employment of young people, maternity benefits, working hours and leave; trade unions and industrial relations; and, occupational health, safety, hygiene, and welfare of workers, and compensation for injury.
National Building Code 2006	Provides for standards for structural integrity; adequate, accessible and discernible means of exit/escape in Buildings; fire extinguishing system.
Public Procurement Rule (PPR) 2008	Requires contractors to provide for adequate measures regarding the "Safety, Security and Protection of the Environment" in the construction works.
National Child Labour Elimination Policy, 2010	Sets a policy to eliminate child labour exploitation through enactment of pragmatic laws, implementation of plans and programs, etc.
Fire Prevention and Extinction Act 2003 Fire Prevention and Extinction Rules 2014	Requires the owner of a building to apply for Occupancy Certificate to ensure compliance with the relevant provisions of the Building Code.

2.2.3 International Policies

The Ramsar Convention, the Bonn Convention on Migratory Birds, the Rio de Janeiro Convention on Biodiversity Conservation, and the Kyoto Protocol on Climate Change are among the international treaties, conventions, and protocols on the environment, pollution control, biodiversity conservation, and climate change that Bangladesh has signed. An overview of the relevant international treaties and conventions signed by GOB is shown in Table 2.2.

Table 2.2: Relevant International Treaties, Conventions and Protocols Signed by Bangladesh

Treaty or Convention	Year	Brief description	Responsible Agency
On protection of birds (Paris)	1950	Protection of birds in the wild state	Department of Environment (DOE)
Occupational hazards due to air pollution, noise, and vibration (Geneva)	1977	Protect workers against occupational hazards in the working environments	Ministry of Health and Family Welfare (MOHFW)
Occupational safety and health in a working environment (Geneva)	1981	Prevent accidents and injury to health by minimizing hazards in the working environment	MOHFW
Occupational health services (Geneva)	1985	To promote a safe and healthy working environment	MOHFW
International convention on climate changes (Kyoto Protocol)	1997	An international treaty on climate change and emission of greenhouse gases	DOE/MOEF

2.2.4 Funding Agencies' Policies

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

The Environmental, Health and Safety (EHS) Guidelines of the World Bank Group (WBG) 2008 contain performance levels and measures that are considered to be achievable in new facilities at reasonable costs using existing technologies. The EHS guidelines have been organized into major four categories: (a) Environment, (b) Occupational Health & Safety, (c) Community Health & Safety, and (d) Construction & Decommissioning.

World Bank has 10 environmental & social safeguard policies which are given below:

ESS1: Assessment and Management of Environmental and Social Risks and Impacts

ESS1 sets out the Borrower's responsibilities for assessing, managing, and monitoring environmental and social risks and impacts associated with each stage of a project supported by the Bank through Investment Project Financing (IPF), in order to achieve environmental and social outcomes consistent with the Environmental and Social Standards

ESS2: Labor and Working Conditions

ESS2 recognizes the importance of employment creation and income generation in the pursuit of poverty reduction and inclusive economic growth. Borrowers can promote sound worker-management relationships and enhance the development benefits of a project by treating workers in the project fairly and providing safe and healthy working conditions.

ESS3: Resource Efficiency and Pollution Prevention and Management

Recognizes that economic activity and urbanization often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the local, regional, and global levels.

ESS4: Community Health and Safety

Addresses the health, safety, and security risks and impacts on project-affected communities and the corresponding responsibility of Borrowers to avoid or minimize such risks and impacts, with particular attention to people who, because of their circumstances, may be vulnerable.

ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement

Involuntary resettlement should be avoided. Where involuntary resettlement is unavoidable, it will be minimized and appropriate measures to mitigate adverse impacts on displaced persons (and on host communities receiving displaced persons) will be carefully planned and implemented.

ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

ESS6 addresses the importance of protecting and conserving biodiversity and managing living natural resources. It also addresses the need to consider the livelihood of project-affected parties, including Indigenous Peoples.

ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities

The Environment Social and Social Responsibility (ESS7) is meant to ensure that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of Indigenous Peoples. ESS7 is also meant to avoid adverse impacts of projects on Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities. It aims to minimize, mitigate and/or compensate for such impacts.

ESS8: Cultural Heritage

Efforts to ensure that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of Indigenous Peoples. ESS7 is also meant to avoid adverse impacts of projects on Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities.

ESS9: Financial Intermediaries

International Financial Institutions (IFIs) are required to monitor and manage the environmental and social risks and impacts of their portfolio and subprojects. The way in which the FI will manage its portfolio will take various forms, depending on several factors, including capacity and scope of funding provided by the FI.

ESS10: Stakeholder Engagement and Information Disclosure

Recognizes the importance of open and transparent engagement between the Borrower and project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.

2.2.4.2 Environmental and Social Management Framework (ESMF) of IDCOL

IDCOL has adopted an Environmental and Social Management Framework (ESMF) in 2011, which is to comply with all infrastructure projects as are to be funded by IDCOL. According to the environmental categorization of ESMF, the project has been categorized as a 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 a Low-Risk project both for Indigenous People (IP) and for Involuntary Resettlement (IR) perspectives.

2.3 APPLICABLE LEGISLATION

2.3.1 National Legislation

2.3.1.1 Bangladesh Environment Conservation Act (ECA) 1995, as amended in 2010

The ECA is currently the main legislation relating to environment protection in Bangladesh. This Act is promulgated for environment conservation, environmental standards development and environment pollution control and abatement.

The main objectives of ECA are:

- Conservation and improvement of the environment; and
- Control and mitigation of pollution of the environment.

The main focuses of the Act can be summarized as:

- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried out/ initiated in the ecologically critical areas (ECA);
- Regulations in respect of vehicles emitting smoke harmful for the environment;
- Environmental clearance;
- Regulation of industries and other development activities' discharge permits;
- Promulgation of standards for quality of air, water, noise, and soil for different areas for different purposes;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines.

Before any new project can go ahead, as stipulated under the ECA, the project promoter must obtain Environmental Clearance from the Director General (DG) of DoE. An appeal procedure does exist for those promoters who fail to obtain clearance. Failure to comply with any part of this Act may result in punishment to a maximum of 5 years imprisonment or a maximum fine of Tk.100, 000 or both. The DoE executes the Act under the leadership of the DG.

The Project will be undertaken in line with the aims and objectives of the Act by conserving the environment and controlling and mitigating potential impacts throughout the drilling program.

Environment Conservation Act (Amendment 2000)

The Bangladesh Environment Conservation Act Amendment 2000 focuses on ascertaining responsibility for compensation in cases of damage to ecosystems, increased provision of punitive measures both for fines and imprisonment and the authority to take cognizance of offences.

Environment Conservation Act (Amendment 2002)

The 2002 Amendment of the ECA elaborates on the following parts of the Act:

- Restrictions on polluting automobiles;
- Restrictions on the sale, production of environmentally harmful items like polythene bags;
- Assistance from law enforcement agencies for environmental actions;
- Break up of punitive measures; and
- Authority to try environmental cases.

Environment Conservation Act (Amendment 2010)

This amendment of the act introduces new rules and restriction on:

- No individual or institution (Gov. or Semi Gov. / Non-Gov. / Self Governing) can cut any Hill and Hillock. In case of national interest; it can be done after getting clearance from respective the department
- Owner of the ship breaking yard will be bound to ensure proper management of their hazardous wastes to prevent environmental pollution and Health Risk
- No remarked water body cannot be filled up/changed; in case of national interest; it can be done after getting clearance from the respective department; and
- Emitter of any activities/incident will be bound to control emission of environmental pollutants that exceeds the existing emission standards.

2.3.1.2 Bangladesh Environment Conservation Rules, 1997

The Environment Conservation Rules, 1997 were issued by the Government of Bangladesh in the exercise of the power conferred under the Environment Conservation Act (Section 20), 1995. Under these Rules, the following aspects, among others, are covered:

- Declaration of ecologically critical areas;
- Classification of industries and projects into four categories;
- Procedures for issuing the Environmental Clearance Certificate;

Rule 3 defines the factors to be considered in declaring an area 'ecologically critical area' (ECA) as per Section 5 of ECA'95. It empowers the Government to declare an area 'ECA' if it is satisfied that the ecosystem of the area has reached or is threatened to reach a critical state or condition due to environmental degradation. The Government is also empowered to specify which of the operations or processes shall be carried out or shall not be initiated in the ecologically critical area. Under this mandate, MoEFCC has declared Sundarbans, Cox's Bazar-Teknaf Sea Shore, Saint Martin Island, Sonadia Island, Hakaluki Haor, Tanguar Haor, Marzat Baor, and Gulshan-Baridhara Lake as ecologically critical areas and prohibited certain activities in those areas.

ECR'97 (Rule 7) classifies industrial units and projects into four categories depending on environmental impact and location for issuance of ECC. These categories are:

- Green
- Orange A
- Orange B, and
- Red

All existing industrial units and projects and proposed industrial units and projects, that are considered to be low polluting are categorized under "Green" and shall be granted Environmental Clearance. For proposed industrial units and projects falling in the Orange- A, Orange-B, and Red Categories, firstly a site clearance certificate and thereafter an environmental clearance certificate will be issued. A detailed description of those four categories of industries has been given in Schedule-1 of ECR'97.

Department of Environment (DoE), under the Ministry of Environment, Forest 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 a development proposal and the responsibility to review ESIA to issue an Environmental Clearance Certificate (ECC) from the DOE. According to the Gazette on 24th December 2017 under Environment Division-3 of Ministry of Environment, Forest and Climate change, Government of the Peoples Republic of Bangladesh, the 1.494 MW Rooftop Solar PV System project is considered as the **"Orange B Category"**.

2.3.1.3 Environment Court Act, 2000

The Environment Court Act, 2000 has been enacted in order to establish environmental courts in each administrative division of Bangladesh. This Act sets out policy for effective pursuance and completion of legal proceedings related to environmental crimes. Under this Act the Director General of the DoE has the power to impose heavy penalties to industrial polluters who are dumping untreated wastewater into the environment or not operating their legally mandated ETPs.

According to this act, government can take legal actions if any environmental problem occurs due to project interventions.

2.3.1.4 National Fisheries Policy, 1998

The policy recognizes that fish production has declined due to environmental imbalances, adverse environmental impact and improper implementation of fish culture and management programs. The policy suggests, among others, that biodiversity will be maintained in all-natural water bodies and in marine environment and control measures will be taken against activities that have a negative impact on fisheries, resources and vice-versa. National Fisheries Policy focuses on aquaculture and marine fisheries development and includes the following mandates:

- Maintaining biodiversity in all-natural water bodies and in marine environment,
- Ensuring that chemicals harmful to the environment will not be used in fish shrimp farms;
- Using environment friendly fish shrimp culture technology;
- Expanding fisheries areas and integrating rice, fish, and shrimp cultivation;
- Undertaking control measures against activities that have a negative impact on fisheries resources and vice-versa; and
- Formulating laws will to ban the disposal of any untreated industrial effluents into the water bodies.

2.3.1.5 The Electricity Act, 2018

The primary objective of this act is to amend the laws relating to the modification for developing and reforming the sectors of power generation, transmission, supply, and distribution and for better service delivery to consumers and meeting the increasing demand for electricity. This act comprises guidelines related to licenses, works, and supply for the supply of energy. It also includes guidelines related to supply, transmission and use of energy by non-licensees. A licensee is a person authorized by the Government to supply energy in any specified area and permitted to lay down or place electric supply lines for the conveyance and transmission of energy. In Part II of this act, guidelines are provided for power Sector Development and Independent System Operators. The independent system operator shall, in such manner as may be prescribed, monitor the flow of power transmission, make a schedule and, on an equity basis, allocate load in accordance with the merit order dispatch and on-demand of the distribution agency or company. Civil Works is provided in Part II of the act. According to this act, the licensee is permitted to lay power supply lines within the area of supply or, subject to the terms of his license, beyond the area of supply, the licensee may, as soon as may be, do necessary civil works, with intimation to the concerned person or the local authority, as the case may be, for supplying electricity to that area. In Part IV of this act, Power Supply, Meter Installation has been provided. Protective Clauses are provided for protection of railways and canals/waterways, docks, wharves, and piers, telegraphic, telephonic and electric signaling lines. Part IV also includes guidelines for occurrences of any criminal offences such as

dishonest abstraction of energy, installation of artificial means, malicious wasting of energy or injuring works, theft of line materials, tower members, equipment, etc. and subsequent procedures to follow up that criminal offence.

2.3.1.6 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 chapter VI of this law safety precautions 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 Chapter VIII provision of safety measures like appliances of first aid, maintenance of safety record book, rooms for children, housing facilities, medical care, group insurance, etc. are illustrated.

2.3.2 Other Relevant National Policies, Act, Rules, Laws & Ordinances

A considerable number of national policy documents have been prepared during recent years and these have been accepted by the GoB. These policy initiatives, strategies, and plans all emphasize consideration of the environment and natural resources to achieve sustainable development.

Table 2.3 presents an outline of the other national legal instrument that will have relevance to the project concerning the social and environmental considerations. The ESIA is prepared in compliance with these national policies.

Table 2.3: Other Relevant National Act, Rules, Laws, and Ordinances

Act/Rule/Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features-Potential Applicability
Environment Court Act, 2000 and subsequent amendments in 2002	Ministry of Environment and Forest	The aim and objective of the Act are to materialize the Environmental Conservation Act, 1995 through judicial activities. This Act established Environmental Courts (one or more in every division), set the jurisdiction of the courts, and outlined the procedure of activities and power of the courts, right of entry for judicial inspection and appeal as well as the constitution of Appeal Court.
Public Procurement Rule (PPR), 2008	Ministry of Public Works (MOPW)	This rule shall apply to the Procurement of Goods, Works, or Services by any government, semi-government, or any statutory body established under any law. The rule includes the adequate measure regarding the "Safety, Security and Protection of the Environment in the construction works. This clause includes mainly, the contractor shall take all reasonable steps to (i) safeguard the health and safety of all workers working on the Site and (ii) protect the environment on and off the Site and to avoid damage or nuisance to persons or property of the public or others.
Water Supply and Sanitation Act, 1996	Ministry of Local Government, Rural Development and	Management and control of water supply and sanitation in urban areas.

Act/Rule/Law/Ordinance	Responsible Agency-Ministry/Authority	Key Features-Potential Applicability
	Cooperatives	
Bangladesh Wildlife Preservation Order 1973 and Revision 2008 (Draft)	Ministry of Environment and Forests (MOEF)	Restricts people from damaging or destroying vegetation in wildlife sanctuaries and hunting and capturing wild animals
National Forest Policy and Forest Sector Review (1994, 2005)	Forest Department (FD), MOEF	▪ Afforestation of 20% land; ▪ Bio-diversity of the existing degraded forests; ▪ Strengthening of the agricultural sector; ▪ Control of global warming, desertification, control of trade in wild birds and animals; and ▪ Prevention of illegal occupation of the forest lands, tree felling, and hunting of wild animals.
The Forest Act 1927, Amendment 2000 (Protected, village Forests and Social Forestry)	FD, MOEF Forest Department. Ministry of Environment and Forest	▪ Declare any forests land or wasteland as protected forests; ▪ May stop public or private way or watercourse in the interest of preservation of the forest; ▪ Declare a reserved forest area as village forests; and ▪ Declare an area as a social forest or launch a social forestry program in Govt. land or private land with permission.
Bangladesh Climate Change Strategy and Action Plan (2008)	MOEF Ministry of Environment and forest	Establishment of six strategic pillars for action, including: 1. food security, social protection, and health 2. disaster management 3. protective infrastructure 4. research and knowledge management, 5. decreased carbon development, and capacity building and institutional strengthening.
Wetland Protection Act 2000	MOWR Ministry of Water Resources	▪ Advocates protection against degradation and resuscitation of natural water-bodies such as lakes, ponds, beels, khals, tanks, etc. affected by man-made interventions or other causes; ▪ Prevents the filling of publicly-owned water bodies and depressions in urban areas for the preservation of the natural aquifers and environment; and ▪ Prevents unplanned construction on riverbanks and indiscriminate clearance of vegetation on newly accreted land.
Vehicle Act 1927 and Motor vehicle ordinance 1983	Bangladesh Road Transport Authority (BRTA)	▪ Road/traffic safety; ▪ Vehicular air and noise pollutions; and ▪ Fitness of vehicles and registration.

2.4 GAP ANALYSIS

The GoB legislations and ESF, 2018 of World Bank is compared and gaps if any are summarized in the Table below.

Table 2.4: Other Relevant National Act, Rules, Laws, and Ordinances

Sl. No	ESS	Equivalent National Environmental Policy and	Policy Gaps and its redressal
1	ESS-1 Assessment and Management of Environmental and Social Risks and	Environmental Impact Assessment (EIA) ECA 1995 (amendment in 2000, 2002 & 2010 and Environmental Conservation	The ESS 1 requires EA for the project irrespective of its type. While, ESIA is required as per ECA 95.
2	ESS-2 Labor and Working Conditions	• Bangladesh Labor Act, 2006 (amended in 2013, 2015 and 2018)	The National legal provisions almost cover all requirements in ESS2 except relating to community workers and a functional GRM for different types of workers. Hence, under this project, a Project's Labor management plan will be prepared to regulate working conditions and management of worker relations including workers specific GRM, terms and conditions of employment, non-discriminations and equal opportunity, protection of work force, prohibition.
3	ESS-3 Resource Efficiency-and- Pollution-Prevention-and-Management	• Environment Conservation Act (ECA) 1995 • Noise Pollution Rules (2006)	The majority of ESS3 requirements are addressed by existing regulations and indirectly for resource efficiency and climate change aspects. There is no laws and policy regarding Resource Efficiency.
4	ESS-4 Community-Health-and-Safety	• Noise Pollution Rules (2006) • Environment Conservation Rules 1997	While other acts cover for all of ESS 4 requirements, gaps exist for Community-community exposure to health issues. The gaps are addressed through suitable provisions in ESMP and contractor obligation as part of C-ESMP for Community health and safety include need for OHS plan, Influx management Plan, Worker's camp management plan, Traffic and road safety management Plan.
5	ESS-5 Land Acquisition Restrictions-on- Land-Use-and- Involuntary Resettlement	The Land Acquisition/ Requisition of Immovable Property Ordinance, 1982 Act	No land acquisition is required. The project will not cause any physical and economic displacement. No gap is addressed.

Sl. No	ESS	Equivalent National Environmental Policy and	Policy Gaps and its redressal
6	ESS-6 Biodiversity Conservation	Not relevant.	
7	ESS-7 Indigenous-Peoples	Not relevant	
8	ESS-8 Cultural-Heritage	Not relevant	
9	ESS-9 Financial Intermediaries	Not relevant	
10	ESS-10 Stakeholder- Engagement and Information- Disclosure	• Environment Conservation Act 1995 • Noise Pollution (2006) • Right to information 2005	The Project has prepared a Stakeholder Engagement Plan (SEP) to engage with all stakeholders relevant to the different components of the project.

2.5 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 an “environmental clearance letter:” from the Department of Environment.

Steps to be followed for obtaining the Environmental Clearance Certificate for this project are shown in Figure 2.1. As the DoE categorizes the solar power plant as Orange-B so the project needs to prepare a full IEE before implementation for environmental clearance. In line with the IEE for the DoE this ESIA study; to meet the requirement of IDCOL, also considered the possible impacts from both the solar power plant and the transmission line.

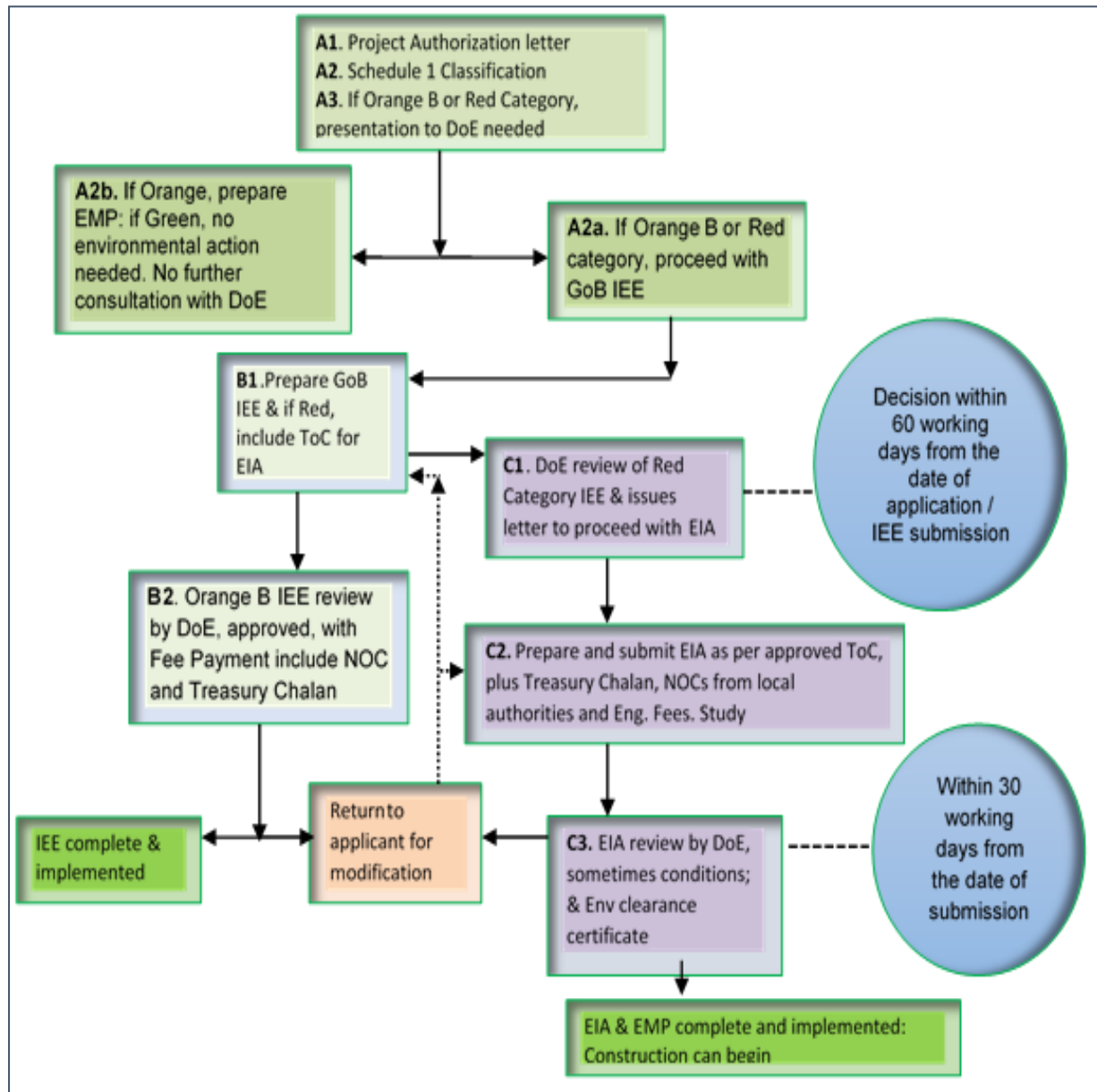


Figure 2.1: Government of Bangladesh Environmental Assessment Process

The first to obtain environmental clearance is for the project proponent to complete & submit an application form that 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, NOC from the 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 decide on Green and Orange-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 including the environmental clearance subject to the implementation of the project activities and all mitigation measures suggested in the ESIA report or the application. Additionally, this ESIA study will secure environmental approval from IDCOL to implement the project as well as a guideline to monitor the environmental and social impacts during its construction and operation stages.

3 PROJECT DESCRIPTION

3.1 PROJECT LOCATION AND DESIGN

NAAFCO group was founded in 1984 & set on over 23 acres, NAAFCO Pharma Limited (24.443865° N, 90.346420° E) started production of human medicines in 2015 with a cGMP manufacturing facility. The production range encompasses tablets, capsules, pellets and liquids in the form of suspension and solutions.

NAAFCO Pharma Limited proposed a project of a 1.494 MWp rooftop solar project on the rooftop. In the proposed system two main equipment will be used which are solar panels and inverters. Sun shines on the solar panels to generate DC electricity. The DC electricity produced from the solar panel will be converted to 415V 3-phase AC using the inverters. Then the energy will be fed into the bus bars of industry. A zero-export controller will be used to ensure “net zero export”. The aggregated installed capacity of the project will be 1.494 MWp.

The project will be implemented in Rooftops of NAAFCO Pharma Limited, which is steel structured and rooftop is corrugated sheet-based shed. Total available space are 160,000 square feet. Plant capacity of a roof-top solar power project mainly depends on available space and load while other factors to be taken into consideration being shading effect, orientation of the building, tilt angle of the building, load bearing capacity and backup generator capacity. Basic Information about the project is given below-

Table 3.1: Project Details of NAAFCO's Rooftop Solar Project

Name of the Project	NAAFCO Pharma Limited 1.494 MWp Roof Top Solar PV System
Capacity of project	1.494 MWp
Project Location	Bandia, Meduary, Bhaluka, Mymensingh, Bangladesh
Coordinate	Latitude: 24.443865°N, Longitude: 90.346420°E
Project Type	Grid-tied Rooftop Solar PV Systems
Project Sponsor	NAAFCO Pharma Limited
EPC	DANA Power Company Limited (DANA Renewable Energy)

The project will be executed on the roofs of different sheds and buildings of NAAFCO Pharma Limited. Sheds were established around 5-6 years ago and rooftop are made of corrugated sheet-based sheds. The purlin spacing is different in each shade and is around 1.2m-1.33m. The sheds are having a tilt angle of around 6-7 degrees. In case of RCC roof, a hot deep galvanized MS structure will be installed with a tilt angle of 20°.

NAAFCO Pharma Limited can be accessed by road. It can be reached in this direction: from Dhaka to Mohakhali to Voradoba bazar to NAAFCO Pharma Factory. Project area Photographs are presented in Figure 3.1. The location of this project is shown in Figure 3.2.



Figure 3.1: Photographs of Location of the project

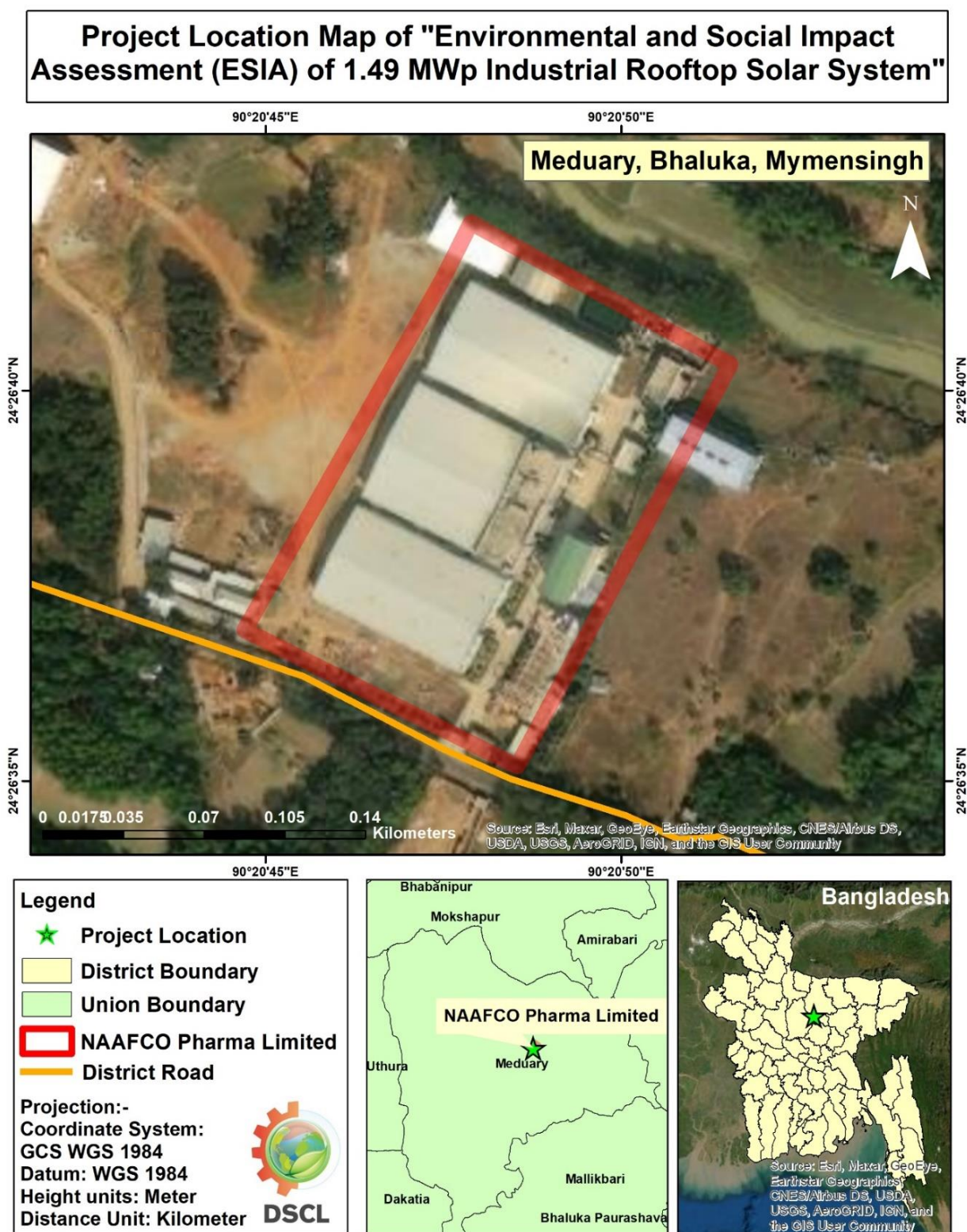


Figure 3.2: Project Location Map

3.2 DESIGN CONSIDERATION

The design of complete connection diagram for the roof top solar system are shown in the below figures:

Sub-station Wise Connection Diagram

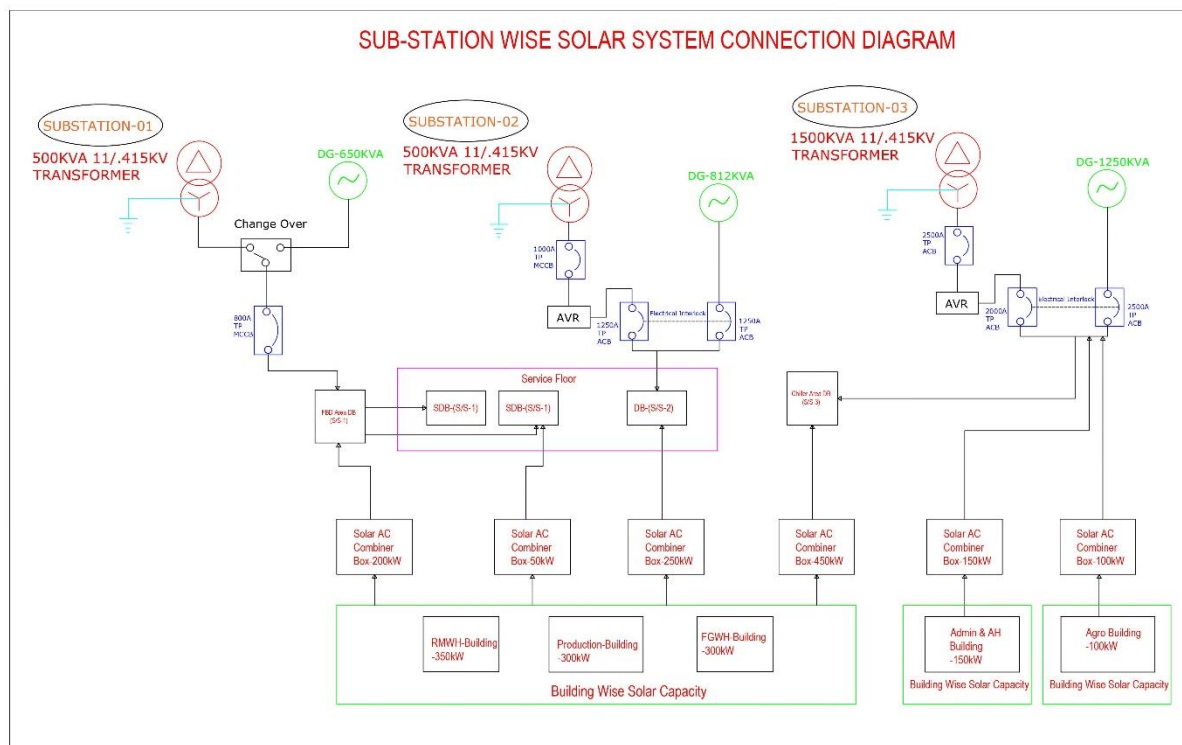


Figure 3.3: Complete Connection Diagram (Source: Technical Documents)

Plant SLD & Connection Diagram

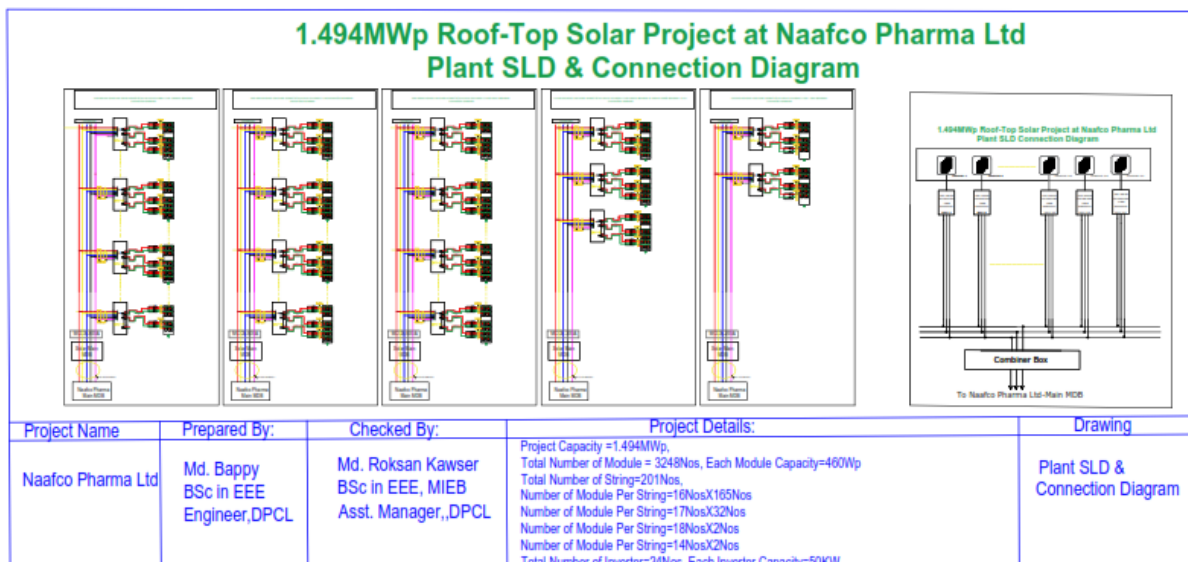


Figure 3.4: Complete Connection Diagram (Source: Technical Documents)

3.2.1 Electrical Design Basics

This project will be a central generation-based grid connected PV system. The system is divided into 3248 numbers of photovoltaic power generation units. As the factory has its own

grid network system and it is 400V AC, there is no need to step up the voltage as the output of inverter is 400V AC and it can be connected directly with the present electrical network.

The total capacity of this project is proposed to be 1.494 MWp. There will be two types of combination for each generation unit. There will be total of 3248 number of total PV systems, with 460 Wp capacity each. To make the subsystem, PV modules will be connected in series and then in parallel. The DC power produced by PV modules will be fed into grid-connected inverter. The DC energy will be converted into AC energy by the grid connected inverters. A total of 26 inverters will be used in system with 50KW capacity of each. The output of AC side of the inverters of a same shed will be combined together and will be connected to the existing electrical network of that shed.

A set of monitoring systems are planned to be used in this project, including inverter systems and combiner boxes, PV modules, low-voltage power distribution equipment, DC systems etc. The monitoring system with remote monitoring capability can send real-time data and information to the designated officials of the factory authority.

3.2.2 PV Array Electrical Connection Scheme

PV array electrical connections mainly refers to the electrical system connected to the DC side and the specific connection scheme are as follows: 3248 PV modules of 460 Wp in series makes one module string in all the units. Each inverter contains 2 types of module strings i.e. (7 & 9) in the system. Output of each inverter is 400V AC, 50 Hz, three phase AC power. The output of each central inverter is connected with 400V AC grid voltage system. The maximum AC capacity of the installed solar PV system will be 1300 KW (AC).

Table 3.2: Project Details and Technical & Electrical Information

➤ Total PV Capacity: 1.494 MWp ➤ Each PV capacity: 460 Wp ➤ Total number of PV: 3248 Nos ➤ Total Number of Inverter: 26 Nos ➤ Each Inverter Capacity: 50 KWp		
Name	Description	Capacity
FGWH Building	South Side	209.76 KWp
	North Side	188.60 KWp
Production Building	South Side	188.60 KWp
	North Side	188.60 KWp
RMWH Building	South Side	198.72 KWp
	North Side	220.80 KWp
Animal Health Plan Building-1	South Side	14.72 KWp
	North Side	14.72 KWp
Animal Health Plan Building-2	East Side	52.44 KWp
	West Side	52.44 KWp
Admin Building	East Side	21.16 KWp
	West Side	21.16 KWp
Agro Building	East Side	52.44 KWp
	West Side	52.44 KWp

(Source: Technical Documents)

3.2.3 Description of Equipment

Rooftop solar PV systems require regular maintenance, mainly cleaning. The PV panels require water servicing depending on the ecological position and type of industry. To save the roof from cleaners' footprints and pressure generated from body weight, walkways will be installed on the roof.

Major Equipment and Quantity for the proposed design are given below-

Table 3.3: Quantity of Major Equipment

Sl	Items/ Accessories	Version /Model /Brand	Unit Capacity (KW/Wp)	# Of Quantity	MoU
1	Solar Module-Mono-facial	JKM 460M-7RL3-V Brand: JINKO Country of Origin: China	460Wp	3248	Nos
2	On-Grid Inverter	Model: PVS-50-TL-SX2-ABB with WIFI Data Logger Brand: ABB/Fimer Country of Origin: Italy	50KW	24	Nos
3	Monitoring & Communication System	Built-in-Inverter (Online Monitoring Solution for Plant Monitoring) Brand: ABB	N/A		
4	Weather Station	Wind, Irradiance ,Cell and Ambient Temperature Measures Model: VSN800-14 Brand: ABB Country of Origin: USA		1	Nos
5	DC Circuit Breaker	1000V/1500V,16A rated Current, TUV Certified Brand: FEEO Country of Origin: China		250	Nos
6	DC Cables	1Cx4rm,UV Protected ; TUV Certified ; Brand : Brand : Kuka Cables Co; Ltd Country of Origin: China		1	Lot
7	MC4 Connector	1000V/1500V,15A rated Current,IP68,TUV Certified Country of Origin: China		1000	Pair
8	PV Mounting Structure	For Tin Shed Building: Aluminum rack Rail: Anodized aluminum(6005-T6+SS304) Rail Joiner: Anodized aluminum(6005-T6+SS304) L-Fect: Anodized aluminum(6005-T6+SS304) Mid Clam: Anodized aluminum(6005-T6+SS304) End Clam: Anodized aluminum(6005-T6+SS304) Grounding Clip: SS304 Grounding Lug: AL6005-T6+Copper+SS304 Country of Origin: China		1	Lot
9	Energy Meter	Model:PM5310 Brand: Schneider Country of Origin: India		3	Nos
10	Combiner Box	Included MCB-ABB, MCCB-ABB with Others Accessories Assemble By: Dana Group		1	Lot
11	Hybrid Controller/Back feeding Protection	Brand: DELTA Country of Origin: Taiwan		1	Lot
12	AC Cable	5Cx25rm, 5Cx150rm,5Cx300rm or as per Final design Brand: BRB/BBS Country of Origin: BD		1	Lot
13	Lightning Protection System	Model: OPR-30/OPR-60 with Counter Brand: ABB Country of Origin: USA		1	Lot
14	Earthing Pit with Boring	Chemical Earthing		1	Lot
15	Walk-Way	AL/Hollow Box/GP Sheet(Width=500mm)		1	Lot
16	Cleaning System	PVC Pipe, Booster Pump with Others Accessories		1	Lot
17	Stair with protection	To roof access with maintenance		1	Lot
18	Safety Equipment	Harness belt with rope, Helmet & Others Safety Equipment		1	Lot
19	Installation & Others Installation Accessories	Cable Tray, Cable Ladder, PVC Pipe, others installation materials & Installation Testing & Commissioning		1	Lot
20	Extended warranty	Extra 5 Years Warranty for On-Grid Inverter		1	Lot
21	Spare-Parts	•PV modules >= 1% of installed modules •PV inverters >= 5%, minimum 1 inverter per type •PV module mounting assemblies = 1% of installed quantity •PV module cable connectors =0.5% •DC string fuses = 5%		1	Lot

(Source: Technical Documents)

3.3 WORKS ACTIVITIES

3.3.1 Scope

This section covers activities related to design, testing, supply, insurance, transportation, delivery at project site, storage, erection, testing - of module mounting structure etc. as detailed hereunder.

3.3.2 Module mounting structure

3.3.2.1 PV module Inclination

The tilt of the rooftops has been considered for the inclination or tilt angle of the solar PV module facing towards the equator (south). Meduari area is located at 24° latitudes and in the northern hemisphere. So, to get the maximum of the incident rays of the sunlight, the module shall be placed facing towards the south. On the other hand, diffused radiation is highest at horizontal plane. But considering safety and suction load analysis the inclination angle is chosen as the same that of the roof (i.e., at 7° facing towards south). For the RCC roof, a suitable structure will be installed with a tilt angle of 20° .

3.3.2.2 Metal Roof Mounting System

The metal sheet roof mounting system is suitable with industrial tin, L feet is available for footing option, making installation faster, competitive and reliable. System will be fully tantamount with the Bangladeshi and other international standards for wind & snow load, making it suitable for a wide variety of climatic zones. The selected system can withstand a wind speed of 200 km/hr.



Figure 3.5: Metal Roof Mounting Structure

3.3.2.3 RCC Roof Mounting System

The hot deep galvanized MS structure is suitable for the RCC roof. There is a square base plate is installed by using appropriate SS nuts with the floor of the roof. Rust proof stand and horizontal angles are used for mounting the PV modules. This mounting system is most using system in Bangladesh. This mounting system follows Bangladeshi and international standard to bear the load and wind pressure. The selected system can withstand a wind speed of 200 km/h.



Figure 3.6: RCC Roof Mounting Structure

3.3.3 Technical Requirements

- The design of the Module Mounting Structure (MMS) shall be appropriate and innovative.
- If during construction, any structure is damaged, even if inadvertently, the same has to be put back to the original condition.
- The Module Mounting Structure (MMS) shall be designed to allow easy replacement of any module and shall be in line with the site requirement.
- Design drawings with material selected and their standards shall be submitted to the department, for prior approval.
- There must be sufficient gaps between the rows of the panels and all precautions should be taken to avoid any shading on the panels.
- The module alignment and tilt angle shall be calculated to provide the maximum annual energy output. This shall be decided based on the location of array installation.
- The mounting structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. Structural Sections i.e., Hollow Square, Rectangular or Circular sections shall conform to IS:4923 and IS:1161 standards with YST 310 grade of steel. Welding of structure at site shall not be allowed.
- Module mounting structure shall be made of G.I. The frames and leg assemblies of the array structures shall be made of M.S hot dip galvanized sections and shall conform with IS:2629 and IS:277 (latest edition). Minimum thickness of galvanization should be 120 microns.
- The structure shall be designed with adequate factor of safety, and as per relevant Standards (with latest edition).
- The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels at the same time.
- All fasteners shall be of stainless steel of grade SS 316 and must sustain the adverse climatic conditions.
- Two numbers of anti-theft fasteners of stainless steel on two diagonally opposite corners for each module shall be provided. However, if stainless steel (SS 304) fasteners are used they must have protective coating to ensure the life of 25 years.
- Clamps/bolts shall use EPDM rubber and shall be designed in such a way so as not to cast any shadow on the active part of the module. Nut & bolt, supporting structures including module mounting structures shall have to be adequately protected from atmosphere and weather prevailing in the area.
- The Mounting structure shall be grounded properly with the roof.

- The module mounting structure shall be designed as per prevailing IS 800 and IS 801 and Sections shall be as per IS 808 and IS 811 (Latest edition) and shall be safe against wind and seismic force. Detailed design including STAAD output file shall be submitted for final approval. However, the minimum thickness of the structural sections shall not be less than 4.0 mm.
- The array structure shall be made of hot dipped galvanized steel of suitable size. The specification of steel should be as per relevant IS 2062 (Latest Edition). The thickness of galvanization should be as per the relevant standards for galvanization but not less than 120 microns.
- Foundation is to be provided with proper technology.
- For multiple modules mounting structures located in a single row, the alignment of all modules shall be within an error limit of maximum 10 mm.
- The bidder/manufacture shall specify installation details of the PV modules and the support structures with appropriate diagram and drawings.
- Bidder must submit all the quality test documents and test certificates complying with the requirement of the structure

3.3.4 Cable Tray and Cable trench

Cable tray of approved make shall be provided, in order to carry the DC cables along the supporting structure and cable trench will be provided in the control room area for connecting the same to the inverters. The Trench shall be as straight as possible, with a firm and smooth base and cover, that allows sufficient air circulation inside the trench.

3.3.5 Additional works

Suitable inspection pathways should be made in order to regular monitoring of PV panels or other types of maintenance works. Detailed designs, drawings, material specifications of control room of ample size are to be prepared as per project requirement.

3.4 OPERATION AND MAINTENANCE

The operation of solar power plant is relatively simple and restricted to daylight hours in a day. With automated functions of inverter and switchyard controllers, the maintenance will be mostly oriented towards better up keep and monitoring of overall performance of the system. The solar PV system requires the least maintenance among all power generation facility due to the absence of fuel, intense heat, rotating machinery, waste disposal, etc. However, keeping the PV panels in good condition, monitoring and correcting faults in the connected equipment and cabling are still required to get maximum energy from the plant. A maintenance schedule needs to be planned as per service/ guarantee terms of supplier to maintain optimum availability of plant at all times. The maintenance functions of a typical solar PV power plant can be categorized as given below.

3.4.1 Day to Day Maintenance Checks

- Ensure security of the power plant
- Monitor power generation and export
- Monitor load-center wise power generation values to detect any abnormality
- Entry of unauthorized person and stray animal at the site

3.4.2 Weekly Maintenance Checks

Inspection of PV panel glass surface clean / wash solar PV panels to free from dust and other dirt like, bird's dropping etc.

3.4.3 Monthly Maintenance Checks

- Inspection of solar PV modules and arrays for any damage
- Check the power terminals for corrosion and proper torque, clean and apply antioxidant jelly, if necessary

3.4.4 Half Yearly Maintenance Checks

- Check all the wiring for physical damage and for any sign of excessive heating
- Check all the junction boxes for proper covering and sealing
- Check the fasteners of Solar PV panel mounting structure and array for proper torque and tightening

3.4.5 Yearly Maintenance Checks

- Check for discoloration of solar PV cells
- Check all the connections and ensure that they are not loose
- Checking corrosion, cleaning and painting switch yard structures

3.5 DECOMMISSIONING

The solar panels need to be removed at the end of their lifecycle, which is typically 20-40 years. This part is known as Decommissioning. A decommissioning plan outlines required steps to remove the system, dispose of or recycle its components, and restore the place to its original state. Plans may also include an estimated cost schedule and a form of decommissioning security.

Solar photovoltaic panels have an impressive lifespan. Manufacturers provide PV modules warranties for 25 years. At some point, though, even the hardiest of these panels will fail. And, as they are composed of both valuable precious metals and toxic materials (along with easily recyclable aluminum and glass), the panels will require careful end-of-life handling. PV modules for example contain substances such as glass, aluminum and semiconductor materials up to 85% of their weight can successfully be recovered and reused.

4 TECHNOLOGICAL ASPECTS

4.1 PROPOSED PROCESS AND TECHNOLOGY

The layout of the roof top solar system project is given in the below figure 4.1. The details plant layout and technical drawings are presented in Appendix B of the report. According to the layout, the capacity of the PV module is illustrated in Table 3.2.

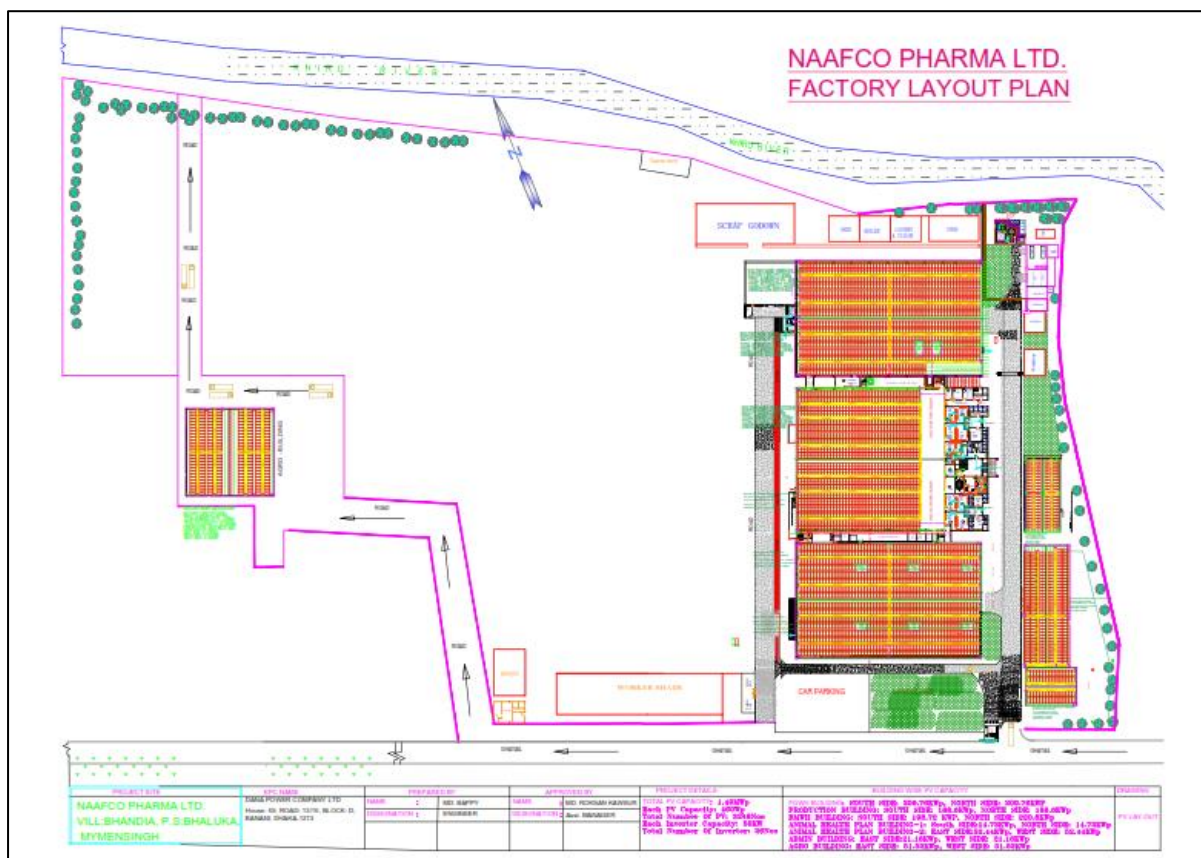


Figure 4.1: Plant Layout of the project

4.2 ADEQUACY OF SOLAR IRRADIATION

The proposed location of the Project is at Bandia, Meduary, Bhaluka Mymensingh, Bangladesh. The latitude and longitude of the proposed project location is 24.443865°N, and 90.346420°E.

The optimum tilt angle for solar panels in Bangladesh is considered to be 23.7±1 degree at any place in Bangladesh². Average solar insolation in Bangladesh is considered to be 4.5 kWh/m²/day. It has been observed that Meduary receives a potential amount of solar energy throughout the year with an average 4.64 kWh/m²/day (Global) on horizontal surface, 4.75 kWh/m²/day on 7° tilted surface and 4.86 kWh/m²/day on 20° tilted surface. It can be seen that during February to May maximum energy can be harnessed by solar panel. Peak sunshine occurs in March which is 5.59 kWh/m²/day. On the other hand, during monsoon solar irradiance comparatively lower than other season and the minimum value is 4.01 kWh/m²/day in the month of July. However, as the PV panel of the proposed site is planned

² Source: Optimum Tilt Angle for the south facing solar devices installing in Bangladesh, M M Rahman, Indian Journal of Radio and Space Physics, Volume: 30, December 2001, pp 292-293.

to install toward south direction with an inclination angle of 6° and 20° the yearly energy yield will be more in compared to global horizontal irradiance.

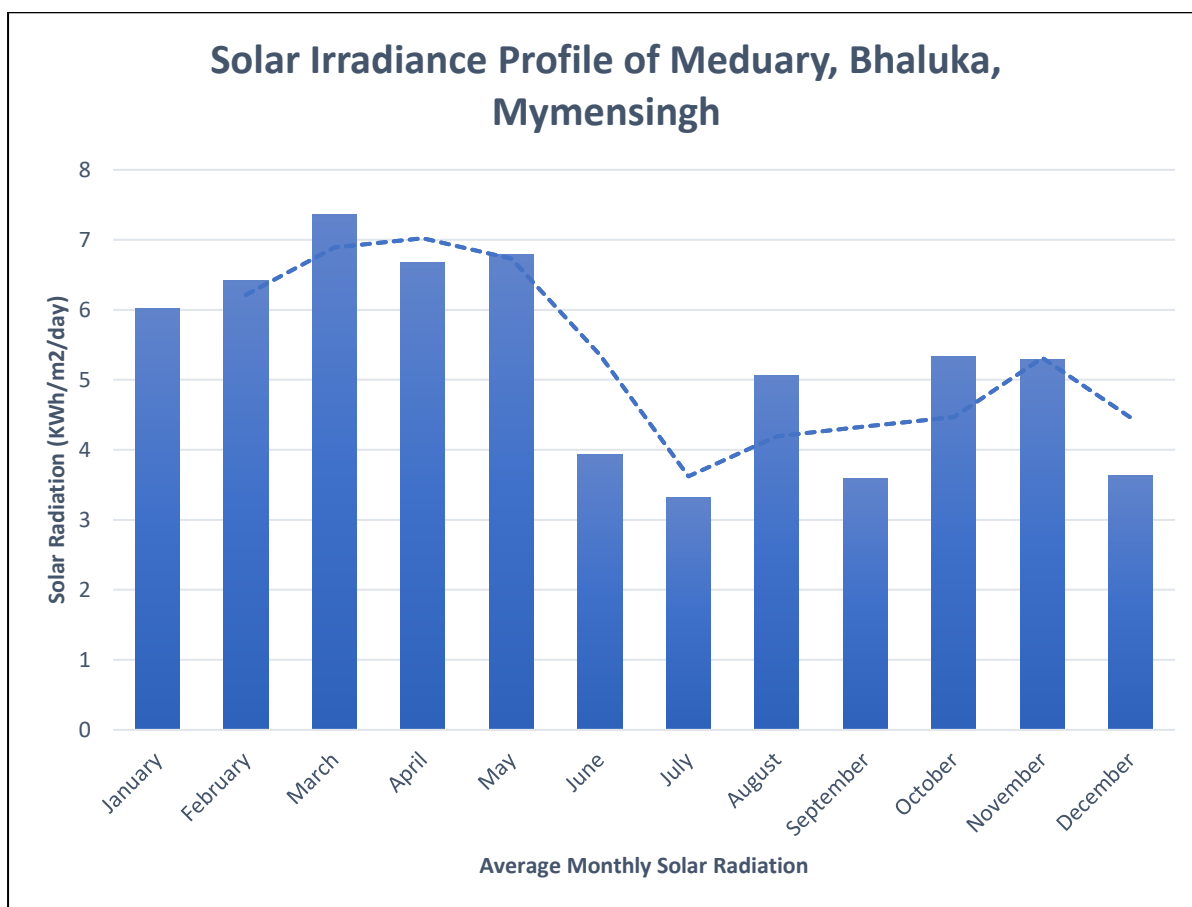


Figure 4.2: Solar Irradiance Profile of Meduary, Bhaluka, Mymensingh (source: BMD, 2020)

4.3 PLANT CAPACITY SELECTION

Considering the climatic information, building structure, electrical profile etc. of the project site, it is evident that an on-grid solar power plant will definitely assist NAAFCO Pharma Limited to create an alternate source of electricity and reduce cost of electricity, thus cost of production. Additionally, it will assist NPL on reducing carbon footprint from its electricity consumption. Plant capacity of the roof-top solar power project mainly depends on available space and load while other factors to be taken into consideration being shading effect, orientation of the building, tilt angle of the building, load bearing capacity and backup generator capacity.

From the technical document of NPL it is found that there is total 3280 number of panels in the project design having a total 1.494 MWp capacity. The distribution and number of panels in each shed are shown in the Table 3.3.

4.4 ON-GRID ROOFTOP INDUSTRIAL SOLAR PV SYSTEM

A grid-tied industrial solar PV system is a power generation plant that produces electricity from the sunlight. The photovoltaic (PV) panels are installed in the rooftop. PV panels generate DC power from sunlight and supply to a solar grid tied inverter. The on-grid solar inverter converts the DC power to AC power and feed the power directly to the power system of the facility. It generates power only when sunlight is available in the rooftop and directly feeds the power to the existing power system. It does not require any storage system i.e., any battery.

Technically, power is produced from PV panel in DC form and that must be conditioned, or processed for use with utility power, by a grid-tied inverter. This inverter sits between the solar array and the grid, draws energy from solar arrays. The inverter must monitor grid network voltage, waveform, and frequency. One reason for monitoring is if the grid is absent or stays too far out of its nominal specifications, the inverter must not pass along any solar energy. An inverter connected to a malfunctioning power line will automatically disconnect in accordance with safety rules, for example IEC 61727, which vary by jurisdiction. For normal operation the inverter must synchronize with the grid waveform, and produce a voltage slightly higher than the grid itself, in order for energy to smoothly flow outward from the solar array.

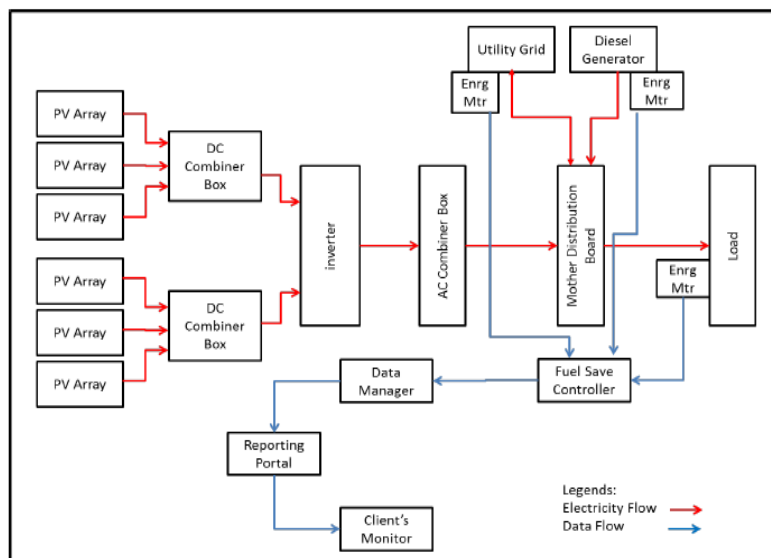


Figure 4.3: A Typical flow diagram of an on-grid rooftop solar power system

One reason for monitoring is if the grid is absent or stays too far out of its nominal specifications, the inverter must not pass along any solar energy. An inverter connected to a malfunctioning power line will automatically disconnect in accordance with safety rules, for example IEC 61727, which vary by jurisdiction. For normal operation the inverter must synchronize with the grid waveform, and produce a voltage slightly higher than the grid itself, in order for energy to smoothly flow outward from the solar array.

5 ANALYSIS OF ALTERNATIVES

5.1 GENERAL

An ESIA should describe a range of reasonable alternatives to the proposed project or to the location of the proposed project site that could feasibly avoid or lessen any significant environmental impacts of the proposed project while attaining most of the project's basic objectives. An ESIA also must compare and evaluate the environmental effects and comparative merits of the alternatives. This chapter describes alternatives considered but eliminated from further consideration (including the reasons for elimination) and compares the environmental impacts of several alternatives retained with those of the proposed project.

The range of feasible alternatives is selected and discussed in a manner to foster meaningful public participation and informed decision-making. Among the factors that may be taken into account when addressing the feasibility of alternatives are environmental impacts, site suitability, economic viability, social and political acceptability, technological capacity, availability of infrastructure, general plan consistency, regulatory limitations, jurisdictional boundaries, and whether the proponent could reasonably acquire, control, or otherwise have access to an alternative site. An ESIA need not consider an alternative whose effects could not be reasonably identified, whose implementation is remote or speculative, and that would not achieve the basic project objectives.

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 7 of this ESIA impacts in some of these issue areas would be significant and unavoidable. Therefore, this section discusses alternatives that are capable of avoiding or substantially lessening effects on these resources.

5.2 DO NOTHING

The Do Nothing 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 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.
- No employment opportunities will be created who will work in the project area.
- Discouragement for donors to allot this level of standard and affordable developments.

5.3 TECHNOLOGY FOR ALTERNATIVE ENERGY GENERATION

This alternative would involve the use of wind energy as an alternative to development of a solar site. Similar to solar power, power from the wind is an alternative to energy production from non-renewable resources like coal and oil, or nuclear sources. Wind energy provides

several benefits, including, but not limited to the following:

- Wind is a renewable and infinite resource.
- The generation of wind energy does not produce any air emissions, including carbon dioxide (GHG).
- Although wind energy requires a significant upfront capital investment, it is a free resource after the capital cost of installation (excluding maintenance).
- In addition, energy production from wind power would not require the significant water usage associated with coal, nuclear, and combined-cycle sources.

Commercial wind farms typically use three-bladed turbines that range in size from 300 feet up to 500 feet in height, with blades of 150 feet in length that are pointed into the wind by computer-controlled motors. The wind farm would consist of a group of wind turbines placed where sufficient, consistent wind resources exist, and electrical power transmission infrastructure is located. The individual turbines would be interconnected with a medium-voltage power collection system and a communications network. Similar to solar energy production facilities, wind energy production facilities also require substations, which would increase the medium-voltage electrical current through a transformer before connection to the high-voltage transmission system. Compared with traditional energy sources, the environmental effects of wind power are relatively minor.

Unlike the proposed project, wind turbines would have the potential to affect avian species in the local area. The development of wind farms would also typically result in greater adverse aesthetics impacts due to the height of the turbines. Agriculture resources would also still be impacted by the presence of wind turbines and associated facilities. Additionally, wind energy production facilities do not reduce short-term construction-related air quality emissions.

While the project area has been identified as suitable for solar projects based on the solar insolation levels (the amount of solar radiation energy) in the area, wind energy production is not well-suited to the project site due to relatively low wind speeds and directionality sufficient to drive wind turbines. No significant facilities have been developed in the project vicinity due to the lack of adequate wind resources.

As noted above, alternatives may be eliminated from detailed consideration in an ESIA if they fail to meet most of the project objectives, are infeasible, or do not avoid or substantially reduce any significant environmental effects. Therefore, this alternative was eliminated from further consideration because:

- It would not substantially reduce the significant environmental impacts associated with aesthetics, agriculture resources, air quality and biological resources;
- It would result in additional/greater impacts than the proposed project (aesthetics and biological resources);
- It would fail to meet the objectives for the proposed project;
- The project site is not suited for wind energy production; therefore, a wind energy production facility would not generate as much electricity as solar equipment. And
- Wind energy is uncommon in Bangladesh and the production material is not available.

5.4 LAND USE ALTERNATIVES

The land which is being used for the project is owned by the Project Authority. The land is inside the project boundary. As well as it is just beside the roadside. The land is currently using by the owner as pharmaceutical factories by NAAFCO Pharma Limited. If we consider any other alternative land use like water body or agricultural land outside the factory

boundary, the Project authority had to purchase the land from the owner. As well as, the agricultural land would have been ruined. Therefore, the current used land is the best possible land for the project.

5.5 ALTERNATIVE SITE

Relocation option to a different site is an option available for the project implementation. Now, there are no alternative sites for the proposed development (i.e., the project proponent does not have an alternative site). This means that the proponent has to look for the land if relocation is proposed and land is not available and if available, it will be too expensive for the proponent to realize 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 is also worth noting that the said project is already underway in terms of seeking development approvals in various government departments.

The project proponent would spend another long period of time on design and approvals of the plans by the relevant government departments. The project design and planning before the stage of implantation would call for cost; already encountered in the proposed development i.e., whatever has been done and paid to date would be counted as a loss to the proponent. 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.

6 BASELINE ENVIRONMENTAL CONDITION

6.1 GENERAL

The creation of a complete and comprehensive description of the present environment is a vital stage 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. This description of the existing environment has been developed from many sources, including personal data collection, research, literature review and with the application of local and expert knowledge.

Field investigations for various environmental components are conducted within and around the project site zone to determine the baseline environmental quality, viz. air, water, noise, land and socio-economy etc. The primary objective was to identify and describe existing environmental conditions and to provide an understanding of the baseline conditions prior to undertaking any development activities.

For the macroenvironmental context like climate (air, water, soil, temperature, rainfall, humidity, sunshine, cloud coverage, wind speed), socio-economy, physiography, geology etc., data was gathered from both primary and secondary sources. Firsthand information has been collected to record the micro-environmental features within and adjacent to the project area. Collection of primary information includes extrapolating environmental features on proposed project design, tree inventories, location and measurement of socio-cultural features adjoining proposed project area. Ambient air, noise, and water quality samples were collected in terms of environment quality to prepare a baseline database. Consultation was another source of information to explain local environmental conditions, impacts, and suggestions, etc.

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

- Physical Environment: factors such geology, climate and hydrology;
- Biological Environment: factors related to life such as flora, fauna and ecosystem; and
- Socio-economic Environment: anthropological factors like demography, income, land use and infrastructure.

6.2 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 of the above-mentioned criteria, 1Km buffer areas was 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 in figure 6.1. This map shows geo-referenced photographs of features and landforms nearby the Project site and provide a general description of the existing environments in the Project area.

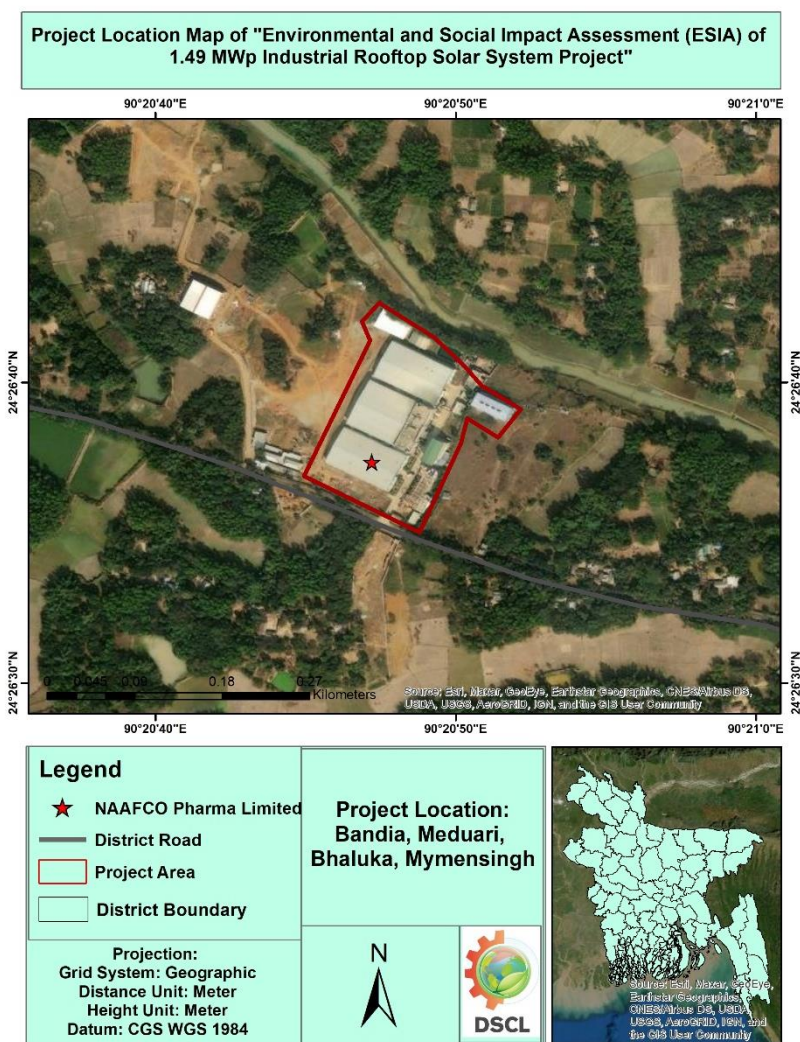


Figure 6.1: Map of Project area

Bhaluka is an Upazila, or sub-district, of the Mymensingh District in Mymensingh Division of Bangladesh. It is the 1st Model Thana of Bangladesh. The project area of Influence (AoI) is located within Bandia, Meduary, Bhaluka, Mymensingh District. 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 are outlined below:

It is one of the fastest growing basic industrial areas of Bangladesh. Bhaluka has a total area of 444.05 km². It is bounded by Fulbaria and Trishal Upazilas on the north, Sreepur Upazila on the south, Gaffargaon Upazila on the east and Sakhipur and Ghatail Upazilas on the west. The main rivers are Sutia, Khiru, Lalti, and Bajua.

Bhaluka thana, now an Upazila, was established in 1917. It is one of the oldest small business hubs in the area. It became an Upazila at 1983. The Upazila consists of 11 union parishads, 87 mouzas and 102 villages. Annual average temperature is between 32.5 °C (91 °F) and 13.5 °C (56 °F), with an annual rainfall of 2,687 millimeters (106 in);

Table 6.1: Detailed Description of Environmental Setting

Particulars	Detail Description
Location	Bandia, Meduary, Bhaluka Upazilla, Mymensingh
Nearby villages	Bandia, Meduary
Site elevation	Undulating, elevation variation of 3-8m a.m.s.l.
Nearest Airport	Dhaka / Hazrat Shahjalal International Airport (DAC) (100.81 km)

Particulars	Detail Description
Nearest Railway Station	Mymensingh Railway station
Climatic conditions	Average Temperature is 18.4 °C 65.1 °F Average wind speed 6.3 miles per hour
Archaeologically important places/monuments	None with 10km radius

6.3 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.

6.3.1 Climate

Although less than half of Bangladesh lies within the tropics, the presence of the Himalaya Mountain range has created a tropical macro-climate 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 South-central climatic zone (Figure 6.2).

i. **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. This is a transitory zone between the South-eastern, North-western and South-western zones and most of the severe hail storms, nor-westers and tornadoes are recorded in this area.

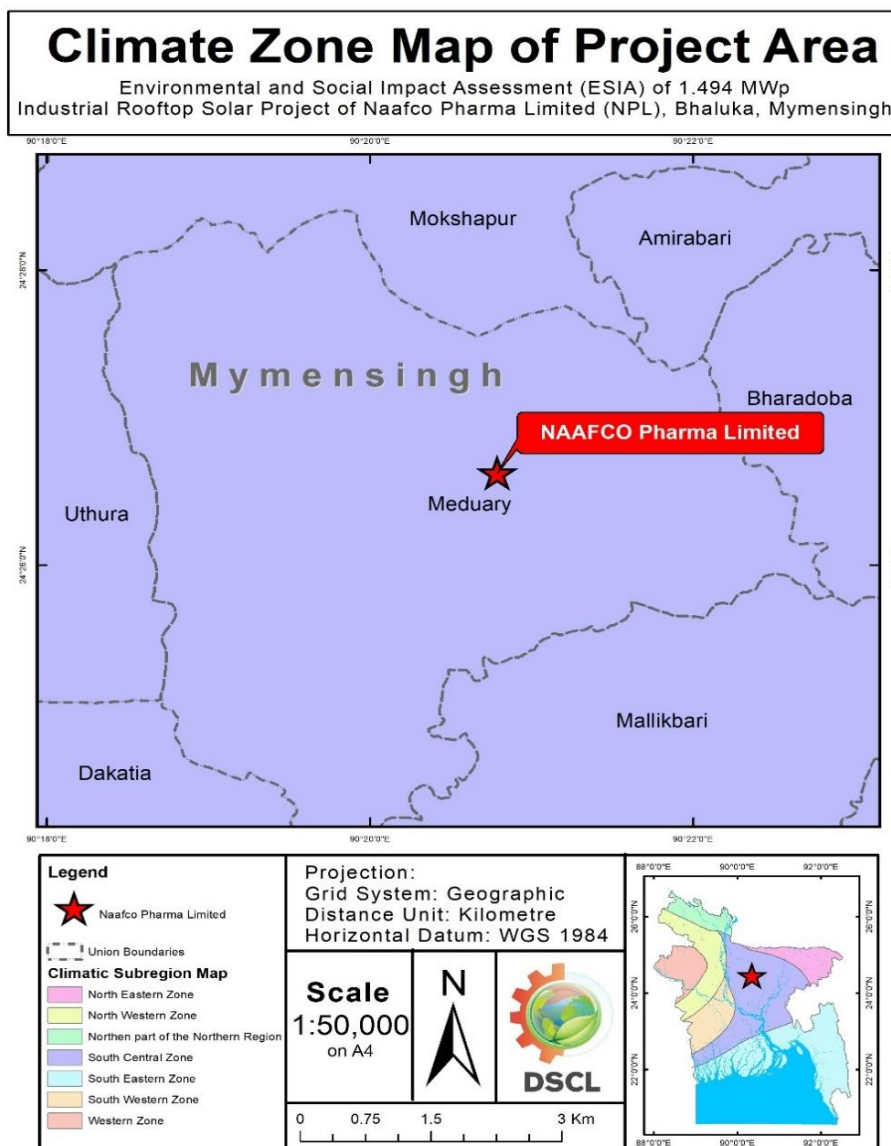


Figure 6.2: Climatic Zones of Bangladesh

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 meagre rainfall. The average temperature in January varies from 17°C in the northwest and north-eastern parts of the country. Minimum temperatures in the extreme northwest in late December and early January reach between 3°C to 4°C.

Temperature: Long-term average monthly temperature data (1989-2019) collected at Mymensingh weather station of Bangladesh Meteorological Department. The highest average recorded temperature in this weather station was 28.74°C in August. The lowest average recorded temperature was found in the month of December which was 19.04°C. Both of the average monthly temperature graphs show that this area faces high temperature from April to September and lowest temperature during winter remains from December to February in the year (Figure 6.3).

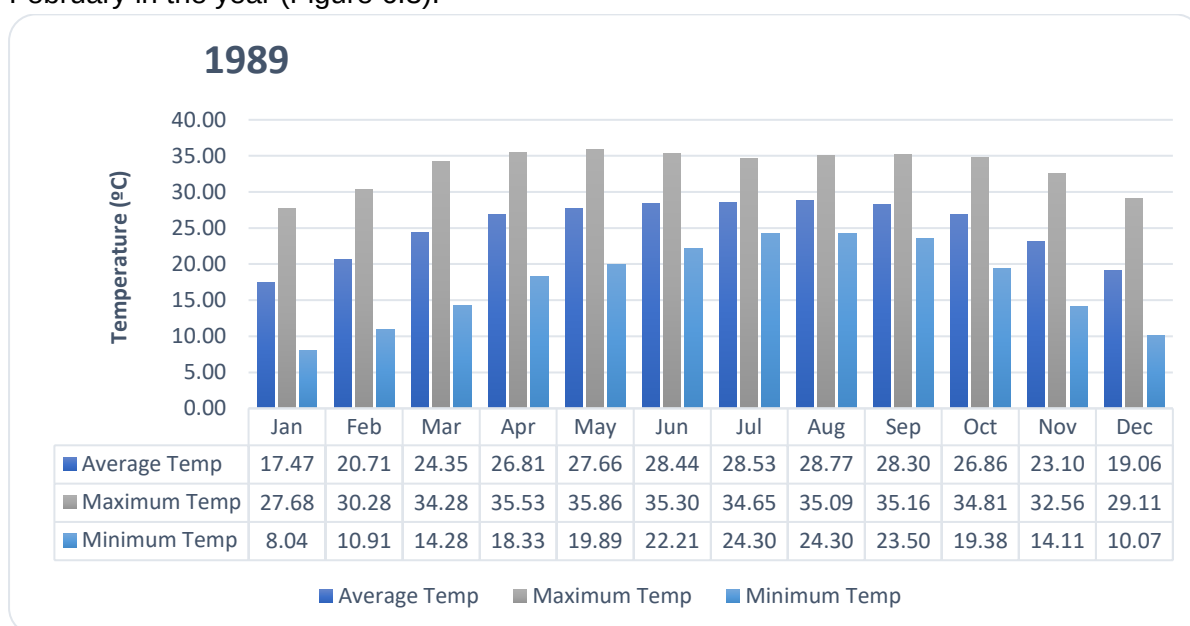


Figure 6.3: Average, Monthly Maximum and Minimum Temperature at Mymensingh

Rainfall: In Mymensingh City rainfall is being above 1800 mm. The range of temperature is much less than to the west, but somewhat more than in South-central zone. 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 1989 to 2019 shows that Mymensingh experience more than 400 mm rainfall during monsoon. In the month of December and January of winter season around 10mm rainfall occurred in the region of Mymensingh weather station (Figure 6.4).

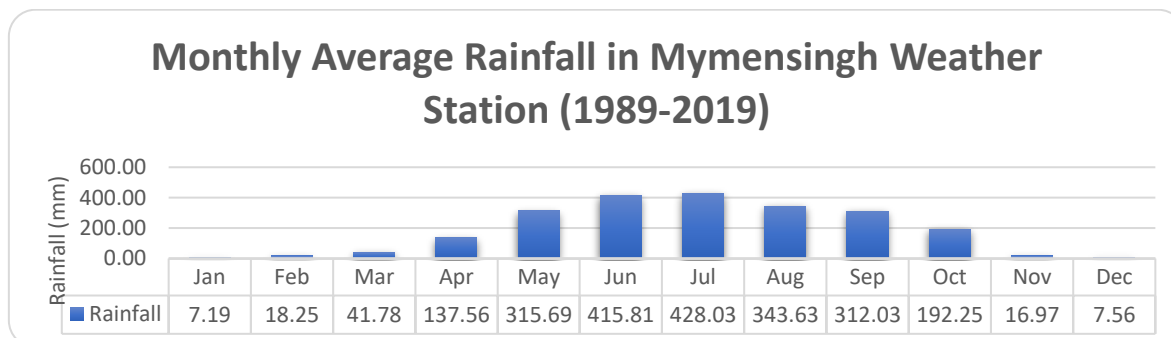


Figure 6.4: Average Monthly Rainfall at Mymensingh

Humidity: Humidity remains high in summer and comparatively low in winter season. The statistical data of humidity from 1989 to 2019 indicates that humidity in the Mymensingh Station area maximized in June to September in the year which is ranges from 85% to 86%. On the other hand, humidity falls around 70% in February, March and April during the winter season in the considered station area (Figure 6.5).

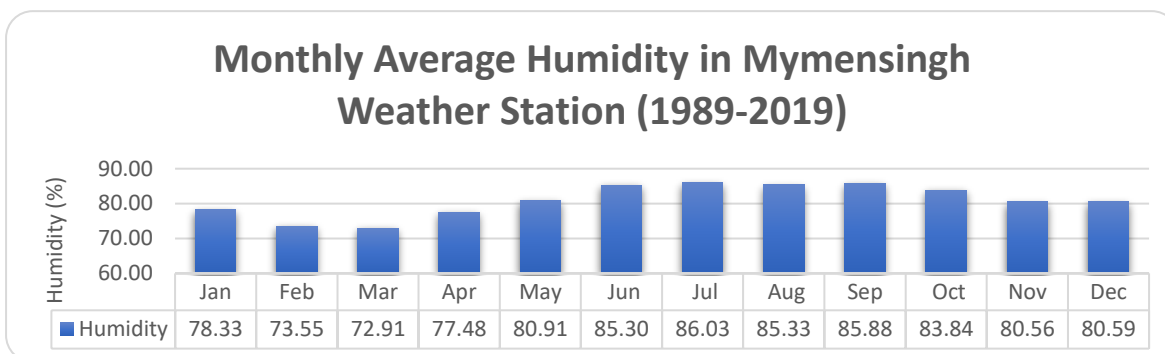


Figure 6.5: Average Monthly Relative Humidity at Mymensingh

Wind Speed and Direction: The statistical wind speed data (Figure 6.6) shows that maximum average wind speed value is 3.86 knots during May while the minimum wind speed value is 2.20 knots in the month of December in the area of Mymensingh station. In the project area, the predominant wind flows from the northwest (Figure 6.7).

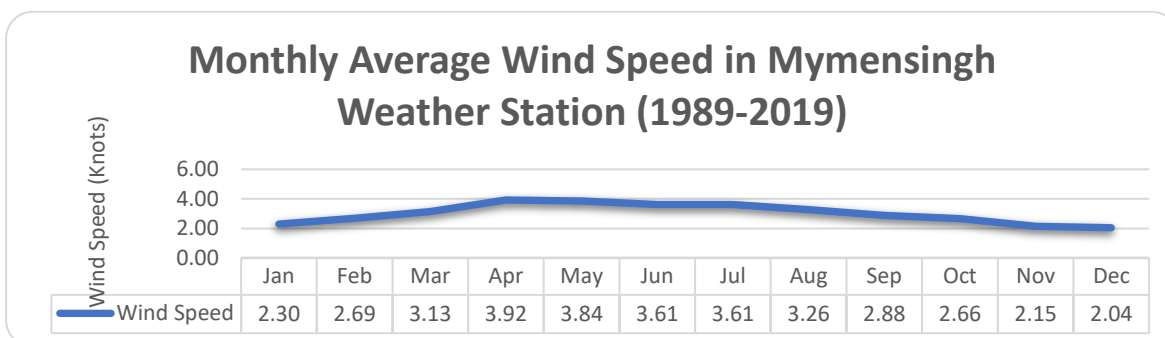


Figure 6.6: Average Monthly Wind Speed at Mymensingh

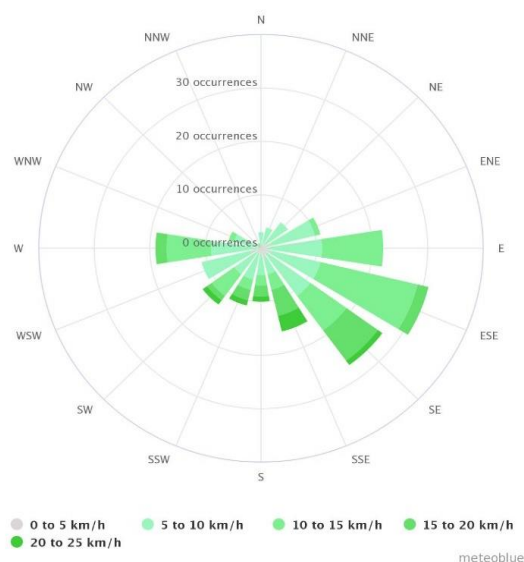


Figure 6.7: Wind Direction at Mymensingh

6.3.2 Topography

Mymensingh is one of the districts of Mymensingh division, Bangladesh, and is bordered on the north by the Meghalaya state of India and the Garo Hills, on the south by Gazipur District, on the east by the districts of Netrokona and Kishoreganj, and on the west by the districts of Sherpur, Jamalpur and Tangail. Mymensingh town is the district headquarter.

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 3-8m a.m.s.l (Figure 6.8). Topographically the cluster of the project location is almost flat, with many depressions, natural water bodies, bounded by the rivers.

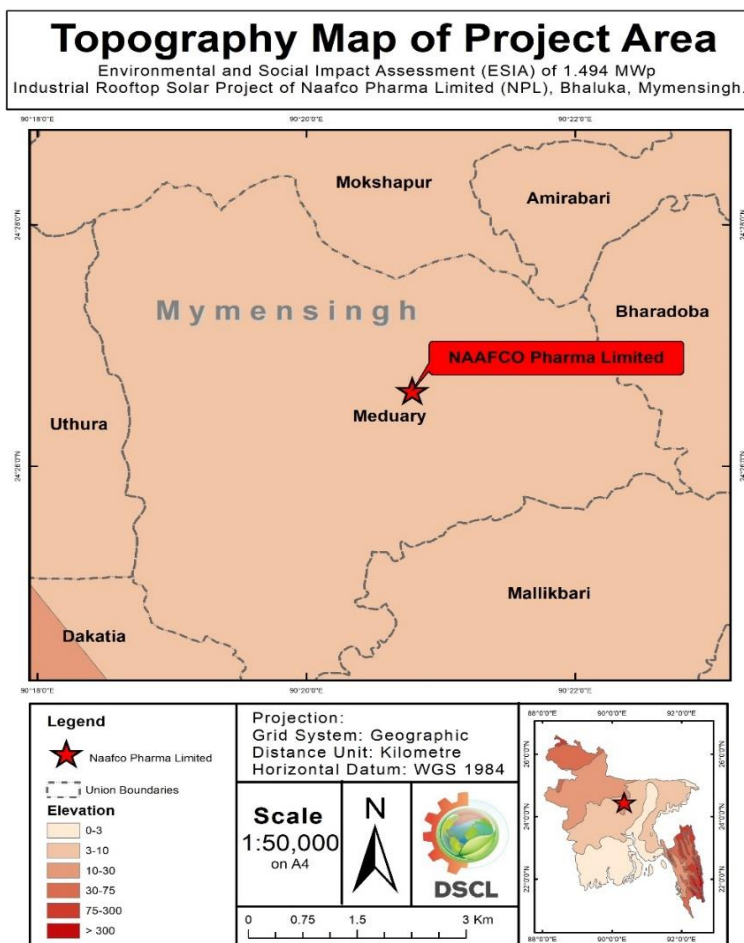


Figure 6.8: Topography of Bangladesh

6.3.3 Seismicity

Seismic Zone expression of the proneness of a region to earthquake occurrence in the historical past including the expectations in future. A region experiencing more frequent and large earthquakes has a higher seismicity compared to one with less frequent and small earthquakes. Both the temporal and spatial distributions of all earthquakes, small and big, have to be systematically accounted for by determining their past behavior to determine the future trend.

Bangladesh is situated in one of the most tectonically active regions in the world. Here is 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 four seismic zones, as Zone-1 (low vulnerable), Zone-2 (moderate vulnerable), Zone-3 (high vulnerable) and Zone-4 (very high vulnerable) 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 6.9), project area falls in the zone 04 comprising the north-central part of Bangladesh represents the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur Tracts, and the western extension of the folded belt. It means the project area is prone to very high seismic intensity. Although, there is no evidence of major earthquakes in the project areas in the recent past.

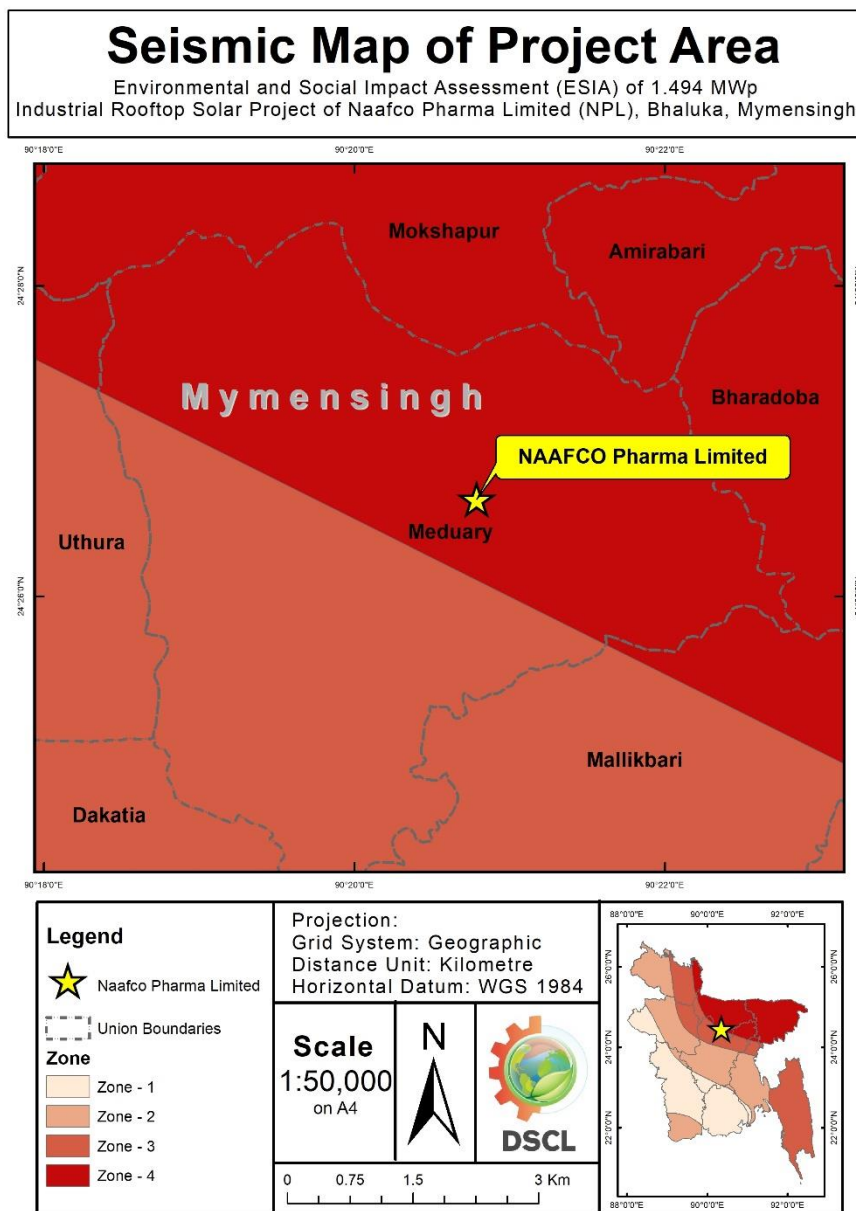


Figure 6.9: Seismic Zones of Bangladesh

6.3.4 Geology

Bangladesh is situated to the east of the Indian sub-continental plate. Nearly 85% of Bangladesh is underlain by deltaic and alluvial deposits of the Ganges, Brahmaputra, and Meghna River systems. Bangladesh is divided into two major tectonic units: (i) Stable Precambrian Platform in the northwest and (ii) Geosynclines basin in the southeast. A third unit, a narrow northeast-southwest trending zone called the Hinge Zone separates the above two units almost through the middle of the country. The geosynclines basin in the southeast is characterized by the huge thickness (maximum of about 20 km near the basin center) of clastic sedimentary rocks, mostly sandstone and shale of Tertiary age. It occupies areas of greater Dhaka, Faridpur, Noakhali, Sylhet, Comilla and Chittagong and the Bay of Bengal. The huge thickness of sediments in the basin is a result of tectonic mobility or instability of the areas causing rapid subsidence and sedimentation in a relatively short span of geologic time. The geosynclines basin is subdivided into two parts, i.e., fold belt in the east and a fore deep to the west.

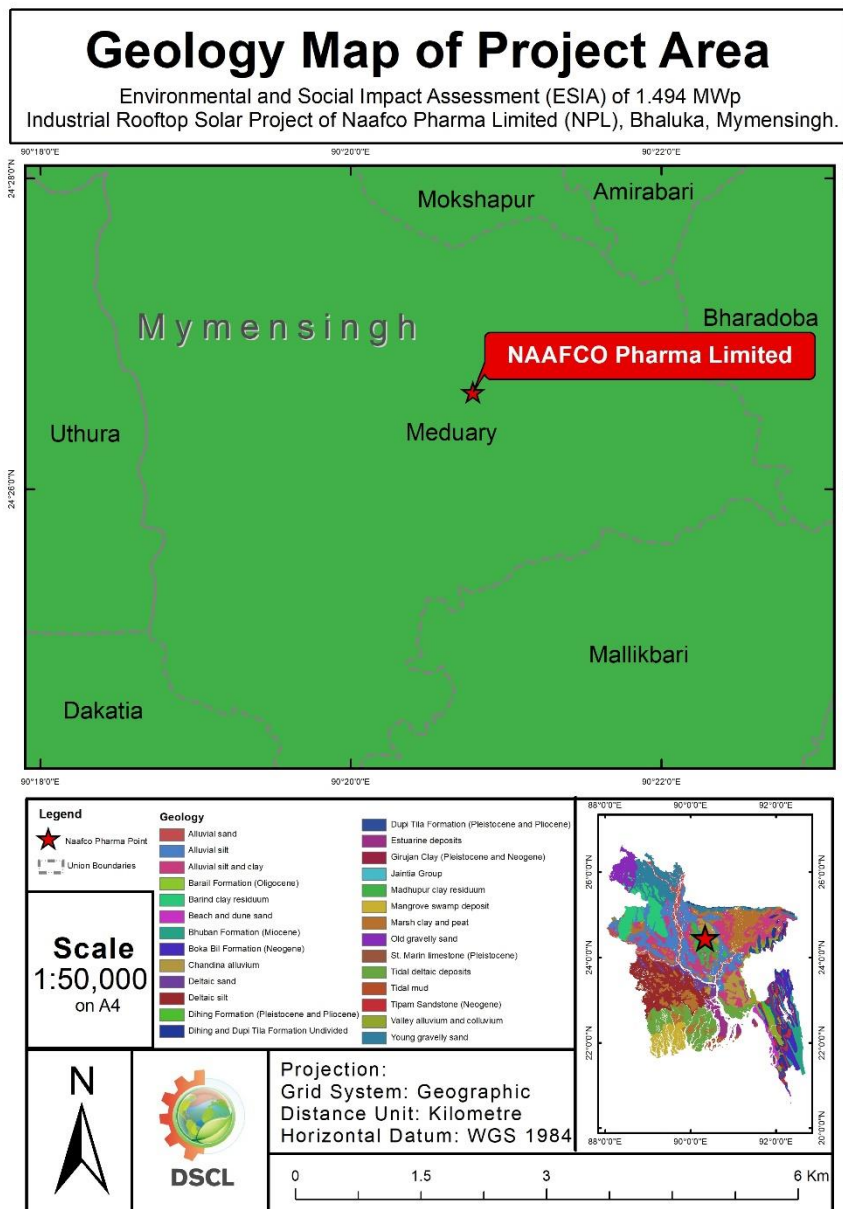


Figure 6.10: Geological Zones of Bangladesh

Bengal Fore deep 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 Fore deep 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 Madhupur High Trough.

6.3.5 Water Resources and Hydrology

Bangladesh is located over a subsiding basin of tectonic origin overlain with a great thickness of sedimentary strata. This sedimentary stratum is an unconsolidated alluvial deposit of recent age overlaying marine sediments. The recent delta and alluvial plains of the Ganges, Brahmaputra and the Meghna Rivers constitute the upper formation. The near surface Quaternary alluvium contains good aquifer characteristics (transmission and storage coefficients). The groundwater (GW) storage reservoir has three divisions: upper clay and silt layer, a middle composite aquifer (fine to very fine sand) and a main aquifer consisting of medium to coarse sand. Drinking water is generally taken from deep tube wells with strainers set between depths of 200 meters to around 400 meters (DPHE, 2011). The Ground water level is at or very close to the surface during the monsoon; whereas, it is at maximum depth during the months of April and May (Banglapedia, 2014).

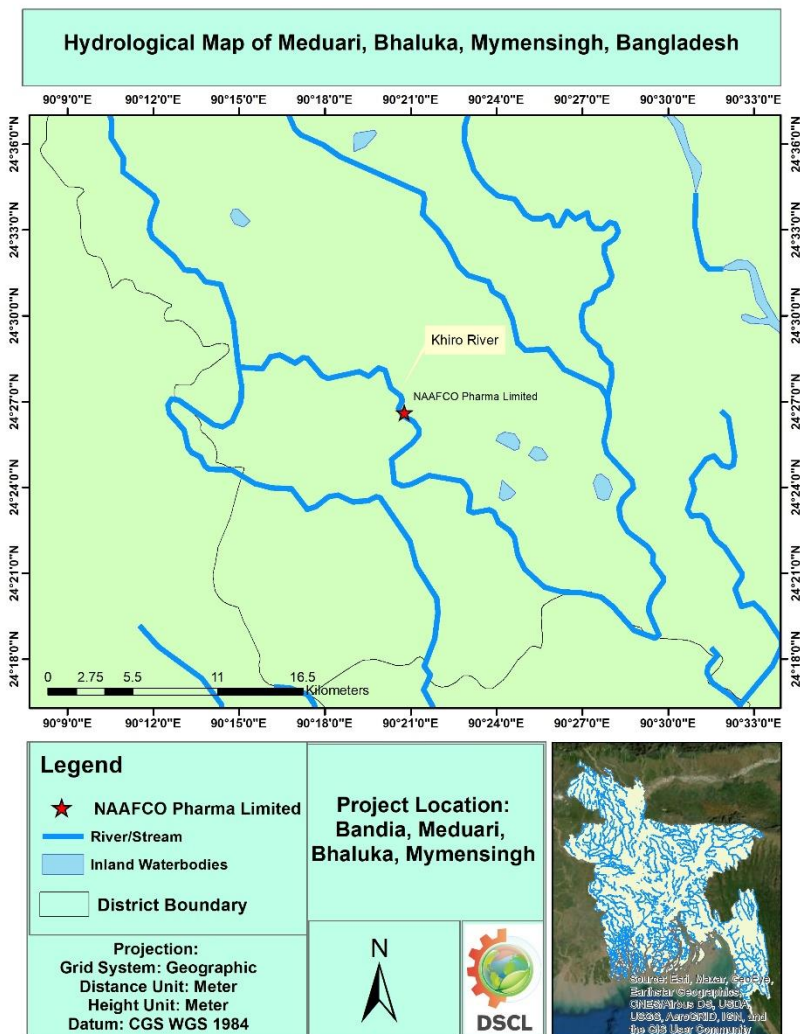


Figure 6.11: Geological Zones of Bangladesh

▪ 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.

▪ Groundwater

Arsenic is a problem in large part of Bangladesh ground water. The project area also has acceptable limit of Arsenic levels in 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

6.3.6 Soil Quality

The soil of the project area is yet not classified and does not fall any of the category of Bangladesh soil types. However, the category of soil near the project location includes the following (Figure 6.12):

- **Deep Red Brown Terrace Soils**

Comprises the former greater districts of Dhaka and Mymensingh and some isolated areas in Chittagong, Comilla and Sylhet districts. The area covered under this tract is around 10,000 sq km. This tract represents the red lateritic soils of Madhupur area, a highland tract above flood level intersected by numerous large and small depressions, locally known as 'baid'. The soils of this tract have clayey texture and contain large quantity of iron and aluminium, which are highly aggregated. The pH value ranges from 5.5 to 6.0 in the topsoil. The cation exchange capacity is low and the soils have the high phosphate fixing capacity. The soils are deficient in organic matter, nitrogen, phosphorus and lime.

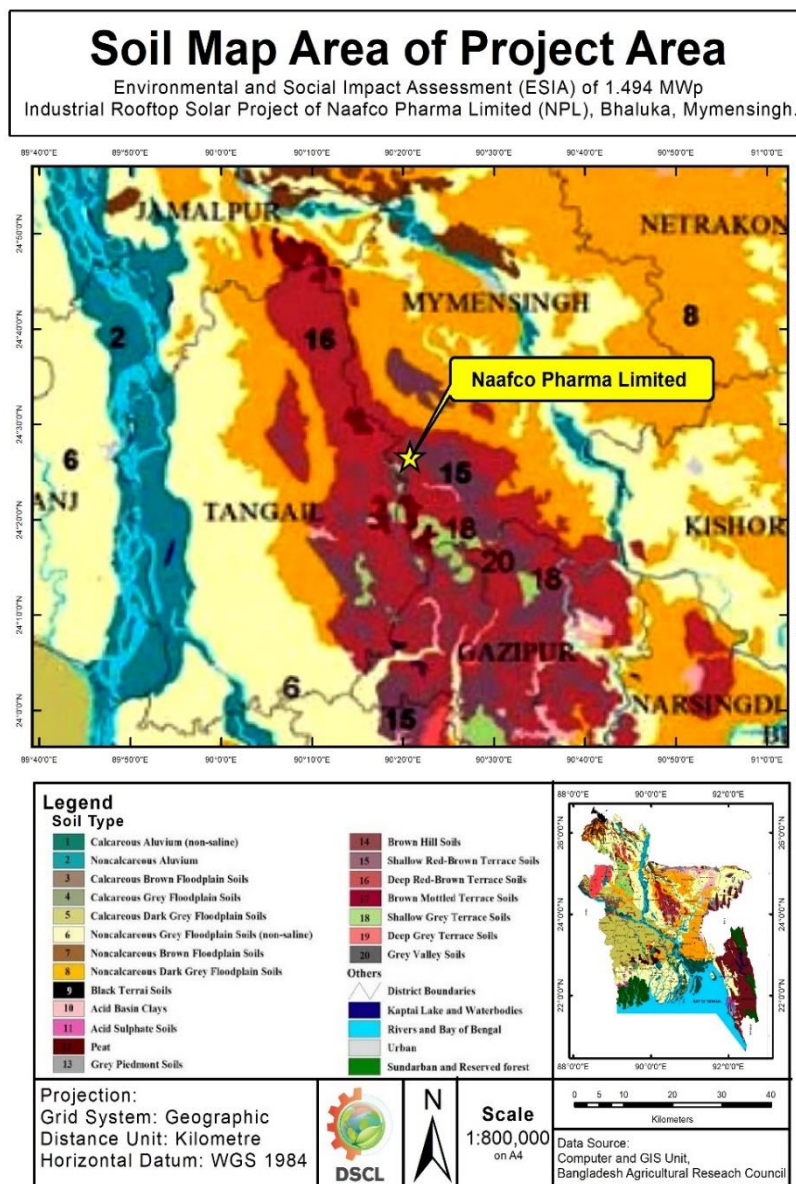


Figure 6.12: Soil Types of Bangladesh

6.3.7 Agroecological Zone

A 1988 study carried out by the United Nations Development Program (UNDP) classified Bangladesh into a series of Agro-ecological Zones (AEZs) based on an assessment of commonalities in characteristics such as physiography, soil types, climate and drainage. In total, 34 regions were identified and characterized, however this information has been updated and further refined on numerous occasions since the original study was undertaken.

The purpose of assessing the AEZs within the project area is to establish a broad overview of expected soil conditions which can be compared against more detailed, Upazila-level data sources. The most recent assessment was completed by the Soil Resource Development Institute (SRDI, 1998) which classified Bangladesh into 30 AEZs. The project area contains the below AEZ (refer Figure 6.13), namely:

- **Madhupur Tract** (4,244 sq km) This is a region of complex relief and soils developed over the Madhupur Clay. The landscape comprises level upland, closely or broadly dissected terraces associated with either shallow or broad, deep valleys. Eleven general soil types exist in the area of which deep red brown terrace, shallow red brown terrace soils and acid basin clays are the major ones. Soils in the valleys are dark grey heavy clays. They are strongly acidic in reaction with low status of organic matter, low moisture holding capacity and low fertility level. The nature and soil characteristics of this zone influence the crops and cropping patterns within the region.

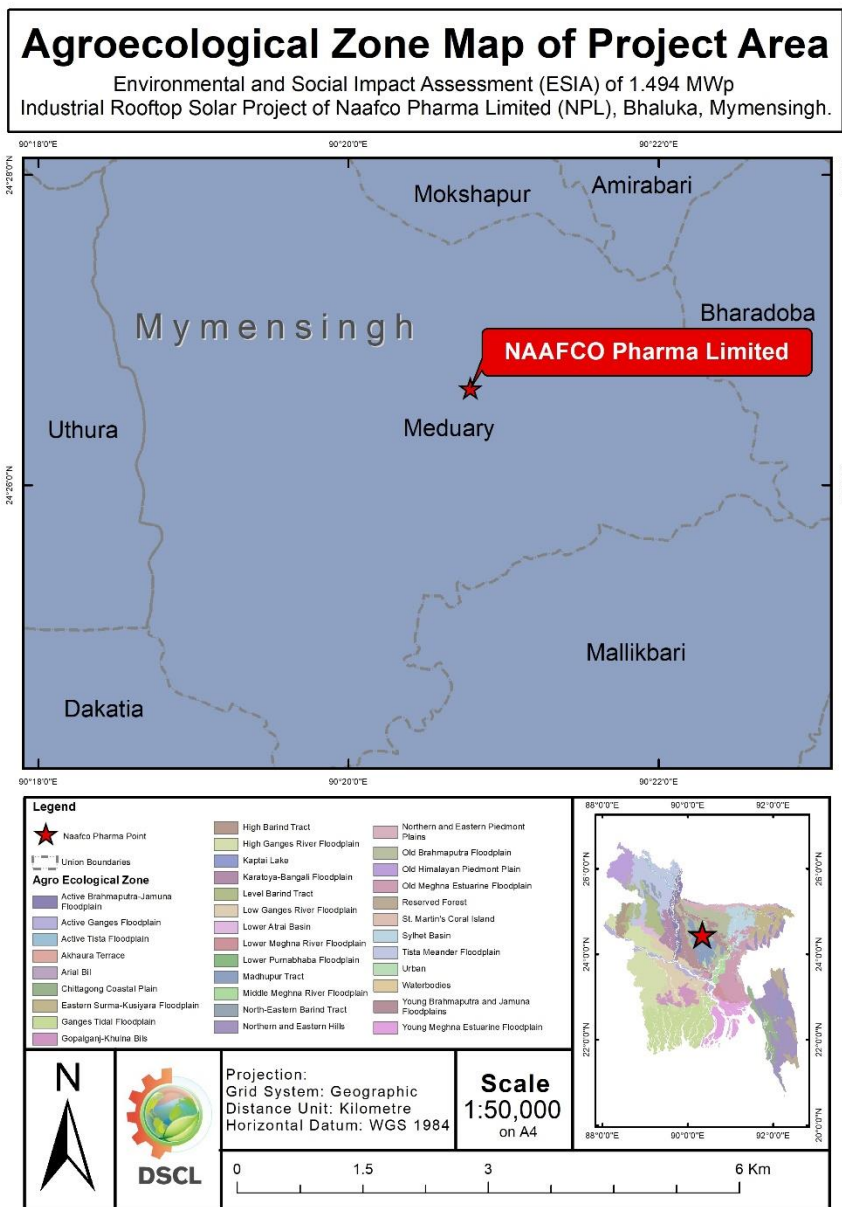


Figure 6.13: Agroecological Zones of Bangladesh

6.3.8 Climate Change and Natural Disasters

Climate change and its associated impacts will be experienced through changing temperatures and precipitation, rising sea levels, changes in the frequency and severity of

climate extremes and in the dynamics of hazardous conditions (IPCC, 2007). Developing countries are considered to be particularly susceptible to climate change because of their exposures and sensitivities to climate-related extremes, and especially because of their limited adaptive capabilities to deal with the effects of hazardous events. Given this limited capacity to adapt, they are considered to be particularly vulnerable to damages associated with climate, just as they are particularly vulnerable to other stresses.

Climate change is a global issue. The world's climate is changing and will continue to change in the coming century. Climate Change is basically the change in climate over a time period that ranges from decades to centuries. It is a normal part of the Earth's natural variability, which is related to interactions among the atmosphere, ocean, and land, as well as changes in the amount of solar radiation reaching the earth. However, the term "climate change" is defined by the United Nations Framework Convention on Climate Change (UNFCCC) as "A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (IPCC, 2007). The risks associated with these changes are real but highly uncertain. Societal vulnerability to the risks associated with climate change may exacerbate ongoing social and economic challenges, particularly for those parts of societies in developing countries dependent on resources that are sensitive to changes in climate. The project area falls under south central climatic zone (Figure 6.14). 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.

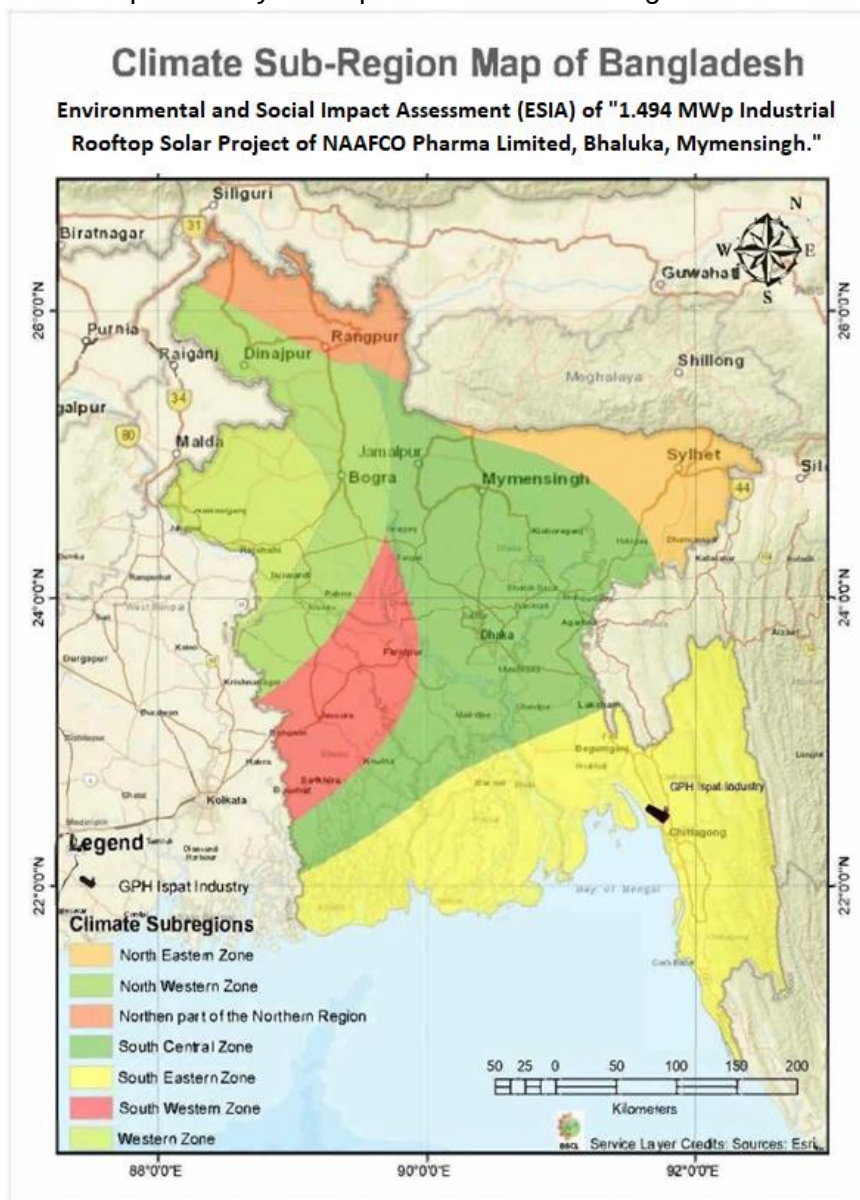


Figure 6.14: Climatic Sub-regions of Bangladesh

A natural hazard is any natural phenomenon that has a negative socioeconomic impact on humans. Alternatively, an extreme natural occurrence that is not caused by humans, such as a storm, earthquake, or flood. These are naturally occurring events that have only become dangerous owing to human involvement. The susceptibility of human infrastructure to catastrophe damage (risk) is also a significant consideration in comprehending natural disasters. The distribution and impact of natural disasters are uneven, with the developing world bearing the brunt of the loss of life and property. This is due to increased susceptibility rather than increased danger frequency.

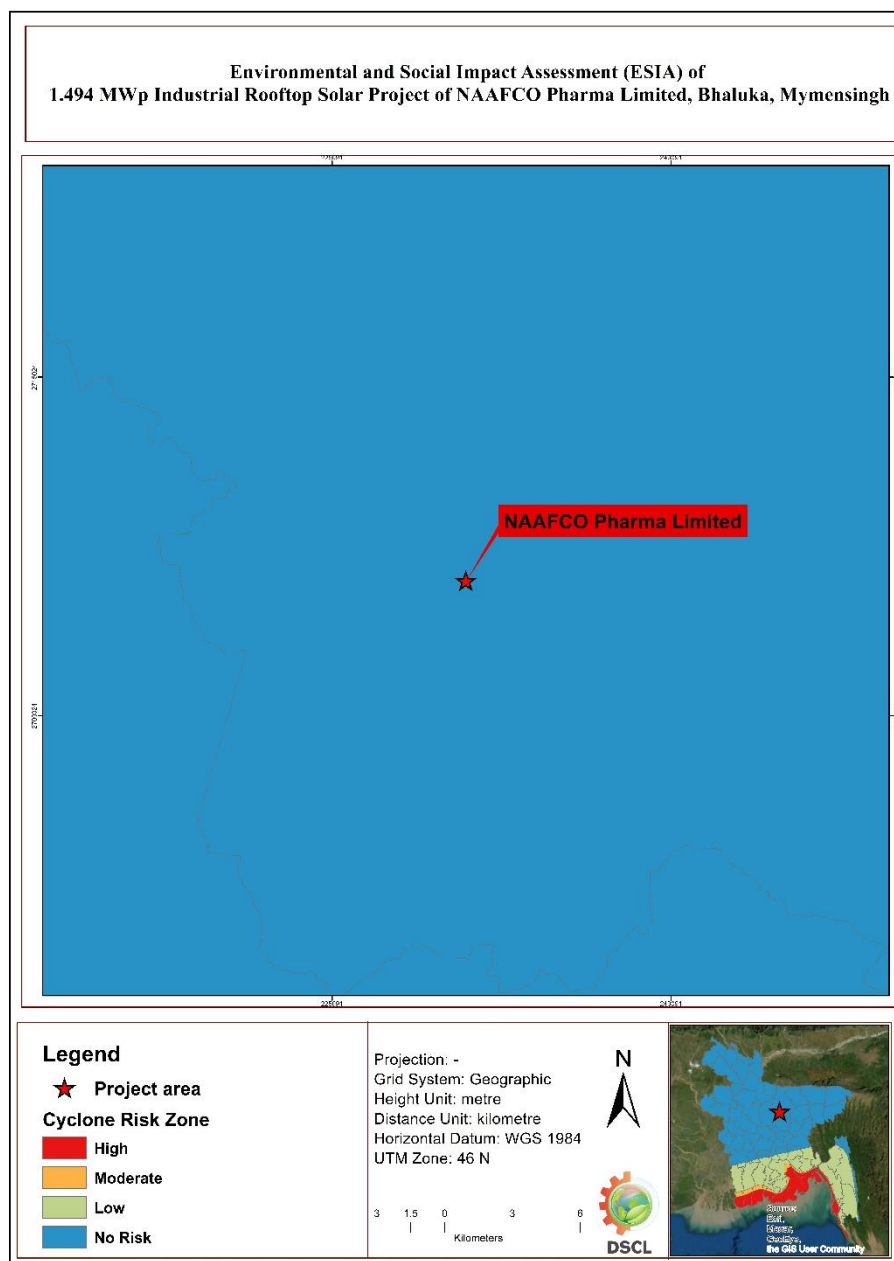


Figure 6.16: Cyclone Risk in the Project Area

In the project area, there is no risk of flood

occurrence as the project area falls under no flood risk area (Figure 6.15). the project area also falls under no risk zone for cyclone occurrences (Figure 6.16).

6.4 BIOLOGICAL ENVIRONMENT

The countries of South and Southeast Asia are recognized by International Union for Conservation of Nature (IUCN) to be regions of high species diversity. A large number of native plants, including 3,000-4,000 species of woody flora, have been recorded from Bangladesh. The country lies at the meeting point (ecotonal region) of several floristic provinces, including the Manipur-Khasia, Bengal and North Burman provinces within the Indo-Malayan realm (IUCN, 2002).

Bangladesh was once well forested, but most of the native forests have disappeared in recent decades due to mounting pressure from human populations. Only scattered patches of native trees, wetlands and associated fauna habitat remain in isolated locations within the terrestrial environment (IUCN, 2002). In many parts of the country, the abundance of plantations and groves of trees around villages creates an aspect of discontinuous forest (Wahab, 2008).

The floodplains of Bangladesh have long been subject to cultivation, the most dominant land use within the project area, with only scattered patches of native trees, wetlands and associated fauna habitat remaining in isolated locations within the terrestrial environment (IUCN, 2002).

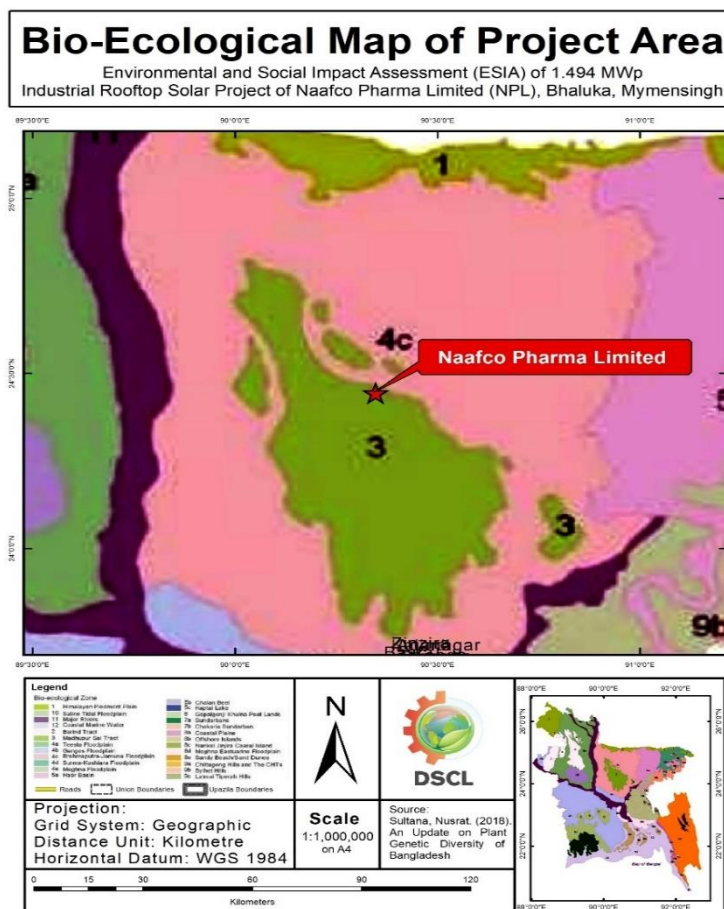


Figure 6.17: Bioecological Zones of Bangladesh

6.4.1 Bioecological Zone

Within a relatively small geographic boundary, Bangladesh enjoys a diverse array of ecosystems. Being a low-lying deltaic country, seasonal variation in water availability is the major factor, which generates different ecological scenarios of Bangladesh. Temperature, rainfall, physiographic variations in soil and different hydrological conditions play vital roles in the country's diverse ecosystems. The ecosystems of Bangladesh could be categorized into two major groups, i.e. (i) land based and (ii) aquatic. The land-based ecosystems include forest and hill ecosystems, agro-ecosystems and homestead ecosystems; while seasonal and perennial wetlands, rivers, lakes, coastal mangroves, coastal mudflats and chars, and marine ecosystems fall into the aquatic category. Each of the ecosystems has many sub-units with distinct characteristics as well. IUCN Bangladesh in 2002 classified the country into twenty-five bio-ecological zones (Figure 6.17). The project area falls below the bio-ecological zone.

- **Madhupur Sal tract** is a large upland area of 4,244 km² in north central part of Bangladesh, stretching from east of Jamalpur in the north, to Fatullah and Narayanganj, in the south. The tract is mostly one large tract, unlike the Barind Tract. It is approximately one to ten meters above the nearby floodplains. The tract is considered as an area of jungle-covered of old alluvium. It is an elevated plateau, with hillocks of varying heights, ranging from 30 to 60 feet. There are also cultivated valleys.

6.4.2 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, cow, dog, goat, etc. 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 6.18: Flora in and around the Project Area

6.4.2.1 Flora survey

The field surveys involve the preparation of an inventory of different species of plants including trees, shrubs, economic plants in the plant community of the area. The observations were also made on the agricultural patterns, agricultural weeds and cultivated and introduced plant species. The documentation of the plant communities was done by random walk through the study area and visual observations. Some of the flora Species found in the study area is presented in **Table 6.2** below:

Table 6.2: List of identified Terrestrial Flora in and around the Project Area

Sl. No.	Scientific Name	Local Name	Type	Habit	Family
1.	<i>Aeschynomene indica</i>	Shola	D	H	Fabaceae
2.	<i>Ageratum conyzoides</i>	Fulkuri	D	H	Asteraceae
3.	<i>Albizia lebbeck</i>	Kalo-koroi	D	T	Mimosaceae
4.	<i>Alternanthera sessilis</i>	Sanchi	D	H	Amaranthaceae
5.	<i>Amaranthus spinosus</i>	Kata-notey	D	H	Amaranthaceae
6.	<i>Angiopteris evecta</i>	Dhekia shak	F	H	Angiopteridaceae
7.	<i>Annona reticulata</i>	Sarifa	D	ST	Annonaceae
8.	<i>Antidesma acidum</i>	Multa	D	T	Euphorbiaceae
9.	<i>Artabotrys hexapetalus</i>	Kathalichapa	D	S	Annonaceae
10.	<i>Artocarpus chama</i>	Chhapalish	D	T	Moraceae
11.	<i>Atylosia scarabaeoides</i>	Banor kolai	D	CH	Fabaceae
12.	<i>Azadirachta indica</i>	Neem	D	T	Meliaceae
13.	<i>Baccaurea ramiflora</i>	Latkon	D	ST	Euphorbiaceae
14.	<i>Bauhinia purpurea</i>	Rakto	D	T	Caesalpiniaceae
15.	<i>Bombax ceiba</i>	Shimul	D	T	Bombacaceae
16.	<i>Breynia vitis-idaea</i>	Vita salpoti	D	S	Euphorbiaceae
17.	<i>Bryophyllum pinnatum</i>	Pathor kuchi	D	H	Crasulaceae
18.	<i>Byttneria pilosa</i>	Harvanga	D	SS	Sterculiaceae
19.	<i>Calophyllum inophyllum</i>	Pipul/ punial	D	T	Clusiaceae
20.	<i>Calotropis procera</i>	Akond	D	S	Asclepiadaceae
21.	<i>Centella asiatica</i>	Thankuni	D	H	Apiaceae
22.	<i>Chromolaena odorata</i>	German lata	D	S	Asteraceae
23.	<i>Cissus adnata</i>	Bhatia-lata	D	CH	Vitaceae
24.	<i>Coccinia grandis</i>	Telakucha	D	CH	Cucurbitaceae
25.	<i>Citrus aurantifolia</i>	Lebu	D	T	Rutaceae
26.	<i>Codiaeum variegatum</i>	Patabahar	D	S	Euphorbiaceae
27.	<i>Colocasia esculenta</i>	Kachu	M	H	Araceae
28.	<i>Cuscuta reflexa</i>	Swarnolata	D	H	Cuscutaceae
29.	<i>Cynodon dactylon</i>	Durba	M	H	Poaceae
30.	<i>Delonix regia</i>	Krishnochura	D	T	Caesalpiniaceae
31.	<i>Desmodium heterophyllum</i>	Bonmotorsuti	D	H	Fabaceae
32.	<i>Dichanthium caricosum</i>	Detara	M	H	Poaceae
33.	<i>Dillenia indica</i>	Chalta	D	T	Dilleniaceae
34.	<i>Dioscorea pentaphylla</i>	Kanta alu	M	CH	Dioscoreaceae
35.	<i>Diospyros malabarica</i>	Deshi gab	D	T	Ebnaceae
36.	<i>Elaeocarpus floribundus</i>	Jolpie	D	T	Eleocarpaceae
37.	<i>Eucalyptus camaldulensis</i>	Eucalyptus	D	T	Myrtaceae
38.	<i>Ficus benghalensis</i>	Bot	D	T	Moraceae
39.	<i>Ficus racemosa</i>	Jagyadumur	D	T	Moraceae
40.	<i>Ficus virens</i>	Pakar	D	T	Moraceae

Sl. No.	Scientific Name	Local Name	Type	Habit	Family
41.	<i>Hemidesmus indicus</i>	Anantomul	D	CH	Asclepiadaceae
42.	<i>Abroma augusta</i>	Ulot kombol	D	S	Sterculiaceae
43.	<i>Abutilon indicum</i>	Petari	D	H	Malvaceae
44.	<i>Acacia auriculiformis</i>	Akashmoni	D	H	Mimosaceae
45.	<i>Acacia nilotica</i>	Babla	D	T	Mimosaceae
46.	<i>Acalypha indica</i>	muktajhuri	D	H	Euphorbiaceae
47.	<i>Achyranthes aspera</i>	Apang	D	H	Amaranthaceae
48.	<i>Adenia trilobata</i>	Akandaphal	D	CH	Passifloraceae
49.	<i>Adhatoda vasica</i>	Bashak	D	H	Acanthaceae
50.	<i>Aegle marmelos</i>	Bel	D	T	Rutaceae
51.	<i>Jasminum sambac</i>	Beli	D	S	Oleaceae
52.	<i>Lagerstroemia speciosa</i>	Jarul	D	T	Lythraceae
53.	<i>Laportea interrupta</i>	Chutra	D	H	Urticaceae
54.	<i>Leucaena leucocephala</i>	Ipil ipil	D	T	Mimosaceae
55.	<i>Litsea monopetala</i>	Pipulti	D	T	Lauraceae
56.	<i>Marsilea minuta</i>	Sunsi shak	F	FH	Marsileaceae
57.	<i>Mimosa pudica</i>	Lozzaboti	D	H	Mimosaceae
58.	<i>Musa acuminata</i>	Pahari kola	M	H	Musaceae
59.	<i>Ocimum sanctum</i>	Tulsi	D	S	Lamiaceae
60.	<i>Oxalis corniculata</i>	Amrul shak	D	H	Oxalidaceae
61.	<i>Phaulopsis imbricate</i>	Kantasi	D	H	Acanthaceae
62.	<i>Phyllanthus emblica</i>	Amlak	D	T	Euphorbiaceae
63.	<i>Polyalthia longifolia</i>	Debdaru	D	T	Annonacea
64.	<i>Psidium guajava</i>	Peyara	D	T	Myrtaceae
65.	<i>Rauvolfia serpentina</i>	Swarpo	D	H	Apocynaceae
66.	<i>Saccharum spontaneum</i>	Kashful	D	CS	Poaceae
67.	<i>Santalum album</i>	Chandan	D	T	Santalaceae
68.	<i>Solanum nigrum</i>	Tit begun	D	H	Solanaceae
69.	<i>Spondias pinnata</i>	Amra	D	T	Anacardiaceae
70.	<i>Stemona tuberosa</i>	Lalgurania alu	M	H	Stemoniaceae
71.	<i>Streblus asper</i>	Shewra	D	T	Moraceae
72.	<i>Syzygium cumini</i>	Kalojam	D	T	Myrtaceae
73.	<i>Tamarindus indica</i>	Tatul	D	T	Caesalpiniaceae
74.	<i>Tectona grandis</i>	Segun	D	T	Verbenaceae
75.	<i>Terminalia arjuna</i>	Arjun	D	T	Combretaceae
76.	<i>Terminalia catappa</i>	Katbadam	D	T	Combretaceae
77.	<i>Terminalia chebula</i>	Haritoki	D	T	Combretaceae
78.	<i>Zizyphus mauritiana</i>	Boroi	D	T	Rhamnaceae
79.	<i>Annona squamosa</i>	atagach	D	T	Annonaceae

Source: Survey Team, 2021

Legend: C=Climber, CH=Climbing Herb, CS=Climbing Shrub, D=Dicot, F=Fern, FH=Fern Herb, G=Gymnosperm, M=Monocot, SS=Scandens Shrub, ST=Small Tree, T=Tree.

6.4.2.2 Fauna Survey

Terrestrial fauna survey studies help to understand the wellbeing of a nature and functioning of ecosystems. It helps to monitor biological richness or heritage quality, habitat change and quantifying threatening species. Animals and birds in the study area were documented using following means:

- Secondary sources and published literature

- By interviewing local people
- Actual sighting
- Indirect evidence (pallets, dung, droppings, scat, marking on the trunks etc.)
- Nesting (birds, burrows for small mammals)



Figure 6.19: Fauna in and around the Project Area

The records for the birds, mammals and other faunal groups were made at the same site where vegetation observation was carried out. Most of the records of the mammalian and reptilian fauna are opportunistic, nonetheless very useful to understand habitat specificity and interrelationship between certain floral and faunal elements and also between certain geological and faunal features. Some of the faunal Species found in the Study area is presented in **Table 6.3** below:

Table 6.3: List of identified Terrestrial fauna in and around the Project Area

Scientific Name	English Name	Local Name	Local Status
Class: Amphibia			
<i>Bufo melanostictus</i>	Common Toad	Kuno bang	NO
<i>Rana temporalis</i>	Bull Frog	Kola bang	NO
Class: Nematoda			

Scientific Name	English Name	Local Name	Local Status
<i>Pheretima Posthuma</i>	Earthworm	Kecho	NO
<i>Diplopoda</i>	Red millipede	Kenno	NO
Class: Reptilia			
<i>Hemidactylus flaviviridis</i>	Common House Lizard	Tiktiki	NO
<i>Calotes versicolor</i>	Common Garden Lizard	Rokto-chosha	NO
<i>Mabuya carinata</i>	Common skink	Anjon	NO
<i>Varanus bengalensis</i>	Bengal monitor	Gui shap	VU
<i>Xenochrophis piscator</i>	Checkered keelback	Dhora shap	NO
<i>Atretium schistosum</i>	Olive keelback	Maitta shap	NO
Class: Aves			
<i>Phalacrocorax niger</i>	Little cormorant	Paan-kowri	NO
<i>Columbidae</i>	Pigeon	Kobutor	NO
<i>Anser anser</i>	Swan	Rajhash	NO
<i>Casmerodius albus</i>	Great egret	Sada bok	NO
<i>Anastomus oscitans</i>	Asian Openbill	Shamuk-khol	NO
<i>Haliastur indus</i>	Brahminy kite	Shankho chil	NO
<i>Spilornis cheela</i>	Crested Serpent-eagle	Khopa Baz	VU
<i>Ichthyophaga ichthyaetus</i>	Grey-headed fish eegol	Metematha kura eagle	LC
<i>S. tranquebarica</i>	Red-collared Dove	Lal Ghughu	NO
<i>Psittacula krameri</i>	Rose-ringed parakeet	Tia	NO
<i>Amaurornis phoenicurus</i>	White-breasted waterhen	Dahuk	NO
<i>Eudynamys scolopacea</i>	Asian cuckoo	Kokil	NO
<i>Tyto alba</i>	Barn owl	Laxmi Pencha	NO
<i>Alcedo atthis</i>	Common kingfisher	Choto Maachranga	NO
<i>Dendrocopos macei</i>	Fulvous-breasted woodpecker	Pakra Kaththokra	NO
<i>Dinopium benghalense</i>	Black-rumped flameback	Kaththokra	NO
<i>Oriolus xanthornus</i>	Black-headed oriole	Holdey Pakhi	NO
<i>Corvus splendens</i>	House crow	Pati Kak	NO
<i>Copsychus saularis</i>	Oriental magpie robin	Doel	NO
<i>A. tristis</i>	Common myna	Bath Shalik	NO

Scientific Name	English Name	Local Name	Local Status
<i>Pycnonotus cafer</i>	Red-vented bulbul	Bulbuli	NO
<i>Orthotomus sutorius</i>	Common tailorbird	Tuntuni	NO
<i>N. zeylonica</i>	Purple-rumped sunbird	Moutusi	NO
<i>D. agile</i>	Thick-billed Flowerpecker	Fuljuri	NO
<i>Passer domesticus</i>	House sparrow	Charui	NO
<i>Ploceus philippinus</i>	Baya weaver	Babui	NO
Class: Insecta			
<i>Danaus plexippus</i>	Butterfly	Projapoti	NO
<i>Papilio polyxenes</i>	Black Butterfly	Kalo Projapoti	NO
<i>Anisoptera</i>	Dragonfly	Foring	NO
<i>Formicidae</i>	Ant	Pipra	NO
Class: Mammalia			
<i>Pteropus giganteus</i>	Flying Fox	Badur	NO
<i>Sus Sus</i>	Pig	Sukor	NO
<i>H. auropunctatus</i>	Small Indian Mongoose	Beji	NO
<i>Vulpes bengalensis</i>	Bengal Fox	Khek shial	VU
<i>Viverricula indica</i>	Small Indian Civet	Khatash	VU
<i>Rattus rattus</i>	Common House Rat	Indur	NO
<i>Suncus murinus</i>	House Shrew	Chicka	NO

Legend: EN – Endangered, VU – Vulnerable, NO – Not Threatened

Source: Survey Team, 2021

6.4.3 Protected Areas and Red Book Species

Many wildlife species are in stress in Bangladesh, many more are endangered/ threatened and a large number already faced extinction. The status of faunal species in Bangladesh has been published by IUCN (2000). According to the IUCN findings this country has lost 10% of its mammalian fauna, 3% avifauna and 4% reptiles over the last 100 years. More than 50 species are presently critically endangered in Bangladesh of which 23 species are already declared as endangered in the Red Data Book of IUCN. In addition, 83 species are commercially threatened and are included in the appendices of Convention on International Trade in Endangered Species (CITES). Among the most endangered species are: elephant, tiger, wild Cat, Leopard or wild goat, dolphin; birds: white-winged duck, comb duck, stork, carne, pheasant, partridge, and crocodile, python, monitor, lizard, tiger terrapin, roofed turtle, soft turtle, and marine turtles. Major Redbook species in the project area are shown in table 6.4.

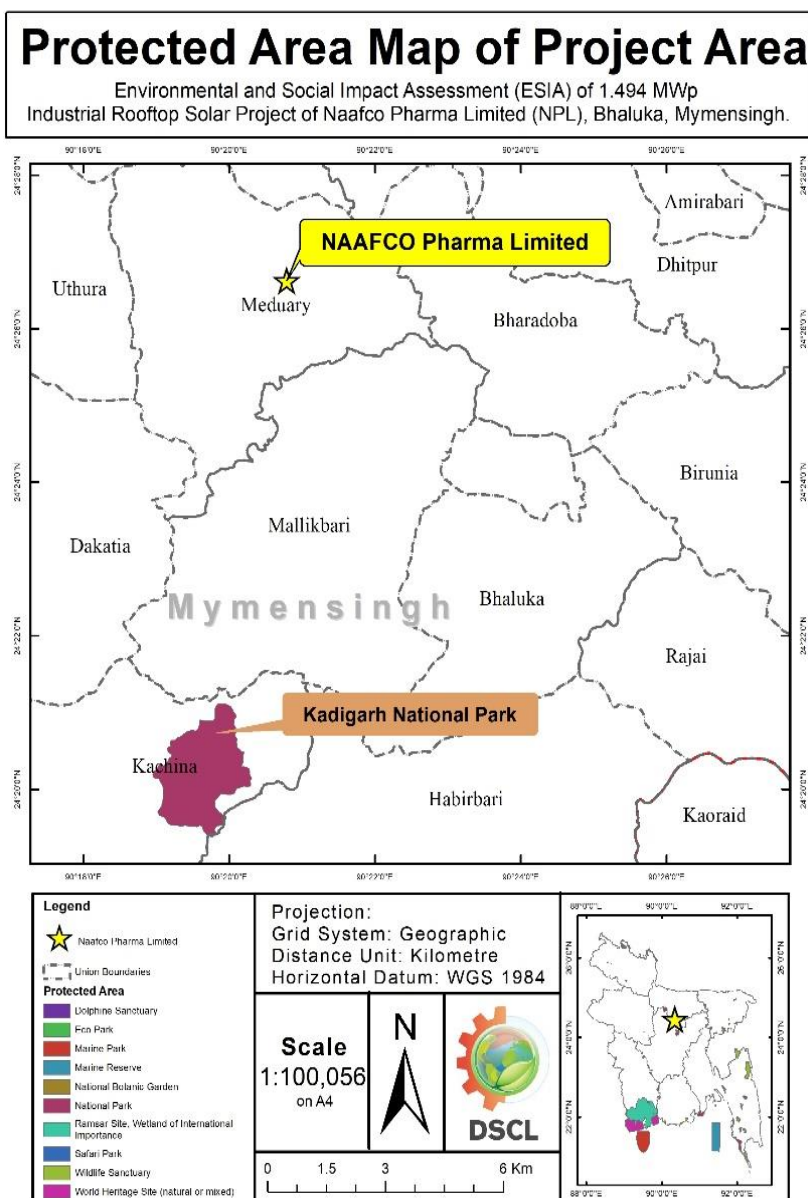


Figure 6.20: Bioecological Zones of Bangladesh

Table 6.4: List of Redbook species identified in and around the Project Area

Order	Family	Scientific Name	English Name	Local Name	Status in Bangladesh	Global Status	Species ID
Primates	Cercopithecidae	Semnopithecus entellus	Northern Plains Sacred Langur, Common langur	Hanuman	EN	LC	MA0055

Carnivora	Mustelidae	Aonyx cinerea	Oriental Small-clawed Otter, Asian Small-clawed Otter, Small-clawed Otter	Dhaira Uud, Uud Biral, Bhodar	EN	VU	MA0071
Carnivora	Canidae	Canis aureus	Golden Jackal	Shial, Pati Shial	LC	LC	MA0058

Kadigarh National Park is the nearby protected area from the project location (Figure 6.20). Though it is far away (approximately 21.8km) from the buffer zone. Construction impacts on the rate of deforestation, loss of habitat, habitat fragmentation, and interruption of wildlife migration patterns are not anticipated.

6.5 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 has been assessed through field studies on 27 October 2021 within the impact zone and analysis the information for various components of the environment, viz. air, noise, water, etc. The sampling locations were in the following Figure 6.21.

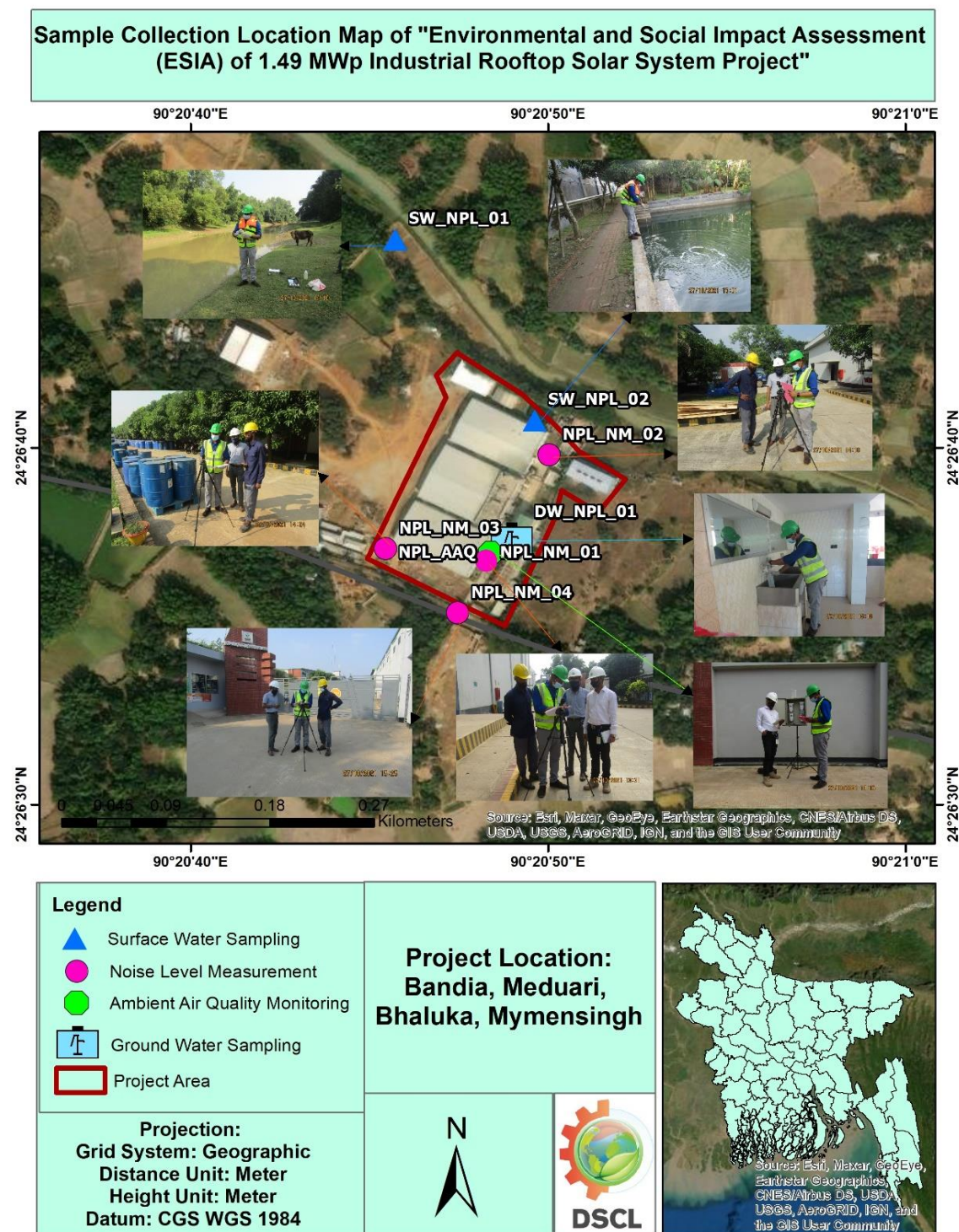


Figure 6.21: Location of Sample Collection

6.5.1 Air Quality

Ambient air quality data at the project site measured to verify the current quality of air. The aim was to collect the baseline air quality data and to compare the data with the air quality data during project activities to check if there is any high air pollution level due to the construction activities and to design adequate mitigation measures, as applicable. The main air pollutants in Bangladesh are nitrogen oxides (NO_x), Sulphur dioxide (SO₂), PM_{2.5} and PM₁₀, carbon monoxide (CO) and Ozone (O₃). Motor vehicles are the major source of PM

pollution. Most of the PM pollutants (greater than 80%) come from diesel-run vehicles.

The ambient air quality monitoring was carried out at the project location on 27th October 2021. The air quality testing was performed for 8 hours (Figure 6.19). The parameters were Particulate Matter (PM_{2.5} and PM₁₀), Sulphur Oxides (SO_x), Nitrogen Oxides (NO_x), Carbon Monoxide (CO), and Ozone (O₃). “AEROQUAL series 500” portable air quality monitors were used for the measurement of particulate matters (PM₁₀ and PM_{2.5}) and gaseous pollutants (SO_x, NO_x, and O₃). To monitor Carbon Monoxide (CO), Lutron air quality meter was used and the value is expressed in ppm. Results of the air quality monitored at the project location have been showed in Table 6.5.



Figure 6.22: Ambient Air Quality Monitoring in Project Location

Table 6.5: Test Results of Ambient Air Quality Monitoring

Parameter	Unit	NPL_AAQ	Bangladesh Standard	Duration (hours)	Weather Condition	Method of Analysis
		24.443630°N 90.346785°E				
		27 October 2021				
		Beside Production & Administrative Building, NAAFCO Pharma Limited, Bhaluka, Mymensingh				
PM _{2.5}	µg/m ³	43.65	65	24	Sunny	AEROQUAL Series 500 Particulate matter monitors
PM ₁₀	µg/m ³	102.50	150			AEROQUAL Series 500 SO _x monitor
SO _x	µg/m ³	17.8	365			AEROQUAL Series 500 NO _x monitor
NO _x	µg/m ³	23.2	100	Annual		AEROQUAL Series 500 O ₃ monitor
O ₃	µg/m ³	<1	NYS	8		Lutron Air Quality Meter (AQ-9901SD)
CO	ppm	2	9			

** The Bangladesh National Ambient Air Quality Standards have been taken from the Environment Conservation Rules, 1997 which was amended on 19 July 2005 vide S.R.O. No. 220-Law/2005.

**NYS- Not Yet Standardized

Table 6.6: Description of the Surrounding Environment

Location	Sample Site Description
NPL_AAQ (Beside Production & Administrative Building, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ The weather was sunny ➤ Traffic volume was low ➤ People movement was moderate ➤ Dust particle was low

The measurement results showed measurement of all air quality standards. Based on the ambient air quality standard of DoE, air quality in the project areas can be stated as in good condition. Particulate matter PM_{2.5} value was 43.65 and PM₁₀ value was 102.50 which are far below the DoE standard. The Laboratory Test result given in **Appendix B** of the report.

6.5.2 Noise Quality

Noise Level Measurement was analyzed at project influenced locations day time at 27 October 2021 (Figure 6.23). Noise level data were taken during day time are summarized in Table 6.7 & 6.8. Noise measurement at each location was done continuously for 30 minutes at day time.



Near Production & Administrative Building



Beside Raw Materials Loading-Unloading Area



Beside Chemical Storage Area



Near Main Gate

Figure 6.23: Noise Level Monitoring from Project Location

Table 6.7: Noise Level Monitoring Test Result

Sample ID	Sample Location	GPS Location	Land Use Category	Time		Noise Level (dBA) (LAeq)	Bangladesh Standard (dBA) **
				Start	End		
NPL_NM_01 27 October 2021	Near Production & Administrative Building, NAAFCO Pharma Limited, Bhaluka, Mymensingh	24.443631°N 90.346786°E	Industrial Area	01:10 pm	01:40 pm	56.28	75
NPL_NM_02 27 October 2021	Beside Raw Materials Loading-Unloading Area, NAAFCO Pharma Limited, Bhaluka, Mymensingh	24.444462°N 90.347253°E		01:45 pm	02:15 pm	61.50	
NPL_NM_03 27 October 2021	Beside Chemical Storage Area, NAAFCO Pharma Limited, Bhaluka, Mymensingh	24.443660°N 90.345961°E		02:20 pm	02:50 pm	48.27	
NPL_NM_04 27 October 2021	Near Main Gate, NAAFCO Pharma Limited, Bhaluka, Mymensingh	24.443159°N 90.346520°E		03:10 pm	03:40 pm	64.45	
Notes: - Land use category is based on the classification provided in the Noise Pollution Control Rules (2006) - The sound level standards for the Industrial area are 75 at day time and 70 at night time. - Noise Level is the average noise recorded during the monitoring period							

Abbreviation: NM- Noise Measurement, dB- decibel

Table 6.8: Description of the Surrounding Environment

Sample Location and ID	Sample Site Description
NPL_NM_01 (Beside Production & Administrative Building, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ Industrial area ➤ Traffic volume was low ➤ People's movement was moderate ➤ Noise from pharmaceutical manufacturing machineries
NPL_NM_02 (Beside Raw Materials Loading-Unloading Area, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ Industrial area ➤ Traffic volume was moderate ➤ People's movement were moderate
NPL_NM_03 (Beside Chemical Storage Area, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ Industrial area ➤ Traffic volume was low ➤ People's movement were moderate
NPL_NM_04 (In front of Main Gate, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ Beside local road ➤ Industrial area ➤ Traffic volume was moderate ➤ People's movement were moderate

The result shows that time weighted average value of the sound monitored inside the project are within the standard set for Industrial area at day time. The details analysis of the result is given in **Appendix C** report.

6.5.3 Surface Water Quality

Surface water samples were collected from project influenced locations on 27 October 2021 (Figure 6.24). The locations along with GPS coordinates are summarized with results in Table 6.9. The sample were collected with Kemmerer Bottle and then transferred in 1-liter plastic sampling bottles. The sampling bottles were then kept in an ice cooler box. Adequate personal protective equipment (PPE) was used during the sample collection. The samples were sent to Department of Public Health Engineering (DPHE) laboratory for chemical analysis.



Figure 6.24: Surface Water Sample Collection from Project Area

Table 6.9: Test Result of Surface Water Quality

Parameters	Unit	Concentration Present		Standards for Inland Surface Water**	Analysis Method
		SW_NPL_01	SW_NPL_02		
		24.446740° N 90.345328° E	24.444730° N 90.346764° E		
		Khiro River, Near NAAFCO Pharma Limited, Bhaluka, Mymensingh	ETP Retention Pond, NAAFCO Pharma Limited, Bhaluka, Mymensingh		
Turbidity	NTU	49.6	32.5	NYS	Turbidity Meter
Temperature*	°C	29.3	27.1	20-30	Multimeter
pH*	-	7.82	7.75	6.5-8.5	Multimeter
Electrical Conductivity (EC)*	µs/cm	711.7	392.90	1200	Multimeter
Total Dissolved Solids (TDS)*	mg/L	975.9	561.3	NYS	Multimeter
Dissolved Oxygen (DO)*	mg/L	5.49	5.60	5 or more	DO Meter

Parameters	Unit	Concentration Present		Standards for Inland Surface Water**	Analysis Method
		SW_NPL_01	SW_NPL_02		
		24.446740° N 90.345328° E	24.444730° N 90.346764° E		
		Khiro River, Near NAAFCO Pharma Limited, Bhaluka, Mymensingh	ETP Retention Pond, NAAFCO Pharma Limited, Bhaluka, Mymensingh		
Total Suspended Solids (TSS)	mg/L	7	3	NYS	Gravimetric Method
Chemical Oxygen Demand (COD)	mg/L	4	40	NYS	CRM
Biochemical Oxygen Demand (BOD ₅)	mg/L	1	10	6 or less	5 days Incubation
Ammonia (Nitrogen)	mg/L	0.20	0.15	NYS	UVS
Chromium (Cr)	mg/L	0.0003	0.0003	NYS	AAS
Chloride	mg/L	12	15	600	Titrimetric

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

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

The test result shows that almost all of the parameters are within the national standard except for BOD₅ in SW_NPL_02 (ETP Retention Pond, NAAFCO Pharma Limited, Bhaluka, Mymensingh) according to ECR, 97 and some of the remaining parameters are NYS according to DoE (ECR, 1997). The laboratory test result is given in **Appendix D** of the report; which also represents that all the parameters are within the national standard.

6.5.4 Drinking Water Quality

Drinking water is collected from canteen tap inside the project location which is used for drinking and others purposes by the workers and personnel of the project area. Water is generally extracted via machine-driven pumps (deep wells) which draw from the deeper main aquifers and then stored in a water reservoir after proper filtration. One sample were collected with purified and filtered 1-liter plastic sampling bottle. 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) laboratory for chemical analysis. For Total Coliform (TC) and Faecal Coliform (FC) analysis, the samples were sent to UL VS Laboratory within 12 hours of collection.



Figure 6.25: Drinking Water Sample Collection from Project Area

Table 6.10: Test Result of Drinking Water Quality

Parameters	Unit	Concentration Present	Standards for Potable Water**	Analysis Method
		DW_NPL_01 24.443656° N 90.347168° E		
Temperature*	°C	27.2	20-30	Multimeter
Turbidity	NTU	0.23	10	Turbidity Meter
pH*	-	7.34	6.5-8.5	Multimeter
Total Dissolved Solids (TDS)*	mg/L	64.2	NYS	
Electrical Conductivity (EC)*	µs/cm	97.3	600	
Salinity*	ppm	5.39	<600	
Alkalinity	mg/L	125	NYS	Titrimetric
Manganese	mg/L	0.03	10	Gravity Multimeter
Turbidity	mg/L	0.23	4.0	CRM
Biochemical Oxygen Demand (BOD ₅)	mg/L	1	0.2	5 days Incubation
Arsenic (As)	mg/L	0.002	0.05	AAS
Total Coliform (TC)	CFV/100ml	42	0	USEPA 9132
Faecal Coliform (FC)	CFU/100ml	0	0	Membrane Filtration
Cr (Total)	mg/L	0.0003	0.05	AAS
Chloride	mg/L	510	150-600	Titrimetric
Iron (Fe)	mg/L	0.72	0.3-1	AAS
Hardness	mg/L	360	200-500	AAS

* On-site Test Result

NYS = Not Yet Standardized

The test result (Table 6.10) shows that almost all of the parameters are within the national standard except for total coliform (TC), according to ECR, 97. The laboratory test result are given in **Appendix E** of the report.

6.6 ENVIRONMENTAL AND SOCIAL HOTSPOT

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 6.26.

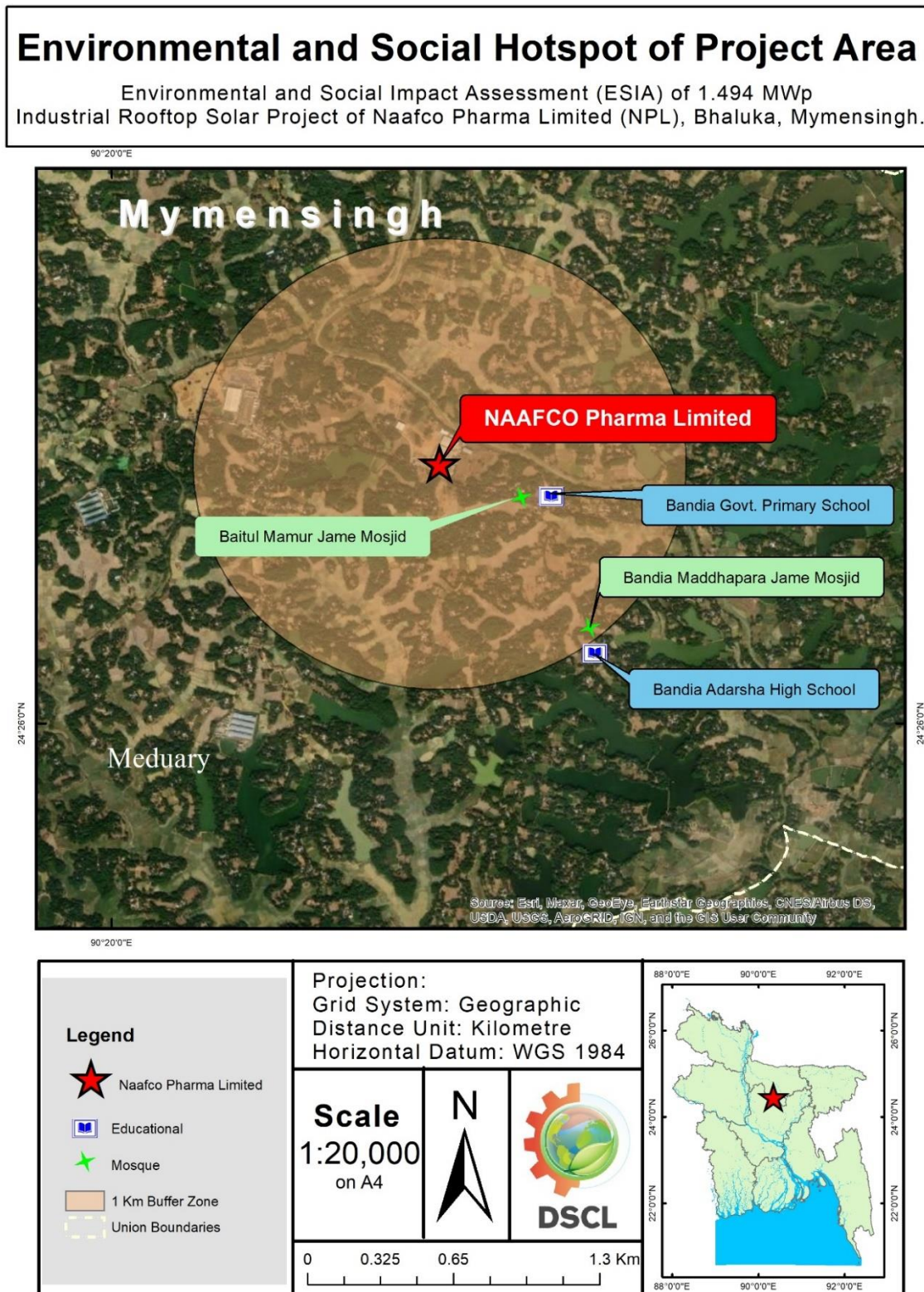


Figure 6.26: Environmental and Social Hotspot of the Project Area

7 DESCRIPTION OF THE SOCIAL CONDITION

7.1 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).

7.2 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 percent in 1990 to 40 percent 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 7.1.

Table 7.1: 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%

Key Indicator	Value
Life expectancy (2006)	
- Male	65.6
- 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)

7.3 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 Bandia, Meduari Union under Bhaluka Upazila of Mymensingh district. The total area of the Bhaluka upazila is 444.05 Km². It is located in between 24°16' and 24°29' north latitudes and in between 90°14' and 90°29' east longitudes. It is bounded by Fulbaria and Trishal upazilas on the north, Sreepur (Gazipur) upazila on the south, Gaffargaon upazila on the east, Sakhipur and Ghatail upazilas on the west. However, the total area of the Kachina union is 56.36 Km². The literacy rate of this is 40.83 % for both male and female (BBS, 2011).

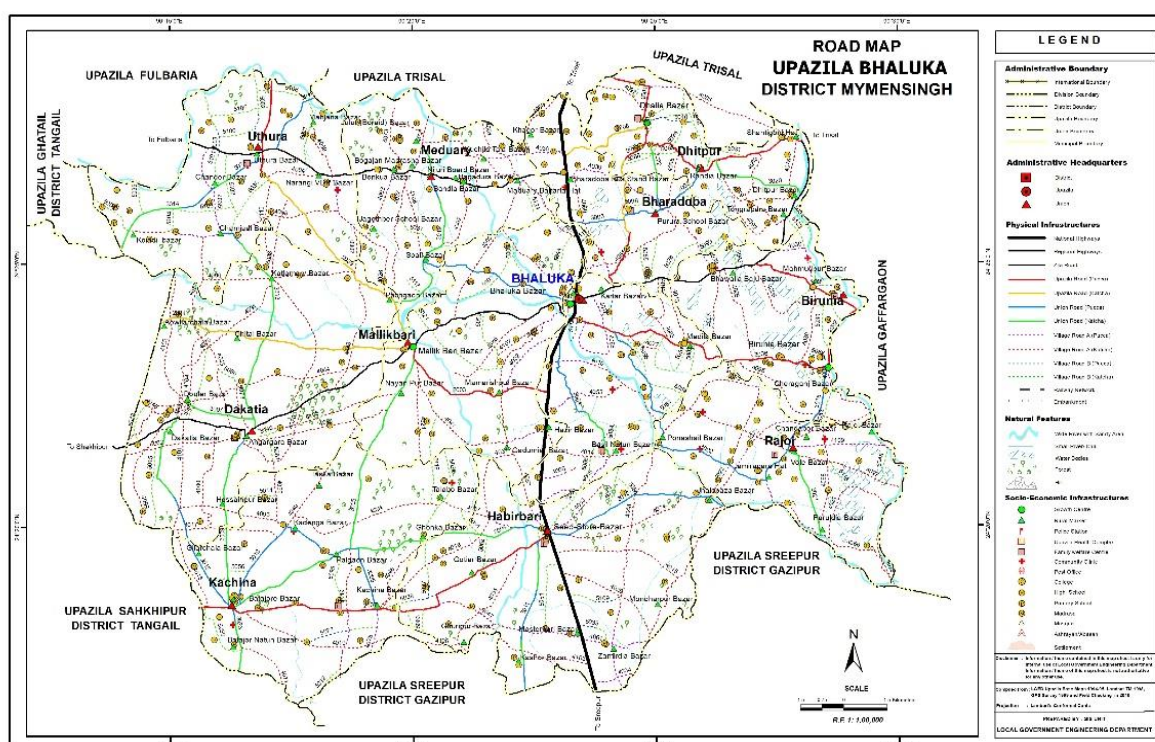


Figure 7.1: Administrative Map of the Project Upazila (Source: LGED)

7.4 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 7.2). The demographic information is collated from Population Census, 2011 by Bangladesh Bureau of Statistics (BBS, 2011).

Table 7.2: Demographic Profile of the Project Area

Upazila/Union	District	Area (Sq.km)	Population		Literacy Rate	Population Density
			Male	Female		
Bhaluka Upazilla	Mymensingh	444.05 Km ²	158003	150755	65.8	695
Meduari Union	Mymensingh	34.873 Km ²	11042	10652	65.8	695

Source: BBS, 2011

7.4.1 Household Size

Comparison of the data collected during household surveys found that the average household size of these villages was 4.1 members per household. The majority of households were headed by males (95%).

7.4.2 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 2011).

The sex ratio of the population in the villages surveyed within the Project Area was 101.7 females per 100 males. This ratio is similar to the National rural sex ratio of 106.6 given above.

7.4.3 Nutrition

The malnutrition level among the children in Bangladesh is among the highest in the world. Almost one-half of children under the age of five are moderately underweight or stunted, and 23 percent are severely stunted (World Bank, 2020). These nutritional outcomes have lifelong consequences in terms of productivity, cognitive ability, educational attainment, vulnerability to disease and quality of life. In Bangladesh, female children are more vulnerable to malnutrition compared to male children.

7.4.4 Religion

Bangladesh is a predominantly Muslim nation, with nearly 90.39 percent of the population recorded as Muslim in the 2011 Population Census (BBS, 2011). The predominance of the Muslim faith was reflected in the results of the household survey, with 95.4 percent of persons surveyed recorded as Muslim, 3.2 percent of person was recorder as Hindu and the remaining 1.4 percent being Buddhist, Christen and Others etc.

Table 7.3: List of Religious Institutions of the Study Area

Sl. No	Religious Institutions	GPS coordinates	
		N	E
1.	Bandia Maddhapara Jame Mosjid	24.43717	90.35246
2.	Bogajan Bazar Mosjid	24.44920	90.32869
3.	Baitul Mamur Jame Masjid	24.44238	90.34972
4.	Baraid Jame Mosjid	24.45806	90.32879
5.	Al jamiatul Madania Jame Mosjid	24.44757	90.30544



Figure 7.2: Religious Institutions of the study area

7.4.5 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. Majority of Bhaluka is inhabited by Bengalis, although a minority of the population belong to the indigenous Garo, Rajbongshi and Koch Mandai tribes. The Koch can be found in Uthura and Dakatiya Unions and are known to have the surname Varman. Though, there are no ethnic groups in Meduary Union (Project area buffer zone) of Bhaluka Upazila.

7.4.6 Education

7.4.6.1 Literacy

According to the population and housing census (2011), the literacy rate for the population 7 years and above in the project area is 65.8% which is lower than the national literacy rate of 58.77%.

7.4.6.2 Educational Infrastructure

In Bhaluka Upazila, there are so many educational institutions. There are about 164 primary school, 61 high school, 42 madrasa, 6 college, and 3 technical school in Bhaluka Upazila. During the field survey, the survey team found some educational institutions in the project impact area. Some of them are mentioned below with GPS coordinates:

Table 7.4: Educational Institutions of the study area

Sl. No	Educational Institutions	GPS coordinates	
		N	E
1.	Bandia Gov. Primary School	24.44241	90.35091
2.	Bandia Adarsha high School	24.43614	90.35265
3.	Lohabai Bonkua High School	24.44651	90.32147
4.	Boraid Shohid Shamsuddin High school	24.45642	90.32905
5.	Shohail Dakhil Madrasa	24.42446	90.33262
6.	Khachachara Government Primary School	24.47251	90.36641
7.	Futi Primary School	24.46596	90.35165
8.	Baraduba Primary School	24.44781	90.37878
9.	Jagatber Government Primary School	24.42153	90.31669
10.	Shapkhali Government Primary School	24.47206	90.34419





Figure 7.3: Educational institutions of the study area

7.5 LAND USE AND OWNERSHIP

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 Industrial ecosystem. By far the most predominant land use in the Project area is agricultural constituting more than 70 percent of the land use. Other major non-agricultural land uses include rural settlements (11%), water bodies (9%) and mud flats (7%). Ownership of agricultural land Landowner 71.69%, landless 28.31%; agricultural landowner, urban 59.59% and rural 73.01%.

7.5.1 Cropping Patterns

The Project area is located in the Padma River Island 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). Paddy potato, sweet potato, onion, pulses, vegetables, arum, till (sesame), betel leaf, betel nut, wheat, sugarcane, mustered, bottle gourd are also grown within the Project area. Fruits like jackfruit, litchi, palm, banana, lemon, black berry and water melon are often grown in smaller amounts and in close proximity to dwellings.

Of the household surveyed approximately 61 percent grew some form of paddy, with Amon being the most commonly grown (48%). Crop rotation was seen to be prominent with 56% either having a rotation twice or three times a year. Further, based on the primary crop intensity and pattern 3.6% do not have a crop rotation pattern with a singular crop dominated by Amon. Of those who crop rotated twice (11.3%), 4.8% was of Amon and Aus and 47.6% of people surveyed rotated their crop three time, which 46.4% was made up of Amon, Aus and Rabi.

7.6 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.

7.6.1 Occupational Status

Most people in the Project area are either underemployed or unemployed, though most people disguise their unemployment by minor involvement in economic activities. Being underemployed is defined as “the condition whereby a person’s employment is considered inadequate in terms of time worked, income earned, productivity or use of his/her skills and the person is looking for additional work in conformity with his/her education or skill to augment income.” For the majority of the surveyed people and their household members, their place of occupation is within their own land in the project area.

7.7 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 island 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.

7.8 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 (73.0%). Of those not owning their own home, alternative arrangement included living in a house owned by relatives or being a tenant. In the subproject area, the built-up infrastructure on the road side consists primarily of pucca, semi-pucca, a few multistory structures, and a few tin-shed stores. People have been erecting multistory structures in recent years as economic situations have improved.

7.9 TRANSPORTS AND COMMUNICATIONS

The project area, Meduary are located on the paved road from Varadoba to Ghatail of Dhaka-Mymensingh highway. The project area is connected with Bus, Truck and other transportation system. The modes of transport in the area are CNG, Bus, Rickshaw, Easy-bike, Motorbike, Van etc. People of this area are connected with mobile network for regular communication.

7.10 POVERTY

Almost all the families of Batajor Village 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 and rest are doing service.

7.11 HEALTH

The health facilities of this area are not satisfactory. There is only two non-government satellite clinics was found in the project influence area. There are 1 Upazila health complex, 2 hospital, 6 health and family welfare centre, 4 satellite clinic and 4 community clinics are present in Bhaluka upazilla. people have to go to Upazila health complex or to the district level hospitals or clinics for better medical facilities.

7.12 SOURCE OF INCOME

Main sources of income Agriculture 69.72%, non-agricultural laborer 3.14%, industry 0.54%, commerce 9.48%, transport and communication 2.61%, service 5.91%, construction 1.04%, religious service '0.17%, rent and remittance 5.99% and others 1.40% in the project influenced Upazila.

7.13 RECREATIONAL ACTIVITIES

The social need for recreation has been identified as compulsory. The upazilla have very limited access to recreational activities. There is no such dedicated place or regular activities as recreational purpose. However, there are some houses have bought television but all the people do not have ability to buy the valuable means of recreation.

8 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION

8.1 GENERAL

This section identifies the overall impacts on the physical, biological and socio-economic environment of the project area. An environmental impact is defined as any change to an existing condition of the environment. Identification of potential impacts has been done on the basis of baseline data collected from secondary and primary sources. Environmental impacts assessment was carried out considering present environmental setting of the project area, and nature and extent of the proposed activities.

8.2 IMPACT MAGNITUDE

The potential impacts of the project have been categorized as major, moderate, minor or nominal based on consideration of the parameters such as: i) duration of the impact; ii) spatial extent of the impact; iii) reversibility; iv) likelihood; and v) legal standards and established professional criteria. These magnitude categories are defined in table 8.1.

Table 8.1: Parameters for Determining Magnitude

Parameter	Major	Medium	Minor	Nominal
Duration of Potential Impact	Long term (more than 35 years)	Medium term lifespan of the project (5 to 15 years)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project Boundary	No detectable location within project component/site boundaries
Reversibility of potential impacts	Potential impact is Effectively permanent, requiring	Baseline requires a year or so with some	Baseline returns naturally or with	Baseline remains constant

Parameter	Major	Medium	Minor	Nominal
	considerable intervention to return to baseline	interventions to return to baseline	limited intervention within a few months	
Legal standards and established professional criteria	Breaches national standards and or international guidelines/obligations	Complies with limits given in national standards but breaches international lender guidelines in one or more parameters	Meets minimum national standard limits or international guidelines	Not applicable
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

8.3 SENSITIVITY OF RECEPTOR

The sensitivity of a receptor has been determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area. Each detailed assessment has defined sensitivity in relation to the topic. Criteria for determining receptor sensitivity of the Project's potential impacts are outlined in Table 8.2.

Table 8.2: Criteria for Determining Sensitivity

Sensitivity Determination	Definition
Very Severe	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
Severe	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Mild	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation.
Low	Vulnerable receptor with good capacity to absorb proposed changes or/and good opportunities for mitigation

Assigning Significance: Following the determination of impact magnitude and sensitivity of the receiving environment or potential receptors, the significance of each potential impact has been established using the impact significance matrix shown below in Table 8.3.

8.4 SUMMARY OF ASSESSED IMPACTS

The project's potential impacts on the key environmental parameters have been assessed and their significance determined using the methodology described in Section 8.3 above. A summary of the potential impacts of the project on the key environmental parameters and significance of these impacts are presented for different phases of this project; the potential impacts are discussed in the subsequent sections.

Table 8.3: Significance of Impact Criteria

Magnitude of Potential Impact	Sensitivity of Receptors			
	Very Severe	Severe	Mild	Low/Negligible

Major	Critical	High	Moderate	Negligible
Medium	High	High	Moderate	Negligible
Minor	Moderate	Moderate	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Potential environmental impacts associated with the proposed project activities of both the projects are classified as:

- (i) Impacts during construction phase;
- (ii) Impacts during operation phase; and
- (iii) Impacts during decommissioning phase.

Qualitative and quantitative techniques have been applied for direct and indirect impact identification. Impacts are classified as being insignificant, minor, moderate and major. Impacts are described in the sections below.

8.5 CORRIDOR OF IMPACT (COI)

The corridor of the proposed Impact (CoI) 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.

8.6 ANTICIPATED IMPACTS AND MEASURES

The Environmental Impact Statement enumerates the likely impacts due to the implementation of the project on the six basic environmental parameters, which are listed below.

- Air environment
- Noise environment
- Water environment
- Land environment
- Biological environment
- Socio-economic environment

The impacts on the above parameters have been identified, analyzed and classified as adverse.

8.6.1 Pre-Construction Phase

Following is the brief description of impacts envisaged during the Pre-construction/Design Phase:

8.6.1.1 Land Use

Impact

The Project site location does not conflict with any of the relevant governmental entities formal planning context. The project initiator will implement the project in their own buildings. 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 environmental & social management plan (ESMP). Since these activities are to be performed temporarily the minimum impact is expected to be acceptable.

8.6.2 Construction Phase

Environmental effects of the construction phase are expected to be temporary. Construction impacts are considered to be minimal as all the construction works will be carried out within the site boundary of the procured land and will be controlled via the mitigation measures defined in the ESMP section. Following is the brief description of impacts envisaged during the construction phase.

8.6.2.1 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. There are some close communities 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.

8.6.2.2 Air Quality

Impacts

- 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 PM 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

- 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 vehicle's having Pollution Under Control (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.
- Mitigation and monitoring measures in the World Bank EHS guidelines on Air Quality and Ambient Air Quality will be followed.

8.6.2.3 Noise

Impact

During construction of solar-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

The following identifies the mitigation measures to be applied by the Contractor during the construction phase and which include:

- Apply adequate general noise suppressing measures. This could include the use of well-maintained mufflers and noise suppressants for high noise generating equipment and machinery, developing a regular maintenance schedule of all vehicles, machinery, and equipment for early detection of issues to avoid unnecessary elevated noise level, etc.
- If noise levels were found to be excessive, construction activities should be stopped until adequate control measures are implemented etc.; and

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).

8.6.2.4 Soil

Impact

Soil characteristics may be deteriorated at project site due to accidental spillage of chemicals, 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.

8.6.2.5 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. A ETP retention pond is located on the backside of the project area which might be affected due to the waste disposal and also by the discharge of wastewater.

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.

8.6.2.6 Terrestrial Ecology

Impact

The activities anticipated during the construction phase for solar-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

8.6.2.7 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 shall be prepared. 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.

8.6.2.8 Income and Employment

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 *Bhaluka Upazila* where feasible. The project proponent will be responsible for creating these employment opportunities. Priority will need to be given to the local community for unskilled labor. This may result in an increase on household income.

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. Job opportunities should be arranged for the PAPs (if any).

8.6.2.9 Occupational 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 plan 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 (HSM) should be engaged for the implementation period of the project. Proper health and safety signboards and appropriate information to the local people about the project activities should be provided.

8.6.2.10 Archaeology and Cultural Resources

Impact

The field visits conducted at the project site and it is found that no archaeological and cultural resources are located within the 500m radius of the project area. Hence, it can be said that there is no anticipated impact from construction on these receptors; therefore, the impact assessment process for this receptor has yielded the low significance.

Mitigation

This impact is temporary and minor negative in nature. Mitigation measures will include:

- Timely completion of the construction work and provision of alternative routes during the construction;
- Establishment of construction site camp and labor camp must maintain proper distance from the cultural sites.

8.6.3 Operation Phase

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.

8.6.3.1 PV Panel Wash

Impact

It is very important to clean solar photovoltaic panels. Dirt on the solar panels prevents the entry of light. Moreover, solar panels are made to work by allowing light enters the solar cells. Bird poop, dust or pollen prevent the light from reaching the solar cells which eventually leads to less energy production. The functionality of solar panels may be affected when they are dirty. Dirty panels tend to produce less energy than the clean ones under the same circumstances. Furthermore, a clean solar power means more efficiency while a dirty one may not be as efficient as needed. This is because dirt prevents light from impact in the on the cells.

Mitigation

Dirt should never be scrubbed from the solar panels. Scrubbing can remove the non-reflective coatings that may be on the panels or permanently destroy the glass on the glass of the pane. Some basic things to keep in mind when cleaning solar panel system are:

- Use a soft sponge and biodegradable soap to get rid of dirt and muddy build-up on PV panels

- Avoid using water on the panels when they are hot for example during midday. The best time to wash the panels is in the morning or evening.
- Not to use any sharp metal objects to remove materials such as bird droppings.

The Cleaning Process is presented below –

- Spray all panels with water to remove any debris or gunk off.
- Mix the cleaning solution with water in the buckets.
- Use a soft bristle brush, dip it in the bucket and scrub the solar panels.
- Continue with this process till effective removal all the gunk off the panel (this may take some time because bird droppings and sap are not easy to clean).
- Start to squeegee the panels until there is no water left on them.
- Put everything away and repeat the process every six months. By doing this solar panels will remain clean while producing much energy as possible.

8.6.3.2 Visual Amenities

Impact

The presence of a large area of PV panels is not expected to constitute a risk for glare since it is situated in the industrial rooftop, moreover, no potential visual disturbance to birds is expected given the fact, and as a result, there is no migratory birds fly way over the project area.

Mitigation

It is not anticipated that visual impacts will be generated due to the PV system design, which is specifically designed to include dark, light-absorbing materials and covered with an anti-reflective coating (ARC) for glass surfaces, which reduces the reflectance from PV panels to 2.5%-2.6% while at the same time improving their efficiency.

It is essential to point out that the intensity of light reflected from a PV module surface depends on factors such as the amount of sunlight reaching the surface and will therefore vary based on, among others, geographic location, time of year, cloud cover, and PV module orientation.

8.6.3.3 Heat Generation

Impact

The presence of the PV panels will reflect heat and increase the surrounding temperature. The heat may be transferred by convection, radiation and conduction method. Theoretically, the solar thermal placement in the shell of the buildings could increase fire risk and water intrusion into the roof.

Mitigation

In order to reduce the impact, air gap between the PV panels may be simulated. These air gaps will be freely connected to the outdoor air to keep the PV panels cool.

8.6.3.4 Noise

Impact

The solar power 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 some close by sensitive receptors such as a school and some residential dwellings within the project site. In addition, noise generated from inverters is only heard when distance

is close (i.e., within 1-2m, however, as distance increases, noise will be greatly reduced, not to mention that they do not generate noise during night time.

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.

8.6.3.5 Air Quality

Impact

No emissions are expected to be released during the operation phase, because solar rooftop systems do not release greenhouse gases or any toxic pollutants during their operation, as a result, no impacts on ambient air quality are anticipated during the operation phase.

It is worth mentioning that solar 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 compared to fossil fuel power generation facilities, since solar power plants do not involve combustion processes.

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 and social management plan (ESMP) included in this report.
- Photovoltaic (PV) is now a proven technology which is inherently safe as opposed to some dangerous electricity generating technologies. Photovoltaic systems make no air pollution and cause no pollution in operation. PV panel should be clean and maintenance regularly for dust free. The supplier will collect wastage PV panels for maintenance and destroy and they will be responsible for management of PV panels.

8.6.3.6 Soil

Impact

Soil impacts during operation phase are limited to accidental spillage of lubricant, fuel and other chemicals that may potentially cause soil degradation. However, since the project area is designated for solar projects near roadside and settlements area, they do not have any agricultural significance. Another most significant source of soil pollution is the damage of PV panels in case of major accidents. These contain chemicals and 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.

8.6.3.7 Terrestrial Ecology

Impact

The project area does not encompass any natural systems. The anticipated impacts on terrestrial ecology are considered low, however, activities such as vehicular movement, may cause disturbance to resident birds and their ground nests.

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.

8.6.3.8 Waste Generation

Impact

PV modules: PV modules wastes are other solid wastes generated during the operational stage. These include end-of-life solar PV modules, electrical wastes, metallic wastes and stationary wastes of office works etc.

Ground-mounted PV solar arrays are typically made up of panels of silicon solar cells covered by a thin layer of protective glass attached to an inert solid underlying substance (or “substrate”). While the vast majority of PV panels currently in use are made of silicon, certain types of solar cells may contain cadmium telluride (CdTe), copper indium diselenide (CIS), and gallium arsenide (GaAs). All solar panel materials, including the chemicals noted, are contained in a solid matrix, insoluble and non-volatile at ambient conditions, and enclosed. Therefore, releases to the ground from leaching, to the air from volatilization during use, or from panel breakage, are not a concern.

Others: 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

Photovoltaic (PV) is now a proven technology which is inherently safe as opposed to some dangerous electricity generating technologies. Photovoltaic systems make no air pollution and cause no pollution in operation. PV panel should be clean and maintenance regularly for dust free. The supplier will collect wastage PV panels for maintenance and destroy and they will be responsible for management of PV panels.

Cleaning of solar panels will be conducted on an overcast day, early in the morning or in the evening. If the sun is beating down on the panels, any water used can quickly evaporate and dirt will become smeared. Early morning can be a particularly good time for cleaning as dew that has settled on the panels overnight will likely have softened grime; meaning that will need to use less water and less energy to clean the solar panels. Groundwater will be used for the cleaning purpose but reuse of water will be emphasized.

8.6.3.9 Health and Safety

Impact

There are many hazards associated with a solar PV power plant if sufficient precautions are not taken during the operation stages. The impact origins are in the following sectors:

- Leaching of materials from broken or fire damaged PV modules
- Emergency Fire Hazard
- Electrocution of workers

- Electromagnetic radiation from PV modules
- a. **Leaching of materials from broken or fire damaged PV modules:** The potential for chemical releases appears to be small since the chemicals are present in the sealed PV modules when completed installations of photovoltaic systems for power generation. Releases are likely to occur only due to fires or other unusual accidents. Cadmium could be a potential concern in this setting with thin-film technologies, as would arsenic and zinc to a lesser extent. Other chemicals that have inhalation toxicity factors are present only during the manufacturing process. Solar PV modules may contain heavy metals like lead, mercury, cadmium, chromium, polybrominated biphenyls (PBBs), or brominated diphenylethers (PBDEs) etc. Leaching of metals from the installed modules is not likely to be a concern, as documented in a study by Steinberger (1998). Leaching from small cells used in electronic devices is also unlikely to be a concern, given the small amounts of chemicals present and the sealed nature of the devices.
- b. **Emergency Fire Hazard:** Since this is a solar 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 solar module, it is theoretically possible for hazardous fumes to be released and inhalation of these fumes could pose a risk to human health. However, researchers do not generally believe these risks to be substantial given the short-duration of fires and the relatively high melting point of the materials present in the solar modules. Moreover, the risk of fire at ground-mounted solar installations is remote because of the precautions taken during site preparation including the removal of fuels and the lack of burnable materials mostly glass and aluminum contained in a solar panel.
- c. **Electrocution of Workers:** Risk of electrocution of workers during performing duties in a power plant is always present. Faulty electrical equipment, electric short circuits, exposed electrical wires may be the chief sources of electrocution. Damaged PV modules with exposed high voltage conductor also present high risk of electrocution.
- d. **Electromagnetic radiation from PV modules:** The strength of electromagnetic fields produced by photovoltaic systems do not approach levels considered harmful to human health established by the International Commission on Non-Ionizing Radiation Protection. Moreover, the small electromagnetic fields produced by photovoltaic systems rapidly diminish with distance and would be indistinguishable from normal background levels within several yards.

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 contactor shall provide all appropriate resources

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

8.6.4 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-

8.6.4.1 Visual Amenity

Impact

During the dismantling of the solar rooftop 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). Moreover, the actual dismantling of the solar power plant will reduce or remove the visual impacts witnessed during the operation phase.

8.6.4.2 Noise

Impact

The decommissioning activities of dismantling the solar power 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 the solar power plant, these increased noise levels are considered occupational noises that require occupational health and safety measures.

8.6.4.3 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 solar power plant facility, clearance of the site, and rehabilitation if needed.

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 & social management plan (ESMP) included in this report.

8.6.4.4 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. Take proper attention in removing the PV panels to prevent any damage as it contains chemicals and might be harmful for soil quality.

8.6.4.5 Terrestrial Ecology

Impact

The activities associated with decommissioning will involve dismantling of the solar 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, and provided dust suppression measures & 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.

8.6.4.6 Waste Generation

Impact

Waste generated during decommissioning limited to non-hazardous and inert wastes such as scrap metals, paper, wood, plastic, given that the contractor will adhere his waste management procedures.

Similar to the construction phase, potential generation of hazardous waste includes absorbent material, batteries, tires, metal drums, empty chemical containers, waste oil from machinery lubricants, etc.

It is not expected that hazardous wastes will be generated from dismantling the solar power plant since the project developer will opt for recycling PV panels of the facility.

PV modules and others: PV modules wastes are the other solid wastes generated during the operational stage. These include end-of-life solar PV modules, electrical wastes, metallic wastes and stationary wastes of office works etc.

Ground-mounted PV solar arrays are typically made up of panels of silicon solar cells covered by a thin layer of protective glass attached to an inert solid underlying substance (or "substrate"). While the vast majority of PV panels currently in use are made of silicon, certain types of solar cells may contain cadmium telluride (CdTe), copper indium diselenide (CIS), and gallium arsenide (GaAs). All solar panel materials, including the chemicals noted, are contained in a solid matrix, insoluble and non-volatile at ambient conditions, and enclosed. Therefore, releases to the ground from leaching, to the air from volatilization during use, or from panel breakage, are not a concern.

End-of-Life Solar Panels: The solar PV panels that will be used in the project will have a life span of 25 years. Disposal of wasted solar PV modules is very important because if not properly decommissioned, the greatest health risk from end-of-life crystalline solar modules arises from lead containing solders. Under the right conditions it is possible for the lead to leach into landfill soils and eventually into water bodies.

While the solar cell is the heart of a photovoltaic system, on a mass basis it accounts for only a small fraction of the total materials required to produce a solar panel. The outer glass cover constitutes the largest share of the total mass of a finished crystalline photovoltaic module (approximately 65%), followed by the aluminum frame (~20%), the ethylene vinyl acetate

encapsulant (~7.5%), the polyvinyl fluoride substrate (~2.5%), and the junction box (1%). The solar cells themselves only represent about four percent (4%) of the mass of a finished module.

Mitigation

The following identifies the mitigation measures to be applied by all involved entities:

- Ensure that hazardous materials are stored in proper areas and in a location where they cannot reach the land in case of accidental spillage. This includes storage facilities that are of hard impermeable surface, flame-proof, accessible to authorized personnel only, locked when not in use, and prevents incompatible materials from coming in contact with one another.
- Maintain a register of all hazardous materials used and accompanying Material Safety Data Sheet (MSDS) must present at all times. Spilled material should be tracked and accounted for;
- If spillage on soil occurs, spill must be immediately contained, cleaned-up, and contaminated soil disposed as hazardous waste;
- Proper decommissioning and recycling of solar panels both ensures that potentially harmful materials are not released into the environment and reduces the need for virgin raw materials. In recognition of these facts, the photovoltaic industry is acting voluntarily to implement product take-back and recycling programs at the manufacturing level.

8.6.4.7 Employment Opportunities

Impact

Short-term job opportunities may be arisen during decommissioning; however, this can negatively impact permanent personnel at the solar 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.

8.6.4.8 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.

8.6.4.9 Traffic

Impact

The anticipated impacts during decommissioning are similar to those for the construction phase, where the heavy machinery that transports disassembled parts of the project solar power plant facility might be of more significance than normal vehicles and pickups.

Mitigation

Proper management actions with adequate mitigations can reduce significantly such anticipated impacts.

8.6.5 Summary of Anticipated Impacts

Table 8.4, Table 8.5, and Table 8.6 below present a summary of the anticipated impacts during the planning and construction, operation, and decommissioning phase of the Project.

Table 8.4: Summary of Anticipated Impacts during the Planning and Construction Phase

Environmental Attribute	Likely Impact– Planning and Construction Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
Landscape and Visual	Visual and landscape impacts due to presence of elements typical of a construction site such as equipment and machinery.	Short term	Local	Reversible	Likely	Medium	Mild	Moderate Negative	Low Negative
Geology and Hydrology	The Project site is a <i>rooftop</i> and there are an ETP pond and river near the project area. Only some possible impacts are dumping of solid waste to the nearby source during construction.	Short term	Local	Reversible	Likely	Medium	Mild	Moderate Negative	Low Negative
	Risk of soil contamination during the various construction activities from spillage of hazardous material, random discharge of waste and wastewater. No risk of groundwater contamination.	Could be long term	Local	Could be irreversible	Likely	Medium	Mild	Low Negative	High Positive
Biodiversity	Construction activities could disturb existing habitats (flora, fauna, and avifauna) and any threatened or endangered species which might be present within the Project site. In addition, other impacts could be from improper management of the site (e.g., improper conduct and housekeeping practices).	Long term	Local	Irreversible	Certain	Minor	Mild	Low Negative	High Positive
Air Quality	Construction activities will likely result in an increased level of	Long term	Local	Reversible	Certain	Medium	Mild	Low Negative	High Positive

Environmental Attribute	Likely Impact– Planning and Construction Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
	dust and particulate matter emissions which in turn will directly impact ambient air quality.								
Noise	Possible noise emissions to the environment from the construction activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities	Long term	Local	Reversible	Certain	Medium	Mild	Moderate Negative	Low Negative
Waste Generation	Improper management and handling of hazardous and non-hazardous waste during construction.	Short term	Local	Reversible	Likely	High	Severe	High Negative	Moderate Negative
Socioeconomic	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants, elevate their standards of living, and bring social and economic prosperity to local communities.	Not applicable.							
Health and Safety	There will be some generic risks to workers health and safety from working on construction sites, as it increases the risk of injury or death due to accidents.	Short term	Local	Could be irreversible	Likely	Medium	Mild	Moderate Negative	Low Negative

Table 8.5: Summary of Anticipated Impacts during the Operation Phase

Environmental Attribute	Likely Impact– Operation Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
Landscape and Visual	The Project is expected to be visible within the immediate vicinity and up to some long distance around the Project site only and thus is likely to create visual impacts related to interaction with surrounding landscape.	Long term	Local	Reversible	Likely	Medium	Low	Low Negative	Low Negative
	Potential for glare caused by minimal sunlight reflected off the PV panel modules which in turn could affect nearby receptors.	Long term	Local	Reversible	Likely	Medium	Mild	Low Negative	Low Negative
PV panels	The most significant source of soil pollution is the damage of PV panels in case of major accidents. These contain chemicals and may be harmful for soil quality. There will be environmental impacts of emission of greenhouse gas, Ozone depletion, photochemical smog, eutrophication and acidification and also health effects on people.	Long term	Local	Reversible	Likely	High	Severe	High Negative	Moderate Negative
Heat Generation	Increased heat by radiation, convection and conduction	Long term	Local	Could be irreversible	Likely	Medium	Mild	Moderate Negative	Low negative
Geology and Hydrology	Risk of soil and groundwater contamination during the various operational activities from improper housekeeping	Long term	Local	Could be irreversible	Likely	Medium	Mild	Moderate Negative	Low negative

Environmental Attribute	Likely Impact– Operation Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
	activities, spillage of hazardous material, random discharge of waste and wastewater. However, most significant sources of soil and water pollution are the chemicals from PV panel's damage and from the expired batteries.								
Biodiversity	Impacts limited to improper management of the site (e.g., improper conduct and housekeeping practices).	Long term	Local	Could be irreversible	Likely	Minor	Low	Low Negative	Moderate Positive
Air Quality	Solar rooftop systems 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.	Long term	Local	Could be irreversible	Likely	Minor	Low	Low Negative	High Positive
Noise	The only significant noise source from the operation activities which will likely include the use of backup generators to ensure continuous power supply.	Long term	Local	Reversible	Likely	Medium	Mild	Moderate Negative	Low Negative
Socio-economic	The Project is expected at a minimum to provide job opportunities for local communities. This, to some extent, could contribute to enhancing the living environment for its inhabitants,	Not applicable.							

Environmental Attribute	Likely Impact– Operation Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
	elevate their standards of living, and bring social and economic prosperity to local communities.								
Occupational and Community Health and Safety	There will be some risks to workers health and safety during the operation and maintenance activities of the Project.	Long term	Local	Could be irreversible	Likely	Medium	Mild	Low Negative	Moderate Positive
	Trespassing of unauthorized personnel into the Project site could result in potential risks from several hazards of the various Project components (e.g., electric shock, thermal burn hazards, exposure to chemicals and hazardous materials, etc.). Leaching of materials from broken or fire damaged PV modules. Emergency Fire Hazard. Electrocution of workers. Electromagnetic radiation from PV modules.	Long term	Local	Could be irreversible	Likely	Medium	Mild	Low Negative	Moderate Positive

Table 8.6: Summary of Anticipated Impacts during the Decommissioning Phase

Environmental Attribute	Likely Impact– Decommissioning Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
Geology and Hydrology	Risk of soil and groundwater contamination during the various decommissioning activities from improper housekeeping activities, spillage of hazardous material, random discharge of waste and wastewater.	Short term	Local	Could be irreversible	Likely	Medium	Low	Moderate Negative	Low Positive
Air Quality	Decommissioning activities will likely result in an increased level of dust and particulate matter emissions which in turn will directly impact ambient air quality.	Short term	Local	Reversible	Certain	Medium	Low	Moderate Negative	Low Negative
Noise	Possible noise emissions to the environment from the decommissioning activities which will likely include the use of machinery and equipment such as generators, hammers, and compressors and other activities.	Short term	Local	Reversible	Likely	Medium	Mild	Moderate Negative	Low Negative
Infrastructure and utilities	Of particular importance related to infrastructure and utilities is the final disposal of the panels at the end of their lifetime. Final disposal of panels, which may contain hazardous material, needs to ensure that existing waste facilities would be able accept such solar modules. In	Long term	Local	Reversible	Likely	High	Severe	High Negative	Low Negative

Environmental Attribute	Likely Impact– Decommissioning Phase	Impact Assessment							
		Duration	Spatial Extent	Reversibility	Likelihood	Magnitude	Sensitivity	Significance Prior to Mitigation	Significance After Mitigation
	addition, it is also important to investigate other disposal options such as buy back and recycling programs.								
Health and Safety	There will be some generic risks to workers health and safety from working on decommissioning sites, as it increases the risk of injury or death due to accidents.	Short term	Local	Could be irreversible	Likely	Medium	Mild	Moderate Negative	Low Negative

9 STAKEHOLDER CONSULTATIONS & INFORMATION DISCLOSURE

9.1 OVERVIEW

This chapter will describe the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders. It will also summarize comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of the project affected peoples. Besides, this chapter will describe the planned information disclosure measures (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation.

Stakeholders' consultation is a means of involving all primary and secondary stakeholders in the project's decision-making process in order to address their concerns, improve project design, and give the project legitimacy. Stakeholder consultation, if conducted in a participatory and objective manner, is a means of enhancing project sustainability.

Information disclosure is one of the most important aspects of any consultation or engagement process. This process is not only part of certain regulatory requirements but also a requirement of the investors in the project. The process of information disclosure can be undertaken in two manners, either voluntary disclosure or disclosure as part of the regulatory requirements. A brief introduction about the proposed project has been given to local community by consultant team. It has been revealed that it is a Solar PV Technology based on a proposed 1.494 MWp Solar Power Plant at NAAFCO Pharma Limited. All information pertaining to the installation and operation of a rooftop solar PV system had been shared with stakeholders.

Public consultation and participation have been viewed as a continuous two ways process involving, promoting of public understanding of the processes and mechanisms through which developmental problems and needs are investigated and solved. It is a requirement of the national ESIA legislative framework in Bangladesh, as well as development partner's policies on Environmental & Social Safeguards, that stakeholders be involved in ESIA's. Based on ESIA obligations for impacted individuals, the Project's consultation program is fair and inclusive, relying on informed consultation. During the ESIA's environmental survey in October 2021, consultation activities were undertaken.

9.2 PURPOSE OF PUBLIC PARTICIPATION

For projects that have environmental and social impacts, consultation is not a single conversation but a series of opportunities to create understanding about the project among those it will likely affect or interest, and to learn how these external parties view the project and its attendant risks, impacts, opportunities, and mitigation measures. Listening to stakeholder concerns and feedback can be a valuable source of information that can improve project design and outcomes and help a company to identify and control external risks. It can also form the basis for future collaboration and partnerships. For stakeholders, a company's consultation process is an opportunity to get information, as well as to educate company staff about the local context in which a project will take place, to raise issues and concerns, ask questions, and potentially help shape the project by making suggestions for the company to consider and respond to.

The purpose of public consultation is to make sure that a participation methodology is used, which in turn documents the concerns of all stakeholder groups and ensures that such concerns are considered, addressed, and incorporated into the development's decision-making process. Following are the main purposes of the consultation:

- Promote public awareness and improve understanding of the local people about the proposed project;
- To have interaction for primary and secondary data collection with project beneficiaries, affected populations, and other stakeholders;
- Assessment of possible requirement of improvements;
- Solicit the views of affected communities/individuals on environmental and social problems;
- Improve environmental and social soundness;
- To settle problems with mutual consent; and
- Create accountability and sense of local ownership during project implementation.

9.3 APPROACH AND METHODOLOGY FOR CONSULTATION

Primary stakeholders were consulted during informal and formal meetings held in the project area. The consultation process was carried out in the Bangla languages. During these meetings a simple, non-technical, description of the project was given, with an overview of the project's likely human and environmental impact. This was followed by an open discussion allowing participants to voice their concerns and opinions. In addition to providing communities with information on the proposed project, their feedback was documented during the primary stakeholder consultation. The issues and suggestions raised were recorded in field notes for analysis, and interpretation.

The following important processes were engaged in the approach taken for information disclosure and consultation:

- Identification of the relevant stakeholders including all those individuals, groups and organizations potentially affected by or interested in the project;
- Imparting information about the project and its potential impacts on their lives in local and simple language;
- During the consultation process the project plan was clearly explained;
- Recording of their concerns and aspirations through survey and discussions;
- Responding to their queries in a neutral manner.
- It was important not to raise community expectations unnecessarily or unrealistically during the stakeholder consultation meetings in order to avoid undue conflict with local leaders or local administrators. The issues recorded in the consultation process were examined, validated, and addressed in the ESIA report.

In the primary survey a list of open-ended questionnaires is used in both the focus group discussions and the individual interviews. A two-person survey team carried out the discussions and the interviews. The list of persons involved in the public consultation is limited to those who were willing to allow their name to be added in the document.

9.4 STAKEHOLDER ASSESSMENT

A stakeholder is defined as “a person, group, or organization that has direct or indirect stake in a project/organization because it can affect or be affected by the Project or its Proponent's actions, objectives, and policies.” Stakeholders vary in terms of degree of interest, influence,

and control they have over the Project or the proponent. In the present study, all the stakeholders have been primarily categorized into two categories that have been identified as:

- **Primary Stakeholders** (people, groups, institutions that either has a direct influence or impact on the project or by the project).
- **Secondary Stakeholders** (people, groups, institutions that has an indirect influence or impact on the project or by the project).

The influence and priority have both been primarily rated as:

- **High Influence/Priority:** This implies a high degree of influence of the stakeholder on the project in terms of participation and decision making or high priority for the project proponent to engage that stakeholder.
- **Moderate Influence/Priority:** This implies a moderate level of influence and participation of the stakeholder in the project as well as a priority level for the project proponent to engage the stakeholder who is neither highly critical nor are insignificant in terms of influence.
- **Low Influence/Priority:** This implies a low degree of influence of the stakeholder on the project in terms of participation and decision making or low priority for the project proponent to engage that stakeholder.

The intermediary categories of low to medium or medium to high primarily imply that their influence and importance could vary in that particular range subject to context specific conditions or also based on the responses of the project towards the community.

The coverage of stakeholders as stated above includes any person, group, institution or organization that is likely to be impacted (directly or indirectly) or may have interest/influence over project. Keeping this wide scope of inclusion in stakeholder category and the long life of project, it is difficult to identify all potential stakeholders and gauge their level of influence over project at the outset of the project. Therefore, the project proponent is advised to consider this stakeholder mapping as a live document which should be revised in a timely manner so as to make it comprehensive for any given period of time.

9.5 STAKEHOLDER CONSULTATION

Stakeholders were identified through systematic consultation with project beneficiaries, project affected people, women, vulnerable and poor members of the community, and other stakeholders who may have an influence over the project, in order to prepare a Stakeholder Engagement Plan. As a result, primary stakeholders were consulted: beneficiaries, disadvantaged, poor, and vulnerable groups, and people who could be negatively affected by the project. Secondary stakeholders, such as local community-based organizations (CBOs) and community representatives, as well as government departments, were also consulted.

Two (02) stakeholder consultations were conducted 27 October 2021 - one with respective authority representatives, and one with the people living beside the factory (Figure 9.1). The primary objective of these discussions was to gain a comprehensive understanding of project issues and concerns from a diverse group of participants, including those who may be impacted by rising unemployment. The focus of the consultations was on community members' willingness to participate, as well as their perceptions and concerns about the project's positive and negative social impacts, including impacts on livelihoods. The feedback

received from the consultation meeting will be used by the project executing agencies to carry out necessary revisions to the technical designs in order to minimize the impacts.



Stakeholder Consultations with respective authority representatives



Stakeholder Consultations with people living beside the factory

Figure 9.1: Stakeholder Consultations with Project Affected Persons

9.6 SUMMARY OF CONSULTATIONS

The proposed project neighbors who were interviewed during public participation of the proposed solar PV systems project raised the following issues. Most comments were similar. The outcomes of stakeholder consultations are given in Table 9.1 & list of participants in **Appendix F**.

Table 9.1: Summary Findings of the Public Consultation

Sl. No	Concerns & Expectations/ Key Issues Raised	Participant's opinion, comments and suggestions
01.	Capacity and Technology adopted for the proposed project	A brief introduction about the proposed project has been given to local community by consultant team. It has been told that it is a Solar PV Technology based on 1.494 MWp Solar Power Plant proposed at NAAFCO Pharma Limited.
02.	How the project will impact on surrounding environment? Please mention both positive and negative sites.	As there is a boundary wall around the project area that separated it from the residential area, so, there will be less environmental impact on the environment.
03.	Any air pollution in the area due to the project activities? If yes, how to mitigate?	Because the project site is far away from residential dwellings, there is a small chance of anticipated impact, but proper care of panels, sensitive equipment, and other items should reduce it.

Sl. No	Concerns & Expectations/ Key Issues Raised	Participant's opinion, comments and suggestions
04.	Any impact on the surface water body (river, khal, pond etc.)? If yes, how to mitigate?	Water quality is not affected by the Solar Power Plant construction. It is important for the project's proponent to confirm that no hazardous or waste materials were accidentally spilled or washed into nearby water bodies during construction, particularly during the monsoon season.
05.	Any noise- impact of the project during construction and operation at the locality? If yes how to mitigate?	Because of the construction machinery and workers, the noise level will increase a little bit. Fortunately, the effects will only last for a short time. This means that when all work is completed, the noise level will return to its previous level of comfort.
06.	Will the upcoming solar power plant create employment opportunities for the local people?	During construction period, the proposed project will provide an employment opportunity to semi-skilled and unskilled worker. The priority of employment will be provided to local villagers/residents on the basis of their skill and qualification.
07.	Will the solar power plant project pose a risk to human health and the environment?	No. It is considered safe to human health and the environment. It does not present any risks to public health and the environment.
08.	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 and Mosque within 1 km radius.
09.	Are you in favor of this project? Why?	It is true that we are all in favor of the project. We're grateful for the initiative you've taken on this. These projects have the potential to have a long-term positive impact on this region's economic and social conditions.

10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

10.1 GENERAL

The Environmental and Social Management Plan (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.

10.2 OBJECTIVES

This Environmental and Social Management Plan (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.

The key objectives of the ESMP are summarized below:

- Minimizing all kind of 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.

10.3 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 pre-construction, construction, operation and decommissioning stages. While preparing the ESMP, medium and significant impacts are taken into consideration to recommend possible mitigation measures. When a mitigation measure complies with the Environmental Quality Standards (EQS), policies for Environmental and Social Considerations / World Bank Safeguard Policies, and DoE environmental guidelines, as well as other relevant GoB legal requirements, it is considered successful. A relevant international or recognized organization's quality standard will be applied in the absence of a DoE-developed EQS.

Table 10.1: Environmental and Social Management Plan (ESMP)-Mitigation Measures

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
Pre-construction Phase						
Land Use	The proposed project is a rooftop system, so there are no anticipated impacts.	-	-	-	NPL	-
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	- National Land use Policy, 2001 - National Environmental Policy, 2018 - National Environmental Management Action Plan, 1995
Water Resources	As the amount of water requirement is too little, the impact on water resources is not that significant.	- The contractor will dispose of the debris material to a designated disposal site. - All reasonable measures will be taken to prevent the wastewater produced in construction from entering into creek and stream. - Contractor's camp will be provided with sanitary latrines that do not pollute surface waters. - The ground water in the project area has been used for different purposes like drinking and irrigation, hence proper mitigation measures must be ensured at construction site to avoid any spillage and leakage of	Daily	Compliance with DoE and National guideline limits for Environmental noise at sensitive receptors.	Contractor	Environmental Pollution Control Ordinance, 1977

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		oil. All the staffs at construction areas must be refrained of discharge any liquid wastes on the ground.				
Noise	Increased noise levels during 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	- 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.	- Setting an appropriate site speed limit to reduce dust generation from vehicles travelling over unmade surfaces. - During construction dust generated on unpaved roadways and work areas should be controlled by the application of water on an “as needs” basis. - Unnecessary handling of dusty materials will be avoided such as minimizing drop heights when loaders dump soils into trucks. - 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	- Environmental Pollution Control Ordinance, 1977 - Environment Conservation Rules (ECR), 1997 - Environment Court Act, 2000 - Bangladesh Climate Change Strategy and Action Plan (2008)

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
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	- 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)
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	Daily	- Compliance with Waste management procedures. - Current and Complete records of regular waste pickup and disposal.	Contractor	- Environmental Pollution Control Ordinance, 1977 - The Environment (Pollution Control) Act, 1995 - Environmental Conservation Rules (ECR), 1997

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		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 off regularly.				
Health and Safety risks	▪ Potential of exposure to safety events such as tripping, working at height activities, fire from hot works, smoking, failure in electrical installation, mobile plant and vehicles, and electrical shocks. ▪ 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. ▪ Risk assessment shall be prepared and communicated prior to commencement of work for all types of work activities on site. ▪ 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	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) ▪ HSE Training Hours	Contractor	▪ Bangladesh Labour Law, 2006

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		nets, where work at height cannot be avoided or the fall prevented. ▪ Carry out fire risk assessment for the construction areas, identify sources of fuel and ignition and establish general fire precautions including, means of escape, warning and fighting fire. ▪ 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 competent to operate plant machines and vehicles. ▪ Ensure clear signages are in place, such as Warning of speed				

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		limits, obstructions, allowable widths/ heights...etc. ▪ 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. ▪ Lock-Out / Tag-Out (LOTO) system shall be implemented during any electrical works. ▪ 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.				

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		▪ 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. ▪ 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.				

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		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.				
Traffic	Additional traffic load due to transport of equipment and materials to and from the site through the surrounding road network	- The contractor to ensure that all trucks and vehicles accessing the facility are operated by licensed operators. - Pedestrians Safety: All project vehicles and trucks shall comply with the proposed speed limits - Ensure adequate maintenance and inspection of vehicles.	Continuously	- No complains or concerns from traditional users of the area's roads routes are received during the construction activities. - No incidents or accidents (collisions) are recorded.	Contractor	
Operation Phase						
Visual Amenity	Reflection from the solar panel will create visual intrusion.	The used technology has Anti-Reflective coating (ARC) that significantly reduces the reflectance of the Panels (from 2.5% to 2.6% only).	N/A	N/A	Project Developer	- National Land use Policy, 2001 - National Environmental Policy, 1992 - National Environmental Management Action Plan, 1995
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.	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.	Project Developer	- Environmental Pollution Control Ordinance, 1977 - Noise Pollution Control Rules, 2006

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		The worker inside the project area should use earmuffs during the operation of diesel generator.				
Air Quality	Very low air emissions of air pollutants such as sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds, and the greenhouse gas carbon dioxide.	- Check regularly to identify potential source of air pollutants. - Replace the damaged and expired tools, equipment, PV panels and batteries as soon as it is notices.	Daily	- No visible dust plumes originating from project site. - Regular machineries maintenance records.	Project Developer	- Environmental Pollution Control Ordinance, 1977 - Environmental Conservation Rules (ECR), 1997 - Environment Court Act, 2000 - Bangladesh Climate Change Strategy and Action Plan (2008)
Heat Generation	- Potential glare from PV panels and Reflected Heat. - Theoretically the solar thermal placement in the shell of the buildings could increase fire risk and water intrusion into the roof.	- This can be easily avoided, since only four holes per panel on the roof will be integral part of the roof. - Air gaps will be provided to keep the system cool.	N/A	No heat generation and complains from the worker.	Project Developer	Environmental Pollution Control Ordinance, 1977
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	- 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

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
		chemicals to prevent their leakage and infiltration into the soil.				
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
Waste Generation	- Solid wastes from PV modules which contains toxic metals. - Wasted PV modules few other solid wastes generated during the operational stage. These include end-of-life solar PV modules, electrical wastes, metallic wastes and stationary wastes of office works etc.	- A proper temporary storage facility is needed for the wasted batteries to avoid potential lead contamination. - Collect the domestic waste in septic tanks to treat according to the approved procedure.	Continuously	- Compliance with Waste management procedures. - Current and Complete records of regular waste pickup and disposal.	Project Developer	- Environmental Pollution Control Ordinance, 1977 - The Environment (Pollution Control) Act, 1995

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
PV panels	The most significant source of soil pollution is the damage of PV panels in case of major accidents. These contain chemicals and may be harmful for soil quality. There will be environmental impacts of emission of greenhouse gas, Ozone depletion, photochemical smog, eutrophication and acidification and also health effects on people. Wasted PV modules few other solid wastes generated during the operational stage. These include end-of-life solar PV modules, electrical wastes, metallic wastes and stationary wastes of office works etc.	Photovoltaic (PV) is now a proven technology which is inherently safe as opposed to some dangerous electricity generating technologies. Photovoltaic systems make no air pollution and cause no pollution in operation. PV panel should be clean and maintenance regularly for dust free. The supplier will collect wastage PV panels for maintenance and destroy and they will be responsible for management of PV panels. 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.	Continuously	Compliance with DoE Regular machineries maintenance records.	Project Developer	- Environmental Pollution Control Ordinance, 1977 - Environmental Conservation Rules (ECR), 1997 - Environment Court Act, 2000
Health and Safety	Leaching of materials from broken or fire	Provide walkways that are clearly designated as a walkway; all walkways shall be provided with good conditions underfoot;	Continuously	Total Recordable Incidence Rate (TRIR)	Project Developer	Bangladesh Labour Law, 2006

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	damaged PV modules - Emergency Fire Hazard - Electrocution of workers - Electromagnetic radiation from PV modules - Slipping and tripping, working at height activities - Lead can enter body in two ways: by breathing or by swallowing it. Lead Sulfide dust enters the body through breathing. Very fine lead particles may penetrate into the lungs result in absorption in the bloodstream. - As a power plant, the plant has always some risks of fire hazards. Electrical equipment is the main source of a potential fire hazard. - Risk of electrocution of workers during performing duties	signposted and with adequate lighting. - 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. - Carry out fire risk assessment during operation to identify sources of fuel and ignition and establish general fire precautions including, means of escape, warning and fighting fire. - 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 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.		- Lost Time Incidence Frequency - Number of safeties Training performed - Number of nonconformance events.		

Aspect	Key Potential Impact	Mitigation Measures	Frequency	Performance Indicator	Responsibility	Legal Requirements
	in a power plant is always present.	- 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.				
Decommissioning Phase						
- As can be noted from the impact assessment chapter 8, no impacts with high significance are anticipated to take place during decommissioning of the project since all facilities will be removed, solar power plant decommissioned, and PV panels will be dismantled and sent for recycling or disposal. - 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. - The solar PV panels that will be used in the project will have a life span of 25 years. Disposal of wasted solar PV modules is very important because if not properly decommissioned, the greatest health risk from end-of-life crystalline solar modules arises from lead containing solders. Under the right conditions it is possible for the lead to leach into landfill soils and eventually into water bodies. - While the solar cell is the heart of a photovoltaic system, on a mass basis it accounts for only a small fraction of the total materials required to produce a solar panel. The outer glass cover constitutes the largest share of the total mass of a finished crystalline photovoltaic module (approximately 65%), followed by the aluminum frame (~20%), the ethylene vinyl acetate encapsulant (~7.5%), the polyvinyl fluoride substrate (~2.5%), and the junction box (1%). The solar cells themselves only represent about four percent (4%) of the mass of a finished module. Proper decommissioning and recycling of solar panels both ensures that potentially harmful materials are not released into the environment and reduces the need for virgin raw materials. In recognition of these facts, the photovoltaic industry is acting voluntarily to implement product take-back and recycling programs at the manufacturing level.						

10.4 ENVIRONMENTAL AND SOCIAL MONITORING PLAN (ESMP)

10.4.1 General

An Environmental and Social Monitoring Plan will be prepared to provide guidelines for environmental and social management plan during the construction and operation phases of the project. The environmental components that will be monitored are those that will be positively or negatively affected, or expected to be affected, by construction activity. 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 10.2.

10.4.2 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 10.2: Environmental and Social Monitoring Plan

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
				Implementation	Supervision
Pre-Construction Stage					
Air Quality	SO ₂ , NO _x , CO, PM _{2.5} , PM ₁₀ , O ₃	Air quality standard by DoE, Bangladesh	Once	Contractor	NPL
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	Once	Contractor	NPL
Water Quality	Surface water: Temp., pH, TDS, EC, DO, COD, BOD ₅ , Ammonia, Cr, Cl, TSS, and Turbidity Ground water: pH, TDS, EC, salinity, Temp., TC, FC, Alkalinity, As, BOD, Cl, Cr, Fe, Mn, Hardness, and Turbidity	Surface water quality standard by DoE, Bangladesh	Once	Contractor	NPL
Construction Stage					
Air Quality	SO ₂ , NO _x , CO, PM _{2.5} , PM ₁₀ , O ₃	Air quality standard by DoE, Bangladesh	Once	Contractor	NPL
Dust	Dust control	Air quality standard by DoE, Bangladesh	Once	Contractor	NPL
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	Once	Contractor	NPL
Water Quality	Surface water: pH, TDS, EC, DO, COD, BOD ₅ , Ammonia, Cr, Cl, TSS, and Turbidity Ground water: pH, TDS, EC, salinity, Temp., TC, FC, Alkalinity, As, BOD, Cl, Cr, Fe, Mn, Hardness, and Turbidity	Water quality standard by MoEFCC, Bangladesh	Once	Contractor	NPL
Waste	▪ Check storage, transportation, disposal, handling of hazardous 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	NPL

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
				Implementation	Supervision
Occupational 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; - Heavy construction materials at construction site to be stored and handled safely; and - Check of personal protective equipment (PPE) for worker at the sites	Monitoring	Regularly	Contractor	NPL
Operation Stage					
Air Quality	SO ₂ , NO _x , CO, PM _{2.5} , PM ₁₀	Air quality standard by DOE, Bangladesh	1/year (5 year)	NPL	DOE/IDCOL
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	1/year (5 year)	NPL	DOE/IDCOL
Water Quality	Surface water: pH, TDS, EC, DO, COD, BOD ₅ , Ammonia, Cr, Cl, TSS, Turbidity Ground water: pH, TDS, EC, salinity, Temp., TC, FC, Alkalinity, As, BOD, Cl, Cr, Fe, Mn, Hardness, Turbidity	Water quality standard by DOE, Bangladesh	1/year (5 year)	NPL	DOE/IDCOL
Accident and Public Safety	Record of accidents, different level of disabilities/fatalities.	None Specific	-	NPL	DOE/IDCOL
PV panels	Chemicals	-	1/year (5 year)	NPL	DOE/IDCOL
Decommissioning Stage					
Air Quality	SO ₂ , NO _x , CO, PM _{2.5} , PM ₁₀	Air quality standard by DOE, Bangladesh	Once	Contractor	NPL/IDCOL
Dust	Dust control	Air quality standard by DOE, Bangladesh	Once	Contractor	NPL/IDCOL
Noise Level	dB(A)	Noise Pollution Control Rules (2006)	Once	Contractor	NPL/IDCOL
Water Quality	Surface water: pH, TDS, EC, DO, COD, BOD ₅ , Ammonia, Cr, Cl, TSS, and Turbidity	Water quality standard by MoEFCC, Bangladesh	Once	Contractor	NPL/IDCOL

Environmental Components	Parameters/ Units	Standards/ Guidelines	Monitoring Period/ Frequency/ Sampling, No/year	Responsibility	
				Implementation	Supervision
	Ground water: pH, TDS, EC, salinity, Temp., TC, FC, Alkalinity, As, BOD, Cl, Cr, Fe, Mn, Hardness, and Turbidity				
Waste	- Check storage, transportation, disposal, handling of hazardous waste - Careful and proper handling of PV panels and batteries - Waste and effluents to be collected and disposed safely from camp. - Wastes and garbage from worker sites to be disposed safely	Monitoring	Weekly	Contractor	NPL/IDCOL
Occupational Health and Safety	- Check quality of food and accommodation at worker camp; - Check safe water supply, hygienic toilet at camps, construction of drain at camp sites; - Check toilets are close to construction site; - First Aid Box with required tools and medicines; - Check of personal protective equipment (PPE) for worker at the sites	Monitoring	Regularly	Contractor	NPL/IDCOL

10.5 ENVIRONMENTAL AND SOCIAL BUDGET

The estimated budget for implementation of the mitigation and monitoring measures proposed in the ESMP is presented in **Table 10.3**. The overall costs of the ESMP will comprise:

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

The total budget is estimated as BDT. 5,15,500. This budget does not include the decommissioning stage since the minimum operation period is 20 years and the rate will vary largely from the present cost.

Table 10.3: Environmental Budget

Component	Item	Unit	Quantity	Rate (In BDT)	Amount (BDT)
PRE-CONSTRUCTION STAGE					
Air Quality	Measuring air quality	No.	1	30,000	30,000
Noise	Measuring ambient noise level	No.	4	4,000	16,000
Water Quality	Surface water quality and groundwater quality measurement	No.	3	10,000	30,000
SUB TOTAL (PRE-CONSTRUCTION STAGE)					76,000
CONSTRUCTION STAGE					
Air Quality	Measuring air quality	No.	1	30,000	30,000
Noise	Measuring ambient noise level	No.	4	4,000	16,000
Water Quality	Surface water quality and groundwater quality measurement	No.	3	10,000	30,000
Waste disposal and management	Disposal and management of construction waste and solar panels of individual households	Lump sum			50,000
Construction Safety	General Safety (provision of PPE like ear muffs, gloves etc.)	Lump sum			15,000
Health	Health check-up camps for construction workers	Camp	-	15,000	15,000
SUB TOTAL (CONSTRUCTION STAGE)					156,000
OPERATION STAGE					
Air Quality	Monitoring air quality	No.	5 (1/2year)	30,000	1,50,000
Noise	Monitoring ambient noise level	No.	5 (1/2year)	4,000	20,000
Water	Monitoring surface water quality	No.	5 (1/2year)	10,000	50,000
SUB TOTAL (OPERATION STAGE)					2,20,000
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
SUB TOTAL (ESTABLISHMENT and TRAINING)					20,000
SUB TOTAL (Pre-construction, Construction, Operation, establishment and training)					4,72,000
CONTINGENCIES @ 10 % on total Environmental Costs					43,500
GRAND TOTAL (in BDT)					5,15,500

11 RISK ASSESSMENT AND EMERGENCY RESPONSE

11.1 RISK ASSESSMENT

The risks affecting solar projects appear throughout the entire project lifetime. Some examples are the risk of environmental damage, hand injury, fatigue and ergonomics, the collapse of scaffold or ladder, falls, electrocution, and fire. In managing the risks associated with the rooftop solar project it is important to carry out a risk assessment which will involve-

1. Identifying all the activities, processes or day-to-day operations to be carried out during the project.
2. Dividing the identified activities into steps.
3. Identifying the hazards and risks associated with each step and deciding who may be harmed and how serious it could be.
4. Developing measures to manage the identified risks to a level that is tolerable and as low as reasonably practicable (ALARP principle).
5. Recording the findings and continually reviewing the risk assessment.
6. Taking account of new working practices, new machinery or more demanding work targets. Based on the risk assessment conducted for the project/activity the controls can be defined based on the following Hierarchy of Controls.

11.2 EMERGENCY RESPONSE

Project personnel will meet with local emergency response groups to review the Fire Safety Plan, discuss the type of work taking place, duration of project schedule and emergency procedures. The following course of action should be taken if an emergency situation develops:

- Evacuation procedures and assembly are contained in the Evacuation plan, which will be posted in all office trailers. Maintain site security and control.
- Notify proper emergency services for assistance. Dial 999 or direct-dial emergency contact numbers if possible.
- Notify Onsite O&M Primary Contact and all affected personnel at the site through use of site communication devices.
- Once emergency personnel have been notified, an employee will then be designated to meet the emergency personnel and then guide them to incident location.
- Only after emergency is declared over by the Onsite O&M Primary Contact can all other communication resume.
- Prepare a summary of the incident as soon as possible and no later than 24 hours after the incident.

Without fulfilling the health and safety requirements of the project sites; construction activity must not be compromised at this time. If an activity cannot be undertaken safely, it should not take place. Emergency services are also under great pressure and may not be able to respond as quickly as usual. The PIU & Contractors need to take into consideration in the planning of work activities, first aid, fire and emergency responses. Contractor must have in place effective arrangements for monitoring and reviewing their compliance with Bangladesh government guidelines during any disaster occurrence. In case emergency, please contact: IEDCR (IEDCR Hotlines are 333, 16263, 10655, and 01944333222.) Hotlines are 999, 333, 16263, 10655, and 01944333222. The site engineers/Supervisor must contact line management to control the situation though Bangladesh government authority's role is very important.

12 GRIEVANCE REDRESS MECHANISM

12.1 GENERAL

Public participation, consultation and information disclosure undertaken as part of the local ESIA process have discussed and addressed major community environmental concerns. Continued public participation and consultation has been emphasized as a key component of successful project implementation. As a result of this public participation during the initial stages of the project, major issues of grievance are not expected. During the operational phase of the project, the complaints that may be anticipated are mostly related to noise & vibration of the engines. However, unforeseen issues may occur. To settle such issues effectively, an effective and transparent channel for lodging complaints and grievances will be established. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project. It should address affected people's concerns and complaints promptly, using an understandable and transparent process. It should also be readily accessible to all sections of the community at no cost and without retribution.

The Grievance Mechanism will be implemented during both the construction and operational period of the project to ensure that all complaints from local communities are dealt with appropriately, with corrective actions being implemented, and the complainant being informed of the outcome. It will be applied to all complaints from affected parties.

The mechanism will be accessible to diverse members of the community, including more vulnerable groups such as women and youth. Multiple means of using this mechanism, including face-to-face meetings, written complaints, telephone conversations should be available. Confidentiality and privacy for complainants should be honored where this is seen as necessary or important.

A grievance redress mechanism & procedure is setup to provide opportunity for project affected persons to settle their complaints and grievances amicably. The established grievances redress procedures and mechanism ensures that project affected persons are provided with the appropriate compensations and that all administrative measures are in line with the law. It also allows project affected persons not to lose time and resources from going through lengthy administrative and legal procedures. Grievances are first preferred to be settled amicably.

12.2 REQUIREMENTS OF THE DEVELOPMENT PARTNER'S

Environmental and social safeguard requirements of all partner agencies were carefully considered during the preparation of this ESIA. The description of a grievance redress mechanism (GRM) is not required under the GoB environmental legislation but is mandatory as per donor agencies requirement. To that end a step-by-step process is defined in this chapter.

Grievance redress refers to the set of actions available to anyone negatively impacted by the project and not properly dealt with, ignored or overlooked the implementation of mitigative and monitoring measures defined in the ESIA. The overriding principle of any GRM is that it must be non-threatening, easily accessible, quick and impartial; delivering decisions to the complainant in an unbiased a-political manner. GRM's have been developed for many past donor-funded projects and have been accepted by the GoB and been reasonably successful in doing what they are supposed to do.

12.3 OBJECTIVES

The objective of grievance redress mechanism (GRM) is to improve the response efficiency and accountability level to the project beneficiaries, ensuring the prompt complaints and feedback consideration and processing, as well as problems identification and finding their solutions together with the stakeholders.

12.4 STEPS OF REDRESSING/RESOLVING GRIEVANCE

The Developers while developing the Grievance Mechanism are required to adhere to the following steps:

11.4.1 Development of Procedures

The developers should ensure that procedures for lodging and registering of grievances are in place before the plan is implemented at the site level. The procedures of Grievance Mechanism should comprise of identifying the personnel (Grievance Officer at Site level) who will be responsible for receiving and addressing the grievances at the site level and handle the cases at the escalation level. The procedures to be developed should include assessment procedures, procedure to determine the appropriate resolution process, procedures for making decisions on proposed settlements, appropriate time frames for each step in the grievance resolution process and notification procedure to the complainant about eligibility, assessment results, proposed settlements and the like.

11.4.2 Develop Resolution Options and Response

Once Developers developed procedures, formal and informal resolution options should also be developed along with preparation of formulating a response. General approaches to grievance resolution many include proposing a solution, reaching a resolution through discussion or negotiation, using a third party to either informally or formally resolve the matter through mediation and through traditional and customary practices.

11.4.3 Publicize the Grievance Mechanism

Once the procedures for Grievance Mechanism have been developed by the developers, it has to be publicized through various stakeholder engagement activities as detailed out in the Stakeholder Engagement Plan and should be disseminated to the developer as well. The Developers should inform the local community in the first instance and then on remind them of this mechanism on a regular basis during the project construction and operation phases. Various communicative methods can be adopted in disseminating the information like printed materials, displays, face to face meetings and website updating. The grievances redress mechanism (GRM) shall be documented in English and Bangla and copies shall be kept at the project site office and corporate office. The GRM is also to be displayed at notice board at the project site office and training on the GRM shall also be provided during orientation. Developer is to ensure that the contractor would keep the workers informed about the grievance mechanism at the time of recruitment and make it easily accessible to them. All pertinent contact information will be made available to them.

11.4.4 Recording of Grievances

Once the stakeholders are aware of the mechanism and access it to raise grievances, developer is required to acknowledge the same and keep the complainant's identity

anonymous. Consequently, developer is required to collect grievances by checking the grievance boxes once every fifteen days, record and register the grievances that have come in as per the identified formats and track them throughout the redressal process to reflect on their status and important details. A Grievance Log or database emphasizing the records and status of the grievance is to be maintained by the identified Grievance Officer at the site level. The Grievance Log can be used to analyze information about grievance and conflict trends, community issues and project operations to anticipate the kinds of conflicts that NAAFCO Pharma Limited (NPL) might expect in the future both to ensure that the grievance mechanism is set up to handle such issues and to propose organizational or operational changes.

11.4.5 Appeal

If the grievance redressal solution is not acceptable or agreed by the complainant, the complainant should be offered to an appeal process. Circumstance revolving around when an appeal can be made should be set by the developers so that accountability and transparency is promoted by them in every step.

11.4.6 Resolve and Follow Up

Once the corrective action has been agreed upon, a good practice is to collect proof of those actions in terms of taking photographs, documentary evidence, getting confirmation from the complainant and filing the same within the case documentation. In addition, monitoring and follow up on the resolution agreed upon should be conducted once to close the case accordingly. Developers are required to provide regular (yearly) reports to NAAFCO Pharma Limited (NPL) that track the number of complaints received, resolved, not resolved and referred to a third party. In addition, the funding agency also needs to be constantly apprised of the yearly reports in order to support identification of developing risks

12.5 PROPOSED GRIEVANCE REDRESS MECHANISM FOR NPL

The Grievance Redress Mechanism outlines the process for lodging of grievances, steps to be taken for subsequent action and the time limit within which the issue would be resolved to the satisfaction of the complainant (community members, project affected persons and workers). All complaints shall be recorded and addressed in a uniform and consistent manner. The GRM for the proposed project is presented below with time bound schedules and specific persons to address grievances.

11.5.1 Grievance Redress Committee

A site level approach is proposed to be developed for redressing of all cases of grievances. All grievances are to be redressed at this stage. The representatives proposed for the grievance committee is provided below,

- Site Supervisor
- EHS Manager
- Admin Officer and
- Safety Officer.

The functions of GRC are as follows:

- To provide support to affected communities on problems arising from environmental or social impacts;
- To record grievances of the affected community by categorizing and prioritizing them, and provide solutions within a stipulated time period; and
- To report to the aggrieved parties, developments regarding their grievances and decisions of the GRC.

The steps of grievance redressal for Developer have been provided below:

11.5.2 Receive and Register a Complaint

The developers in order to implement the Grievance Redress Mechanism is required to nominate a Grievance Officer for registering the grievances, initiating the process of registering and action taken thereon for the resolution of the grievance and the timeline required in each step. The contact details of the Grievance Officer shall be maintained and updated in the following format displayed at prominent places available to public and the project area.

Table 12.1: Contact Details of Grievance Officers

Sl. No.	Name	Designation	Mobile Number	Signature

- Any stakeholder such as worker, person from local community or any other stakeholder, with concerns pertaining to onsite work such as community health and safety, local employment, community risk, migrant labor or any issues etc., may register their complaint in writing to the nominated person/grievance officer at site level;
- All grievances will be addressed by the developers during the construction and operation phase. For any unresolved grievances or any grievances related to land, the developer will forward the grievances to NAAfco Pharma Limited who in turn will subsequently forward them to appropriate authority for redressing;
- Secured grievance boxes shall be placed at the entrance of the site office;
- If any stakeholder or community member wishes to remain anonymous, he/she can write down the grievances and drop in the available complaint box; and
- Once a complaint has been received it shall be recorded in the grievance log register or data system.

Details of grievance received shall be maintained by the Grievance Officer in a register as per the following format.

Table 12.2: Records of Grievance Received

Sl. No.	Date of Receipt	Particulars of Complainant				Particulars of Grievance			
		Name	Address	Contact No	Whether acknowledge ment given at time of receipt	Subject of the Grievance	Office	Brief Description	Date of acknowledge ment/ Date of redress

11.5.3 Assessment and Addressal of Complaint

- The Grievance Officer will open the grievance boxes once every week and register the grievance in the Grievance Log Register as per the format provided above;
- The Grievance Officer will then forward the grievances after registration to the Site Supervisor for further action;
- The grievance will be assessed by the Site Supervisor within two (2) working days to determine if the issues raised by the complaint fall within the mandate of the grievance mechanism or not;
- During the assessment of complaints, the GRC team (EHS Manager Admin Officer, Site Supervisor & Safety Officer) will gather information about the key issues and concerns and helps determine whether and how the complaint might be resolved.
- The grievances will be redressed at the Site Level by the GRC within seven (7) working days;
- If the grievance fails to be addressed at this level the complainant will have the option to approach the appropriate court of laws for redress; and
- The complainant will have the opportunity to be present at the committee meetings and discuss the grievance faced by him/her.

The Grievance Mechanism proposed for Developer to consider and implement has been provided in Figure 11.1 below.

11.5.4 Documentation

- The Grievance Redress Mechanism will be documented in English and Bangla and copies will be kept at the project site office;
- The GRM will also be displayed at notice board at the project site office and labor camp sites and will be included in worker documentation;
- The developers/EPC should inform the local community and workers about Grievance Redress Mechanism during the project construction and operation phases. Various communicative methods can be adopted in disseminating the information like printed materials, displays and face to face meetings;
- The Contractor or Admin Officer will inform the workers about the grievance mechanism at the time of recruitment or induction training and make it easily accessible to them;
- The Grievance Officer's contact number will be made available to them. The project office phone number will be posted in public areas within the project area;
- The mechanism will address concerns promptly, using an understandable and transparent process and provide timely feedback to the concerned stakeholder;

- Verifiable records of implementation of corrective action like dated photographs, documentary evidence, getting confirmation from the complainant and filing the same within the case documentation should be kept;
- A Grievance Log or database emphasizing the records and status of the grievance shall be maintained by the Grievance Officer at the site level.

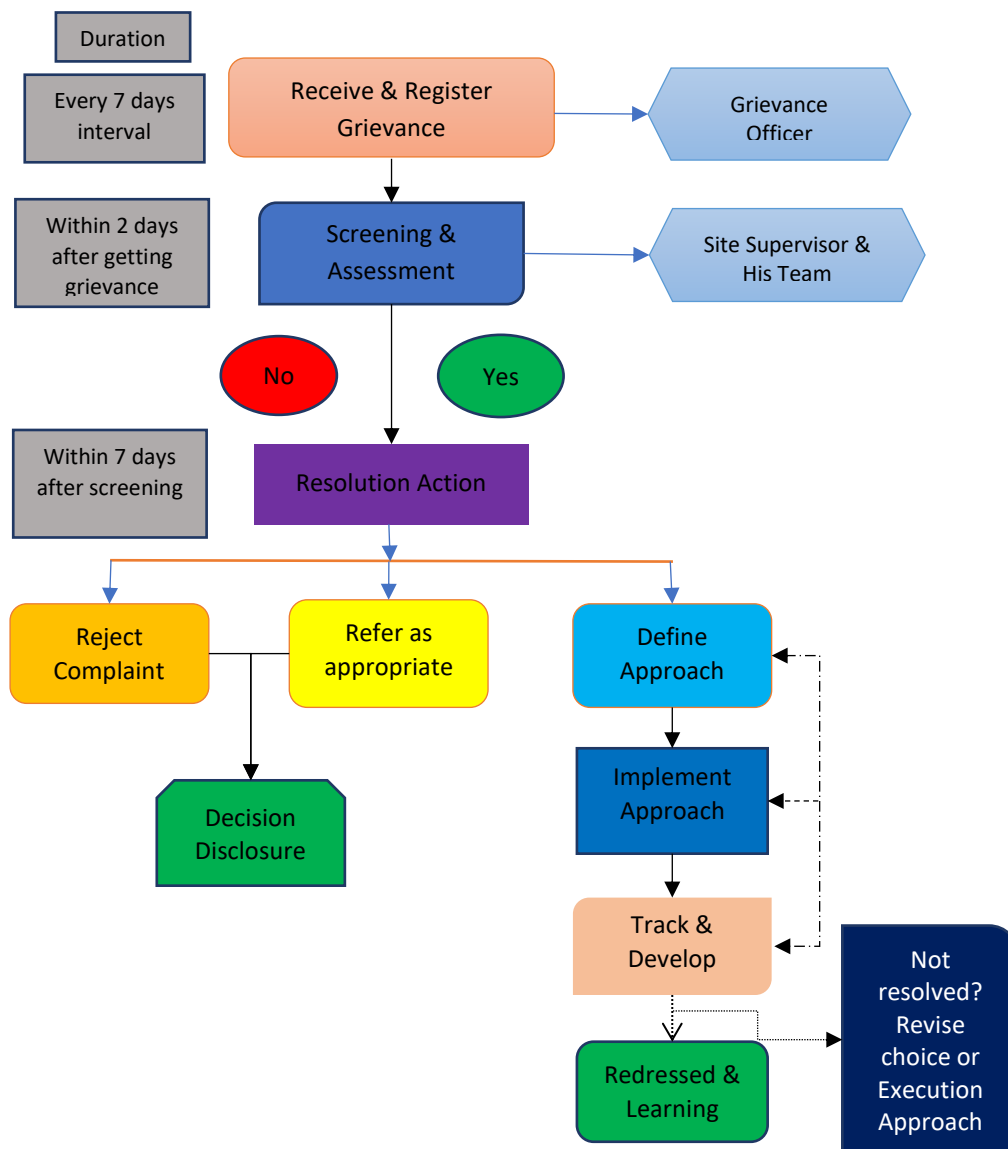


Figure 12.1: Proposed Grievance Mechanism for Developer

12 ENVIRONMENTAL AND SOCIAL BENEFIT

12.1 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.

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.

Solar rooftop systems generate electricity with no associated air pollution emissions. While solar rooftop energy systems emit some air pollutants, total air emissions are generally much lower than those of coal and natural gas-fired power plants. In addition, solar energy 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.

12.2 ENERGY AND CLIMATE CONCERN

The negative environmental impacts from generating electricity through conventional fossil fuel burning at thermal power plants are very well known. This most importantly includes air pollutant emissions such as ozone, sulfur dioxide (SO₂), Nitrogen Dioxide (NO₂), particulate matter, and other gases, which are the cause of some serious environmental concerns such as smog, acid rain, health effects, and many others.

In addition, the burning of fossil fuels results in carbon dioxide emissions; a primary greenhouse gas emitted through human activities, which contributes to global warming. The main human activity that emits CO₂ is the combustion of fossil fuels for electricity production and transportation. Concurrently, global climate change has become an issue of concern and so reducing greenhouse gas emissions have also emerged as primary issues to be addressed as the world searches for a sustainable energy future.

Electricity produced using solar energy emits no greenhouse gases (GHGs) or other pollutants. As with any electricity-generating resource, the production of the PV systems themselves requires energy that may come from sources that emit GHGs and other pollutants. Since solar PV systems have no emissions once in operation, an average traditional PV system will need to operate for an average of four years to recover the energy and emissions associated with its manufacturing. A thin-film system currently requires three years. Technological improvements are anticipated to bring these timeframes down to one or two years. Thus, a residential PV system that can meet half of average household electricity needs is estimated to avoid 100 tons of carbon dioxide (CO₂) over a 30-year lifetime.

12.3 ENERGY AND LIVELIHOOD CONCERN

The belief that the provision of electricity through renewable resources can bring about desired socio-economic changes (increased economic opportunities, improved health and education facilities. With the availability of energy livelihood strategy changes connecting the industrial production, output, cost and other variability. The changes come from using a

renewable resource technology is positive and sustainable for the livelihood strategy and running business.

The development of micro-enterprises in rural areas is linked with the increase in access and use of grid electricity services, leading to changes in micro-enterprises, and changes in livelihood characteristics of entrepreneurs, employees and community members in areas where these enterprises located. Micro-enterprises are important in their role as contributors to the economy of the rural poor especially women, technological development of rural people and in their potential for employment creation.

12.4 ENERGY AND ECONOMY CONCERN

Bangladesh has major problems with energy shortage, persisting poverty and environmental degradation. Per capita energy use is only 180 kW-h (Energypedia-2014). With only 59.60% of Bangladesh's having access to electricity connection whereas the national grid could so far cover only 42 percent of 161 million of the total population.

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.

In the last two years, countries around the world have added almost as much new solar photovoltaic (PV) capacity as had been added since the invention of the solar cell. Nearly 38,000 megawatts of PV came online in 2013, a new annual record. In all, the world's installed PV generating capacity is now close to 140,000 megawatts. Falling costs and effective policies continue to drive tremendous growth in solar power.

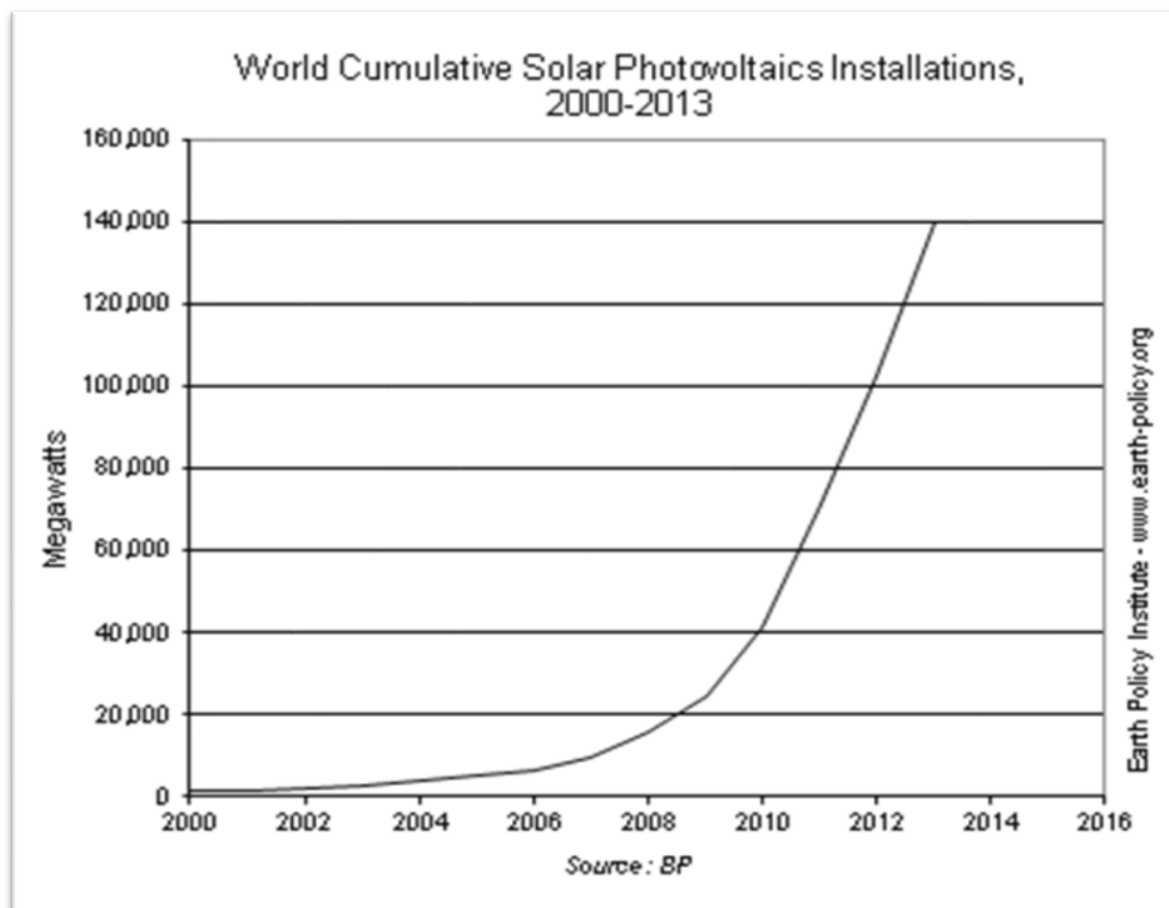


Figure 12.1: Trends of World Solar Energy Growth

PV remains the most rapidly growing energy technology by a wide margin. Indeed, global PV installations for 2014 should reach at least 40,000 megawatts, expanding world PV capacity by another 30 percent. As concerns about climate change grow, solar PV has firmly established itself as an integral player in the transition from fossil fuels.

13 CONCLUSION AND RECOMMENDATION

13.1 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.

13.2 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 life cycle.

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APPENDICES

Appendix A: Terms of Reference (ToR) for ESIA

TOR for ESIA of 1.49 MWp Industrial Rooftop Solar Project of Naafco Pharma Limited (NPL), Bhaluka, Mymensingh.

A Terms of Reference (TOR)

for

Environmental & Social Impact Assessment (ESIA)

Of

*1.49 MWp Industrial Rooftop Solar Project of Naafco Pharma Limited (NPL),
Bhaluka, Mymensingh.*

1 BACKGROUND

Availability of plenty open rooftops may address the space constraint issue for installing solar panels. The Government of Bangladesh has enacted Net Metering Guideline on August 2018 to encourage the use of vacant spaces and rooftops in solar power generation. Till date, 1473 rooftop solar systems have been installed by the in Bangladesh which has a cumulative capacity of 63.90 MWp*. These installations have contributed towards 12.8% of countries' solar energy generation. As solar power has turn into inexpensive compared to grid electricity for industrial consumers, using solar power reduces their electricity bills together with net-metering scheme has created an enabling environment for industrial consumers to monetize unutilized roof space through installation of rooftop solar. (*Source: <https://www.irena.org/en/Newsroom/PressReleases/2019/04/19-04-01>)

Also, Load shedding is a frequent phenomenon in the locality, which happens for almost 2-3 hours on average per day. This translates into approximately BDT 37,118,488 lac of fuel expenditure in a year. For this reason, the client has now planned to install a roof top solar power system that now envisages to fully replace the diesel generators.

Electricity tariff in Bangladesh is currently subsidized which keeps electricity cost affordable to general public of the country. However, given government's aspiration to become a middle-income country by 2041, gap between electricity generation cost and tariff needs to be eliminated gradually. Thus, it can be anticipated that, electricity tariff for generated power from traditional sources will continue to soar in future to eliminate the gap.

With the advent of solar based technologies and the current global trend of reduction in solar panel costs, electricity generated using solar based technologies is expected to become cheaper than electricity generated from traditional sources. Thus, different industries are being encouraged to install solar PV based power plants to save electricity expenses in future.

Current electricity cost from solar plant is almost similar to grid tariff which is expected to be cheaper than grid tariff in future due to the constant fall in price in solar based technologies vs. expected rise in grid tariff to minimize gap between generation cost and tariff. Thus, financing such kind of projects makes financial sense apart from achieving country's target to promote renewable energy based technologies in the country to ensure access to electricity for all.

NPL proposed a project of a 1.49 MWp rooftop solar project on their industrial rooftop of Naafco Pharma Limited. In the proposed system two main equipment will be used which are

TOR for ESIA of 1.49 MWp Industrial Rooftop Solar Project of Naafco Pharma Limited (NPL), Bhaluka, Mymensingh.

solar panels and inverters. Sun shines on the solar panels to generate DC electricity. The DC electricity produced from the solar panel will be converted to 440V 3-phase AC using the inverters. Then, the energy will be fed into the bus bars of industry. A Zero Export Controller will be used to ensure “net zero export” The aggregated installed capacity of the project will be 1.49 MWp.

This TOR is prepared to carryout detailed Environmental and Social Impact Assessment (ESIA) study for the rooftop solar project on the rooftop of Naafco Pharma Limited. As part of the ESIA the project proponent will prepare an Environmental and Social Management Plan (ESMP) that addresses the potential impacts and risks identified by the environmental and social assessment. The ESMP will include the proposed mitigation measures, environmental and social monitoring and reporting requirements, emergency response procedures, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, and performance indicators. Where impacts and risks cannot be avoided or prevented, mitigation measures and actions will be identified so that the project is designed, constructed, and operated in compliance with applicable laws and regulations and meets the requirements specified in this document.

2 LEGISLATIVE REQUIREMENTS

According to Bangladesh Bank ESRM under ESDD risk assessment tool this particular project falls into moderate category and DoE ECR 1997 (Addendum December 24, 2017), Solar sub-projects more than 1 MW falls in to **Orange B Category**. Notably, Solar Rooftop projects itself categorized B by the World Bank. For **Orange B Category** projects, ECC from DOE is mandatory for that particular sub-project.

3 PROJECT DESCRIPTION

The project is located at Bandia, Meduary, Bhalika, Mymensingh . It can be reached in this direction: from Dhaka to Mohakhali to Voradoba bazar to NAAFCO Pharma Factory. The project will be implemented in Rooftops of Naafco which is steel structured and rooftop is corrugated sheet based shed. Total available space are 160,000 square feet. Plant capacity of a roof-top solar power project mainly depends on available space and load while other factors to be taken into consideration being shading effect, orientation of the building, tilt angle of the building, load bearing capacity and backup generator capacity.

4 OBJECTIVES

The main objective of the Environmental and Social Impact Assessment (ESIA) study is to assess both positive and negative environmental impacts due to the project (Industry & Roof Top Solar 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. The ESIA will be used as a decision-making tool to ensure that the project design and implementation activities are environmentally sound and

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sustainable. During the implementation phase, the prepared Environmental and Social Management Plan (ESMP) shall serve as a framework for strengthening the mitigation, enhancement and environmental monitoring measures and system of the rooftop solar project. In the preparation phase, the ESIA shall achieve the following objectives:

- To establish the environmental and social baseline in the study area, and to identify any significant environmental issue;
- To assess these impacts and provide for measures to address the adverse impacts by the provision of the requisite avoidance, mitigation and compensation measures;
- To integrate the environmental and social issues in the project planning and design;
- To develop appropriate management plans for implementing, monitoring and reporting of the environmental and social mitigation and enhancement measures suggested.

5 SCOPE OF WORK

5.1 Legal and Administrative Procedure

- Collection and review of relevant information regarding environmental legislation, statutory orders, by-laws, etc. connected to preparation and approval of the ESIA report by the Infrastructure Development Company Limited (IDCOL), and draft the memo. The memo will also consider the requirements of Bangladesh Bank & Donor agencies' guidelines.
- Conduction of meetings with the Department of Environment, the Ministry of Environment and Forest (MoEF). During these meetings appropriate legal and administrative procedures will be discussed. Review of other relevant environmental laws, regulations, Norms, and Standards on Air, Noise, Water, Waste, Wildlife, and etc.
- Conduction of discussion meeting with the Department of Environment particularly for "Environmental Clearance Certificate" in accordance with the Environment Conservation Act, 1995 and Bangladesh Environment Conservation Rules, 1997(Addendum December 24, 2017),.

5.2 Project Description

A comprehensive description of the project in the construction and operational phases will be analysed and summarised. The information provided will cover broader and more in depth details of project activities, including information on the surrounding environment and project infrastructure necessary to identify and assess the environmental impacts of the project.

This will include history and background of the project, project objectives and information on the nature, site location/existing setting, timing, duration, frequency, general site layout, pre- construction activities, construction methods, works and duration, and post construction plans. A description of raw material inputs and system components, technologies designed for project components and processes to be used as well as products and by-products generated, will be provided. Additionally an overview of proposed project infrastructure, including

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structural components of the wind turbines will be described in detail. Other areas to be covered include:

- Methods to be employed in the offloading and transportation of equipment to the proposed site and any associated works that may be required to facilitate these activities
- Any physical measures to be employed during the operational phase to ensure the security of the infrastructure
- Proposed modifications to slopes, both on temporary and permanent bases
- Proposed land clearances and modification to shelterbelts; and
- Proposed modification to existing roads (physical and/or functional)
- Areas to be reserved for construction and areas to be preserved in their existing state will be noted as well as activities and features which will introduce risks or generate impacts (negative and positive) on the environment.
- Schematic plans and essential maps, including, map showing project location, project area, including project boundaries, aerial map of project areas, land use map of the study area, site layout plan and an area drainage contour map.

5.3 Baseline Studies

An inventory and assessment of baseline conditions will be done via the collection of primary and secondary baseline data within the project area. The baseline data will be generated in order to give an overall evaluation of the existing environmental conditions, values and functions of the area, as follows:

- physical environment
- biological environment
- socio-economic and cultural constraints

Primary data collection will be undertaken within a half km radius of the project area/boundary, while secondary data collection will extend within a 2km radius of the project area/boundary. The methodologies employed to obtain baseline and other data will be clearly detailed, with all limitations and assumptions clearly stated. Data gathered will be presented in both written and graphical form. This will be standard throughout the ESIA.

A comprehensive baseline survey will be conducted as part of the ESIA in alignment with the requirements of local permitting authority (i.e. DOE), IDCOL and other funding agencies. The impact assessment will rely on these data and it is necessary to ensure sufficient data are collected to enable a robust assessment.

Collection of general baseline information on existing environmental condition in the project influence area and environmental quality baseline monitoring along the project corridor and identification of the environmental components that need detailed study. Baseline assessment will be done based on the available secondary information, field visits, sampling and environmental monitoring including but not limited to the following for the Project Site and Area of Influence:

- **Physical Environment:**

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- A description of the existing **soil and geology, landscape, aesthetic values and hydrology**, with special emphasis on storm water run-off, drainage patterns and aquifer characteristics will be provided. Any slope stability issues that could arise will be explored based on any proposed modifications to slopes. The description will focus on the geology of the proposed site, the distribution of soil types in the proposed study areas using appropriate soil survey procedures and the implications of environmental effects on ecosystem sustainability. Where applicable the paleontological, architectural, archeological and cultural features will also be examined.
- **Water quality** of any existing wells, rivers, ponds or streams in the vicinity of the proposed development and study area will be described. This will include a description of potential changes in water quality over the life of the Project. Consideration will be given to the magnitude, extent, timing, duration, significance and seasonal variation. Consideration will also be given to the analysis and testing of appropriate water quality parameters (e.g., Temperature, pH, Conductivity, Dissolved oxygen, Suspended sediment, Dissolved solids, Nutrients etc.) if necessary.
- Obvious **sources of existing pollution** and extent of contamination affecting the physical environment will be described.
- **Noise** levels of undeveloped sites and the ambient noise in the area of influence will be assessed by:
 - ✓ Providing representative baseline noise levels and a description of the measurement/prediction methods used
 - ✓ Identifying components of the Project that have the potential for creating increased noise levels at sensitive receptors and discuss the implications and measures to mitigate
 - ✓ Presenting the results of a noise assessment, which will include:
 - ❖ Potentially-affected people and wildlife;
 - ❖ An estimate of the potential for increased noise resulting from the development;
 - ❖ The implications of any increased noise levels;
 - ❖ Heat or Light Reflection and
 - ❖ Proposed mitigation measures and their anticipated effectiveness.
- A description of the natural **hazards** affecting the project area will be described. Meteorological data covering the following will be incorporated in the ESIA report. The data for at least a 5 year period will be presented from the nearest meteorological station
 - ✓ Wind speed and direction
 - ✓ Rainfall
 - ✓ Relative humidity
 - ✓ Temperature
 - ✓ History of hurricanes

- **Biological Environment:**

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A detailed description of the flora and fauna (terrestrial and aquatic) of the area, with special emphasis on rare, endemic, protected or endangered species will be presented. Migratory species will also be considered.

- Information on existing vegetation, proposed vegetation loss and resulting loss and/or fragmentation of habitat for fauna will be presented. Generally, species dependence, niche specificity, community structure and diversity will be considered.
- The presence of bats will also be determined. A description will be given of:
 - ✓ Different ecosystem types including cave and sinkholes and their species, if present
 - ✓ Nocturnal species within the project site.
 - ✓ Flight and behavioral patterns of bat species identified (Attention will be paid to the species of tree dwelling bats (*Ariteus flavescens*) inhabiting areas in close proximity to the proposed alignment)
 - ✓ Habitat of flora
 - ✓ Biological diversity importance of the area
 - ✓ Invasive and economically important species
 - ✓ Mitigation measures to avoid or minimize negative impacts on wildlife, wildlife habitat and vegetation communities/ecosystems.
 - ✓ Anticipated changes to wildlife and vegetation within the study area will also be examined and documented

A map(s) illustrating the location of all ecosystem types will be included.

- **Socio-economic and Cultural:**

The section on socio-economic and cultural environment will provide a detailed description of:

- Population Demographics: population size, age distribution, gender composition
- Community structure: community groups, community programmes and projects
- Social infrastructure and facilities: education, health and welfare facilities and infrastructure
- Infrastructure: water, electricity, telecommunications
- Economic structure: Employment and income, economic opportunities, programme and projects
- Cultural traditions/customs
- All existing resource users (including traditional users) ranging from subsistence utilization of the natural resources to commercial activities
- Archaeological features: The historical importance (heritage, archaeological sites and feature) and other material assets of the area will be examined if applicable.

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- Land Use: Present and proposed land use (including settlements, commercial, tourism, bauxite mining and other uses. Details including nature and magnitude, proximity to site etc. will be included.);
- Transportation and traffic considerations: transportation of heavy equipment, road construction and modification and associated traffic considerations (particularly in the construction phase), planned development activities; issues relating to squatting and relocation and public health and safety will be covered
- Public Perception: An assessment of public perception of the proposed development will be conducted using appropriate methods and tools such as public meetings and/or questionnaires/surveys.

5.4 Analysis of Alternatives

An examination and evaluation of the project and potential alternative of not proceeding with it will be taken into consideration in the ESIA. The evaluation will include:

- An analysis of the alternative means of carrying out the Project, including need for the project, alternative sites, alternate projects and variations to the scope of the project (major components included and excluded) and if any of the alternatives could result in a minimization of adverse impacts. For the project components, a comparison of their environmental and technical performance potential and other relevant variables will be included.
- A discussion on the status of any ongoing analyses, including a discussion of the options not chosen and the rationale for their exclusion.
- Contingency plans if major project components or methods prove infeasible or do not perform as expected; and
- The implications of a delay in proceeding with the Project, or any phase of the Project.
- Examination of the 'do nothing' alternative

5.5 Risk Assessment and Emergency Response

It is understood that the Project Engineer will consider a hazard risk mitigation plan (such as cyclones, tornadoes, droughts, floods, earthquakes, road accidents, etc.) during the initial planning and design stage. Depending on the timing, the results of this will be summarized in the ESIA and used to inform the Emergency Response Plan which will be coordinated with the surrounding community and resources.

5.6 Impact Assessment and Mitigation Measures

The approach to the assessment of environmental and social impacts will be based upon the changes in the receiving environment caused by the Project, followed by an assessment of the overall significance of these changes, compared with the baseline condition. This section will predict and assess the project's likely positive and negative direct and indirect impacts on physical, biological, socioeconomic environment in the project's area of influence, in

TOR for ESIA of 1.49 MWp Industrial Rooftop Solar Project of Naafco Pharma Limited (NPL), Bhaluka, Mymensingh.

quantitative terms as far as possible; identify mitigation measures and any residual negative impacts that cannot be mitigated; explore opportunities for enhancement; identify and estimate the extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topics; and examine transboundary, and cumulative impacts as appropriate. Wherever possible, impacts will be quantified and/or represented via GIS mapping. Where such assessment is not possible or practicable, impact assessment will be based on expert professional judgment and informed by the results of consultation. The environmental significance will be judged in relation to applicable national/international environmental standards. The impact assessment exercise will cover all related project activities and the full project lifecycle (i.e. construction, operations, etc.). Mitigation measures will be coordinated with the Project Engineer to identify the embedded mitigations and determine the need for any additional mitigation measures.

5.7 Environmental Management and Monitoring Plan

In this section the set of mitigation and management measures to be adopted during project implementation to avoid, reduce, mitigate, or compensate for adverse environmental impacts (in that order of priority). It may include multiple management plans, sub plans and actions. It will include the following key components:

(i) Mitigation: Under mitigation the ESMP will:

- (a) Identify and summarize anticipated significant adverse environmental impacts and risks;
- (b) describe each mitigation measure with technical details, including the type of impact to which it relates and the conditions under which it is required (for instance, continuously or in the event of contingencies), together with designs, equipment descriptions, and operating procedures, as appropriate; and
- (c) Provide links to any other mitigation plans (for example, for involuntary resettlement) required for the project.

(ii) Monitoring: Under monitoring the ESMP will:

- (a) describe monitoring measures with technical details, including parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits and definition of thresholds that will signal the need for corrective actions; and
- (b) Describe monitoring and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures and document the progress and results of mitigation.

(iii) Implementation arrangements: Under the implementation arrangements the ESMP will:

- (a) Specify the implementation schedule showing phasing and coordination with overall project implementation;
- (b) describe institutional or organizational arrangements, namely, who is responsible for carrying out the mitigation and monitoring measures, which may include one or more of the following additional topics to strengthen environmental management capability: technical

TOR for ESIA of 1.49 MWp Industrial Rooftop Solar Project of Naafco Pharma Limited (NPL), Bhaluka, Mymensingh.

assistance programs, training programs, procurement of equipment and supplies related to environmental management and monitoring, and organizational changes; and

(c) Estimate capital and recurrent costs and describe sources of funds for implementing the environmental and social management plan.

(iv) Performance indicators: Here the desired outcomes as measurable events will be described to the extent possible, such as performance indicators, targets, or acceptance criteria that can be tracked over defined time periods.

5.8 Institutional Arrangement, Capacity building and Grievance Redress Mechanism

Assessment of institutional capacity of the implementing agencies will be conducted for effective implementation of environmental and social management and monitoring plan. To identify the responsible institutes for implementation and supervision of the environmental and social management and monitoring plan (ESMMP). Assess training needs of these agencies and propose capacity building measures and institutional arrangements to strengthen these agencies along with the cost estimates.

In this section the grievance redress framework (both informal and formal channels) will be described, prepared for the power plant project, setting out the time frame and mechanisms for resolving complaints about environmental and social performance.

5.9 Information Disclosure, Consultation, and Participation

This section will:

(i) Describe the process undertaken during project design and preparation for engaging stakeholders, including information disclosure and consultation with affected people and other stakeholders;

(ii) summarize comments and concerns received from affected people and other stakeholders and how these comments have been addressed in project design and mitigation measures, with special attention paid to the needs and concerns of vulnerable groups, including women, the poor, and Indigenous Peoples; and

(iii) Describe the planned information disclosure measures (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation with affected people and facilitating their participation during project implementation.

5.10 Conclusion and Recommendation

This section will provide the conclusions drawn from the assessment and present the recommendations.

6 CONTENTS OF THE ESA REPORT

The ESIA Report will have the following outline:

TOR for ESIA of 1.49 MWp Industrial Rooftop Solar Project of Naafco Pharma Limited (NPL), Bhaluka, Mymensingh.

Executive Summary		
1.0	Introduction	
1.1	Project Background and Rationale	
1.2	Project Objectives and Benefits	
1.3	ESIA Methodology	
1.4	ESIA Study Team	
2.0	Project Description	
2.1	Project Location and Design	
2.2	Design Considerations	
2.3	Civil Works	
2.4	Project Schedule	
2.5	Decommissioning	
3.0	Legal and Policy Framework	
3.1	Applicable Policies	
3.1.1	National Policies	
3.1.2	International Policies	
3.1.3	Funding Agencies' Policies	
3.2	Applicable Legislation	
3.2.1	National Legislation	
3.2.2	International Legislation	
3.2.3	Funding Agencies' Legislation	
3.3	Recommended Standards	
4.0	Technological Aspects	
4.1	Proposed Process and Technology	
4.2	Adequacy of Solar Irradiation	
4.3	Plant Capacity Selection	
4.4	Adequacy of Generator Size	
4.5	Adequacy of Energy Storage Requirement	
5.0	Analysis of Alternatives	
5.1	Do Nothing	
5.2	Alternative Energy Generation Technology	
5.3	Alternative Land Use	
5.4	Alternative Site	
6.0	Description of Environment and Social Baseline	
6.1	Physical Environment	
6.1.1	Climate	
6.1.2	Ambient Air Quality	
6.1.3	Physiography	
6.1.4	Regional and Site Topography	
6.1.5	Geology	
6.1.6	Physiography	
6.1.7	Soil Quality	
6.1.8	Agro-ecological Zones within the Project Area	
6.1.9	Hydrology	
6.1.10	Noise Assessment	
6.1.11	Seismicity	

TOR for ESIA of 1.49 MWp Industrial Rooftop Solar Project of Naafco Pharma Limited (NPL), Bhaluka, Mymensingh.

	6.1.12	Climate Change and Natural Hazards
6.2		Ecological Environment
	6.2.1	Bio-ecological Zones
	6.2.2	Terrestrial Flora and Fauna
	6.2.3	Aquatic Flora and Fauna
	6.2.4	Protected Areas and Red Book Species
6.3		Social Environment
	6.3.1	Administrative Information
	6.3.2	Demographic Information
	6.3.3	Utility Services
	6.3.4	Land use
	6.3.5	Transports and Communications
	6.3.6	Livelihoods
	6.3.7	Education
	6.3.8	Health
	6.3.9	Recreational Activities
	6.3.10	Archaeological and Cultural Heritage
	6.3.11	Community Organisations
7.0		Anticipated Impacts and Mitigation Measures
7.1		Environmental and Social Considerations
7.2		Significant Environmental and Social Impacts
	7.2.1	Pre-construction Phase
	7.2.2	Construction Phase
	7.2.3	Operation Phase
	7.2.4	Decommissioning Phase
7.3		Cumulative Impacts
7.4		Summary of Significant Impacts
8.0		Environmental and Social Management Plan
	8.1	Objectives
	8.2	Environmental and Social Management Plan (EMP)
	8.3	Environmental and Social Monitoring Plan (ESMoP)
9.0		Environmental and Social Benefit
	9.1	Energy and Climate Concern
	9.2	Energy and Livelihood Concern
	9.3	Energy and Economy Concern
10.0		Conclusions and Recommendations
	10.1	Conclusions
	10.2	Recommendations
		References
		Appendix

Appendix B: Air Quality Test Reports



Development Solutions Consultant Limited

Multidisciplinary Development Consultants

DSCL Laboratory

Name of the Project	Environmental & Social Impact Assessment (ESIA) Of 1.49 MWp Industrial Rooftop Solar Project of NAAFCO Pharma Limited (NPL), Bhaluka, Mymensingh
Description of Sample	Ambient Air Quality
Sampling ID	NPL_AAQ (Beside Production & Administrative Building, NAAFCO Pharma Limited, Bhaluka, Mymensingh)
Sample Collector	Collected by DSCL Personnel
Sampling Date	27 October 2021

Test Result of Ambient Air Quality Analysis

Parameter	Unit	NPL_AAQ	Bangladesh Standard	Duration (hours)	Weather Condition	Method of Analysis
		24.443630°N 90.346785°E				
		27 October 2021				
		Beside Production & Administrative Building, NAAFCO Pharma Limited, Bhaluka, Mymensingh				
PM _{2.5}	µg/m ³	43.65	65	24	Sunny	AEROQUAL Series 500 Particulate matter monitors
PM ₁₀	µg/m ³	102.50	150			AEROQUAL Series 500 SOx monitor
SO _x	µg/m ³	17.8	365			AEROQUAL Series 500 NOx monitor
NO _x	µg/m ³	23.2	100	Annual		AEROQUAL Series 500 O ₃ monitor
O ₃	µg/m ³	<1	NYS	8		Lutron Air Quality Meter (AO-9901SD)
CO	ppm	2	9			

** The Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19th July 2005 vide S.R.O. No. 220-Law/2005.

**NYS- Not Yet Standardized

Sample Site Description

Location	Sample Site Description
NPL_AAQ (Beside Production & Administrative Building, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ The weather was sunny ➤ Traffic movement was low ➤ People movement was moderate ➤ Visible Dust particle was low

Test Performed by:
Muhammad Anwar Iqbal
Jr. Environmental Specialist



Checked by:
Saiful Islam Imran
Deputy Manager



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Appendix C: Noise Level Measurements Reports



Development Solutions Consultant Limited

Multidisciplinary Development Consultants

DSCL Environmental Laboratory

Name of the Project	Environmental & Social Impact Assessment (ESIA) Of 1.49 MWp Industrial Rooftop Solar Project of NAAFCO Pharma Limited (NPL), Bhaluka, Mymensingh
Description of Sample	Noise Level Measurement
Sample Collector	Collected by DSCL Personnel
Sampling Date	27 October 2021

Test Result of Noise Level Analysis

Sample ID	Sample Location	GPS Location	Land Use Category	Time		Noise Level (dBA) (LAeq)	Bangladesh Standard (dBA) **
				Start	End		
NPL_NM_01	Near Production & Administrative Building	24.443631°N 90.346786°E	Industrial	01:10 pm	01:40 pm	56.28	75
NPL_NM_02	Beside Raw Materials Loading-Unloading Area	24.444462°N 90.347253°E		01:45 pm	02:15 pm	61.50	
NPL_NM_03	Beside Chemical Storage Area, NAAFCO Pharma Limited, Bhaluka, Mymensingh	24.443660°N 90.345961°E		02:20 pm	02:50 pm	48.27	
NPL_NM_04	Near Main Gate, NAAFCO Pharma Limited, Bhaluka, Mymensingh	24.443159°N 90.346520°E		03:10 pm	03:40 pm	64.45	

Notes:

- Land use category is based on the classification provided in the Noise Pollution Control Rules (2006)
- The sound level standards for the Industrial area are 75 at day time and 70 at night time.
- Noise Level is the average noise recorded during the monitoring period

Abbreviation: NM- Noise Measurement; dB- decibel

Test Performed By:
Muhammad Anwar Iqbal
Jr. Environmental Specialist



Checked By:
Saiful Islam Imran
Deputy Manager



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Description of the Surrounding Environment

Sample Location and ID	Sample Site Description
NPL_NM_01 (Beside Production & Administrative Building, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ Industrial Area ➤ Traffic volume was low ➤ People's movement was moderate ➤ Noise from Pharmaceutical Manufacturing Machineries
NPL_NM_02 (Beside Raw Materials Loading-Unloading Area, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ Industrial Area ➤ Traffic volume was moderate ➤ People's movement were moderate
NPL_NM_03 (Beside Chemical Storage Area, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ Industrial Area ➤ Traffic volume was low ➤ People's movement were moderate
NPL_NM_04 (Near Main Gate, NAAFCO Pharma Limited, Bhaluka, Mymensingh)	➤ Beside local road ➤ Industrial Area ➤ Traffic volume was moderate ➤ People's movement were moderate

A. Iqbal

Test Performed By:
Muhammad Anwar Iqbal
Jr. Environmental Specialist



Saiful Islam Imran

Checked By:
Saiful Islam Imran
Deputy Manager

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Appendix D: Surface Water Quality Test Reports



Development Solutions Consultant Limited

Multidisciplinary Development Consultants

DSCL Environmental Laboratory

Name of the Project	Environmental & Social Impact Assessment (ESIA) of 1.49 MWp Industrial Rooftop Solar Project of NAAFCO Pharma Limited (NPL), Bhaluka, Mymensingh
Description of Sample	Surface Water
Sampling ID	SW_NPL_01 (Khiro River, Near NAAFCO Pharma Limited, Bhaluka, Mymensingh) SW_NPL_02 (ETP Retention Pond, NAAFCO Pharma Limited, Bhaluka, Mymensingh)
Sample Collector	Collected by DSCL Personnel
Sampling Date	27 October 2021

On-site Test Result of Surface water

Parameters	Unit	SW_NPL_01	SW_NPL_02	Standards for Inland Surface Water**	Analysis Method
		24.446740°N 90.345328°E Khiro River, Near NAAFCO Pharma Limited, Bhaluka, Mymensingh	24.444730°N 90.346764°E ETP Retention Pond, NAAFCO Pharma Limited, Bhaluka, Mymensingh		
pH	-	7.82	7.75	6.5-8.5	Multimeter
Temperature	°C	29.3	27.1	20-30	
Total Dissolved Solids (TDS)	mg/L	975.9	561.3	NYS	
Electrical Conductivity (EC)	µs/cm	711.7	392.90	1200	
Dissolved Oxygen (DO)	mg/L	5.49	5.60	5 or more	DO Meter

**Standards for Inland Surface Water is followed Environmental Conservation Rule (ECR) '97 {Schedule-3(A)}
NYS = Not Yet Standardized

Test Performed By:
Muhammad Anwar Iqbal
Jr. Environmental Specialist



Checked By:
Rajib Roy
Deputy Manager



Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
Central Lab, 38-39, Mohakhali C/A, Dhaka-1212
 Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com



Lab Memo: 370/ CC, DPHE, CL, Dhaka

Date: 17-11-2021

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2021110175	Sample Receiving date: 31-10-2021
Ref. Memo No: DSCL/2021/Nill & Dated: 31-10-2021	Sample Source: River Water
Sent by: Muhammad Anwar Iqbal, Assistant Manager, DSCL, Mirpur DOHS, Dhaka.	Dist: Mymensingh, Upa: Bhaluka
Care Taker: DSCL (Sample ID : SW_NPL_01)	Union:, Vill.: Bandia, Meduary
Sample Collection date:	Date of Testing: 31/10/202-16/11/2021

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.20	mg/L	UVS	0.10
2	Biochemical Oxygen Demand (BOD)	0.2	1	mg/L	5 days incubation	0.1
3	Chemical Oxygen Demand (COD)	4.0	4	mg/L	CRM	-
4	Chloride	150-600	12	mg/L	Titrimetric	-
5	Cr (Total)	0.05	0.0003	mg/L	AAS	0.0003
6	Total Suspended Solid (TSS)	10	7	mg/L	Gravimetric Method	-
7	Turbidity	10	49.6	NTU	Turbidity Meter	-

Comments: Sample was collected & supplied by client.

N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 17.11.2021	1.) Name: Mita Sarker Designation: Senior Chemist	 17.11.2021
2.) Name: Taslima Akhter Designation: Sample Analyzer	 17.11.21	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 17.11.2021

Md. Biplab Hossain
 Chief Chemist
 Department of Public Health Engineering
 Central Laboratory Mohakhali, Dhaka



Government of the People's Republic of Bangladesh
Office of the Chief Chemist
Department of Public Health Engineering
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Lab Memo: 370/ CC, DPHE, CL, Dhaka

Date: 17-11-2021

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2021110176	Sample Receiving date: 31-10-2021
Ref. Memo No: DSCL/2021/NIIL & Dated: 31-10-2021	Sample Source: Pond Water
Sent by: Muhammad Anwar Iqbal, Assistant Manager, DSCL, Mirpur DOHS, Dhaka.	Dist: Mymensingh, Upa: Bhaluka
Care Taker: DSCL (Sample ID : SW_NPL_02)	Union:, Vill.: Bandia, Meduary
Sample Collection date:	Date of Testing: 31/10/202-16/11/2021

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Ammonia	0.5	0.15	mg/L	UVS	0.10
2	Biochemical Oxygen Demand (BOD)	0.2	10	mg/L	5 days Incubation	0.1
3	Chemical Oxygen Demand (COD)	4.0	40	mg/L	CRM	-
4	Chloride	150-600	15	mg/L	Titrimetric	-
5	Cr (Total)	0.05	0.0003	mg/L	AAS	0.0003
6	Total Suspended Solid (TSS)	10	3	mg/L	Gravimetric Method	-
7	Turbidity	10	32.5	NTU	Turbidity Meter	-

Comments: Sample was collected & supplied by client.

N.B: AAS- Atomic Absorption Spectrophotometer, UVS- UV-Visible Spectrophotometer, CRM-Closed Reflex Methods, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 17.11.2021	1.) Name: Mita Sarker Designation: Senior Chemist	 17.11.2021
2.) Name: Taslima Akhter Designation: Sample Analyzer	 17.11.21	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 17.11.2021

Md. Biplab Hossain
 Chief Chemist
 Department of Public Health Engineering
 Central Laboratory Mohakhali, Dhaka

Appendix E: Drinking Water Quality Test Reports



Development Solutions Consultant Limited

Multidisciplinary Development Consultants

DSCL Environmental Laboratory

Name of the Project	Environmental & Social Impact Assessment (ESIA) Of 1.49 MWp Industrial Rooftop Solar Project of NAAFCO Pharma Limited (NPL), Bhaluka, Mymensingh
Description of Sample	Drinking Water
Sampling ID	DW_NPL_01
Sample Collector	Collected by DSCL Personnel
Sampling Date	27 October 2021

On-site Test Result of Drinking water

Parameters	Unit	DW_NPL_01	Standards for Potable Water	Analysis Method
		24.443656°N 90.347168°E		
		Canteen, NAAFCO Pharma Limited, Bhaluka, Mymensingh		
pH	-	7.34	6.5-8.5	Multimeter
Temperature	°C	27.2	20-30	
Electrical Conductivity (EC)	µs/cm	97.3	600	
Total Dissolved Solids (TDS)	mg/L	64.2	NYS	
Salinity	ppm	5.39	<600	

NYS = Not Yet Standardized

Sample Site Description

Sample Location and ID	Sample Site Description
Canteen, NAAFCO Pharma Limited, Bhaluka, Mymensingh (DW_NPL_01)	- The sample was taken from the Canteen's tap water. - The water comes from the Central Reservoir. - The water is used for drinking and other domestic purposes. - Septic tank is 5m distance from the sampling source.

Test Performed By:
Muhammad Anwar Iqbal
Jr. Environmental Specialist



Checked By:
Saiful Islam Imran
Deputy Manager



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 Phone: 88-02-9881927, Fax: 88-02-9882003, Email: wqmsc_central_lab@yahoo.com



Lab Memo: 370/ CC, DPHE, CL, Dhaka

Date: 17-11-2021

Physical /Chemical/ Bacteriological Analysis of Water Sample

Sample ID: CEN2021110177	Sample Receiving date: 31-10-2021
Ref. Memo No: DSCL/2021/NIll & Dated: 31-10-2021	Sample Source: Others
Sent by: Muhammad Anwar Iqbal, Assistant Manager, DSCL, Mirpur DOHS, Dhaka.	Dist: Mymensingh, Upa: Bhaluka
Care Taker: DSCL (Sample ID : DW_NPL_01)	Union:, Vill.: Bandia, Meduary
Sample Collection date:	Date of Testing: 31/10/202-16/11/2021

LABORATORY TEST RESULTS:

Sl.#	Water quality parameters	Bangladesh Standard	Concentration present	Unit	Analysis Method	LOQ
1	Alkalinity	-	125	mg/L	Titrimetic	-
2	Arsenic (As)	0.05	0.002	mg/L	AAS	0.001
3	Biochemical Oxygen Demand (BOD)	0.2	1	mg/L	5 days Incubation	0.1
4	Chloride	150-600	510	mg/L	Titrimetic	-
5	Cr (Total)	0.05	0.0003	mg/L	AAS	0.0003
6	Hardness	200-500	360	mg/L	Titrimetic	-
7	Iron (Fe)	0.3-1	0.72	mg/L	AAS	0.05
8	Manganese (Mn)	0.1	0.03	mg/L	AAS	0.03
9	Turbidity	10	0.23	NTU	Turbidity Meter	-

Comments: Sample was collected & supplied by client.

N.B: AAS- Atomic Absorption Spectrophotometer, LOQ- Limit of Quantitation.

Test Performed by:	Signature	Countersigned/Approved by:	Signature
1.) Name: Md. Saiful Alam Khosru Designation: Sample Analyzer	 17.11.2021	1.) Name: Mita Sarker Designation: Senior Chemist	 12.11.2021
2.) Name: Taslima Akhter Designation: Sample Analyzer	 17.11.21	2.) Name: Md. Biplab Hossain Designation: Chief Chemist	 17/11/2021

Md. Biplab Hossain
 Chief Chemist
 Department of Public Health Engineering
 Central Laboratory Mohakhali, Dhaka



TEST REPORT NO: 1001357993

Nov.7,2021

UL ORDER NO: 14069966

Page : 1 of 3

Applicant : DEVELOPMENT SOLUTIONS CONSULTANT LIMITED Test Date : Oct.28 -Nov.7,2021
 Address : HOUSE-734, 1-A, ROAD-10, AVENUE-4, DOHS MIRPUR,
 DHAKA-1216, BANGLADESH

Contact Person : MUHAMMAD ANWAR IQBAL

Sample Description: DRINKING WATER (TAP WATER), SAMPLE ID: DW_NPL_01

Testing Protocol: ECR 1997 Standard

Project Name: Environmental Quality Test Assessment for Construction of 1.49 MW Industrial Rooftop Solar Project.

Water Source: Drinking Water (Tap Water)

Location: Bandia, Meduary, Bhaluka, Mymensingh

Sample Information :

Sample ID	Description	Equivalent Code / Color
001	Drinking Water (Tap Water)	DW_NPL_01

TEST	Sample ID
Total Coliform (TC)	001
Faecal Coliform (FC)	NC

Note:

For and on behalf of
 UL VS Bangladesh Ltd.

Md. Nur Alam – Lab Technical & Operations Manager

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TEST REPORT NO: 1001357993

Nov.7,2021

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(01) Total Coliform (TC)

Test Method: With reference USEPA 9132

Test ID	Detection limit, CFV/100ml	Result, CFV/100ml	Requirement, CFV/100ml	Comment
001	25	42	-	NC

(02) Faecal Coliform (FC)

Test Method: Membrane Filtration

Test ID	Result, CFU/100mL	Requirement, CFU/100mL	Comment
001	0	-	NC
" < " means "less than" ; "CFU" means "colony forming units"			

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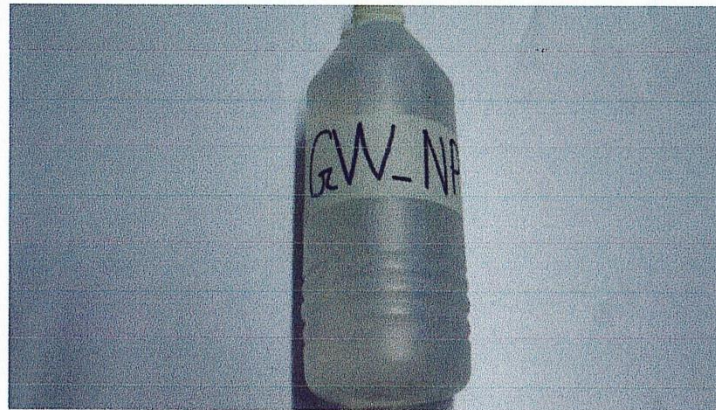


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Appendix F: FGD Participants Attendance List

FGD-1 Location: NAAFCO Pharma Limited Date: 27.10.2021 Time: 4:40 pm to 5.30 pm
(GPS: 24.44238⁰N, 90.35972⁰E)

Table: Details of Focus of Discussions

SI No.	Name	Occupation	Question/Comment	Response
01.	SK. Md. Khurshed Alam	HSE Head	- How the project will impact on surrounding environment? - Please mention both positive and negative sites.	As there is a boundary wall around the project area that separated it from the residential area, so, there will be less environmental impact on the environment.
02.	Md. Rakibul Ahsan	Engineering Head	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 and Mosque within 1 km radius.
03.	Mahbubul Alam	WH - Assistant Manager	- Are there any possibilities of impact on the surface water body (river, khal, pond etc.)? - If yes, how to mitigate?	Water quality is not affected by the Solar Power Plant construction. It is important for the project's proponent to confirm that no hazardous or waste materials were accidentally spilled or washed into nearby water bodies during construction, particularly during the monsoon season.
04.	Md. Majharul Islam	Manager, QA	- Are you in favor of this project? - Why?	It is true that we are all in favor of the project. We're grateful for the initiative you've taken on this. These projects have the potential to have a long-term positive impact on this region's economic and social conditions.
05.	Nur Hasan	Assistant Manager, HSE	- Are there any possibilities of air pollution in the area due to the project activities? - If yes, how to mitigate?	Because the project site is far away from residential dwellings, there is a small chance of anticipated impact, but proper care of panels, sensitive equipment, and other items should reduce it.



**Environmental & Social Impact Assessment (ESIA) of
1.49 MW Industrial Rooftop Solar Project of NAAFCO Pharma Limited (NPL),
Bhaluka, Mymensingh**

List of Participants in Public Consultation/FGD

Address: NAF NAAFCO Pharma Ltd., Bhaluka, Mymensingh.
 GPS: 24.44238, 90.34972
 Date: 27/10/2021 Time: 4:40 P.m.

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
01	Md. Shah Alam Bhuiyan	46	Private Service	01713274264	SAL 27/10/2021
02	SK. Md. Khurshed Alam	66	HSE Head.	01973062141	A. Abu 27/10/2021
03	Md. Rakibul Atisam	38	Engg. Head	01818329063	(Rakibul) 27/10/2021
04	Mahbubul Alam	32	NH- Asst Manager	01704117327	Arif 27/10/2021
05	Md. Majharul Islam	36	Manager, QA	01713274248	CJ 27/10/2021
06	Sujan Barua	44	Manager, PD	01313473 01313026718	Min 27/10/2021
07	Md. Mohsin Hossain	37	Manager (Chemist)	01704117344	MD 27/10/2021
08	Nur Hasan	30	Asst. Manager HSE	01716416694	Nur Hasan 27/10/2021
09	Mahmudur Rahman CH	44	Asst. Manager Dist.	01713336352	Saleh 27/10/2021
10	JPLan K. G. Ash	60	Director	01713274262	MAHMOUD 27/10/2021
11	Abdullah al Fakir Khan	29	Officer	01713371372	Fakir 27/10/2021

Facilitated By Anwar Iqbal

Signature [Signature]

FGD-2 Location: Near NAAFCO Pharma Limited Date: 27.10.2021 Time: 3:20 pm to 4.00 pm
 (GPS: 24.443630°N, 90.346785°E)

Table: Details of Focus of Discussions

SI No.	Name	Occupation	Question/Comment	Response
01.	Md. Shah Alam	Shopkeeper	Will the upcoming solar power plant create employment opportunities for the local people?	During construction period, the proposed project will provide an employment opportunity to semi-skilled and unskilled worker. The priority of employment will be provided to local villagers/residents on the basis of their skill and qualification.
02.	Md. Atik Hasan	Teacher	- What's type of technology are being used in this project? - How much power can be generated from the project?	A brief introduction about the proposed project has been given to local community by consultant team. It has been told that it is a Solar PV Technology based on 1.494 MWp Solar Power Plant proposed at NAAFCO Pharma Limited.
03.	Sree. Suttan Roy	Businessman	Will the solar power plant project pose a risk to human health and the environment?	No. It is considered safe to human health and the environment. It does not present any risks to public health and the environment.



**Environmental & Social Impact Assessment (ESIA) of
1.49 MW Industrial Rooftop Solar Project of NAAFCO Pharma Limited (NPL),
Bhaluka, Mymensingh**

List of Participants in Public Consultation/FGD

Address: Near Natco Pharma Ltd., Bhaluka, Mymensingh.

GPS: 24.443630, 90.346785

Date: 27/10/21 Time: 3:20 Pm.

SL No.	Participant's Name	Age	Occupation	Telephone No.	Signature
	তারেক হোসেন	৪০		০১৭১২৪৬৭৫৪৭	
	জাহা	৩০		০১৬২০৬৪১৬২৪	
	Manif	২৩	no	০১৮৩৪৩৫৭৬৩২	
	Md. Atik Hasan	৩০		০১২৪৬২৭৭২৪	
	Md. Mizanur Rahman	৪০		০১৭১৪২৪০০০৬	
	Md. Ruzel Mia	২০		০১৭২৪৬৫৬৬৩	
	Md. Masud Rana	৩৪		০১৭১৪৭৭২৩৭২	
	Imren Hossain Bebi	২৭		০১৭১০৭৭৭২০	
	Sree. Satten Ray	২০		০১৭২৭৭৭৭৩৯১	
	Md. Samad	২৫		০১৭০৫৭১৫৪৭৭	
	Mr. Jishu	৬০		০১৭৪৭০৭৭৭৭	

Facilitated By Anwar Jibal

Signature