

Environmental & Social Impact Assessment (ESIA) Report for USA Agro and USA Auto Bricks Limited (UABL)

**Prepared by
DevGlow Consulting**

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EXECUTIVE SUMMARY

Fired clay bricks are one of the most important construction materials in Bangladesh. Bangladesh stands as the fourth largest brick producer in the world. The country has more than 7,000 brick kilns, producing about 23 billion bricks annually. The industry accounts for approximately 1% of the country's GDP and generating employment for more than a million people. Bangladesh has a population of 159.9 million and at current growth rate, Bangladesh will require constructing approximate 4 million new houses annually to meet the demand for the growing population and that, in turn, will lead the growth for the brick sector.

Brick making is considered an ancient art. It has been used from the ancient time and now used enormously in modern construction in everywhere. Modern auto bricks use refined technology and machines to do the firing work. Auto bricks are environment friendly and have the highly ingenious kiln technology that ensures lower energy usage, superior quality brick production and decreases air pollution.

This report has been prepared for a coal based tunnel kiln brick manufacturing project undertaken by USA Agro and USA Auto Bricks Limited (UABL). This ESIA report contains the findings and results achieved from identification of the current condition and evaluation of possible impacts and accordingly recommendation of possible mitigating and enhancing measures for negative and positive results, respectively.

The description of the environment and social baseline conditions are made encompassing all relevant current baseline data on the environmental and social characteristics of the study area including physical, biological, ecological and social environments. In the backdrop of the above scenarios, the relevant regulations and standards governing environmental quality, health and safety, protection of sensitive areas, protection of endangered species, land use control, land acquisition, compensation, etc. at every level are described.

Viewed against these, all significant impacts were identified and evaluated including atmospheric emissions and changes in ambient air quality, discharge of effluent and ambient water quality impacts, changes in ambient noise and local land use patterns, impacts due to land acquisition, impacts of the project and its activates on the community's access to social infrastructure and local developments.

Following identification of potential impacts, efforts have been taken to distinguish between positive and negative impacts, direct and indirect impacts including impacts from possible accidents and long-term impacts. Attempts are made to describe the impacts quantitatively in terms of environmental and social cost and benefits and

assigning economic values where feasible. In addition, an analysis was conducted of reasonable alternatives in meeting the ultimate objects of the project.

As a part of this ESIA, public consultation was conducted including community members and local stakeholders. The objective of the consultation process was to share the views of the respondents about the proposed project. The community people expressed optimistic views concerning potential employment and related income opportunities throughout the life cycle of the project. The local stakeholders also expressed much positive response to the Project due to the high demand for quality bricks in the region and lack of long term income opportunities in the locality.

Finally, an Environmental Management Plan (EMP), Occupational Health & Safety Plan (OHS), Emergency Response & Disaster Management Strategies and a Grievance Redress Mechanism (GRM) have been developed and proposed to integrate into the project implementation process. The proposed plans, strategies and mechanisms include feasible and cost-effective measures to prevent or reduce significant negative impacts to an acceptable level and containing detailed implementation plans, monitoring indicators and clear allocation of responsibility among project sponsors, construction contractors, government agencies, and community-based organizations. Issues and concerns of the people exposed to potential impacts have been taken into consideration and compliance with national laws and regulations have been maintained throughout the development and preparation stage of this ESIA report.

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CHAPTER-1: INTRODUCTION

1.1. Rationale of the Study

In Bangladesh, brick is the predominant building material in urban areas. It has become significant building material even in the rural areas. High prices and/or scarcity of alternate building material such as, stones, iron sheets, wood, bamboo, and straw are increasing the demand for bricks at a very high rate. To meet the increasing demand, brickfields are mushrooming all over the country with heavy concentrations at the outskirts of urban areas. With increasing demand for bricks, more and more paddy fields are being converted to brickfields thus putting tremendous pressure on the already scarce agricultural land of the country. The haphazard growth of the brick industry is completely unsustainable. There is an urgent need for making it more efficient both in terms of fuel and land usage.

According to Bangladesh Brick Manufacturers Owners Association (BBMOA), there are 3,935 registered brick kilns and more than 4,000 unregistered brick kilns in Bangladesh. About 90% of the existing brick kilns are fixed chimney based, highly energy intensive and release huge amount of carbon. Each year about 9.8 million tons of GHG is emitted for manufacturing about 17.2 billion bricks. The cost of brick manufacturing can be minimized and the amount of GHG emission can be reduced by applying advanced technology like Hybrid Hoffman, Tunnel etc.

It is to mention that the proposed project named “USA Agro & Auto Bricks Limited” is of a Tunnel Kiln based intervention with the capacity of 120,000 pcs of solid bricks per day. The proposed Project site consists of an area of 8 acres at Angaria Union, Dumki Upzilla in Patuakhali District. The site is 14 km away from Patuakhali Sadar. The Project site is easily accessible by 30 feet road named Doshnima-Lebukhali Road and also through river ways by the Payra River. Patuakhali Science and Technology University is only 3 km away from the site and the proposed Lebukhali Cantonment is on the other side of the Payra River.

In order to avail financing from lenders and also to ensure compliance with national guidelines and benchmark, the project requires an Environmental and Social Impact Assessment (ESIA) Study. The ESIA study and report cover the aspects of potential environmental, occupational and social impacts as well as possible mitigation measures. To facilitate the assessment, the project authority engaged DevGlow Consulting to undertake Environmental and Social Impact Assessment (ESIA) of the proposed brick manufacturing plant. This report presents the findings of the ESIA study conducted by the team of experts of DevGlow Consulting along with recommendations and mitigation plans.

1.2. Objectives

1.2.1. Broad Objective

The core purpose of the study is to provide an examination and assessment of the principal environmental impacts of an automatic brick manufacturing industry. The study covers not only physical and chemical aspect, but also the human dimension or social aspect. The study purpose also includes outlining an environmental management plan with an indication of the extent of work to be done to keep the development and environment compatible.

1.2.2. Specific Objective

The major objectives of the ESIA are described but not limited to the following:

- To present an overview of the project and relevant environmental regulation thereof.
- To assess the baseline environmental and social conditions in the Project area.
- To identify the potential environmental, social and occupational impacts due to the Project.
- To propose appropriate mitigation and monitoring measures to minimize adverse environmental, occupational and social impacts as per national and international standard practices.
- To propose required emergency preparedness and disaster management strategies and frameworks.
- To integrate the environmental regulations and propositions into project implementation.

1.3. Scope of the Study

The ESIA will cover the environmental, occupational and social impacts of the following three major components of the Project:

1. Establishing and operating an energy efficient brick manufacturing plant
2. Sourcing of soil, coal and clay in a sustainable manner
3. Ensuring traffic safety and other relevant comfort to adjacent community

1.4. Methodology

This ESIA report has been developed based on the review and collection of primary and secondary sources of information. Primary sources have included observations, stakeholder consultation outcomes and the results of survey & FGD. Secondary sources included published material, statistics, maps and results from other investigative methods. Information and data collected from primary and secondary sources have been summarized to develop a robust, reliable and detailed baseline case. This baseline

is used as a standard to which the proposed Project can be compared in order to determine appropriate potential impacts and suitable mitigation and management measures.

1.4.1. Primary Sources

DevGlow team members have undertaken field visit to the project location and conducted various meetings, interview and discussion with key stakeholders to collect primary data. Our approach to conduct this study is based on key participatory elements entailing “Key Informant Interviews (KII)”, “Focus Group Discussions” and “Stakeholder Participation” followed by Qualitative and Quantitative Analysis and a series of consultations. Elementary descriptions on utilization of the techniques are mentioned below:

- **Consultative Meeting:** This included start-up consultation with the project management including Managing Director, Director, and investment officials from IDCOL.
- **Key Informant Interview:** In-depth one to one interview has been conducted with key local stakeholders to understand baseline environmental and socio-economic consideration. The informants include Government officials, NGO officials, School teachers and respected community members. A list of key informants interviewed has been attached with this report.
- **Focus Group Discussion:** The ESIA study team members conducted two FGDs, one consisting male participants and the other consisting female participants. The demographic of the participants was limited to the community members living within 1 km radius of the manufacturing plant are to collect information on baseline condition and gain insight on stakeholder participation.

1.4.2. Secondary Sources

The ESIA consultants gathered required secondary data from dependable and consistent sources. They have applied standard EIA framework, EMP guideline, DMP manual, OHS system and other relevant project matrix to review and analyze information from secondary sources. This includes but not limited to the following:

- **Desk Research:** The desk research involved review of company brochure, project profile and other relevant documents and analysis of related environmental laws, regulations and guidelines of Govt. of Bangladesh, multilateral donor agencies like Asian Development Bank and World Bank. This also included reviewing published documents, reports, websites and other relevant information available online to develop an understanding of the

project's managerial and operational activities and consider relevant guidelines and procedures.

- **Data Collection:** Historical weather and environmental data was collected from Bangladesh Meteorological Department (BMD), local Union office and other relevant government entities.

1.5. Limitation

The ESIA investigation may not exhaustively cover all possible aspects and circumstances that may occur. However, an effort is made to discover all meaningful areas under the stipulated time available. Services performed by the consultant are conducted in a manner consistent with that level of care and skill generally exercised by members of the engineering and consulting profession. The consultants have faced some constraints in conducting the study that are outlined below:

- The study was assigned to conduct within a very short time period. The consultants have made rigorous effort to discover all meaningful areas under the stipulated time available.
- The nearest BMD station from the project location is Patuakhali. Thus the historical analysis is based on the data gathered from this station. Due to distance of the station from the project site, the data analysis may slightly differ from the actual baseline scenario. Specific circumstances and condition of site can change due to which conclusion and opinions may also change.
- The consultants have to rely in good faith on information provided by the project management and other key informants. The Consultants assume that the information provided by community members and other informants interviewed are factual and accurate and accept no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omission or misrepresentation of any person interviewed or contacted.

It should be recognized that the information given in this report is time specific and with the constraint of time the relevancy of data and analysis may suffer.

1.6. ESIA Consultant

The ESIA has been conducted by professional consultants of DevGlow Consulting, a multidimensional research and management consulting firm with core focus in providing professional advisory, technical assistance and project management services to both public and private sector organizations. Its goal is to facilitate sustainable

economic and social development by offering advanced research, hands-on training and progressive consultancy services. DevGlow has expertise in various dimensions of project management cycle ranging from project initiation to project implementation, project monitoring & impact assessment. The firm has specialization in feasibility assessment, policy & strategy formulation, monitoring & evaluation, institutional strengthening and capacity development. DevGlow combines professional knowledge, expertise and experiences of highly competent researchers, consultants and trainers from a wide range of sectors. A team of highly skilled and competent experts are associated with DevGlow. Benchmark service quality and highest professional integrity are core strength of the organization. We understand that every client is unique. Thus we utilize a customized approach to address every client's demand through innovation and optimization.

CHAPTER-2: POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK

Regulatory requirements toward protection and conservation of environment and various environmental resources and also toward protection of social environment from adverse impact of brick manufacturing projects and activities associated with them have been enunciated by the Govt. of Bangladesh and other multilateral donor agencies. Policy and regulations pertinent to the project are briefly discussed in this chapter.

2.1. Bangladesh Environment Conservation Act, 1995

The Bangladesh Environment Conservation Act, 1995 (ECA '95) is the principle legislation for protection of environment in Bangladesh. This Act is promulgated for environment conservation, environmental standards development and environment pollution control and abatement. The law aims to conserve and improve the environmental quality and control and mitigate environmental pollution.

The enabling powers of the ECA'95 are wide ranging and allow for the formation of a Department of Environment (DOE) and the appointment of a Director General (DG) to oversee the department. Wide-ranging powers are also given to the DG to take various actions or measures to enforce the ECA'95.

The main highlights of the act are:

- Declaration of Ecologically Critical Areas;
- Obtaining Environmental Clearance Certificate;
- Regulation with respect to vehicles emitting smoke harmful for the environment;
- Regulation of development activities from environmental perspective;
- Promulgation of standards for quality of air, water, noise, and soils for different areas and for different purposes;
- Promulgation of acceptable limits for discharging and emitting waste;
- Formulation of environmental guidelines relating to control and mitigation of environmental pollution, conservation and improvement of environment

2.2. Environment Conservation Rules, 1997

The Environmental Conservation Rules (ECR), 1997 is the main subsidiary legislation of the Bangladesh Environment Conservation Act, 1995 which outlines various procedures or measures that need to be taken for compliance with the related provisions of the ECA'95. The ECR provides specific rules and procedures for various categories of

projects in relation to their approval prior to construction and operation. Considering sites and the impact on the environment, the industrial units and projects have been classified into four categories given below:

Table 2.1: Project Classification as per ECR, 1997

Green	<i>Projects with positive environmental impacts or negligible negative impacts</i>
Orange A	<i>Projects with minor and mostly temporary environmental impacts</i>
Orange B	<i>Projects with moderately significant environmental impacts for which mitigation measures are easily identified</i>
Red	<i>Projects which may cause 'significant adverse' environmental impacts</i>

ECR 1997 also includes Environmental standards which were prescribed for varying water sources, ambient air, noise, odour, industrial effluent and emission discharges, vehicular emission, etc. with the main aim of limiting the volume and concentrations of pollution discharged into the environment. While these standards are intended to assist project planners in determining measures to be taken to comply with these requirements, it is the ultimate responsibility of the Project Proponent to ensure that the environmental impacts arising from their projects are minimal or within acceptable levels that will protect the environment.

ECR 1997 requires three tiers of Environmental Assessment:

- Screening: required for all projects;
- Initial Environmental Examination (IEE): required of Orange B and Red category projects; and
- Environmental Impact Assessment (EIA): required of Red category projects.

In the context of the ECR 1997, screening would be in reference to determining the category in which the project or activity falls under (Schedule 1 of the Regulations). Upon determination as to which category the project or activity falls into, the process of environmental assessment and approval will follow that which is prescribed in the Regulations.

Brick kilns are classified as Orange B projects under the ECR 1997, hence mandatory for IEE to be prepared and submitted to the DOE. An IEE is typically a preliminary Environmental Impact Assessment study that is normally carried out at the early stage of project planning and is used to identify and estimate the potential environmental impacts from the project activities. IEE is normally done within a short time duration based on preliminary information that is readily available through environmental reconnaissance. In the context of the ECR 1997, an IEE is required to be submitted for obtaining location clearance from the DOE.

2.3. Emission Standard for Brick Kiln

Discharges and emission due to construction and operation of brick kilns must comply with appropriate standards and limits that have been set out in the Environmental Conservation Rules 1997 (ECR 1997). Emission standard for particulate matter is the only standard specific to brick kiln stipulate in ECR 1997. Emission standard for particulate matter stipulated in schedule 11 of ECR 1997 is 1000 mg/Nm³. In case of absence of other specific standards for brick projects, the standards and limits prescribed for industries is deemed applicable for the discharges and emissions arising from the brick activities.

2.4. Brick Kiln Policy, 2008

The Brick Kiln Policy 2008 has been formulated with the focus of controlling indiscriminate establishment of brick kilns, using the tool of environment clearance certificate issued by the Department of Environment under the Bangladesh Environment Conservation Act, 1995. The Brick Kiln Policy is based on 3 objectives and 7 issues.

2.4.1. Objectives

The objectives of this policy is threefold, namely

1. Ensure that brick kilns are established in suitable locations complying regulations;
2. Ensure rational and efficient use of natural resources e.g., soil, water.
3. Control environmental pollution and improvement of environment, where applicable.

2.4.2. Issues

The Brick Kiln Policy 2008 provides the framework for management of brick sector, focusing on 7 different issues elaborated below:

1. Locational Aspects
2. Operational Aspects
3. Re-locational Aspects
4. Environmental Pollution Control Aspects
5. Environmental Clearance and Monitoring Aspects
6. Research and Development
7. Policy Formulation Aspects

2.5. Brick Manufacturing and Brick Kiln Establishment (Control) Act, 2013

The first act to regulate brick burning was formulated during 1989 which was named as Brick Burning (Control) Act, 1989. That act was emendated (revised) twice and the revised versions were published as Brick Kiln (Control) (Amendment) Act, 1992 and Brick Kiln (Control) (Amendment) Act, 2001. However, in November 2013, a new law in this regard was formulated which is referred to as Brick Manufacturing and Brick Kiln Establishment (Control) Act, 2013. This act came into force on 1st of July 2014.

This act strictly bans the establishment of brick kilns in residential, business and preserved areas, agricultural land, government or private forests, orchard, sanctuary or wetland, degraded air shed and in ecologically critical area. It also restricts the collection of soil from agricultural land, mountains, and hillocks for manufacturing bricks. However, no one would be able to collect soil from haor-baors, ponds, canals, beels, river beds, chars and fallow land for brick manufacturing purpose without the permission from appropriate authority. In order to reduce the use of soil, this act requires all the brick kilns with modern technology to prepare at least 50% hollow brick. This act prohibits burning fuel wood or any kind of wood for brick burning. Moreover, it proscribes the use of coal which exceeds the standards of sulphur, mercury, ash contents or other similar substances. Violation of this law would cause a person a maximum of 5 years of jail and/or BDT 500,000. All the punishable crimes under this law would be incognizable and bailable.

Table 2.2: Relevant Provisions of the Brick Manufacturing and Brick Kiln Establishment Act, 2013

Relevant Section	Summary of Provision Under the Section
Section 4	Prohibits brick manufacturing without taking license from the Deputy Commissioner of the district.
Section 5 (1)	Bans collection of soil from agricultural land, hill or hillock for brick making.
Section 5 (2)	Requires permission from appropriate authority for collection of soil for brick manufacturing from haor-baors, ponds, canals, beels, river beds, chars and fallow land.
Section 5 (3)	Minimum 50% hollow bricks shall be made in the brick kilns with modern technology.
Section 6	Bans fuel wood in brick kilns for burning bricks
Section 7	Proscribes the use of coal, exceeding the standards of sulphur, mercury, ash contents or other similar substances in the brick kilns.
Section 8(1)	Bans the establishment of brick kilns within the boundary of residential, commercial or preserved area, municipality or upazila headquarters,

	forest, orchard, wetland, sanctuary, agricultural land, ecologically critical area and degraded air shed.
Section 8(2)	Bans the establishment of brick kilns in the following distance or places, namely: (a) within 1 kilometer distance from the boundary of prohibited areas (mentioned above), (b) within 2 kilometers distance from boundary of public forest, (c) within half kilometer distance from the foot of the hill or hillock, (d) within 1 kilometer distance from any special structure, railways, educational institutions, hospitals and clinics, research institutions or any other similar place or institution, and (f) with half kilometer distance from upazila (sub-district), union or rural roads made by Local Government Engineering Department (LGED).
Section 12(1)	Requires forming a Search Committee in each district consisting of an Additional Deputy Commissioner, Upazila Executive Officer, Upazila Health Officer, Upazila Agriculture Officer, Divisional Forest Officer and a district officer of the Department of Environment.
Section 12(2)	Outlines functions of the Search Committee which include making recommendation regarding issuance or renewal of license.

2.6. Bangladesh Labour Act, 2006 (amended in 2013)

The Bangladesh Labour Act, 2006 deals with the employment of labour, relations between workers and employers, determination of minimum wages, payment of wages and compensation for injuries to workers, formation of trade unions, raising and settlement of industrial disputes, health, safety, welfare and working conditions of workers, and apprenticeship and matters ancillary thereto. The main issues covered in the Act include:

- Conditions of service and employment
- Employment of adolescents
- Provisions relating to health, hygiene
- Employee welfare
- Working hours and leave
- Wages and payment
- Wages boards
- Workers compensation for injury by accident
- Trade union and industrial relations
- Disputes, labour court, labour appellate
- Tribunal, legal proceedings, etc
- Workers participation in companies' profits
- Regulation of employment and safety of dock workers
- Provident funds
- Apprenticeship
- Penalties and procedure etc

Moreover, as per the Bangladesh Labour Act 2006, organizations which do not fall within the scope of the Act, cannot have any employee rules, regulations and benefits less favorable than those provided under the Act.

With several small amendments, the Bangladesh Labour Act, 2006 has constantly been adapted to the ever-changing employment and common practices in the country. The Labour (Amendment) Act 2013 makes a large number of amendments to the Labour Act 2006 and, particularly, introduces several provisions aimed at improving workplace safety. Among others, the amended legislation now requires the creation of safety committees in factories with 50 workers or more, the establishment of workplace Health Centres in workplaces with over 5000 employees and safety welfare officers in workplaces with more than 500. Under the amendments compensation for work-related deaths is provided after two years in employment, compared to the current three years period. Workplaces of over 500 employers are required to arrange for and cover the cost of treatment of occupational diseases. The labour inspectorate is given new responsibilities to inspect safety and health conditions of workplaces and conduct on-the-spot inspections. Other important amendments deal with dangerous work for children; emergency exits; access to gangways and stairs for workers; mandatory use of personal safety equipment; notification of competent authority in case of incident and provisions on social dialogue, trade unions and dispute resolution; and employers and companies responsibilities.

2.7. Land Acquisition & Resettlement Regulations

The policy framework for land acquisition and resettlement is based on the Land Acquisition Act 1894, and the Acquisition and Requisition of Immovable Property Ordinance 1982 (amended in 1994, 1995 and 2004). These regulations are being enforced by the Revenue Department. Articles 42 and 47 of the 1972 Bangladesh Constitution provide for the basic principles of property compensation. The Acquisition and Requisition of Immovable Property Ordinance 1982 (ARIPO) supersedes Land Acquisition Act 1894 and is the current legislation and guidelines on acquisition and requisition of land. ARIPO is limited to legal property owners who are supported by ownership documents such as deeds, title or agreements to be eligible for compensation under the law. In the event of differences between the ARIPO and ADB practices for projects with potential significant impacts (e.g., Category A), the provisions relevant to involuntary resettlement and land acquisition in SPS 2009 will prevail.

2.8. Indigenous People (Small Ethnic Community) Policies

The protection of the fundamental rights of all citizens which include indigenous peoples are provided for in the 1972 Constitution (Articles 11, 19 and 28). Specifically, Articles 23 and 24 set forth the protection of the cultural tradition of indigenous

peoples. The Chhoto Nagpur Tenancy Act of 1908 allows for (i) individual ownership of lands to ethnic communities, and whereby the transfer of tribal land to non-tribal people without the permission of Deputy Commissioner was illegal; (ii) free to profess and practice their religions and develop their own culture, and (iii) “Adivasi” right to protect their own land.

2.9. Asian Development Bank Guidelines

The Asian Development Bank (ADB) requires environmental assessment of all project loans, program loans, sector loans, sector development program loans, financial intermediation loans, and private sector investment operations. Environmental assessment is a process rather than a one-time report, and includes necessary environmental analyses and environmental management planning that take place throughout the project cycle.

The process followed by ADB for determining a project’s environment category is to prepare a Rapid Environmental Assessment (REA). REA requires the completion of the environmental categorization form prior to the project initiation. REA uses sector-specific screening checklist, taking into account the type, size, and location of the proposed project; sensitivity and vulnerability of environmental resources in project area; and the potential for the project to cause significant adverse environmental impacts. A project is classified as one of the four environmental categories (A, B, C, or FI) based on the most environmentally sensitive component. Categories are as follows:

- **Category A:** A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment (EIA), including an environmental management plan (EMP), is required.
- **Category B:** A proposed project is classified as category B if its potential adverse environmental impacts are less adverse than those of category A projects. These impacts are site-specific, few if any of them are irreversible, and in most cases mitigation measures can be designed more readily than for category A projects. An initial environmental examination (IEE), including an EMP, is required.
- **Category C:** A proposed project is classified as category C if it is likely to have minimal or no adverse environmental impacts. An EIA or IEE is not required, although environmental implications need to be reviewed.
- **Category FI:** A proposed project is classified as category FI if it involves the investment of ADB funds to, or through, a financial intermediary.

The operations department of ADB ensures that the following safeguard documents are published on ADB's website: (i) draft EIA report at least 120 days before Board consideration for an environment category A project; (ii) the final or updated EIA or IEE, upon receipt. The project team makes the draft IEE reports available to interested stakeholders before project approval by the Board on request. In addition, if the final IEE is not available upon Board approval, the draft IEE is posted on ADB's website upon Board approval of a project.

2.10. The World Bank Guidelines

The World Bank procedures for EA study cover policies, guidelines and good practices. The World Bank guidelines therefore illustrate the national best practices for such work in Bangladesh. The environment safeguard policies those may be applicable are the following:

- **Environmental Assessment (EA) (OP 4.01/BP/GP 4.01):** An Environmental Assessment is conducted to ensure that Bank-financed projects are environmentally sound and sustainable, and that decision-making is improved through appropriate analysis of actions and of their likely environmental impacts. Any World Bank funded project that is likely to have potential adverse environmental risks and impacts in its area of influence requires an EA indicating the potential risks, mitigation measures and environmental management framework or plan.
- **Natural Habitats (OP/BP 4.04):** Natural habitats are land and water areas where most of the original native plant and animal species are still present. Natural habitats comprise many types of terrestrial, freshwater, coastal, and marine ecosystems. They include areas lightly modified by human activities, but retaining their ecological functions and native species. The Natural habitats policy is triggered by any project (including any subproject under a sector investment or financial intermediary loan) with the potential to cause significant conversion (loss) or degradation of natural habitats, whether directly (through construction) or indirectly (through human activities induced by the project). The policy has separate requirements for critical (either legally or proposed to be protected or high ecological value) and non-critical natural habitats. The Bank's interpretation of "significant conversion or degradation" is on a case-by-case basis for each project, based on the information obtained through the EA.
- **Forest (OP/GP 4.36):** This policy is triggered by forest sector activities and other Bank sponsored interventions, which have the potential to impact significantly upon forested areas. The Bank does not finance commercial logging operations but aims to reduce deforestation, enhance the environmental contribution of

forested areas, promote afforestation, reduce poverty and encourage economic development.

- **Physical and Cultural Resources (OP 4.11):** Physical cultural resources are defined as movable or immovable objects, sites, structures, groups of structures, natural features and landscapes that have archaeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. Physical cultural resources may be located in urban or rural settings, and may be above ground, underground, or underwater. The Bank seeks to assist countries to manage their physical cultural resources and to avoid or mitigate adverse impact of development projects on these resources. This policy is triggered for any project that requires an EA.

Mentionable that the tunnel kiln will be set-up around peri-urban areas, which will not involve any impact on critical natural habitats or physical and cultural resources.

2.11. IDCOL Environmental and Social Safeguard Policy

Infrastructure Development Company Limited (IDCOL) is committed to finance projects that are environmentally compliant with national and international standards. Following are some benchmark environmental and social safeguard policy maintained by IDCOL:

- IDCOL gives due importance to Environmental and Social (E&S) considerations in appraising and financing infrastructure projects to minimize adverse impacts and risks to the environment and people that may be affected.
- IDCOL is committed to comply with all relevant E&S policy and legislative requirements and laws of the lands with which it engages and remain responsive to the E&S requirements of ADB and World Bank.
- IDCOL is committed to avoiding or minimizing land acquisition and resettlement through selection of appropriate locations and design of projects
- IDCOL is committed to ensuring protection of vulnerable groups, such as the economically and socially disadvantaged, women, children, physically handicapped and indigenous populations.

CHAPTER-3: PROJECT DESCRIPTION

3.1. Project Synopsis

Project Title	USA Agro and Auto Bricks Limited (UABL)
Project Location	<i>Village: West Angaria, Union: Angaria, Upazila: Dumki, District: Patuakhali, Division: Barisal, Country: Bangladesh.</i>
Corporate Office	House-LA 55 (3rd Floor), Post Office Road, Middle Badda, Dhaka-1212.
Legal Status	Private Limited Company
Authorized Capital	BDT 50 Crore
Paid up Capital	BDT 1 Crore
Total No. of Shares	50 Lac @BDT 100 each
Project Objective	To produce high quality clay bricks and other associated products using modern green technology to meet continuously increasing demand at regional and national level.
Products	Solid Bricks, Facing Bricks.
Production Capacity	Solid Bricks: 120,000 pcs / day, Facing Bricks: 6000 m ² / day, @ 100% rated capacity.
Land Area	800 decimal
Project Technology	Tunnel Kiln
Fuel Type	Coal
Production Cycle	<i>Forming: 16 hours /day Drying & Firing: 24 hours / day</i>
Annual Operation Cycle	330 days
Total Project Cost	BDT 45.0917 Crore
Debt-Equity Ratio	70:30
Payback Period	5 years
Project Management/ Sponsors	1. Mr. Gazi Munibur Rahman, Chairman 2. Mr. Gazi Mostafizur Rahman, Vice Chairman 3. Mr. Md. Ayeub Ali Khan, Managing Director 4. Ms. Mushfika Rahaman, Director 5. Ms. Tania-A-Nur, Director 6. Mr. Md. Shahidul Islam, Director 7. Mr. Md. Abdul Matin Molla, Shareholder 8. Mr. Md. Zoynal Abedin Chowdhury, Shareholder 9. Mr. Md. Shajahan, Shareholder

3.2. Organization and Management

The company has been formed and registered with the Registrar of the Joint Stock Companies and Firms, Govt. of Bangladesh as a 'Private Limited Company' under the

name 'USA Agro and Auto Bricks Limited (UABL)'. The sponsors or management of the organization are in due process of establishing a brick manufacturing plant for uniform & superior quality brick production round the year with lower energy usage and little pollution potential. The sponsors have considerable experiences in trade and commerce. They possess necessary management capabilities and experiences achieved from vast experience of ongoing trade and business concerns. The project envisages producing high quality clay products which includes *Solid/Perforated Clay Bricks and Facing Bricks* to meet the growing domestic demand. The project will be equipped with the most modern drying and firing technology that is not only energy efficient, environment friendly as well. Description of the technology used in the project and potential market demand of the product are discussed in this chapter to justify the feasibility and Return on Investment (RoI) potential of the mentioned project.

3.3. Production Technology

This project will use local clay to produce bricks with Plastic extrusion molding system, automatic loading system, one chamber drying system, one single stage tunnel kiln production lines, kiln temperature computerized auto control system, forklift to transport to the stock yard.

It will have latest Auto Tunnel Kiln Technology with one dryer and one kiln with following dimensions:

- 1 kiln each of 144.35 meter length, 4.8 meter width and 2.6 meter height
- 1 dryer each of 96 meter, 4.6 meter width and 2.19 meter height

By implementing the project with 01 (one) dryer and 01 (one) kiln will give the opportunity to tune up production according to market demand and it will save cost of production for the entrepreneur.

There will 50 numbers of carts with following features:

- Dimension : 4.86m x 4.35m x 0.84 m
- Number of bricks per cart : 6,720

Once proper synchronization is achieved, average frequency of cart (coming out of kiln with finished product) will be 80min/cart.

Another key aspect of the project is Auto coal spraying system. UABL will have the latest auto coal spray technology from Italian manufacturer – Bernini Impianti, which is the best in class in the world for auto coal spray system for kilns.

At the very beginning all clay will be kept under the shade for 4 (four) months for natural drying to keep the moisture under 25% - 30%. Subsequently, these clay will go through different stages of raw material preparation workshop where it will be crushed,

cleaned and mixed with crushed coal for preparation of perfect raw material. Preparation of raw material it will be kept in the aging section for 15 days. Afterwards, these processed clay will be placed into molding workshop for green brick formation, where it will be mixed with water to form the slack for green bricks. Green bricks will have 20% - 22% moisture. Subsequently, Green bricks will be stacked with half load on the cart using robotics technology. Those half loaded carts will then pass through the air blow drying process. Afterwards, bricks from two half loaded carts will be transferred to a single cart with full load of 5616 Bricks. Then, these fully loaded will be sent to dryer and subsequently to the kiln for burning. The same cart will come out of the kiln carrying finished goods. Moisture content before sending to dryer will be 10% and before sending to kiln it will be 3%. There will be no manual labor involved from the green brick production to finished goods stage.

This approach results lower use of energy, production of high quality bricks with minimum wastage and reduction of pollution. All bricks will be of uniformly burnt and international standard in respect of strength, quality and appearance. Mentionable that the water consumption need will be met by own water pump.

3.4. Operation Process & Timeline

This project uses clay as raw material and adopts Single Layer Drying Technology, which belongs to Two-Times Setting and Baking Technology, Finger Forklift Type. This project adopts Semi-Stiff Plastic Extruding Process; drying in the Drying Chamber and firing in the Tunnel Kiln.

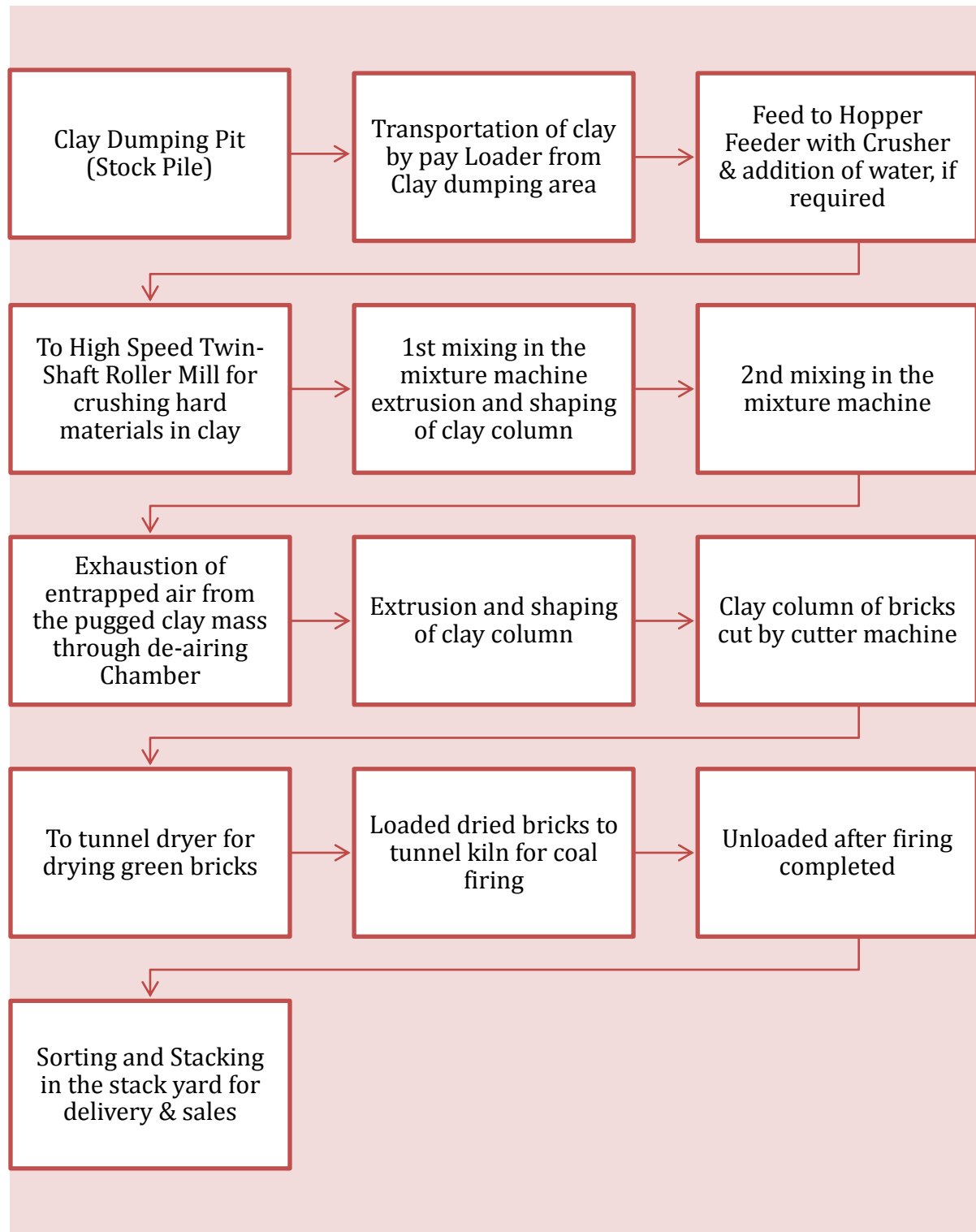
Main machinery include: box feeder, primary roller crusher, fine pulverizing rolling crusher, double shaft mixer, extruding type mixer, double stage vacuum extruder, reversible belt conveyor in aging room, chamber dryer, advanced tunnel kiln and so on.

This project is composed of Clay shed, Aging Section, Raw material preparation workshop, Molding section, Drying & Firing Section, Finished product stockyard, Sub Station and all supporting facilities. Section wise working periods are shown below:

Table 3.1: Operation Timeline

Sl.	Name	Working Days per Year	Shifts per Day	Hours per Shift
1.	Raw Material Preparation and Aging	330	1	8
2.	Molding	330	1	8
3.	Drying & Firing	330	3	8
4.	Sub-station	330	3	8

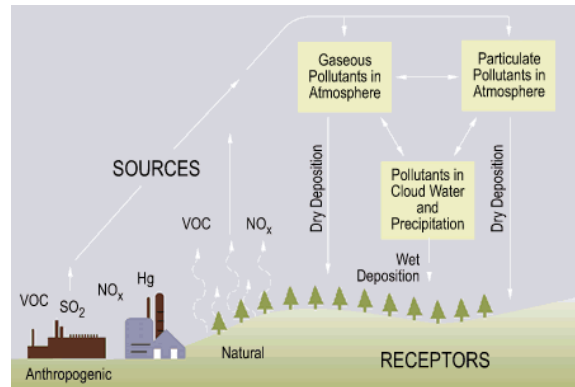
3.5. Production Process Flow Diagram



3.6. Contribution to GHG Emission Reduction

The primary emissions to the air from combustion of fossil fuels are sulfur dioxide (SO₂), nitrogen oxides (NO_x), particulate matter (PM), carbon monoxide (CO) and other GHG such as CO₂. Depending on the fuel type and quality, other substances such as heavy metals, halide compounds etc. may be emitted in smaller quantities but may have a significant impact on the environment due to their toxicity and persistence.

The scale of construction for the project is of a medium type. So, there is limited requirement of using heavy construction equipment as well as movement of vehicle. The limited amount of SO_x will be emitted due to operation of diesel fuelled construction equipment and machineries. During operation, there will be diesel generator as back up support, which can result in localised SO_x emission. Localised dust will be generated due to handling of construction materials. But none of them seems to be a concern from environmental and health safety points of view. During operation phase, the movement of loading and unloading tracks in relevant to finished bricks and raw materials may result in limited dust concern.



In this project coal will be used as fuel. There is scope of emission of SO_x due to application of high-sulfur content coal. But as the exhaust gas will be re-used for drying the green bricks, the scope of actual emission and subsequent environmental pollution is less. But there is a significant concern with the dust particle especially coming from clay and grinding from coal at operation phase, which can be mitigated by regular sprinkling as well as adopting proper personal protective equipment (PPE).

However, in comparison to other type of brick manufacturing processes, the GHG emission for this project is significantly less as outlined in the table below:

Table 3.2: GHG Emission Comparison of Various Kiln Types

Types of Kiln	Pollution Level	Emissions (mg/m ³ per 100,000 bricks)	CO ₂ Emission (tons per million)	Coal consumption (tons per million)
Bull's Trench	very high	>1,000	631	260
Fixed Chimney	high	>1,000	582	240

Improved Zigzag	medium	500–800	440	180–200
Vertical Shaft Brick	medium low	78–187	291	100–120
Hybrid Hoffman	low	20.3	315	120–130
Tunnel Kiln	low	<50	291	100–120
<i>Source: ADB Report</i>				

3.7. Requirement and Source of Power Supply

3.7.1. Requirement

Requirement of power as outlined in the EPC contract is as follows, with the break down according to respective process and equipment:

Table 3.3: Power Supply Requirement

Sl.	Item Name	Power (KW)
1.	Brick Making Machinery	452.80
2.	Automatic Internal Fuel System	87.00
3.	Automatic loading System	44.20
4.	Dryer Equipment	194.30
5.	Tunnel Kiln Equipment	188.20
6.	Refractory Materials	-
7.	Rail & Accessories	-
8.	Automatic Burning System	68.70
9.	Spare Parts	-
	Sub-Total	1,035.20

3.7.2. Source

Total installed load will be 1,035.2 kW, while consumption will be 70% of installed load. Apart from these there will be an estimated 100kW load for other support use such as project interior and exterior lighting, pumps etc. UABL has already applied to Rural Electrification Board (REB) to get the required approval for setting up the sub-station of capacity 1200 kVA.

3.8. Requirement and Source of Clay, Coal and Water Supply

3.8.1. Requirement & Source of Clay

Considering a production capacity of 130,000 fired bricks per day, the clay consumption has been calculated as follows:

Table 3.4: Clay Requirement

Balance of clay process			Solid Bricks			Facing Bricks		
			Dry basis	Mois- ture (%)	Wet basis (kg)	Dry basis	Mois- ture (%)	Wet basis (kg)
Firing	By tunnel kiln	tons/day	408	-	-	312	-	-
Drying	By rack tunnel dryer	tons/day	431	16	499	332	16	385
Shaping	By extrusion	tons/day	494	16	573	377	16	437
		tons/hour	31	-	36	24	-	27
Clay preparation	Storage to box feeder	tons/day	543	-	-	415	-	-
	Processed clay	tons/day	598	16	693	456	16	529
		tons/hour	37	-	43	29		33
Clay Quarry	Storage	40 days	-	-	-	-	-	-
	Storage Capacity	tons	23910	18	28213	23910	18	28214
	Net Occupied area	m ²	2687			2687		

The Project site is located adjacent to Payra River. Therefore, clay may be collected from the river bed either directly or through third party suppliers.

3.8.2. Requirement & Source of Coal

Table 3.5: Coal Requirement

Fuel Consumption			
Coal	ton/day	24	18
	kg/hour	996.45	763.29

There are two koyla ghats around 10km away from the Project site. Coal imported mainly from India are distributed from those koyla ghats. UAABL will collect coal from those two ghats.

3.8.3. Requirement & Source of Water Supply

The plant will require 52.56 m³ of water per day. The Project proposes to obtain this water from by setting up a deep tube-well at the site. Moreover, due to close proximity of Payra river, water can be sourced from the river in case of emergency situation or additional requirement.

- Water usage for production: 18 % of 292 tons of clay = 52.56 tons of water as moisture content. 52.56 x 1000kg (1 kg=1 Liter) = 52,560 liter or 52.56 m³ water per day.
- Water usage for resident officers & workers: 50 persons @ 15 Liter per person per day = 750 liter =0.75 m³ water per day.

3.9. Layout Plan of the Proposed Project

The project is located at Angaria, Dumki under Patuakhali district and shall be built on around 8 acre of land. Major sections of the layout plan are Factory Building, Clay Storage Area and Coal Storage Area.

- Factory Shed: 70,038 square feet
- Clay Shed: 50,424 square feet
- Coal Shed: 5,304 square feet

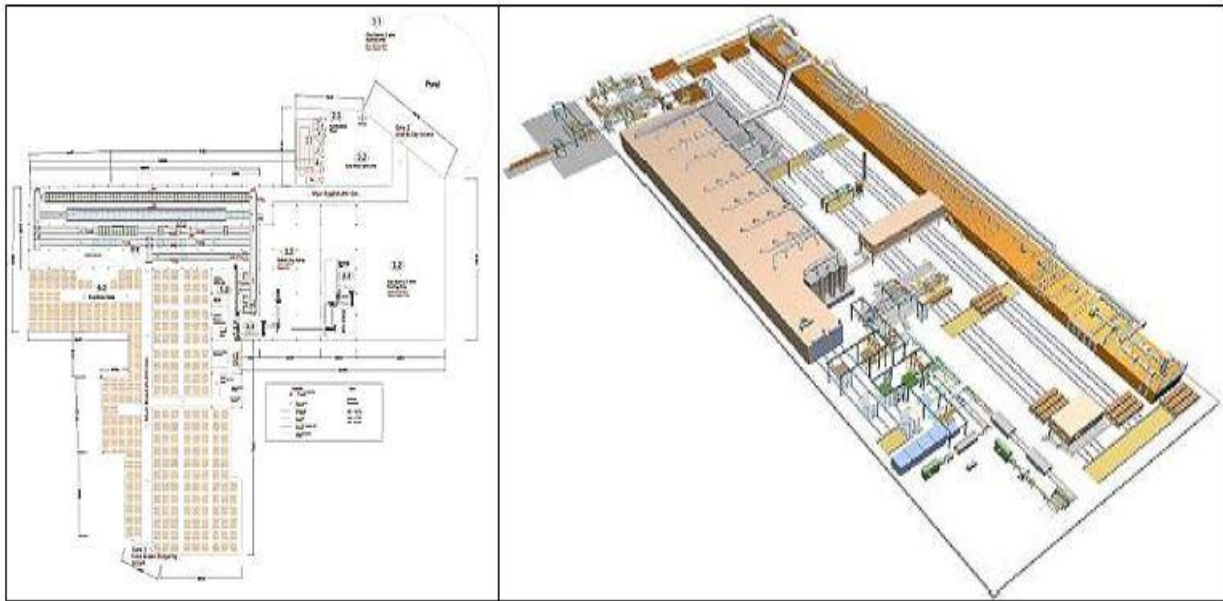


Figure 3.1: Project Site Layout (left) and isometric view of site layout (right)

3.10. List of Equipment and Machinery

The major equipment and machinery required for the project are categorized in the following:

- ❖ **Part 01: Bricks Making Machinery**
- ❖ **Part 02: Automatic Internal Fuel System**
- ❖ **Part 03: Automatic loading System**
- ❖ **Part 04: Dryer Equipment**
- ❖ **Part 05: Tunnel Kiln Equipment**
- ❖ **Part 06: Rail & Accessories**

Category wise equipment list is provided in the following:

Table 3.6: Part 01: Bricks Making Machinery

Sl. No.	Machine Name & Specifications	Power (KW)	Qty.	Unit
Raw Material Processing Equipment				
1	Box feeder	10.50	1	set
2	Iron remover	-	2	set
3	Belt conveyor	5.50	1	set
4	Primary roll crusher	44.00	1	set
5	Belt conveyor	5.50	1	set
6	High Speed Super fine roll crusher	55.30	1	set
7	Belt conveyor	5.50	1	set

Sl. No.	Machine Name & Specifications	Power (KW)	Qty.	Unit
Brick shaping				
8	Double Shaft Mixture	55.00	1	set
9	Belt conveyor	8.00	1	set
10	Vacuum extruder	202.00	1	set
11	Vacuum pump	22.00	1	set
12	Air compressor	30.00	1	set
13	Waste belt conveyor - 1	4.00	1	set
14	Waste belt conveyor - 2	5.50	1	set
15	Control cabinet		1	group
	Total	452.80	KW	

Table 3.7: Part 02: Automatic Internal Fuel System

Sl. No.	Machine Name & Specifications	Power (KW)	Qty.	Unit
1	Box feeder	10.50	1	set
2	Belt conveyor	5.50	1	set
3	Fine crusher	55.00	1	set
4	Belt conveyor	4.00	1	set
5	Box feeder	10.50	1	set
6	Coal weighting system (frequency control)	1.50	2	set
7	Control cabinet		1	group
	Total	87.00	KW	

Table 3.8: Part 03: Automatic loading System

Sl. No.	Technical Parameters	Power (KW)	Qty.	Unit
1	Columns cutter	3.00	1	set
2	Two cutting frame brick cutter	11.20	1	set
3	Setting Machine	30.00	1	sets
4	General control system	-	1	set
	Total	44.20	KW	USD

Table 3.9: Part 04: Dryer Equipment

Sl. No.	Machine Name & Specifications	Power (KW)	Qty.	Unit
1	Hot air feeding centrifugal blower	90.00	1	set
2	Exhaust moisture fan	75.00	10	set
3	Hot air generator	15.00	1	set
4	Drying Cart	-	1500	set
5	Dryer door	-	20	set
6	Dryer car ferry pusher(hydraulic pusher)	14.30	1	set
7	Waste Cart	-	3	set
Control cabinet				
1	Dryer Temperature Monitoring and control Panel	-	1	set
Total		194.30	KW	

Table 3.10: Part 05: Tunnel Kiln Equipment

Sl. No.	Machine Name & Specifications	Power (KW)	Qty.	Unit
1	Hydraulic pusher for kiln	30.00	1	set
2	Outlet pulling machine for kiln	3.00	1	set
3	Ferry cart for kiln	20.40	4	set
4	Kiln cart return tractor	38.50	7	set
5	Kiln cart (Refractory bricks included)		50	set
6	Entrance gate for kiln	2.20	1	set
7	Kiln counter gate	4.40	2	set
8	Kiln exit gate	2.20	1	set
9	Exhaust smoke fan	45.00	1	set
10	Cooling fan (under cart)	5.50	1	set
11	Cooling Blower (kiln exit)	37.00	2	set
12	Temperature monitor and electrical control system		1	set
Total		188.20	KW	

Table 3.11: Part 06: Rail & Accessories

Sl. No.	Technical Parameters	Power (KW)	Unit	Qty
1. Dryer				
1	Rail line (8kg/m)	Rail	t	30
2		Join Plate & bolt	set	220
3		Base Pate	t	4600
4	Rail line (22kg/m)	Rail	t	5
5		Join Plate & bolt	set	35
6		Base Pate	set	550
2. Tunnel Kiln				
1	Rail track	Rail 22kg/m	t	23.50
2		Accessories (clamping plate and bolt)	set	150
3		Accessories (keep plate and bolt)	set	1050
Total				6663.5

3.11. Brief description of EPC contractor

3.11.1. Brictec Engineering Limited (BEL)

Brictec Engineering Ltd., registered in Bangladesh, is providing complete solution for Brick Industry. The services are provided include both turnkey solution and part basis for Tunnel Kiln, Hoffman Kiln, Zig-Zag Kiln with fully automatic robotic, setting and sensor based machinery. Xi'an Brictec Engineering Co., Ltd., China and Shangdong Mine Machinery Group, China are BEL's strategic partners.

Table 3.12: Brictec Engineering Limited (BEL) Details

COMPANY DETAILS	
Company Name	Brictec Engineering Limited
Managing Director	Mr. Monir Hossain
Chairman	Mr. Xingming Lan (Known as Brandon Lan in Bangladesh)* * Mr. Brandon Lan is also the Managing Director of Xi'an Brictec Engineering Co. Ltd. China
Local Telephone	8872320

Mobile Telephone	0184119094
Address (Physical)	House # 126/A (1st Floor), Road # 05, New DOHS, Mohakhali, Dhaka-1206
Email	brictecbd@yahoo.com & info@brictecbd.com

Xian Brictec is engaged in the brick industry for the complete project design, kiln design, project implementation and management. It is located in Xian, China. All machinery under sales contract will be manufactured by Shangdong Mining Machinery Cosmec Construction Materials Machinery Co., Ltd. In 2011, Shangdong Mining and Xian Brictec started to work as strategic partner. Xian Brictec Engineering Ltd. is also manufacturing coal spray system under the leadership of former General Manager of COSMEC PICININI SRL, Italy. Brictec Engineering Limited, registered in RJSC, is working as local partner of Xian Brictec Engineering Ltd., China. Managing Director of Xian Brictec, Mr. Brandon, is the Chairman of Brictec Engineering Ltd.

Table 3.13: Experience Summary of Xi'an Brictec (EPC Contractor)

Xi'an Brictec Engineering Co., Ltd.	
Number of implemented projects	China: 40
	Internationally: 50
	Countries: China, Bangladesh, India, Nepal, Uzbekistan, Vietnam, Africa
International collaboration under license	Bernini, Italy
Flagship project	Location: Shanghai, China
	Capacity: 300,000 pcs/day

Table 3.14: List of Completed Projects in Bangladesh by the EPC Contractor

Sl.	Name	Location	Technology	Capacity	Status
1	SAS Building Materials Ltd.	Cumilla	Tunnel Kiln	160,000 pcs/day	Operational
2	Comprehensive	Tangail	HHK	100,000	Operational

	Limited			pcs/day	
3	New Generation Clay Bricks	Narayanganj	HHK	50,000 pcs/day	Operational
4	S.B. Auto Bricks Ltd.	Chattogram	HHK	50,000 pcs/day	Operational
5	Conforce Limited	Savar	Tunnel Kiln	50,000 pcs/day	Operational
6	Banolata Refractory Ltd.	Natore	HHK	50,000 pcs/day	Operational
7	Kanaipur Auto Bricks Ltd.	Faridpur	HHK	50,000 pcs/day	Operational
8	Pachgaon Auto Bricks Ltd.	Tangail	HHK	50,000 pcs/day	Operational
9	Paiker Auto Bricks Ltd.	Bogura	Tunnel Kiln	100,000 pcs/day	Operational
10	Alif & Co. Ltd.	Panchagar	Concrete Block & Pavers	12,800 pcs/hr	Operational

Table 3.15: List of Ongoing Projects in Bangladesh and India by the EPC Contractor

Sl	Name	Location	Technology	Capacity
1	SD Ceramics LLP	Assam, India	Tunnel Kiln	100,000 pcs/day
2	SD Ceramics LLP	Assam, India	HHK	50,000 pcs/day
3	Mamun Green Bricks Ltd.	Magura	HHK	100,000 pcs/day
4	Jehaan Auto Bricks Ltd.	Tangail	HHK	100,000 pcs/day
5	A&A Auto Bricks Ind. Ltd.	Panchagar	HHK	100,000 pcs/day
6	Alpha Auto Bricks Ltd.	Jamalpur	HHK	50,000 pcs/day

3.11.2. Shandong Mining Machinery Cosmec Construction Materials Machinery Co., Ltd.

Shandong Mining Machinery Cosmec Construction Materials Machinery Co., Ltd. is a subsidiary of Shandong Mining Machinery Group Co., Ltd., which was established in 1955 and at present has 13 subsidiaries. The group owns a total of RMB 2.7 billion in assets, covering an area of 67 hectares and employs 2000 employee. The group was listed on the Shenzhen Stock Exchange on Dec. 17, 2010 (stock code: SZ002526). As one of the most important machinery manufacturers in China, the group is leading the way in the industry in both market share and technological innovation. The main products are fully-mechanical equipment for coal mining, coal washing, mine safety, brick-making, post-press packaging, and unmanned aviation.

The group has obtained certification of ISO9001:2000 and has 17 national patents of their products, especially for Brick Automatic Handling System.

The group comprises of the following subsidiary companies:

1. Xinjiang Changmei Mining Machinery Co., Ltd.
2. Shandong Changkongyan Aviation Technology Company
3. Weifang Keer Building Material Machinery Co., Ltd.
4. Beijing Zhongke Daizong Aviation Science and Technology Co., Ltd.
5. Shanghai Dragonlink Trading Investment Co., Ltd.
6. Changle Jieyuan Metal Surface Treatment Co., Ltd.
7. Chengdu Lituo Electronic Control Technology Co., Ltd.
8. Yulin Tianning Mining Service Co., Ltd.
9. Shandong Xinchuan Machinery Co., Ltd.
10. Shandong Mine Safety & Harm Avoidance Equipment Co., Ltd.
11. Beijing Sankuangtong Technology Co., Ltd.
12. Chengtu Forging Co., Ltd.
13. **Shandong Mining Machinery Cosmec Construction Materials Machinery Co., Ltd.**

3.12. Annual Demand of Clay Bricks in the Target Region

The average production of bricks in the target region was 3.57 million bricks whereas their average sales were 3.27 million. Reported average sales are showing a gradually increasing trend over last 5 years indicating to the increasing demand of clay bricks in the target region.

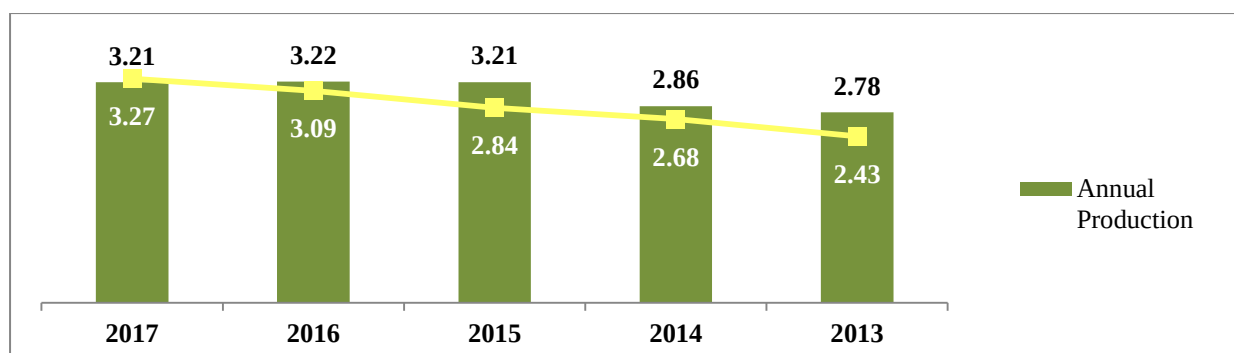


Figure 3.2: Average Production vs. Sales (in million)

Total annual demand of bricks in the target area is around 40 Crores of unit. Out of this around 19 crores are required for the government's projects and another 21 crores are going for private sector development.

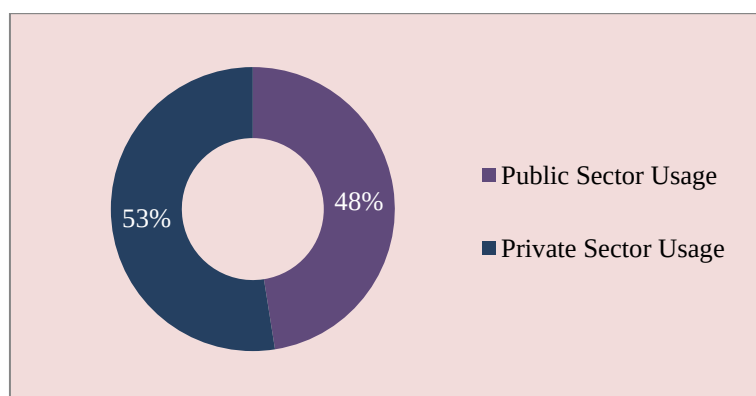


Figure 3.3: Public vs. Private Sector Usage

Demand of bricks is lower in Jhalokathi and Borguna. In these region on an average near about 5.2 crores bricks are needed in each region per annum. In Patuakhali, Pirojpur and Bhola the average demand is around 6.8 crores per district per annum. The highest annual demand reported is for Barisal district which is more than 8.2 crores.

Table 3.17: By-District Demand Projection of Barisal Division

Name of District	Annual Projected Demand (Unit in Crore)
Barisal	8.2
Bhola	6.8
Potuaakhali	6.8
Pirojpur	6.8
Jhalokathi	5.2
Borguna	5.2

Near about 25%-30% of the required bricks are used for producing pickets.

3.13. Demand Supply Gap Analysis in the Target Region

Gap between supplies vs. demand has been observed across Patuakhali, Borguna, Jhalokathi and Pirojpur.

In Patuakhali which is the project's key target area, overall supply of bricks is less than 50%. Lack of brick fields in this particular region is the main reason behind this gap. The additional requirement of brick is fulfilled from Koloshkathi Upzilla of Jhalokathi or Barisal Sadar with bearing extra cost of transportation which ranges between BDT 700 to 1200 for each thousand.

In Borguna, lower number of brick fields has been identified as the main reason behind the gap.

In Jhalokathi, there are some gaps between demand and supply. To meet this gap there is a practice of forward buying of bricks from the brick fields. In that case sometimes quality standard falls down.

The major issue with the Pirojpur's supply is the quality of brick. Because of the sandy soil structure of this region bricks are not that strong here. So getting the grade-1 brick is a challenge for the purchasers of this region. People procure clay bricks from Bhola, Barisal or Khulna District's brickfields bearing extra transport cost which varies from BDT 2000 to 2500 per thousand units.

On the other hand, in Barisal and Bhola, the supply condition of clay brick is better than other 4 districts of the Division.

Moreover, due to new DoE policy all the FCK (Fixed Chimney Kiln) will wind up business in the near future it is anticipated that this will result in a huge supply gap until new plants come into production.

3.14. Prospective Buyers

Major consumers of clay bricks can widely be classified into two categories: Private Sector Consumers and Public Sector bodies.

3.14.1. Private Sector

The project owners are well known business people in the Patuakhali region. They are engaged in an NGO operating in the target area. Prior to setting up the project, the entrepreneurs have conducted a feasibility study to gather information on economic potential of the project. The project authority provided our firm the findings of the market research portion of the feasibility study to gain insight on profitability potential

of the proposed project. According to the survey findings, the incidence of construction activities in Patuakhali region has increased in last few years due to the reduced cost of rod and other relevant raw materials in the region as well as a positive socio-economic shift of the locality. It is evident that overall lifestyle and purchasing power have been improved of the locality of the region resulting many households are shifting from traditional non-brick-built house to brick-built house.

Lots of infrastructure development activities are happening in the region particularly led by builders, contractors, educational institutions, NGOs, hospitals and various other commercial and residential entities. Major commercial entities as buyers of brick in the market are large groups of companies, market complex manufacturers, privately owned university buildings, banks and insurance companies etc.

3.14.2. Public Sector

Major buyers of brick in the region are mainly the government enlisted contractors. However they purchase bricks mainly on-behalf of different departments of government like LGRD, Roads and Highways, PWD, PDB, Union Parishod, Upazilla Porishod, City Corporations, Facility Schools & Colleges etc.

For the maintenance of road transport network, Roads and Highways department needs around 1 million bricks per annum.

Table 3.16: List of Prospective Buyers of Clay Bricks

Private Sector	Public Sector
Land Owners	LGRD
Builders and Contractors	Roads & Highway
Educational Institutes	Upazilla Porishod
NGOs	Union Porishod
Hospitals and Clinics	PWD
Large Group of Companies	City Corporation
Opsonin Pharmaceuticals	Facility School/ College University
Private University Authorities	PDB

3.15. Price Comparison

In last few years the price of bricks has been increased significantly for all categories. For example, the price of Grade-1 bricks has took 25% increment over last 6 years. Across all the areas it was a common finding that customers purchase a particularly separate grade of bricks for the purpose of picket production that are over burned. These bricks are also sold just like other grades of bricks. The price of this picket brick is equal to the Grade 1 bricks.

Following is the detail price comparison of different category clay bricks from 2011 to 2016:

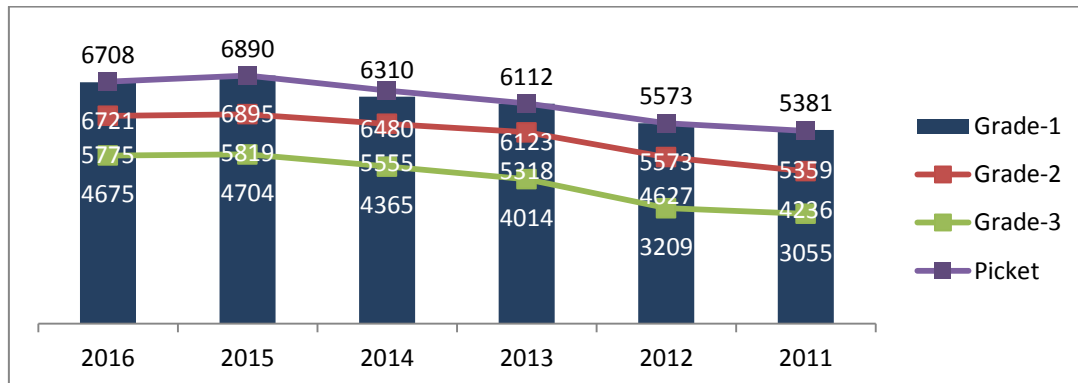


Figure 3.4: Price of different grades of bricks (for each 1000)

3.16. Demand Forecast for Next 10 Years

The pace of development of the Greater Barisal Region is walking to its momentum. As an effect of the Padma Bridge development, this certain region is now getting priority. Lots of large scale projects are queued up in both public and private sector. Some of the major on-going or upcoming projects are stated below:

Private Sector:

- i. In Barisal:
 - a. Regional Office Set-up for Pran-RFL: in Barisal a regional office for Pran-RFL Company is supposed to be set-up. This project will require around 2 to 2.5 crores of clay bricks.
- ii. In Patuakhali:
 - a. A privately developed EPZ is going to be established where around 3 crores of bricks will be required.
 - b. M.P. Firoz Tobacco Company would be set-up.
- iii. In Bhola:
 - a. A farm for Kazi Farms Ltd.
 - b. Lalmohon Cold Storage & Junaid Rice Mill might require around 2.4 million bricks.
 - c. Zilla Porishod Market would require 1.5 million bricks.
 - d. Ayesha Memorial Hospital would require 5 million bricks.
 - e. Office set-up for SAP Bangladesh
- iv. In Borguna:
 - a. A large scaled office set-up for Heed Bangladesh
 - b. Office set-up for South Asian Partnership

- c. A large scaled ice-factory is going to be established in Kumarkhali,
- d. A big project of World Bank is going to be initiated where around 2 million bricks would be required.
- v. *In Jhalokathi:*
 - a. A college and an orphanage are going to be built in the name of wife of honorable minister Mr. Amir Hossain Amu.

Public Sector:

- i. Police Academy Building which will require around 10 crores of bricks.
- ii. Lebukhali Cantonment and Lebukhali Bridge would require around 15 crores of bricks.
- iii. A Medical University is going to be established.
- iv. Chief Judicial Court would be built where 5 crores bricks would be required.
- v. A Nursing Dormitory may be established.
- vi. University residential area would require 4 to 5 cores bricks.
- vii. Shilpo Kola Building would require 5 million bricks.
- viii. Around 2 crore bicks would be needed to establish the residential building of Govt. Hatem Ali College.
- ix. In Bhola there is a plan of establish a Textile Institute which may require around 2 crore bricks.
- x. A medical college is supposed to be established in Bhola.
- xi. Bhola Jazz Court.
- xii. Road network from Bhola's Lalmohon to Char Fashion would be developed and around 5 million bricks would be needed for that.
- xiii. Mukti Joddha Complex is going to be built in the Thana Circle of Lalmohon, Bhola where around 0.3 million bricks would be required.
- xiv. For develop LGRD's roads and Cyclone Center around 1 crore bricks will be required.
- xv. Coast Guard Office set-up may require around 4 million bricks.
- xvi. A 300 MW Power Plant is going to be built which would require around 4 crore bricks.
- xvii. Residential buildings for the officials of Payra Deep Sea-port are to be established where 6 crore bricks would be required.
- xviii. Around 2 crores bricks would be required for the establishment of Kuakata Parjatan Kendra.
- xix. Four lanes highway is being expected to be developed from Faridpur to Kuakata within next five years which would require a vast amount of Grade-1 bricks and brick chips.

Table 3.18: Expected future demand in next 10 years due to development works

Project Description	District	Projection of Required Bricks Quantity
Private Sector		
Regional Office Set-up for Pran-RFL	Barisal	2.5 Crores
A privately developed EPZ	Potua khali	3 Crores
M.P. Firoz Tobacco Company	Potua khali	Large quantity
Commercial structures to accommodate tourists in Kuakata	Potua khali	Large quantity
Kazi Farms	Bhola	Large quantity
Lalmohon Cold Storage	Bhola	2.4 Million
Junaid Rice Mill	Bhola	
Zilla Porishod Market	Bhola	1.5 Crores
Ayesha Memorial Hospital	Bhola	5 Million
SAP Bangladesh office set-up	Bhola	Large quantity
Office set-up for Heed Bangladesh	Borguna	Large quantity
Office set-up for South Asian Partnership	Borguna	Large quantity
A large scaled ice-factory	Borguna	Large quantity
A big project of World Bank	Borguna	2 Million
A college and an orphanage in the name of wife of honorable minister Mr. Amir Hossain Amu	Jhalokathi	Large quantity
Public Sector		
Police Academy Building	Barisal	10 Crores
Lebukhali Cantonment and Lebukhali Bridge	Patuakhali	15 Crores
A Medical University	Barisal	Large quantity

Project Description	District	Projection of Required Bricks Quantity
Chief Judicial Court	Patuakhali	5 Crores
A Nursing Dormitory	Barisal	Large quantity
University residential area	Patuakhali	5 Crores
Shilpo Kola Building	Patuakhali	5 Million
Residential building of Govt. Hatem Ali College	Barisal	2 Crores
Textile Institute	Bhola	2 Crores
A medical college	Bhola	Large quantity
Bhola Judge Court	Bhola	Large quantity
Road network from Bhola's Lalmohon to Char Fashion	Bhola	5 Million
Mukti Joddha Complex	Bhola	0.3 Million
LGRD's roads and Cyclone Center	Bhola	1 Crores
Coast Guard Office	Patuakhali	4 Million
A 300 MW Power Plant	Patuakhali	4 Crores
Residential buildings for the officials of Payra Deep Sea-port	Patuakhali	2 Crores
Four lanes highway is being expected to be developed from Faridpur to Kuakata		Large quantity

3.17. Project Specific Advantages/ Disadvantages

Since Barisal region is now getting priority on infrastructure development the region targeted is by-default in an advantageous position though this region has some disadvantages too. Comparative analysis of project specific advantages and the reverse are discussed below:

- i. Due to the planned development of connectivity of the Barisal region with the other parts of the country as a result of Padma Bridge, this region is getting a huge priority by both public and private sector. Lots of infrastructures are

going to be established in near future which would require a huge amount of good quality bricks.

- ii. The selected site (Angaria, Dumki, Patuakhali) has very good connectivity through water ways not only with the Barisal regions but also with most of the parts of the country specially Dhaka and Khulna. The Project would be able to utilize the cost advantage in case of transporting raw materials and finished goods (bricks) to different parts of Barisal, Khulna and Dhaka region using the low-cost water ways.
- iii. Automatic brick manufacturing projects require less number of human labors. The average human labor required for other kiln based factories is 130 where in the auto kiln factories this size is around 80. So by establishing auto brick kiln the project might enjoy fewer hassles on socio-economic issues caused by human labor engagement.
- iv. In this region there is a presence of a lot of unstable islands which are fragile by nature. Lots of boatmen collect the soil broken from the island and sell it to the brick fields. DoE does not have any allegation on using the soil from these sources and are not classified either as top soil or agricultural soil. So sourcing clay is comparatively less challenging in this particular region.
- v. In Patuakhali region number of brick fields is very limited and demand is increasingly high. Moreover this is pretty much expected that the demand for bricks would be very high in near future since a lot of big projects are being planned particularly in Patuakhali and the adjacent areas.
- vi. Government is creating immense pressure on the brick field owners to shift their operation in more eco-friendly process. Shifting technology is very costly and time consuming. For the most of the players it would be very difficult to accommodate this increasing cost and time and eventually have to end up by shutting down the operation. This down-sizing competition can be a huge opportunity for the Project.
- vii. Auto bricks are usually superior in quality. Because of its uniformity in size and shape, during construction using auto bricks can create optimization in the cost of other construction materials (eg. Cement, sand, concrete etc.). On the other hand using bricks processed through traditional technologies increase the waste ratio of bricks due to miss-matched size-shape. Because of the uniformity of auto bricks the wall produced by using this type of bricks gets optimized strength and 1000 auto-processed bricks suffice the need of 1200 traditionally processed bricks.

CHAPTER-4: BASELINE ENVIRONMENTAL CONDITION

Baseline condition of environment states the present status and historical data analysis of different components of environment in the project location and surrounding area. The main objective of examining the present environment is to provide a baseline environmental analysis against which potential impacts from construction and operational phases of the project can be determined. Another important aspect of establishing a baseline for parameters such as air, noise and water quality is to monitor potential impact of the brick manufacturing plant and to avoid any not erroneous obligation of the proposed project. In this study, different components have been examined for setting baseline conditions of the project area in terms of physical, biological, meteorological and socioeconomic conditions.

4.1. Target Study Area

The brick manufacturing plant is located at Angaria Union of Dumki Upazila, Patuakhali District, Barisal Division. Baseline condition has been analyzed by utilizing both primary and secondary data. Primary data has been collected through field visit and investigation within 2 km radius of the project site and measurement of key environmental parameters were conducted within 1 km radius. Secondary data has been collected from Bangladesh Meteorological Department for the Patuakhali station for last 5 years. Historical data has been considered from relevant published materials with disclosed sources.

4.2. Climate

The regional climate of the project location is classified as tropical. Observations depict that the area can become sweltering and scorching hot during daytime. Even the nights can be very warm until early morning. The cool mornings quickly become warm until the hottest temperatures are reached in early afternoon between 12:00 p.m. to 2:00 p.m. It remains warm until early evening after sunset but starts to cool off rapidly until just before sunrise the next day. Rain might fall as quick thunderstorms or as steady downpours depending on the wind patterns and the time of year. There is just a likelihood of having a little or less rain.

However, some characteristics of the wet and dry seasons of the project location are mentioned below:

- A lengthy dry season and a relatively short wet season. The dry season includes 7-8 months and the wet season duration is about 4-5 months.
- The wet season experiences heavy rainfall. Most of the region's annual rainfall is experienced from May to September.

- Winter is observed from December to February with lowest range of temperature. This period is considered as dry season since there is less possibility of rainfall.
- The direction of prevailing winds is generally consistent during the winter and monsoon seasons and more variable during the transition periods.

The seasonal variation of climate in the region is described below:

- **Winter or Northeast Monsoon (December - February)**

This season is characterized by very light northerly winds, mild temperature. Dry weather and clear to occasionally cloudy sky with fog is the common characteristics of this season. The mean temperature is in the range of 11-33 deg. cel. During this period when the ridge of sub-continental high pressure extends up to northwestern part of Bangladesh, temperature begins to fall. Sometimes minimum temperature goes below than 10°C and cold wave situation occurs.

- **Summer or Pre-Monsoon (March - May)**

The mean temperature of the region during the summer months varies between 14-38 deg cel. April and May are the hottest months. When the maximum temperature goes above 36°C heat wave situation occurs. The heat wave is classified as- mild heat wave (maximum temperature lies between 36-38°C), moderate heat wave (maximum temperature lies between 38-40°C), severe heat wave (maximum temperature greater than 40°C). The project location generally experiences mild heat wave. Occasionally moisture incurs in the afternoon.

- **Southwest Monsoon (June - September)**

In this season, the surface wind changes to southwesterly/southerly direction. Wind speed remains light to moderate. The onset and withdrawal of monsoon vary from year to year and place to place. The normal date of onset of Southwest Monsoon is 2nd June which during 1st half of June. Generally rain with widespread cloud coverage and high humidity are the characteristics of this season. More than 71% of the total annual rainfall occurs in this season. With the advance of the monsoon, the summer extreme temperatures fall appreciably in the region.

- **Autumn or Post-Monsoon (October - November)**

This is the transitional season from summer monsoon to the winter. Rainfall decreases considerably during October and November and the dry period starts setting over the country. Only 8-10% of the annual total rainfall occurs in this season. Temperature falls noticeably. Range of temperature varies from 14-35 deg. cel.

4.3. Meteorology

To understand the nature of climate around the project area it is very essential to find out the monthly and seasonal variation of climate parameters. As such temporal and spatial distribution of temperatures (maximum, minimum, and dry bulb), surface wind and rainfall are computed and analyzed.

4.3.1. Rainfall

The annual rainfall in the project location for last 5 years range from 2028 mm to 3098 mm and approximately 80% occurs during the period May to September. The rainfall follows the standard climate pattern of Bangladesh. However, the project area experiences heavy rainfall mostly during July. Month-wise rainfall data for the last 5 years is provided below:

Table 4.1: Monthly & Yearly Total Rainfall in mm.

Year	Month												Annual
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Spt.	Oct.	Nov.	Dec.	
2013	1	4	0	27	637	333	552	411	412	281	0	0	2658
2014	0	3	2	14	301	406	543	349	279	131	0	0	2028
2015	9	4	33	179	38	648	1033	595	374	157	6	22	3098
2016	12	53	3	42	454	387	677	521	203	254	145	0	2751
2017	0	0	119	249	65	368	743	530	272	416	17	52	2831
<i>Source: Bangladesh Meteorological Department (BMD)</i>													

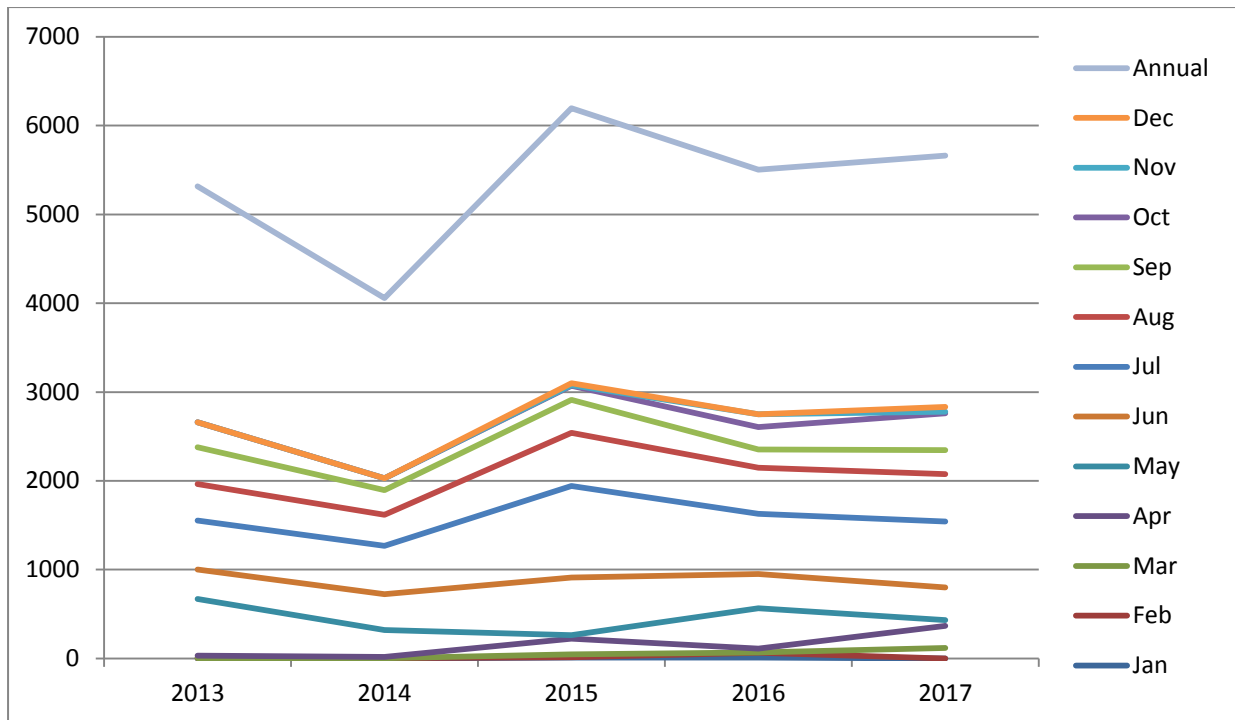


Figure 4.1: Rainfall distribution for the last 5 years

4.3.2. Temperature

Maximum temperature is observed during April or May and minimum temperature during January or February. Considering temperature level at the project area it is to mention that the plant workers will be exposed to heat-related illness. Increased hot days due to climate change may worsen the extent of heat stress for individuals working around heat generating sources. Mitigation measures should be adopted during project operation.

Monthly average Maximum & Minimum Temperature in degree celsius for last 5 years is mentioned below:

Table 4.2: Maximum & Minimum Temperature for last 5 years

Month	Year									
	2013		2014		2015		2016		2017	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Jan.	29.5	7.4	29.7	9.1	32	11.6	29.5	9.3	30.3	9.5
Feb.	33.5	12.5	30.7	11.6	33.6	10.2	35.4	14	32.6	13.4
Mar.	36.5	14.7	38.7	16	36	15.2	36	19.4	35.2	16.7

Month	Year									
	2013		2014		2015		2016		2017	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Apr.	37.2	19.5	39.5	22	35.6	20.6	37.2	18.3	35.3	20.4
May	38	21.6	37.6	21	36.6	22.3	37.7	21.4	36.5	21.3
Jun.	36	24.5	36.7	23.3	36.3	24.4	35.4	23.5	36	23.9
Jul.	33.6	24.6	34.1	25.2	34.7	24.3	35	24.6	34	24.8
Aug.	34.6	24.9	34	24.5	34.5	25	35	23.6	35	24.4
Sep.	35.6	24.1	35.5	24	36	24.7	35	24.5	35.7	24.6
Oct.	34.6	21	35.6	20.2	35.3	21	34.5	22	34.9	19
Nov.	32	15.8	34	14.4	33	17.2	34	17.2	33	15.2
Dec.	30.2	11.4	29.7	11.9	30.5	11.5	30.4	14.3	29	14.7
Annual	38	7.4	39.5	9.1	36.6	10.2	37.7	9.3	36.5	9.5
<i>Source: Bangladesh Meteorological Department (BMD)</i>										

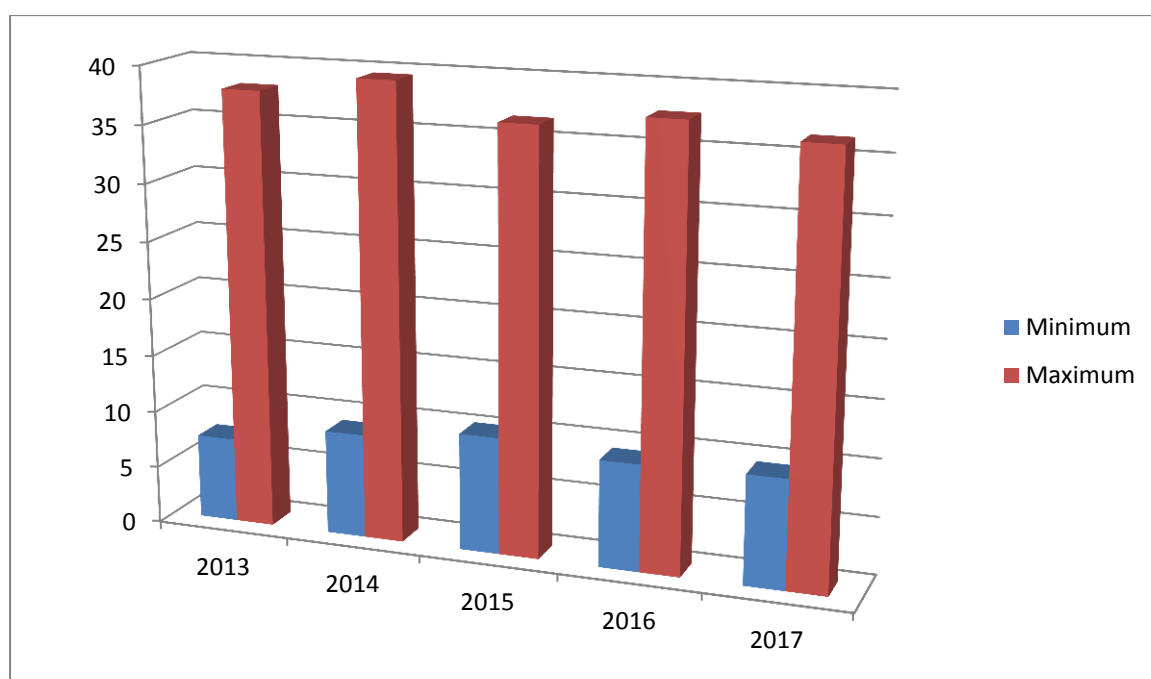


Figure 4.2: Maximum & Minimum Temperature for the last 5 years

4.3.3. Humidity

Annual humidity in the region ranges from 82 to 85 whereas highest humidity is observed as 90 to 92 during July to September. Lowest humidity is observed during February and March. Excess humidity can cause condensation on equipment, wet floors and saturated electrical panels. Moisture forming on the machines can result in product discoloration. If air moisture levels are too high, drying times can be longer than needed. Impacts also include slowing production, losing productivity and increasing energy consumption.

Table 4.3: Monthly & Yearly Average Humidity in % for last 5 years

Year	Month												Annual
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
2013	77	71	73	77	87	86	89	89	90	89	79	81	82
2014	80	75	71	74	82	88	89	91	88	84	82	85	82
2015	80	76	69	80	81	88	92	90	89	87	85	82	83
2016	81	81	80	83	85	87	92	89	88	87	84	83	85
2017	75	72	78	82	80	86	90	91	91	90	86	87	84

Source: Bangladesh Meteorological Department (BMD)

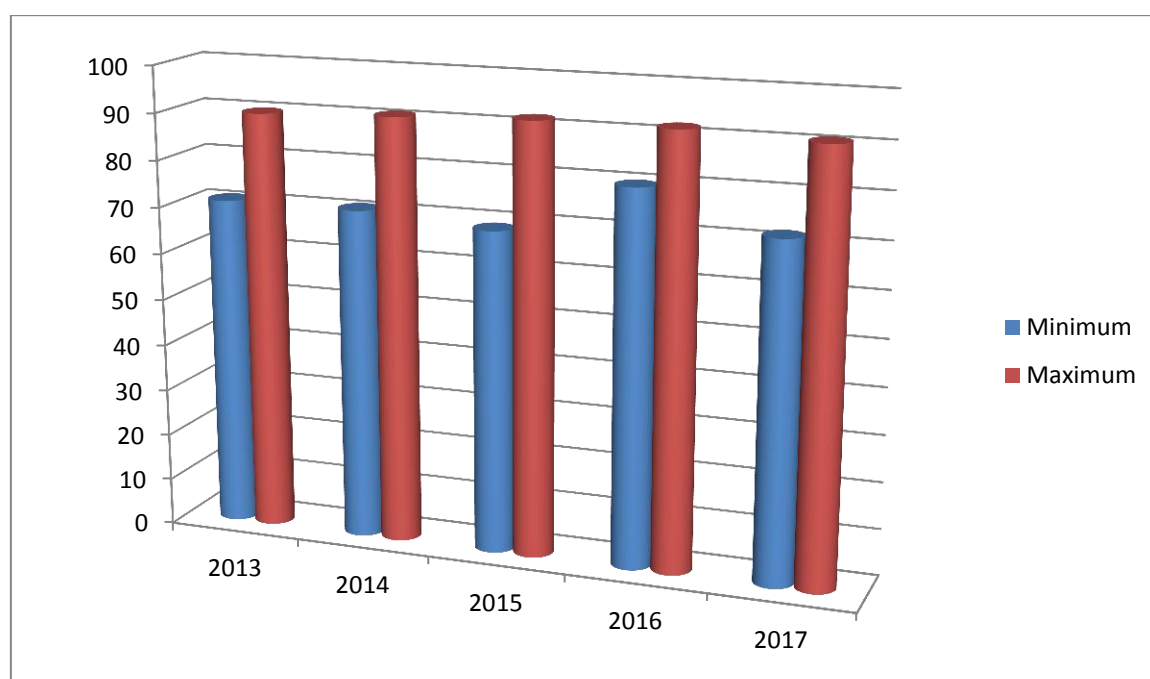


Figure 4.3: Maximum & Minimum Humidity for the last 5 years

4.3.4. Dry bulb/ Ambient Air Temperature

The Dry Bulb temperature, usually referred to as "air temperature", is the air property that is most commonly used. The Dry Bulb Temperature refers basically to the ambient air temperature. It is called "Dry Bulb" because the air temperature is indicated by a thermometer not affected by the moisture of the air. It can be noted that the ambient temperature has been lowest in the month of January for last five years whereas the maximum temperature varies during April to June.

Table 4.4: Monthly average dry bulb temperature in degree celcius

Year	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
2013	17.7	21.8	26.7	28.8	28.2	29.5	28.7	28.7	28.3	27.1	23.6	20
2014	18.1	21.3	26.3	30.2	29.8	29.6	29	28.5	28.9	27.4	23.8	19.5
2015	19.1	22.1	25.9	28.2	30.3	28.8	28.1	28.7	28.8	27.4	24.3	20.6
2016	18.9	24.4	27.8	30	29.3	29.3	28.2	28.8	29.1	28	23.8	20.8
2017	19.1	23	25.6	28.4	30.1	29.4	28.5	29	28.7	27.4	24.1	20.9

Source: Bangladesh Meteorological Department (BMD)

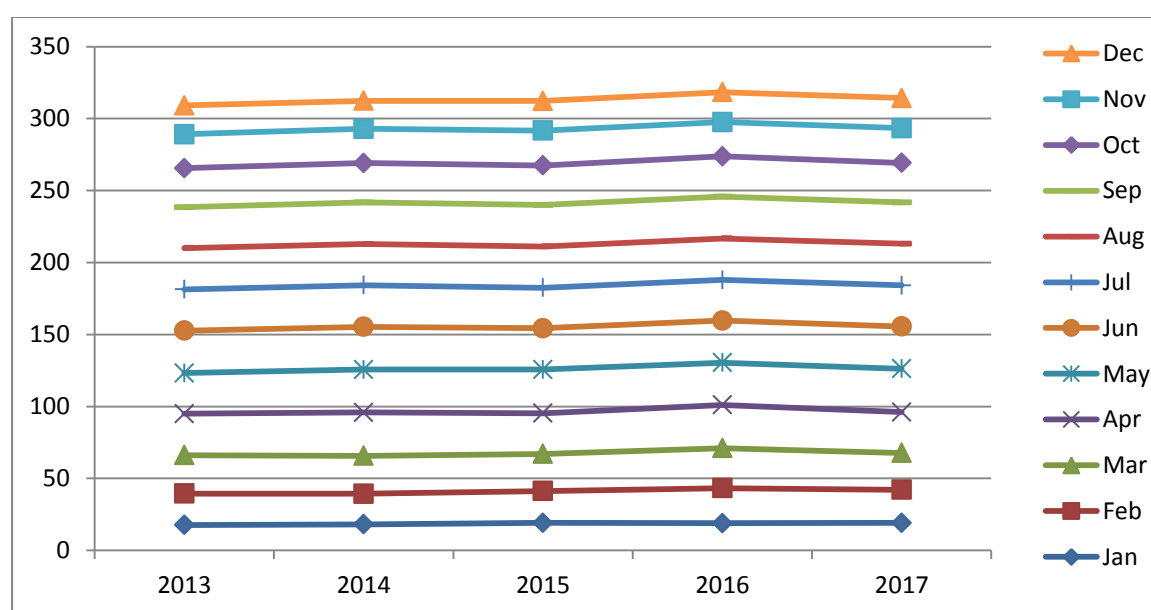


Figure 4.4: Dry bulb/ Ambient Air Temperature for the last 5 years

4.3.5. Sea Level Pressure

Historical data of sea level pressure in the project region is provided below. It can be observed that the highest pressure level is during January each year. But the lowest level varies from June to September. Sea level varies from day to day and week to week, depending on the weather situation. Air pressure has a direct influence on the sea level. High air pressure corresponds to low sea level and conversely low air pressure results in higher sea levels.

Table 4.5: Monthly & yearly average sea level pressure

Month	Year				
	2013	2014	2015	2016	2017
Jan.	1015.5	1016.5	1015.9	1015.6	1014.9
Feb.	1013.7	1012.9	1014.5	1014.4	1014
Mar.	1010.9	1012	1013.1	1011.7	1010.6
Apr.	1007.6	1008.4	1009.6	1006.7	1007.8
May.	1003.5	1006	1006	1005.1	1005.6
Jun.	1001.1	1000.3	1002.5	1003.6	1001.5
Jul.	1000.1	1000.3	1000.2	1002.7	1001.6
Aug.	1002.8	1003.2	1003.8	1001.6	1003.1
Sep.	1005	1005.9	1006.3	1001.4	1006
Oct.	1009.9	1011.3	1011.1	1007.7	1008.4
Nov.	1012.8	1012.4	1013.4	1011.9	1011.9
Dec.	1014.2	1014.8	1015.6	1013.7	1014.4
Annual	1008.1	1008.7	1009.3	1008	1008.3
<i>Source: Bangladesh Meteorological Department (BMD)</i>					

4.3.6. Wind speed

Historical data on wind speed and direction at the project region is given here. Highest and lowest value of wind speed varies throughout the year. Higher wind speed exerts a force on the surroundings and results in water movement. Meteorological studies have concluded that water levels at a particular location are not only affected by the local air pressure but also by other environmental factors.

Table 4.6: Wind speed & direction for last 5 years

Month	Year					
		2013	2014	2015	2016	2017
Jan.	Spd.	2.6	2	2.6	2.3	2.6
	Dir.	NNW	N	NNW	N	N
Feb.	Spd.	3	2.3	1.8	1.9	2.9
	Dir.	NNW	NNW	S	S	S
Mar.	Spd.	1.9	1.9	3.6	1.9	2.8
	Dir.	S	S	NNW	S	S
Apr.	Spd.	2.2	2.1	2.5	3.3	3
	Dir.	S	S	S	S	S
May.	Spd.	3.3	2.4	2.5	2.5	1.9
	Dir.	S	S	S	S	S
Jun.	Spd.	2.2	1.8	2.4	2	2.8
	Dir.	S	S	S	S	S
Jul.	Spd.	2.3	2.1	2.1	2	1.8
	Dir.	S	S	S	S	S
Aug.	Spd.	2.1	2	2.4	2.3	1.9
	Dir.	S	S	S	S	S
Sept.	Spd.	1.8	2.1	2.2	2	1.7
	Dir.	S	S	S	S	S
Oct.	Spd.	2	2	2.1	2	1.8
	Dir.	S	N	N	N	S
Nov.	Spd.	2.2	2	2.2	3.3	1.4
	Dir.	N	N	N	N	N
Dec.	Spd.	1.8	1.9	2.6	2.2	1.3
	Dir.	N	N	N	N	NW
Source: Bangladesh Meteorological Department (BMD)						

4.4. Measurement Result of Key Parameters at Project Site

4.4.1. Air Quality

Air quality depends on presence of specific substances in the atmosphere in such concentration that they produce undesirable effects on human being, animal and plant as well as the entire environment of the area. Such substances include gases (SO₂, NO_x, CO etc.), Suspended Particulate Matter (smoke, dust, fumes, etc.), and many others. There are national and international standard on acceptable concentration limit of different pollutants which can establish baseline air quality. In this study, 12-hour monitoring was conducted through high volume air sampler. Result of the sample testing is mentioned below along with the standard limit:

Table 4.7: Ambient Air Monitoring Result

Sl.	Parameter	Ambient Air Pollution Concentration in micro gram/cubic meter ($\mu\text{g}/\text{m}^3$)				
		*PM10	*SPM	*SO ₂	*NO _x	*CO mg/m ³
01	Method of analysis	Gravimetric	Gravimetric	West-Geake	Jacob and Hochheis	Indicator Tube
02	Bangladesh Standard (As per DoE)	150	200	365	100	10
03	IFC/ World Bank Standard	150	NF	125	200	NF
04	Concentration present	86.72	109.74	13.65	17.43	1.76
05	Remarks	Excellent	Excellent	Excellent	Excellent	Excellent

(NF – not found, DoE – Department of Environment)

* **PM10** - Respirable Dust Content; **SPM** - Suspended Particulate Matter;

NO_x - Oxides of Nitrogen; **SO₂** - Sulphur Di-Oxide; **CO** - Carbone Mono-Oxide

The above result for ambient air quality monitoring shows the PM10, SPM, SO₂, NO_x & CO Concentrations of the ambient air within 1 km radius of the project location. From the above analysis it is observed that the concentration of all these parameters is far below the acceptable limit as per Bangladesh Standard and International standard for ambient air.

4.4.2. Ambient Noise Level

The project site is located in a rural area with no other factory in the region. But the Payra river and the Lebukhali Ghat is very close to the project area. So noise generating source is already available at close proximity of the project site. Machinery used for agriculture is also significant source of noise in the area. Thus the installation and operation of project machinery will not create significant noise that can hamper the condition of the people living close to the project site. Due to gathering of people and operational activity, noise generation will be increased but that will certainly not exceed the acceptable standards. The ambient noise level data were collected from different side of the project location by sound level meter and average maximum results are presented here along with the standards.

Table 4.8: Tolerable limit of noise in Bangladesh

Area types	Unit	Tolerable limit at day	Tolerable limit at night time
Areas require high level of silence like hospital,	dBA	45	35
Residential areas	dBA	50	40
Mixed areas for residence, commercial and	dBA	60	50
Commercial areas	dBA	70	60
Industrial areas	dBA	75	70
<i>Source: ECR 1997</i>			

Table 4.9: Ambient Noise Monitoring Result

Sl.	Site Location	Concentrations present (LAeq) dBA.	
		Day Time	Night Time
1	West Side (nearby Payra river)	58.5	50.6
2	East Side (nearby Patuakhali-Bauphal Highway)	52.3	44.7
3	North Side (nearby Local community)	48.4	39.1
4	South Side (nearby Local community)	46.3	37.5
DoE (Bangladesh) Standard for Industrial		75	70
IFC/International Standard for Industrial/Commercial Zone		70	70

4.4.3. Water Quality

4.4.3.1. Surface Water Quality

The water quality of limited parameters of a small pond near the project site is analyzed and the results are given in the following table.

Table 4.10: Surface Water quality Monitoring Result (limited parameters)

Sl.	Parameter	Concentration present	Bangladesh Standard (As per DoE)	Method of analysis
01	Ph	6.8	6 – 9	pH Meter
02	TDS	430 mg/l	2100 mg/l	Gravimetric
03	BOD	10.9 mg/l	50 mg/l	Dilution
04	COD	32.6 mg/l	200 mg/l	COD Reflection

4.4.3.2. Ground Water Quality

Ground water label exists at moderate (70-80 ft. approx.) depth. Usage of ground water for irrigation is limited here. There is no complaint regarding non- availability of ground water in this area.

Water will be used in the project mainly from underground source. Currently two water pump is functioning in the project area. To determine quality of ground water, water sample was collected from nearby deep tube well of the existing plant. Results show that all the parameters remain within allowable limit of drinking water value as per Environmental Quality Standards for Bangladesh. The parameters which have been analyzed during this study are presented below in Table.

Table 4.11: Ground Water quality Monitoring Result (limited parameters) of the Factory Site

Sl.	Parameter	Result	Bangladesh Standard (As per DoE)
01	pH	7.3	6.0-9.0
02	Total Dissolved Solids	480 mg/l	1000 mg/l
03	Hardness	92 mg/l	(200-500) mg/l
04	Chloride	58.2 mg/l	(150-600) mg/l

4.5. Seismicity

On the basis of distribution of earthquake epicentres and morphotectonic behaviour of different tectonic blocks Bangladesh has been divided into three generalised seismic zones. The northeastern folded regions of Bangladesh are the most active zones and belong to the zone-I. The Bask seismic coefficient of this zone is 0.08. The zone II consists of the regions of recent uplifted Pleistocene blocks of the Barind and Madhupur and the western extension of the folded belt and the Bask coefficient for this zone is 0.05. The southwest Bangladesh is seismically quiet zone and represented by zone III with Bask coefficient 0.04. Characteristic features of seismic zonation of Bangladesh are presented in the table.

Table 4.12: Seismic Zoning of Bangladesh

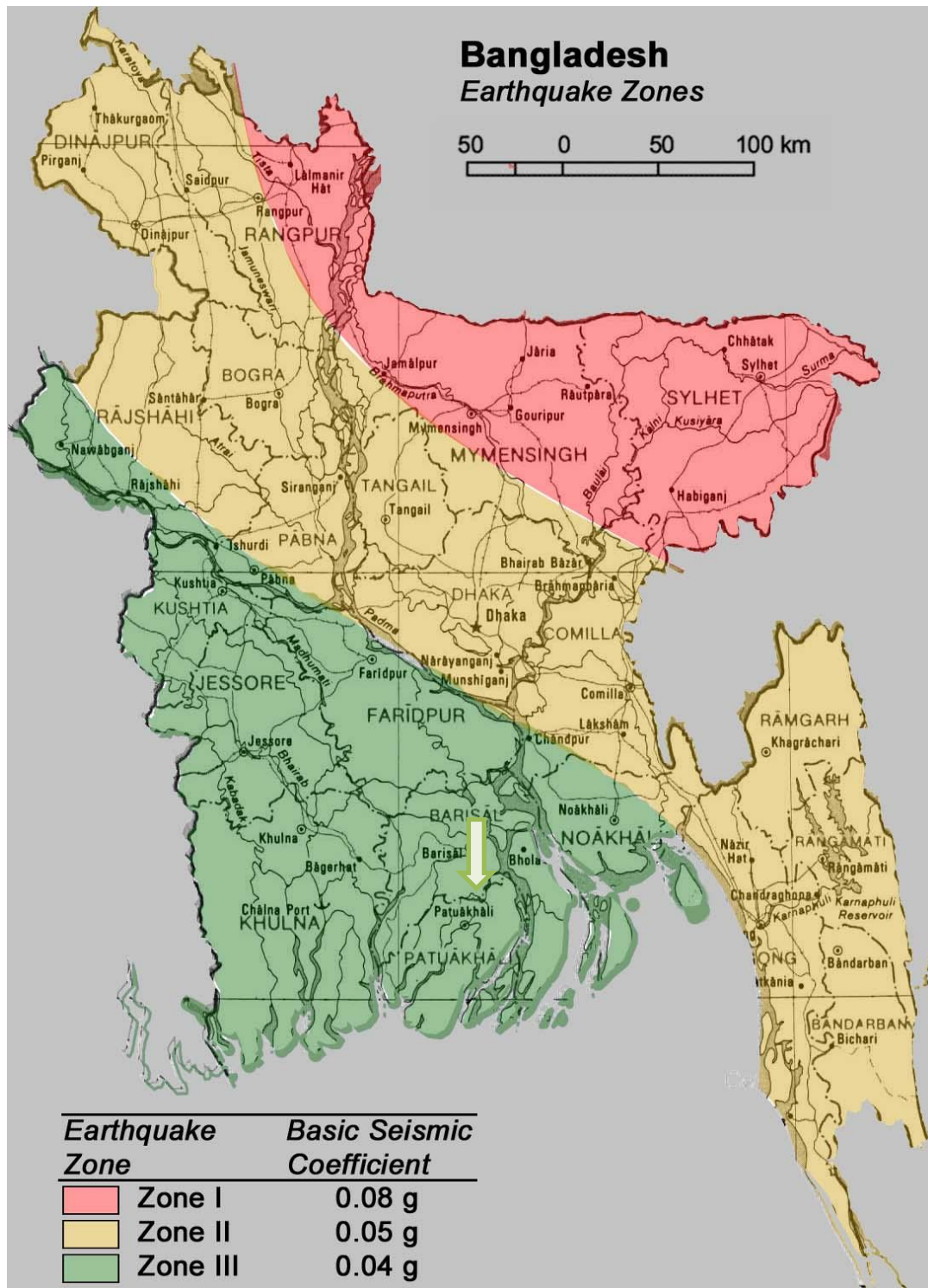
Zoning Area	Scale
I	North and eastern regions of Bangladesh (Seismically most active)
II	Lalmai, Barind, Madhupur Tracts, Dhaka, Comilla, Noakhali and western part of Chittagong Folded belt.
III	Khulna division S-E Bangladesh (Seismically relatively quiet)
<i>Source: Bangladesh Water Development Board (BWDB)</i>	

The proposed project falls into the Zoning Area III and can be concluded that this area has very less seismic risk. During field investigation, the local inhabitants mentioned that they did not experience any major earthquake for the last two years. Moreover, historical incidence of earthquake in the region is very rare and happened after long interval of period. Though the occurrence of earthquakes cannot be prevented, issuing of warning and preparing for emergency can minimize the loss of life and property.

The project management should consider the following measures to mitigate the earthquake disaster impacts:

- i. Pre-disaster physical planning of human settlements,
- ii. Management of settlements in case of occurrence.

The following map shows the seismic zoning of Bangladesh along with highlighted project area.



Source: Flood Forecasting and Warning Centre, BWDB

Figure 4.5: Bangladesh Map (Earthquake Zones)

4.6. Flood Risk Assessment

Flooding is a natural phenomenon, which cannot be prevented. In general, there are 4 types of flood in Bangladesh:

- i. **Flash Floods:** Caused by overflowing of hilly rivers mainly in eastern and northern Bangladesh
- ii. **River Floods:** River flood is a common phenomenon in the country caused by bank overflow.
- iii. **Rain-fed Flood:** This kind of flood generally occurs in many parts of the country but is mainly prevalent in the south-western part of the country.
- iv. **Coastal Floods:** This kind of flood mostly occurs along the coastal areas of Bangladesh over a coastline of about 800 km along the southern part.

From the flooding map attached in the following, it can be observed that the proposed project location falls under the category of “*Not Flood Prone*” area. There is very little risk of normal and flash flood in the project location. Moreover, the Flood Forecasting & Warning Centre (FFWC) of Bangladesh Water Development Board (BWDB) has not included Payra river in its Water Level Table considering the least risk criteria of flooding. So, the project location is not exposed to flood risk. During field investigation, the local community members mentioned that no major flood occurred in the area for last 10-12 years. However, heavy rain for longer period may cause disruption in production and transportation. Additionally, overflowing river banks is a very common phenomenon in our country during rainy season. Since the project location is close to Payra river, the brick plant is exposed to the risk of being affected by such overflowing condition. The project directors have informed that they will fence the manufacturing plant with heavy brick wall to mitigate such risk. They will also build artificial drainage or canal around the project site to bypass water that may possibly be stored during rainy season.

As there is no certainty of natural calamity, we would like to propose to make necessary arrangement for mitigation in terms of the worst case scenario. Thus the project management should regularly monitor weather forecasting and flood early alert information during rainy season. Moreover, emergency evacuation plan and other related flood management tools should be kept in place to ensure safety of the plant workers and personnel.

The map highlighting the flood prone areas in Bangladesh including type and level of risk is below:

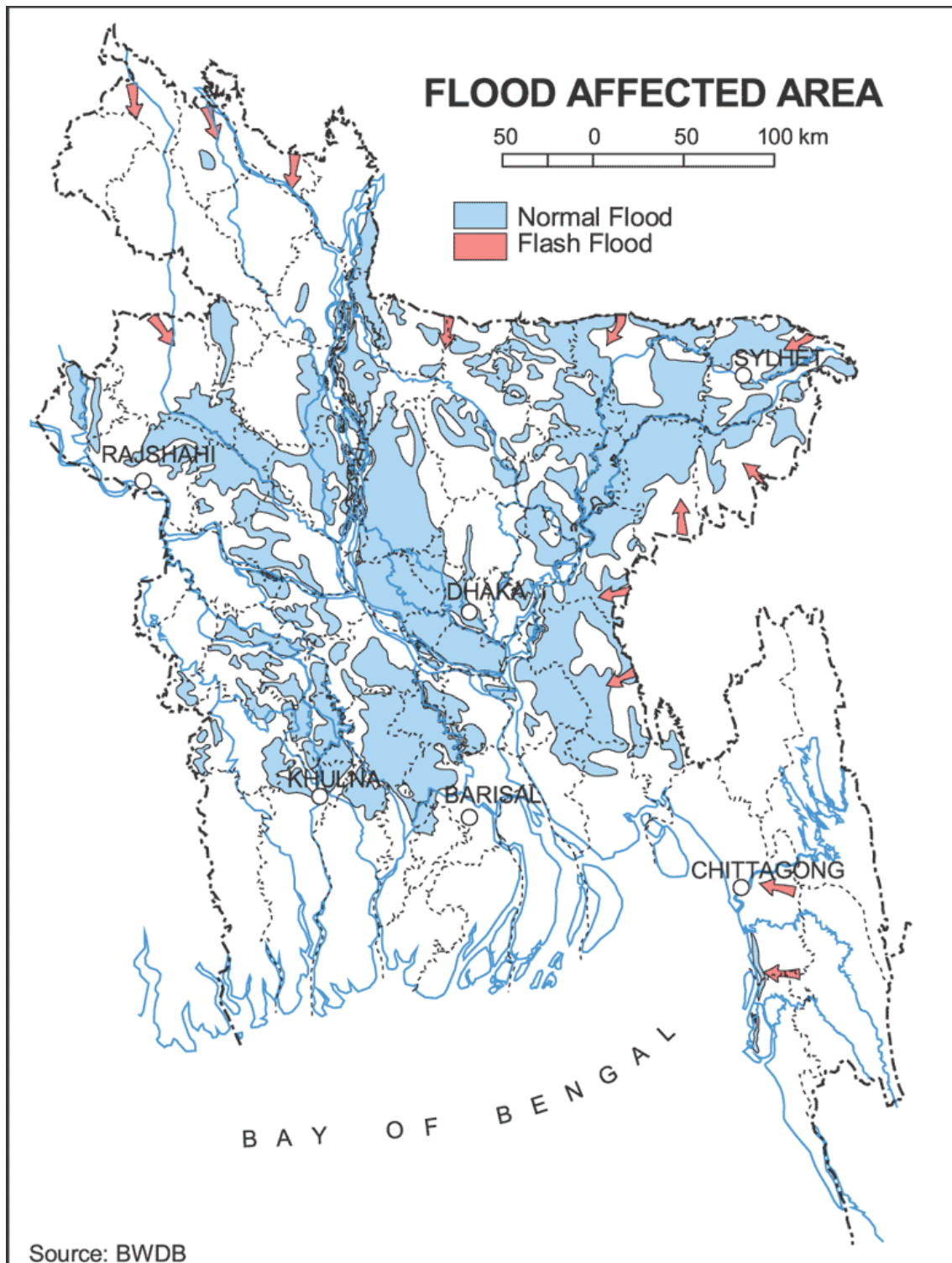


Figure 4.6: Bangladesh Map (Flood Affected Area)

4.7. Ecology & Biological Resources

4.7.1. Overview

The countries of South and Southeast Asia are considered by the IUCN as 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).

The entire floodplain of Bangladesh was once well forested, but most of the native forests have disappeared in recent decades due to mounting pressure from human populations. The floodplain land has long been subject to cultivation, the most dominant land use within the study area. Thus 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 river systems within the study area are used as local transport routes and are also important for fishing and fish farming. The freshwater watercourses also provide an important nursery ground for native fish. In addition, a number of fish ponds and freshwater wetlands occur within the study area. These areas provide diverse habitats for many freshwater aquatic flora and fauna.

4.7.2. Bio-ecological Zone

Twenty-five bio-ecological zones have been delineated within Bangladesh by the IUCN. Six parameters were used to determine the areas including: physiography, soil, rainfall and temperature, floral distribution, faunal distribution and flood depth (IUCN 2002). The Project area occurs in both the Ganges Floodplain and Offshore Islands bio-regions, which are separated by the Tentulia River. The Project location is contained within one bio-ecological zone, Ganges Floodplain bio-ecological zone (4b) mapped by IUCN as shown here.

4.7.2.1. Ganges Floodplain Bio-ecological Zone

The Ganges Floodplain is basically consisted of the active Floodplain of the Ganges River and the adjoining meandering Floodplains, and is mostly situated in the administrative districts Jessore, kushtia, Fardpur and Barisal. The adjoining meander Floodplains mainly comprises a smooth landscape of ridges, basis and old channels. Noteworthy aspect here is that the Genetic alluvium is readily distinguishable from the old Brahmaputra, Jamuna and Meghna sediment but its high lime content. Besides, the relief is locally irregular alongside the present and former river courses, especially in the west, comprising a rapidly alternating series of linear low ridges and depressions. The

Ganges channel is constant shifting within its active Floodplain, eroding and depositing large areas of new char lands in each Flooding season, but it is less braided than that of the Brahmaputra- Jamuna. Interestingly enough, both plants and animals move and adapt with the pattern of Flooding (Brammer, 1996)

This Floodplain is characterized by mixed vegetation. Presence of a lot of stagnant water bodies and channels, rivers and tributaries in this zone support a habitat of rich biodiversity to some extent. In the beels and other water bodies, free floating aquatic vegetation is prominent. Homestead forests, on the other hand, include both cultivated wild plants species, the dominant floral types are: the Panimorch (*Polygonum Orientale*), Jhanji (*Hydrilla verticillata*), Helecha (*Alternanthera philoxeroides*), Topapana (*Pistia stratiotes*), (*Sclenoplectus articulatus*), Shade shapla (*Nymphaea nouchali*), Keshordam (*Ludwigia adscendense*), Kolmi (*Ipomoea aquatic*), Dhol kolmi (*Ipomoea pes-caprae*), Hijal (*Barringtonia acutangula*), (*Ipomoea aquatic*), Tamarind (*Tamarindus indica*), Panibaj (*Salix tetrasperma*), Etc. Moreover, Grasses are most abundant in the Ganges floodplain and begin to grow as soon as the Flood water begins to recede. The notable grass species are *Cyperus rotundus*, *C. difformis*, *Eleocharis*, *Hemarthria* sp. etc. (GoB-IUCN, 1992).

Nearly all the major groups of the oriental birds are represented in this zone by one or more species. In addition, a large number of migratory birds are found here during the winter. Besides, different species of freshwater tortoises and turtles are also found in the river and ponds most of which are a popular delicacy among the non-Muslim locals. The amphibian species found in this zone include a new species toads and free frogs. Among the mammalian fauna foxes, Rats, mice, species, bats, etc. are seen everywhere (GoB-IUCN, 1992).

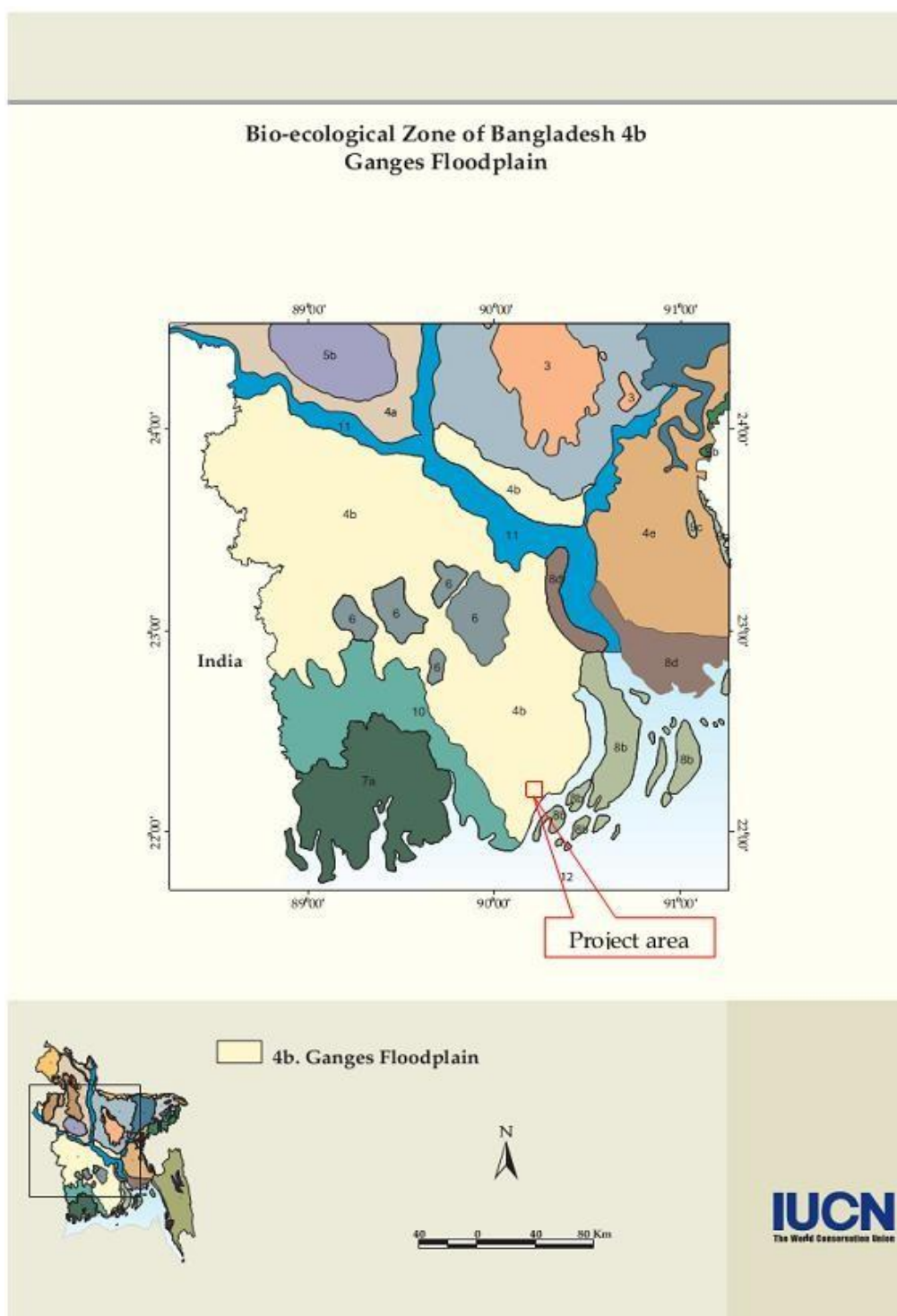


Figure 4.7: Bio-Ecological Zones of the Study Area

The ecosystem can be categorized into two different types concerning bio-ecological zoning to identify and distinct biological resources within the vicinity of the Project site as mentioned below:

- **Terrestrial:** This represents the flora and fauna that occurs in the project area that remain relatively unaffected by inundation associated with the monsoon; and
- **Aquatic:** This includes the Freshwater sub-ecosystems and represents the freshwater rivers, channels and semi-permanently inundated freshwater bodies and their associated flora and fauna within the Project area.

4.7.3. Terrestrial Ecosystem

Terrestrial ecosystems comprise a community of organisms and their environment that occurs on the land masses of continents and islands. Due to less diversity in the land use within the Project area, there are only two terrestrial ecological communities:

- Agricultural Land;
- Village and Homestead Plantation & Vegetation;

4.7.3.1. Terrestrial Flora

Considering diverse range, terrestrial flora is described following the mentioned terrestrial ecological communities.

- **Agricultural land**

Agricultural land extends over more than 60 percent of the terrestrial Project area. The agricultural area is used for Aman rice monoculture in the monsoon season, while in winter a small portion of the land is used for rice (Boro) production. In general, land remains fallow during remaining time of the year and is used for grazing. Following the cultivation pattern, very limited types of native flora species were found around the project location. Some of the most common flora species within the Project area are provided in the table below.

Table 4.13: Common flora species in agricultural lands nearby Project site

Scientific Name	Family	Local Name
<i>Ageratum conyzoides</i>	Compositae	Fulkuri
<i>Alternanthera sessilis</i>	Amaranthaceae	Sachishak
<i>Clerodendrum inerme</i>	Verbenaceae	Bhant
<i>Cotula hemispherica</i>	Compositae	Kancha ghash
<i>Croton bonplandianum</i>	Euphorbiaceae	Banjhal

Scientific Name	Family	Local Name
<i>Cynodon dactylon</i>	Gramineae	Durba
<i>Cyperus cephalotes</i>	Cyperaceae	Niratraba
<i>Dentella repens</i>	Rubiaceae	Hachuti
<i>Eupatorium odoratum</i>	Compositae	Assamlata
<i>Euphorbia hirta</i>	Euphorbiaceae	-
<i>Heliotropium indicum</i>	Boraginaceae	Hatisur
<i>Nicotiana plumbaginifolia</i>	Solanaceae	Bantamak
<i>Rorippa indica</i>	Cruciferae	Bansarisha
<i>Rumex dentata</i>	Polygonaceae	Bonpalang
<i>Vernonia petula</i>	Compositae	Shilmuta
<i>Xanthium indicum</i>	Compositae	Hagra

- **Village and Homestead Plantation & Vegetation**

Village forests and homestead plantations are known to support some 149 tree species which consist mainly of fruit trees and multi-purpose species (IUCN, 2002). The vegetation in these areas supplies food and fuel for local villagers. Village and homestead vegetation is the single most important plant community in terms of diversity.

Homestead vegetation occupies about 10 percent of the community area around the project site. This vegetation generally included two types of plants: those cultivated for their economic value and those that are self-propagating. The most dominant species in the Project area is Rain tree (*Samanea saman*), which occupies more half of the canopy cover in many areas. Other common species are Narikel (*Cocos nucifera*), Khejur (*Phoenix sylvestris*), Amm (*Mangifera indica*), Supari (*Areca catechu*), Gab (*Diospyros perigrina*), Tal (*Borassus flabelifer*), Raj Sirish (*Albizia richardiana*) and Bot (*Ficus benghalensis*).

Other species such as Bamboo (*Bambusa sp.*) is also available in the homestead areas. On the ground level, a variety of species of shrubs and herbs were found.

Table 4.14: Common plants and vegetable species around the project site and nearby community

Scientific Name	Family	Local Name
<i>Acacia nilotica</i>	Mimosaceae	Babla
<i>Albizia procera</i>	Leguminosae	Silkaro
<i>Albizia richardiana</i>	Leguminosae	Gogon Sirish
<i>Albizia saman</i>	Leguminosae	Raintree
<i>Areca catechu</i>	Palmae	Supari

Scientific Name	Family	Local Name
<i>Artocarpus lacucha</i>	Moraceae	Dephal
<i>Barringtonia acutangula</i>	Barringtoniaceae	Hijal
<i>Cleorodendrum siphonanthus</i>	Verbenaceae	Banchat
<i>Cocos nucifera</i>	Palmae	Narikel
<i>Casuarina equisetifolia</i>	Casuarinaceae	Jahu
<i>Diospyros perigrina</i>	Ebenaceae	gab, deshigab
<i>Diospyros discolor</i>	Ebanaceae	Bilatigab
<i>Erythrina variegata</i>	Leguminosae	Mandar
<i>Mangifera indica</i>	Anacardiaceae	Am
<i>Mikania scandens</i>	Compositae	Assamlata
<i>Mikania scandens</i>	Compositae	Assamlata
<i>Musa paradisiaca</i> var. <i>sapientum</i>	Musaceae	Kala
<i>Pandanus</i> sp.	Pandanaceae	Keya
<i>Physalis minima</i>	Solanaceae	Bantepari

4.7.3.2. Terrestrial Fauna

Cultivation and plantation areas support a diverse range of common fauna species however the quality of such habitat is influenced by a variety of agricultural practices, including cultivation processes and the use of agro-chemicals. Within the Project area, cultivated land and associated plantation & vegetation areas represent the majority of habitat available for terrestrial fauna species.

Agricultural cropland provide important hunting and feeding grounds for birds and other wildlife. Species such as the Lesser bandicoot rat (*Bendicota bengalensis*) and Greater bandicoot rat (*Bandicota indica*) prefer agricultural areas. Thus, predatory birds such as the Brahminy kite (*Haliastur indius*) are commonly found foraging in the agricultural areas around the Project location.

The local community area provide habitat for a number of reptile species, particularly shelter and foraging resources for insects and small vertebrates and reptiles. Reptiles that may inhabit these areas include the Common garden lizard (*Calotes versicolor*), Common skink (*Mabuya carinata*) and the Binocellate cobra (*Naja naja*).

Birds associated with the community areas were recorded. The House sparrow (*Passer domestics*), Crow (*Corvus* sp.), and the Magpie robin (*Copsychus saularis*) are common species available.

4.7.4. Aquatic Ecosystem

The project study area contains Freshwater ecosystem. Payra, a major river of the Barisal Division is only about 300 meter distant from the project site. Nearby community areas around the project site consist of some small ponds. No estuarine/costal ecosystem is available in close proximity of the project location.

4.7.4.1. Aquatic Flora

Some common river/creek bank species are *Acanthus ilicifolia*, *Acrstichum aureum*, *Hibiscus tiliaceus*, *Pongamia glabra*, *Sonneratia apetala* and *Streblus asper*. Very few ponds inside the nearby community area with fresh water contain culture fisheries and have some kind of floating plants. These ponds are the source of fresh water for small wildlife, living in the homestead grooves and provide feeding grounds for some of these species.

The most common liverworts (Bryophyta, thalloid plants) found in Payra river are *Riccia fluitans* and *Ricciocarpus natans*.

The number of algae shows great diversity. Some examples are *Scenedesmus*, *Pediastrum*, *Chlamydomonas*, *Volvox*, *Euglena* (phytoplankton), *Botrydiopsis*, *Lamprospira*, *Nitzschia*, *Achnanthes*, and *Gomphonema*, *Oscillatoria*, *Spirulina*, *Navicula*, *Closterium*; and *Oedogonium*, *Ophiocytium*, *Characium*.

Among aquatic ferns the most common ones are *Azolla pinnata*, *Salvinia cucullata*, *S. auriculata*, *S. natans*, *Marsilea quadrifoliata*, *Ceratopteris thalictroides* and *Isoetes*.

Among the angiosperm, member of both monocotyledons and dicotyledons are found in river water. Many aquatic migratory birds build their nests in aquatic plants (such as *Trapa*, *Phragmites*, etc). Fishes lay their eggs and take shelter under many aquatic plants (*Najas*, *Ceratophyllum*, *Hygroryza*, *Sagittaria*, *Monochoria*, *Eichhornia*, *Ipomoea*, *Telanthra*, *Myriophyllum*).

4.7.4.2. Aquatic Fauna

The Payra river around the Project area is used as local transport routes, and important for fishing and fish farming as well as providing an important nursery ground for native fish. In addition, a limited number of fishponds and freshwater wetlands occur within the Project area, particularly during the monsoon season. These areas provide diverse habitats for many aquatic fauna.

- **Fish**

Since the project site is adjacent to Payra river, fish diversity in the river is described here. There are very few ponds in local community area which contain selected species from the table below.

Table 4.15: Fish diversity in the nearby Payra river

Family	Local name	Common name	Scientific name
Anguilliformes (2 species)			
Anguillidae	Banehara	Indian mottled eel	Anguilla bengalensis
Moringuidae	Rata boura	Purple spaghetti eel	Moringua raitaborua
Beloniformes (4 species)			
Adrianichthyidae	Bechi	Spotted ricefish	Oryzias carnaticus
Adrianichthyidae	Bechi	Ricefish	Oryzias dancena
Belonidae	Kakila	Freshwater garfish	Xenentodon cancila
Hemiramphidae	Ek thota	Wrestling halfbeak	Dermogenys pusilla
Clupeiformes (5 species)			
Engraulidae	Phasa	Gangetic hairfin anchovy	Setipinna phasa
Clupeidae	Chapila	Indian river shad	Gudusia chapra
Clupeidae	Kachki	Ganges river sprat	Corica soborna
Clupeidae	Ilish	Hilsa shad	Tenualosa ilisha
Clupeidae	Chandan ilish	Toli shad	Tenualosa toli
Cypriniformes (26 species)			
Cobitidae	Gutum	Guntea loach	Lepidocephalichthys guntea
Cyprinidae	Along	Bengala barb	Megarasbora elanga
Cyprinidae	Bata	Bata	Labeo bata
Cyprinidae	Chebli	Giant danio	Devario aequipinnatus
Cyprinidae	Darkina	Flying barb	Esomus danricus
Cyprinidae	Darkina	Striped flying barb	Esomus lineatus
Cyprinidae	Darkina	Gangetic scissortail rasbora	Rasbora rasbora
Cyprinidae	Dhela	Cotio	Osteobrama cotio
Cyprinidae	Katol	Catla	Catla catla
Cyprinidae	Mrigal	Mrigal carp	Cirrhinus cirrhosus
Cyprinidae	Rui	Roho labeo	Labeo rohita
Cyprinidae	Kalibaus	Orange fin labeo	Labeo calbasu
Cyprinidae	Mola	Indian carplet	Amblypharyngodon microlepis
Cyprinidae	Chep chela	Silver hatchet barb	Chela cachius

Family	Local name	Common name	Scientific name
Cyprinidae	Chep chela	Indian glass barb	Laubuca laubuca
Cyprinidae	Mola	Mola carplet	Amblypharyngodon mola
Cyprinidae	Punti	Swamp barb	Puntius chola
Cyprinidae	Kanchan punti	Rosy barb	Puntius conchoni
Cyprinidae	Punti	Puntio barb	Puntius puntio
Cyprinidae	Shorpunti	Olive barb	Puntius sarana
Cyprinidae	Bhadi punti	Pool barb	Puntius sophore
Cyprinidae	Tit punti	Ticto barb	Puntius ticto
Cyprinidae	Chela	Silver razorbelly minnow	Salmophasia acinaces
Cyprinidae	Chela	Finescale razorbelly minnow	Salmophasia phulo
Psilorhynchidae	Titari	River stone carp	Psilorhynchus sucatio
Cyprinodontiformes (1 species)			
Aplocheilidae	Kanpona	Blue panchax	Aplocheilus panchax
Mugiliformes (4 species)			
Mugilidae	Khorsula	Corsula mullet	Rhinomugil corsula
Mugilidae	Bata	Greenback mullet	Chelon subviridis
Mugilidae	Bata	Broad-mouthed mullet	Paramugil parvatus
Mugilidae	Parse	Goldspot mullet	Chelon parva
Osteoglossiformes (2 species)			
Notopteridae	Chital	Clown knifefish	Chitala chitala
Notopteridae	Foli	Bronze featherback	Notopterus notopterus
Perciformes (31 species)			
Ambassidae	Ranga chanda	Indian glassy fish	Parambassis ranga
Ambassidae	Lomba chanda	Elongate glass-perchlet	Chanda nama
Ambassidae	Nalua chanda	Scalloped perchlet	Ambassis nalua
Ambassidae	Phopa chanda	Himalayan glassy perchlet	Pseudambassis baculis
Anabantidae	Koi	Climbing perch	Anabas testudineus
Channidae	Cheng	Dwarf snakehead	Channa gachua
Channidae	Gozar	Great snakehead	Channa marulius
Channidae	Ranga	Walking snakehead	Channa orientalis
Channidae	Taki	Spotted snakehead	Channa punctata
Channidae	Shol	Striped snakehead	Channa striata
Eleotridae	Kuli	Duckbill sleeper	Butis butis
Eleotridae	Bhut bele	Dusky sleeper	Eleotris fusca
Gobiidae	Dali cheua		Apocryptes bato
Gobiidae	Bele	Scribbled goby	Awaous grammepomus

Family	Local name	Common name	Scientific name
Gobiidae	Bele	Tank goby	Glossogobius giuris
Gobiidae	Bailla	Pacific river goby	Awaous guamensis
Gobiidae	Chewa	Pointed-tailed goby	Pseudapocryptes elongatus
Gobiidae	Chuno bele	Glass goby	Gobiopterus chuno
Gobiidae	Dogri	Burrowing goby	Trypauchen vagina
Gobiidae	Dahuk	Boddarts goggle-eyed goby	Boleophthalmus boddarti
Gobiidae	Dahuk	Giant mudskipper	Periophthalmodon schlosseri
Gobiidae	Dahuk	Walking goby	Scartelaos histophorus
Gobiidae	Nuna bailla	Bumblebee goby	Brachygobius nusus
Latidae	Bhetki	Barramundi	Lates calcarifer
Nandidae	Veda	Gangetic leafish	Nandus nandus
Osphronemidae	Chuna	Honey gourami	Trichogaster chuna
Osphronemidae	Khailsha	Banded gourami	Colisa fasciata
Osphronemidae	Lal kholisha	Dwarf gourami	Trichogaster lalius
Polynemidae	Taposi	Paradise threadfin	Polynemus paradiseus
Sciaenidae	Poa	Pama croaker	Otolithoides pama
Sillaginidae	Tular dandi	Flathead sillago	Sillaginopsis panijus
Pleuronectiformes (4 species)			
Soleidae	Kathal pata	Pan sole	Brachirus pan
Cynoglossidae	Kukur jib	Largescale tonguesole	Cynoglossus arel
Cynoglossidae	Kukur jib	Long tongue sole	Cynoglossus lingua
Cynoglossidae	Kukur jib	Bengal tongue sole	Cynoglossus cynoglossus
Siluriformes (28 species)			
Ariidae	Gagla	Gagora catfish	Arius gagora
Bagridae	Bajari tengra	Pyjama catfish	Mystus tengara
Bagridae	Gulsa tengra	Day's mystus	Mystus bleekeri
Bagridae	Kabasi tengra	Gangetic mystus	Mystus cavasius
Bagridae	Nuna tengra	Long whiskers catfish	Mystus gulio
Bagridae	Tengra	Kerala mystus	Mystus armatus
Bagridae	Tengra	Stripped dwarf catfish	Mystus vittatus
Bagridae	Rita	Whale catfish	Rita rita
Bagridae	Air	Long-whiskered catfish	Mystus aor
Bagridae	Guijja air	Giant river-catfish	Sperata seenghala
Clariidae	Magur	Walking catfish	Clarias batrachus
Heteropneustidae	Shingi	Stinging catfish	Heteropneustes fossilis
Pangasiidae	Pangas	Yellowtail catfish	Pangasius pangasius

Family	Local name	Common name	Scientific name
Schilbeidae	Bacha	Batchwa vacha	Eutropiichthys vacha
Schilbeidae	Batasi	Indian potasi	Pseudeutropius atherinoides
Schilbeidae	Kajuli	Gangetic ailia	Ailia coila
Schilbeidae	Kajuli	Jamuna ailia	Ailia punctata
Schilbeidae	Muribacha	Garua Bachcha	Clupisoma garua
Schilbeidae	Shillong	Silond catfish	Silonia silondia
Siluridae	Kani pabda	Butter catfish	Ompok bimaculatus
Siluridae	Madhu pabda	Pabdah catfish	Ompok pabda
Siluridae	Pabda	Pabo catfish	Ompok pabo
Siluridae	Boal	Freshwater shark	Wallago attu
Sisoridae	Baghair	Dwarf goonch	Bagarius bagarius
Sisoridae	Gang tengra	Clown catfish	Gagata cenia
Sisoridae	Gang tengra	Yellow spotted trevally	Gagata gagata
Sisoridae	Gang tengra	Indian gagata	Gagata youssoufi
Sisoridae	Gang tengra	Huddah nangra	Gogangra viridescens
Synbranchiformes (5 species)			
Mastacembelidae	Baim	Zig-zag eel	Mastacembelus armatus
Mastacembelidae	Guchi	Barred spiny eel	Macragnathus pancalus
Mastacembelidae	Tara baim	Lesser spiny eel	Macragnathus aculeatus
Synbranchidae	Bamosh	Bengal eel	Ophisternon bengalense
Synbranchidae	Kuchia	Mud eel	Monopterus cuchia
Tetraodontiformes (2 species)			
Tetraodontidae	Potka	Green pufferfish	Tetraodon fluviatilis
Tetraodontidae	Tepa	Ocellated pufferfish	Tetraodon cutcutia
Source: International Journal of Fisheries and Aquatic Studies 2015; 2(3): 160-165			

- **Amphibians**

Frogs and toads are most common amphibians found within the Project area during the field investigation. They are the major biological pest controller in the agricultural areas. The Common Toad (*Duttaphrynus melanostictus*) and the Asian Brown Tree Frog (*Polypedates leucomystax*) are available in the project study area.

- **Birds**

Common aquatic birds in the project region are Heron and Egrets. Moreover, swans and ducks were found present within the community area nearby the project site. During winter, a number of migratory birds visit areas close to the project site.

Photographs concerning terrestrial and aquatic ecosystem of the project location are given below:

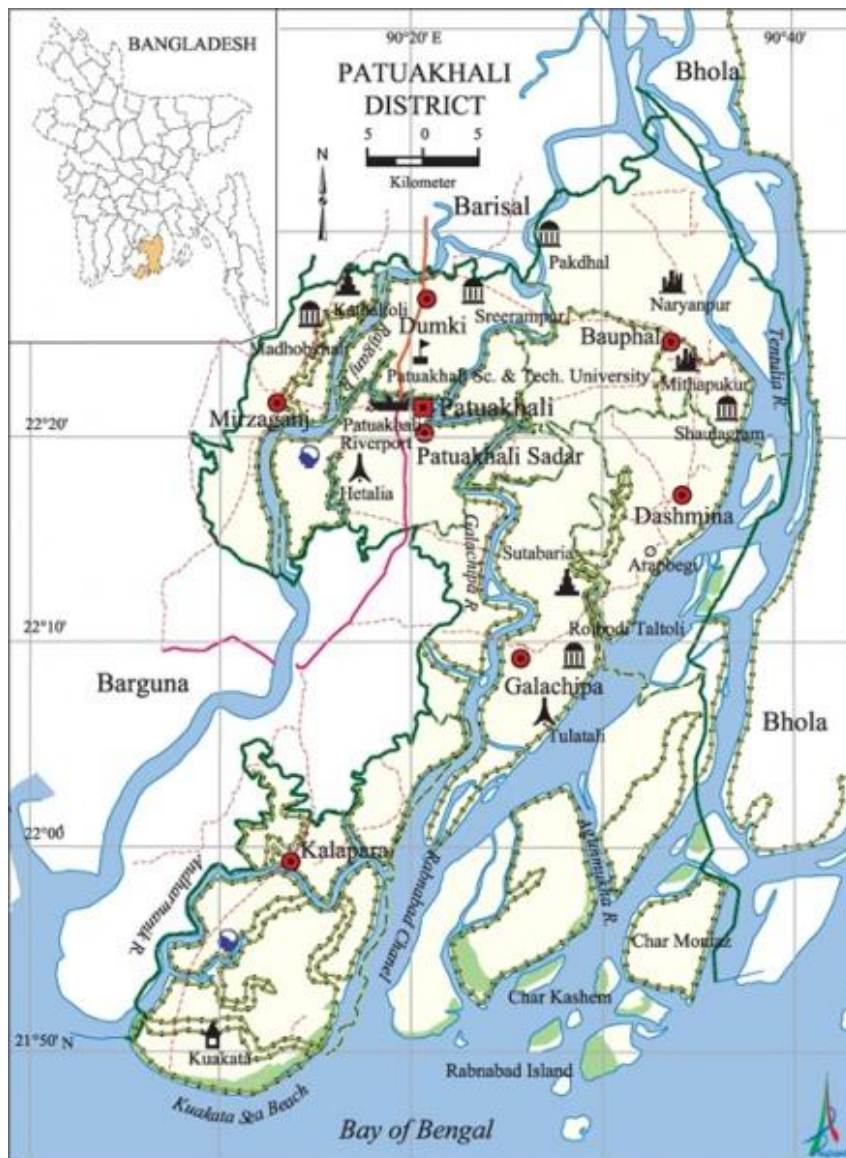




CHAPTER-5: BASELINE SOCIO-ECONOMIC CONDITION

5.1. District Profile: Patuakhali

Patuakhali is a district in South-western Bangladesh. It is a part of the Barisal Division. This is the main entrance for the beach of Kuakata. This district is famous for watching both the sun rise and sun set. It is situated at the fringe of the Bay of Bengal. It became a sub division of Barisal district 1871 and was upgraded to a separate district on December 1, 1983. It is bounded on the north by Barisal district, on the east by Bhola district, on the south by the Bay of Bengal and on the west by Barguna. It lies between 21°48' and 22°36' north latitudes and between 90°08' and 90°41' east longitudes. The total area of the district is 3221.31 sq. km and 71.33 sq. km is under forest.



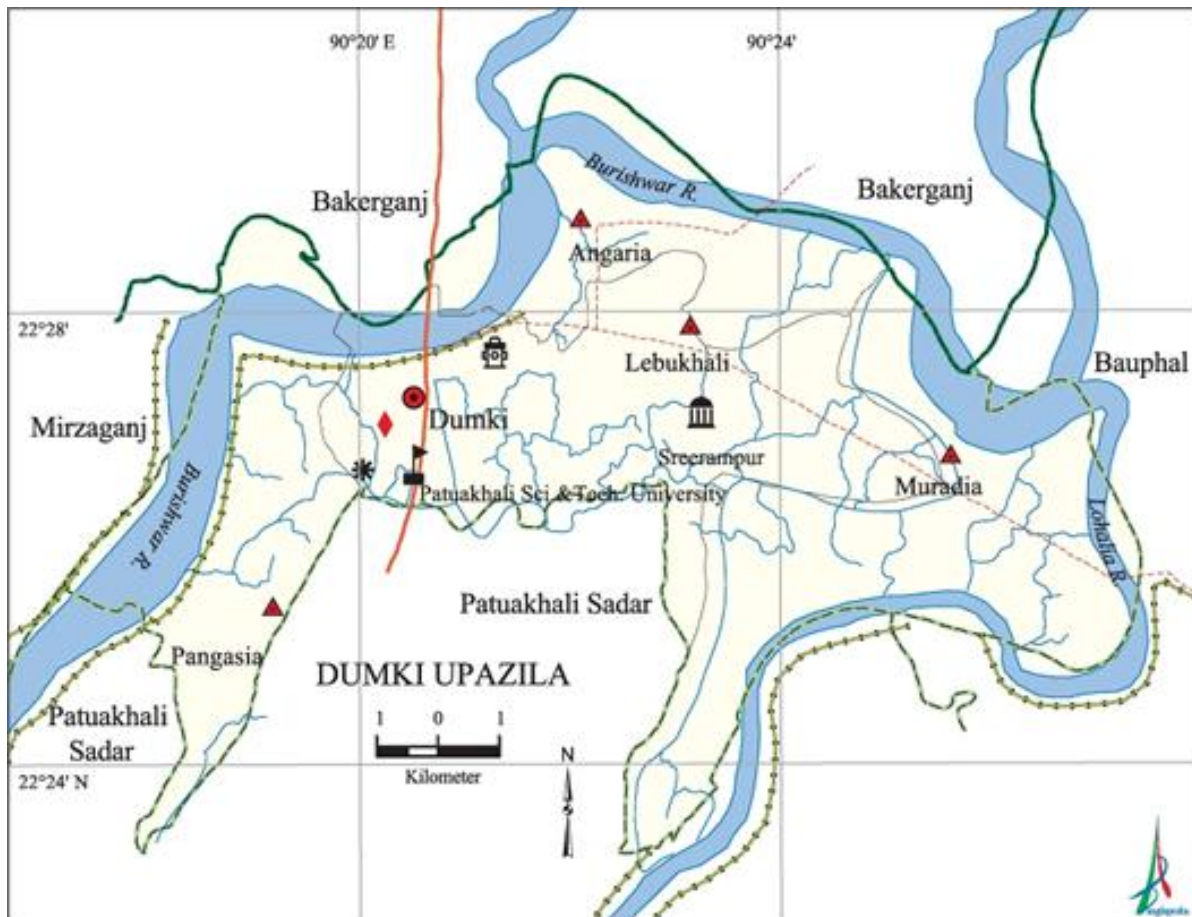
Source: bangladeddia.org

Figure 5.1: Patuakhali District

- **Temperature and Rainfall:** Annual average temperature of this district varies from maximum 25.3°C to minimum 12.2°C and annual rainfall 2377 mm.
- **Main Rivers:** The Andharmanik, Agunmukha, Payra, Lohalia, Patuakhali, Tentulia etc. are main rivers of this district.
- **Main Crops:** Paddy, jute, potato, mug, lentil, khesari, gram, sesame, chilli, mustard, linseed, coriander seed, ground nut, betel leaf, sugarcane, watermelon, vegetables etc. are main crops of this district.
- **Main Fruits:** Mango, jackfruit, banana, papaya, guava, plum, lemon, coconut, betel nut, palm, wood nut, kaijou nut etc. are main fruits of this district.
- **Administration:** Patuakhali district consists of 8 upazilas, 71 unions, 561 mauzas, 878 villages, 5 paurashavas, 45 wards and 82 mahallas. The upazilas are Bauphal, Dashmina, Dumki, Galachipa, Kalapara, Mirzaganj, Rangabali and Patuakhali Sadar.
- **Economic Condition:** The economy of Patuakhali district is predominately agricultural. Out of a total 323,502 holdings of the district, 65% holdings are farms and remaining 34.04% are non-farms. Farm-holdings produce varieties of crops, namely local and HYV rice, wheat, vegetables, spices, cash crops, pulses, oilseeds, maize and others. Various fruits like banana, jackfruits, guava, coconut, etc. are grown. Fishes of various species abound in the district like other parts of the country. Varieties of fish are caught from rivers, tributary channels and creeks and from paddy fields during rainy season. In the fresh water popular fish species are ruhi, katla, mrigel, kalbous, airh, ghania, shoel, boal, gulsha, koi, shing, magur, etc. In marine water hilsha, prawn and pangas fishes are famous. The district has plenty of fishery resources. Besides, crops, livestock, forestry and fishery are the main source of household income. Valuable timber and other forest trees are also grown in this district.

5.2. Upazila Profile: Dumki

Dumki Upazila area is of 92.46 sq km (land: 40.35 sq km and river: 12.11 sq km), located in between 22°23' and 22°30' north latitudes and in between 90°17' and 90°27' east longitudes. It is bounded by Bakerganj upazila on the north, Patuakhali sadar and Bauphal upazilas on the south, Bauphal upazila on the east, Mirzaganjupazila on west.



Source: banglapedia.org

Figure 5.2: Dumki Upazila

- **Population:** 70705; male 35209, female 35496; Muslim 64634, Hindu 5996, Buddhist 51 and others 24.
- **Main rivers:** Lohalia, Rajaganj and Burishwar.
- **Administration:** Dumki Upazila was established in 2000. It consists of 5 unions namely Angaria, Pangashia, Muradia, Lebukhali and Shrirampur.
- **Literacy rate:** Average literacy 66%; male 70.2%, female 62%.
- **Educational institutions:** university 1, college 5, secondary school 22, primary school 56, madrasa 22.
- **Economic Condition:** Agriculture 43.10%, non-agricultural labourer 4.66%, industry 0.92%, commerce 14.62%, transport and communication 3.01%, service 18.17%, construction 3.20%, religious service 0.30%, rent and remittance 0.62% and others 11.40%.

5.3. Union Profile: Angaria

- **Population:** Total population 7989; Male 3789, Female 4203. No of voters is more than 14,000. 95% of the population is Muslim and rest 5% is Hindu. There is no indigenous or small ethnic community in the Angaria Union.

Table 5.1: Household distribution in Angaria Union

Ward No.	Household No.
1*	325
2	356
3	334
4	421
5	421
6	355
7	408
8	349
9	523
Total	3,492
<i>Source: Angaria Union Parisad</i>	

*The project is located in ward no. 1 with 325 households.

- **Education:** Angaria Union is quite enriched with availability of educational institutes. According to the Union Parishad Office data, there are 10 Govt. Primary Schools, 5 Govt. High Schools, 1 Govt. College and 1 Govt. Technical College in Angaria Union. Thus the people in Angaria have convenient access to education. During our field investigation, the local community people mentioned that they are not being able to effectively utilize such opportunity due to their poverty and lack of continuous sources of income. Thus the dropout rate of school children at primary and secondary level are quite higher.
- **Infrastructure:** There are more than 100 mosques and 5 temples in Angaria Union. People living in Angaria are attached to religious activities. There are some madrasha available in the union. Some community people send their children to madrasha but the dropout scenario is no different there. Most of the houses are tin-shade. Hardly a few houses were seen to be 'semi-paka' or brick walls with tin roof. No mentionable physical and cultural resources were found in the union area.
- **Economic Condition:** Major occupation of the rural people of Angaria are agriculture and fishing. Due to seasonal barrier and other impediments, living on agriculture is not sustainable to the local poor people. Moreover, depending on

fishing for income is also inconsistent and challenging. Thus people are involved in other occupation with daily or weekly income opportunity like truck driving, autorickshaw driving, land-filling/ dredging and other available opportunity to work as day laborer. Due to lack of industrialization, the poor people of Angaria are not able to find contiguous source of income and thus their living standard hardly changing over period.



Source: Union Parishad, Angaria

Figure 5.3: Unions of Patuakhali District

5.4. Socio-economic Condition around the Project Site

5.4.1. Population Distribution (within 2km radius)

There are total 5 small communities near the project area. Community 1 consists of 6 houses and around 25 members. Community 2 consists of 18 houses and around 80-90 members. Community 3 consists of 10-12 houses and 50-60 members. Community 4 consists of 12-15 houses and 60-70 members. Community 5 consists of 2 houses with 6 members. Housing pattern in all the communities is mostly tin-shed with 2-3 semi-brick made houses. On the east side of the project site, beyond the Patuakhali-Bauphal Highway, there are many agricultural lands and no distinct community were found besides the mentioned community 5.

5.4.2. Access to Utility

Electricity is available in all the nearby community areas of the project site. People use water from nearby ponds in their locality. Deep tube-well was also found available in the community areas. Community people also mentioned about fetching water from the river on many occasion.

5.4.3. Land Acquisition

Total land within the project area is 1150 decimal. Out of which the project management had 210 decimal and purchased 940 decimal. This was purchased from total 90 individuals through fair market value. However, land exchanged occurred in case of 40 decimal land with 2 individuals. The occupations of the people from whom the land was acquired were mostly business and service. Around 8-10 people were involved in agriculture as their secondary income source. They had separate income source and received fair market value against their land. It is to mention that about 800 decimal land is utilized for establishment of the proposed project.

5.4.4. Soil Sourcing/ Land Development

The Soil sourcing place for site development was Payra river. It was conducted through dredging. Total 36 lac cft sand required to complete project site development. Around 50-60 labors worked for 2 months to complete land filling. Cost incurred due to land filling was around 4 Crore 32 Lac. It is evident that soil sourcing activity did not affect livelihood dependency of any people instead it created income opportunity to the local poor people and day laborers. During construction phase, 100-120 labors are estimated to get working opportunity in the project location.

5.4.5. Key Socio-economic Issues

- The community people living close to the project area have access to electricity, safe drinking water and education.
- The project involved land acquisition with fair market value. Though no resettlement was required being agricultural land. Land acquisition did not hamper any primary economic activity of the previous land owners. Land exchange occurrence highlights meeting reasonable demands of all previous owners.
- There is no cultural or historic place located close to the project area and also no indigenous people live in this village.
- The soil sourcing was conducted from the Payra river which did not affect any people or alternate economic activity.

5.5. Private Stakeholder Representation: NGO

Many NGOs are operating in the project location i.e. Angaria Union. Following are some well reputed national NGOs that we found to be functional in the target study area with large or small scale intervention.

- **ASA:** ASA, a leading microfinance institution, renders multifaceted services to more than seven million people of Bangladesh as well as underprivileged people of some other developing countries. Besides microfinance program, the organization has a number of non-financial programs including Primary Healthcare, Education, Health Awareness, Physiotherapy, Sanitation, Hygiene, Agricultural aids etc. out of its own resources. ASA has developed 15 schools for unprivileged children in Dumki Upazila, 2 of those are in Angaria union. They also provide low cost health and sanitation schemes. ASA has 2 branches and more than 5000 beneficiaries in Dumki Upazila.
- **BRAC:** BRAC, top global NGO of 2018, spans all districts of Bangladesh in Microfinance and one of the largest NGOs involved in primary education in Bangladesh. It provides collateral-free loans to mostly poor, landless, rural women, enabling them to generate income and improve their standards of living. BRAC provides 3 types of microfinance scheme through Dumki Upazila office namely DABI, BCUP, PROGOTI. It has around 2000 beneficiaries in Dumki Upazila comprising 5 unions.
- **GRAMEEN BANK:** Grameen Bank has reversed conventional banking practice by removing the need for collateral and created a banking system based on mutual trust, accountability, participation and creativity. Grameen Bank provides credit to the poorest of the poor in rural Bangladesh without any collateral and 97 percent of its beneficiaries are women.

- **UDDIPAN:** UDDIPAN's programmatic interventions are broadly focused on meeting individual's economic and social needs and empowering them to claim their rights and entitlements. UDDIPAN provides economic support to involve them in income generating activities and also create opportunities for recreation and inter-generational exchanges. In Dumki Upazila, it has 1720 beneficiaries for microfinance program and around 500 beneficiaries for WASH program.
- **SHUSHILAN:** Since 1991, Shushilan has been working on socio-economic development, disaster, climate change & environmental resource management, education & ICT, health & nutrition, human rights, good governance and people's organizations.
- **SANGRAM:** SANGRAM has been working for awareness development aiming to promote positive change of target people. SANGRAM hopes economic development of the community emphasizing the importance of empowerment. It has notable presence in Angaria Union.

Photographs around project site and community stakeholder participation are given below:



CHAPTER-6: ANTICIPATED ENVIRONMENTAL, OCCUPATIONAL IMPACTS AND MITIGATION MEASURES

This project can certainly be considered as environmental friendly project since it will adopt modern and cleaner technology that will significantly reduce the emissions comparing to the existing technology. The project will be based on Tunnel Kiln technology for manufacturing clay bricks that adopts countercurrent principle, and therefore high thermal efficiency, fuel economy, because the use of heat and waste heat to maintain very good, so it saves fuel.

6.1. Project Impacts and Mitigation Measures during Construction Phase

The environmental management during the construction phase will be primarily focused on addressing the possible negative impacts arising from relevant construction activities.

The following table summarizes the potentially significant environmental impacts during construction phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts. The project will also focus on enhancing the possible beneficial impacts from employment of local workforce for construction works.

Table 6.1: Impact-Mitigation Matrix for Construction Phase

Sl.	Activity/ Issues	Potential/ Significant Impacts	Proposed Mitigation and Enhancement Measures
1.	Land development	• Change in land use • Soil erosion and sedimentation • Soil stability and compactness	• To design appropriate engineering of slopes to prevent slumping, slippage and erosion. • To adopt erosion control and soil stabilization measures. • To restore abundant soil to an alternate use.
2.	Transportation of equipment and materials	• Increased traffic/navigation • Generation of noise especially affecting residential areas	• Scheduling of transportation may be done in consultation with local communities or be limited to day-time only. • Speed reduction provision in critical areas and road turns. • Use of safety road symbols if required.

Sl.	Activity/ Issues	Potential/ Significant Impacts	Proposed Mitigation and Enhancement Measures
3.	Storage of materials	• Wind blown dust from material (e.g., fine aggregate) storage areas	• Watering unpaved/dusty roads. • Sprinkling and covering stockpiles. • Covering top of trucks carrying construction debris away from the site.
4.	Operation of construction equipment	• Generation of noise from general plant and access road construction, affecting nearby community	• Avoiding as much as possible, construction equipment producing excessive noise during school hours and also at night • Maintaining equipment in good working condition and where appropriate using noise suppressors, mufflers and acoustic hoods • Creation a buffer zone between the school/residential areas and construction site to reduce disturbance to normal schooling/residential activities, if there is close school/residence.
5.	Waste Management	• Generation of construction waste	• Hauling of construction debris away from the site and their appropriate disposal in a sanitary landfill. Waste must not be kept in open space.
6.	Emergency Response	• Accidents during construction	• Regular inspection and maintenance of equipment • Environmental health and safety briefing • Provision of protective gear
7.	Employment generation	• Loss of work opportunity due to acquiring agricultural land.	• Local community people and people from Angaria union would have the highest priority in employment for various construction related activities.

6.2. Project Impacts and Mitigation Measures during Operation Phase

Environmental sustainability is a major concern in case of implementing such project. Though most of the environmental parameters will experience beneficial effects during the operation phase in comparison to existing FCK technology, initiatives should be taken to enhance these beneficial impacts to ensure project viability and environmental sustainability. Some of the activities concerning major environmental impact are given below:

- **Sourcing of Raw Materials**

Clay is the major raw material used in green brick making in Bangladesh. In this project, clay will be sourced from nearby Payra river bed and beds of ponds owned by the management. Moreover, brick burning requires considerable amount of water. The proposed brick manufacturing plant is located close to Payra river to utilize surface water. Since water sourcing from groundwater reservoirs will be less in this project, it would not cause lowering of groundwater especially during dry season for irrigation purposes.

- **Plant Operation**

Emissions from brick manufacturing plant include SPM, PM₁₀, PM_{2.5}, SO₂, NO_x, CO, CO₂ and many more hazardous air pollutants. Factors that may affect such emissions include raw material composition and moisture content, kiln fuel type, kiln operating parameters, and plant design. Use of coal with more ash and sulphur content also leads to higher emissions. In this project, the technology used is more environment friendly compared to traditional plants. The tunnel kiln technology would require around 50% less coal compared to FCK technology. Moreover, coals having higher calorific values (with low sulphur and ash content) will be used to minimize emission levels. Since brick burning will be complete inside the tunnel, the workers and the local community will face much less exposure to dust, coal particles and fly ash. The proposed technology does not include machinery that may create substantial noise disturbance. Thus the noise level will certainly maintain national standard of 75dBA during plant operation.

- **Transport of Bricks**

Traffic flow will be increased significantly during the operational phase for sourcing of raw materials and distribution of produced bricks. This increased vehicle movement will lead to higher noise level. The negative impact of the increased traffic flow will mainly be concentrated around the project site. Due to project location in rural area and adjacent to river bank, the noise level would be adjusted to regular condition with less disturbing impact to the local community.

The following table summarizes the potentially significant environmental impacts during operation phase, the measures needed to eliminate or offset adverse impacts and enhance positive impacts. The project will also focus on enhancing the possible beneficial impacts from employment of local workforce for construction works.

Table 6.2: Impact-Mitigation Matrix for Operation Phase

Sl.	Activity/Issues	Potential/ Significant Impacts	Proposed Mitigation and Enhancement Measures
1.	Raw Materials Sourcing	Depletion of top soils and farmland	- Use of clay from non-agricultural land and water bodies only - Use of coal in optimal amount as internal fuel - Explore options for use of alternative materials - Planting of indigenous trees around the project site, especially along the boundary of the project site and close community areas
2.	Water Level	Lowering of groundwater during dry seasons	- Encourage recycling and reuse of water where possible - Make aware regarding use of groundwater during dry season
3.	Plant Operations	Emission of particulate materials and fuel gases	- Optimal use of high-grade coal - Regular maintenance of plant - Capacity building of master mason and other workers - Adjustment of design (increase of chimney height etc.) if required.
4.	Operational effect	Exposure of dust, fly ash and coal particles	- Mandatory use of masks where necessary and other safety provision for workers - Provision of sufficient covering of storage materials - Watering of bare areas - Proper disposal of unused fly ash from the site - Ensuring proper house

Sl.	Activity/Issues	Potential/ Significant Impacts	Proposed Mitigation and Enhancement Measures
			keeping
5.	Waste Management	• Generation of sewerage, solid waste and others	• Construction of sanitary latrine and septic tank system • Erecting no litter sign, provision of waste bins/cans, where appropriate • Waste minimization, recycle and reuse • Proper disposal of solid waste • If the rejected bricks are not reused, disposal of such bricks should be in an appropriate manner
6.	Noise handling	• Generation of noise from plant operation	• Maintaining equipment in good working condition and where appropriate using noise suppressors, mufflers and acoustic hoods
7.	Transport of Bricks	• Generation of noise from transportation of bricks	• In case of any objection from the local communities regarding the noise pollution during transportation of bricks, scheduling of brick deliveries may be done in consultation with local communities • Speed reduction provision in critical areas and road turns • Use of safety road symbols if required • Encourage voluntary indigenous tree plantation around road side to make a buffer zone with local residence

6.3. Occupational/ Health Safety Impact Issues and Mitigation

6.3.1. Impact and Mitigation Measures of Dust

Construction materials such as building blocks, cement, sand, steel bars, stone/brick chips will be bulky and thus will require to be delivered on site by a fleet of trucks driving in and out of the construction site. During this exercise dust is likely to be generated from the following:

- Handling of cement which is dusty by nature of the way it is;
- Handling of sand, stone/brick chips may contain loose dust particles;
- Site clearing of area of holding ballast, building blocks and sand will expose the site to wind action;

6.3.1.1. Potential Impacts

Dust produced will negatively affect the following:

- i. Employees and construction workers;
- ii. Nearby community and general public;

6.3.1.2. Effects of Dust to Employees

Cement dust can affect plant employees in the following way

- Eye irritation;
- Skin irritation;
- Impairment of normal sweating of the skin as it blocks pores on the skin;
- Chocking of the throat;
- Respiratory difficulties;
- Difficulty in breathing;
- Potential course of chest complication and ailment.

6.3.1.3. Dust Impacts to nearby community and general public

- Reduced visibility; emission of high particulate matter to the environment will reduce local visibility;
- Continuous exposure of people to dust will likely affect one's eye sight that can potentially result in an outbreak of eye infection;
- Chest related ailment; continuous exposure of people to dust will likely result in chest complications and respiratory disorders.

6.3.1.4. Proposed Mitigation Measures

Following mitigation measures are proposed to minimize the air pollution during the construction stage:

- The Project management should ensure the complete paving of the service road;
- Regular sprinkling of water to be done on open surface and dust grounds until paving is done;
- Transport of materials in tarpaulin- covered trucks/ tractors;
- The sand and other such dispersible material will be stored at site for minimum working period;
- Removal of soil/mud from trucks and other appliances prior to leaving the project area;
- Storage of top-soil in a safe space and creation of top-soil on filled land utilizing this preserved soil;
- Plantation of trees in the construction yard as quickly as possible. Any open area should be planted with appropriate vegetation (trees, flowers and grasses);
- Project management and contractor to enforce strict use of personal protective clothing;
- Complaints of dust related ailments among employees and neighbors to be given access to medical attention;
- The equipment design will be chosen for least suspension of dust/sand into atmosphere;
- The construction activity will be carried out during day time only;

It is to note that the emissions are temporary and not expected to contribute significantly to the ambient air quality and will be within prescribed limits for rural residential regions by National Ambient Air Quality Standards.

6.3.2. Impact and Mitigation Measures of Noise

Building materials to be used in construct site will first be gathered and assembled on site. These include building blocks, timber, steel bars, sand, gravel, cement. Possible courses of noise nuisance when assembling construction material on site include:

- Offloading of building materials on site especially steel bars, gravel and building blocks can result in noise;
- Trucks/ tractors carrying in building materials can be a source of noise;
- Employees involved in offloading of building material can be a source of noise.

Construction of the civil work structures for the project will be labor intensive. This will involve engaging a large workforce, also during construction some machines and equipment will be in use. Possible sources of noise during construction work may include the following:

- Loud talking, shouting and conversation among employees;
- Noise from equipment such as cement mixers;
- Noise from machines such as welding machines and wood working machines;
- Increased machine and equipment activity on site.

6.3.2.1. Potential Impacts

Noise Impacts to Employees and construction workers

- High noise level will force employees to shout loud when communicating to one another;
- Exposure of employees to high noise level (above 85dB) continuous for 8hours per day may result in noise induced hearing loss;
- Exposure of ear to peak sound level instantaneously may result to deafness.

Impacts of Noise to nearby community and general public

- Continuous exposure of neighbors to noise nuisance may result in noise induced hearing loss;
- Noise nuisance may reduce concentration of neighbors in their private matters.

6.3.2.2. Proposed Mitigation Measures

- Noisy construction works to be limited to daytime hours
- Nearby Community member to be notified in writing on the date of commencement of construction work at least one month in advance;
- All employees likely to be exposed to ear noise to be provided with ear protectors;
- The project management and contractors to ensure strict enforcement on use of ear protectors;
- Where applicable and possible exceptionally noisy machines to be fitted with noise reduction devices;
- Any employee who may complain about ear related pain and or complication while at work to access medical attention at the expense of the contractor or project proponent;
- Fitting noise machines with noise reduction devices;
- Providing suitable hearing protection to all workers exposed to noise levels above 85dB(A);

The noise impacts will be local; limited to the premises and very short – term. Proposed measures can control noise level within acceptable limit.

6.3.3. Impact and Mitigation Measures of Sanitation & Drinking water Hazard

The health of the project personnel, construction workers and laborers living at the base camp could be impacted if arrangement of sanitation and drinking water is not ensured adequately and properly. During construction stage, lot of local labors will work and hence they would generate considerable amount of human waste. These are the potential source for spread of diseases, as various insects will play dominating role in the spread of diseases. There are chances for the spread of water borne diseases also.

6.3.3.1. Proposed Mitigation Measures

Proper sanitation system should be provided and at the same time, regular, proper and safe disposal of human waste should be ensured. Contractors and workers should obey appropriate means of waste removal and sanitation measures. Adequate number of toilets and bathrooms should be made for the workers, and proper disposal system of sewage waste should be implemented for sanitation purpose and the workers should be aware to practice those facilities.

Since the project activities shall make higher demand on the local utilities and service facilities particularly potable water, health and sanitary facilities, the project authority sufficient number of tube-wells for drinking purpose. Currently, there are two deep tube-wells.

CHAPTER-7: ANTICIPATED SOCIAL IMPACTS AND MITIGATION MEASURES

7.1. Impact & Mitigation Measure of Location Selection

7.1.1. Land Acquisition

The project land comprises of partial ownership of project management and acquisition of remaining portion. The project authority purchased about 940 decimal land from 90 individuals. Among them only 10 people were involved in cultivation. They had other lands or were involved in separate income generating activity. Only two people were fully dependent on their portion of land for livelihood. The project authority provided same portion of land in a different location to then in exchange of their portion in the project land. The people from whom the lands were acquired are mostly involved in business and service. Thus no people were affected in terms of their primary source of income. Land acquisition involved providing fair market value to the previous owners for their respective portion of land and land exchange occurred to mitigate possible adverse impact on primary income generating activity of concerned people. Land acquisition did not involve any resettlement issue since no people were living in the project land.

7.1.2. Substitution of Agricultural Land

The project land is flat and partially cultivable land. A small portion of the project land was cultivated during only one season throughout the year. Most of the project land was kept unused for longer period during a year. So the project involves displacement of agricultural land in very small and insignificant manner. However, such displacement has been duly addressed and mitigated during the land acquisition phase.

7.1.3. Alternate Livelihood Arrangement

The project authority made arrangement for alternate livelihood of the people who were solely dependent on the income generating activity of the project land. This includes land exchange and providing fair market value against purchased land. The people who sold their piece of land were able to buy land in a different location as per their convenience. Some did invest the money in their owned businesses and some made investment for additional source of income. Thus the project arranged for alternate livelihood of the concerned people prior to its operation through land acquisition.

7.2. Cultural Impact & Mitigation Measure

Cultural differences among foreign experts, local workers and nearby rural community may create some disagreement or dispute over the time. Since the project is in the rural area, the local people specially the religiously conservative segment of the community will not accept the workers who are religiously and culturally different in general. The project authority and the contractor should maintain some procedures to manage workers of different cultures in a tactful manner. It is recommended to aware the culturally different workers about the social & religious norms and practice in the area so that they could maintain those when they interact with local community.

7.3. Traffic Impact & Mitigation

Due to carrying raw materials and finished bricks, there will be significant increase of traffic movement in the project area. As the project is adjacent to Patuakhali/Lebukhali-Baupal Highway, movement of vehicles will not impact regular traffic condition of the area. Moreover, the project management has been developing an 800 ft. long road with width of 30 ft. from their own funding proving their own land. This secondary road will directly connect the project site to the highway. Since the project will use its own secondary road to connect to the highway, it will not affect the adjacent community people and their accessibility. Considering connectivity to both highway and waterway, it is assumed that vehicle movement concerning the project will not create adverse impact to the traffic condition of the local area and accessibility of community people.

7.4. Beneficial Social Impact to Community People

Since there was no habitation located inside the project site, resettlement would not be necessary for the project. But migration will be increased due to creating new job opportunities and plant operation in the area. People in the neighborhood are expected to get benefit from the employment that would be generated and from the increased business activities during both construction and operation period. Since there is no cultural or historic place near the site, the noise and air pollution arising from the project will not create any potential social impact. People of the surrounding area will be benefited by the development of local small businesses due to the increase of migration in the area.

7.5. Potential Economic Impact

The proposed project will contribute to cover the increasing demand of machine bricks which is a beneficial operational factor. Site development created job opportunity for 50 local workers. On the other hand, during the construction and operation activities, jobs and other income opportunities will be created and thus per capita income will increase for the local community.

7.5.1. Impact during Construction Phase

During construction period, the plant will create job opportunities for approximately 150 of skilled, semi-skilled and unskilled labors. This impact being for a relatively short duration would be limited to local community during construction period. In addition, the construction site would attract small traders, who supply food and other consumable to the work force. Economic impact on individuals can be disproportionately high considering current economic condition of people living in nearby community. Employment preference will be given to the land less people and day laborers.

7.5.2. Impact during Operation Phase

The most significant positive impact of the plant would be manufacturing the auto green bricks. The other important positive impact of the plant would be the permanent employment of personnel for the operation of the plant. The project envisages employing more than 100 skilled and unskilled personnel during its operational phase. Due to vibrant operational scale of the project, income generating opportunities will be created in the form of grocery shops, tea-stalls and other vendors of daily necessities. The project management has expressed interest to employ local people wherever possible and to give preference of the jobless people. Workers who worked during construction phase will also get such opportunity based on requirement of their skill-set.

7.6. Field Investigation Assessment

7.6.1. Survey & FGD Analysis

During FGD, almost every participant mentioned about the expected employment creation of the project. Currently, the community people living near the project area are involved in occupations like agriculture, fishing, day-labor, truck driving, auto-rickshaw driving etc. Most of the people do not have permanent job. They face uncertainty in earning their livelihood. Since the project will employ both unskilled and semi-skilled labors for longer period, the opinion of local community people is very positive and hopeful towards the implementation of the project. Moreover, the operation phase will provide scope for permanent employment to the required workers. This will contribute to bring economic stability in the locality and also increase purchasing power of the local inhabitants. Many community members mentioned that they have availed micro-credit from the local NGOs. Since their source of income is not consistent and permanent, they face many difficulties in maintaining the required installments of the loan. Thus it has become a surviving challenge for them to continue income generating activities to earn their livelihood utilizing the availed loan. This has become an

unavoidable impediment for them and their living condition or purchasing power is not progressing. Due to lack of industrial employment opportunity in the locality, people are not being able to find permanent jobs. In order to keep their family afloat, they need to depend on micro-credit to create source of income. But the opportunities are temporary and inconsistent. So the people living in nearby community of the project site have expressed their intense need of having operational plants and permanent jobs during FGD and interview. They are viewing the proposed project as an opportunity for permanent employment in the locality which can contribute to positive changes in their living condition and purchasing power. Moreover, the women living in the nearby community are mostly housewife and not directly involved in any income generating activity. Some of them help their husbands who are engaged in agriculture. Some women look after the vegetation around their house. Upon running of the project activities, the women living nearby community would get some working opportunity following requirement. Moreover, they would have the scope to be involved in small businesses concentrating the proposed brick kiln project.

During FGD, participants mentioned that the project would give them the opportunity to get engage in small businesses which is an addition to both income source and income level of the community people. Due to possible migration during project implementation, the number of people around the project site will be increased. This will certainly lead to increased economic activity and accelerated social changes. Thus it can be confined that the project will have significant impact in poverty alleviation and social uplifting.

7.6.2. Key Informant Interview Summary

During field investigation, interview was conducted with NGO officials, Union Parishad officials, School Teachers and some well-known person in the local community. During discussion, most participants mentioned about lack of long term permanent employment opportunity in the locality. They informed that the major professions of the local marginalized people include agriculture, fishing, day-labor and vehicle driving. The day labors face lack of working opportunity on regular basis due to unavailability of large scale production factory or industry in the local area. Some get work at the district area in textile factories. Upon knowing about the proposed project, they expressed positive opinion considering the potential employment opportunity that will be created for the local people. They also mentioned about the possible increase of economic activity that may generate concentrating the brick kiln project. Officials of BRAC and Uddipan mentioned that the repayment ratio of their micro-credit facility is decreasing for the last couple of years in Angaria Union. People are availing loan for income generating activity but are forced to spend some portion for their households due to irregular nature of income sources. They mentioned that the local people need more economic activity to get engaged in. The proposed project can certainly create and accelerate such opportunities. Moreover, the project will create long term permanent

employment opportunity which will certainly act as blessing to the local community people. Thus the project can act as a tool to alleviate poverty and enhance standard of living of the people living in nearby community and in the region. Due to income generating impact of the project, the NGO officials mentioned about possible growth potential of their various schemes including micro-credit. As stakeholder, they expressed optimistic observations about successful implementation of the proposed project.

CHAPTER-8: ANALYSIS OF ALTERNATIVES

In case of analyzing alternatives, the 'No build' alternative is considered unacceptable. The potential socio- economic benefits of implementing such project far outweigh the adverse impacts and all such impact can be controlled and minimized to an allowable level.

8.1. Site Selection Rationale

- The proposed project will be set up in the land that was mostly unutilized and partially cultivated during only one season during the year. The project authority received complete cooperation from the previous owners and no conflict was raised during land acquisition. Considering seasonal cultivation nature, the land will be more utilized as round the year operational project. Moreover, the land acquisition did not involve any resettlement issue.
- The project land is adjacent to Patuakhali/Lebukhali-Baupal Highway, which is suitable for transportation of project equipment, raw materials and finished bricks. It is also very close to Payra River and Lebukhali Ghat. Thus the project site is well connected with both road and water transportation.
- The project site has locational advantage since transportation of raw materials and finished bricks would be more convenient and cost effective by water transport.
- Soil sourcing for the proposed project will mainly be done from the nearby Payra river bed. Distance between the project site and Payra river is about 1000 ft. Soil sourcing process would involve dredging with direct access to the project site. Thus no additional transport expenditure will be required. Due to suitable location of the project site, the soil sourcing process would be efficient considering less cost and reduced time.
- Distance from the project site to Patuakhlali district is about 46 km and to Barisal district is about 37 km. Due to such short distance, transportation of bricks to the customers will be convenient and cost effective.
- The project will employ many labors who live in nearby community with focus to the people who lost their land due to river erosion and also to the unemployed.

8.2. Technology Selection Rationale

Project Technology: Tunnel Kiln

8.2.1. Functional Comparison of Alternative Brick Kiln Technologies

There are five different technologies being used in brick kilns in Bangladesh such as Fixed- Chimney Kiln (FCK), Zigzag, Hybrid Hoffman (HHK), Vertical Shaft Brick Kiln (VSBK) and Tunnel Kiln. Among these kiln technologies, the FCK is the least efficient and most polluting and the Tunnel, the most efficient and less polluting. Other technologies such as Improved Zigzag and HHK are substantially cleaner, consuming less energy and emitting much lower amounts of pollutants technology, at an early adoption stage.

The Table below shows comparison of different types of technologies being used in Bangladesh in 2009 and 2017 with the market share for each technology. Out of the total 15.75 billion bricks produced in 2009, the FCK accounted for about 92%, the remaining technologies were responsible for 8% of the bricks. In 18 years, the mix of technologies in the brick industry has changed dramatically. From 2009 to 2017, the number of FCKs has declined from staggering 4500 to 2373. On contrary, the number of Zigzag Kilns rose to 4274 in 2017 from a mere 150 in 2009. This rapid change has taken place due to the banning of FCKs through a government notification effected in September 2010, many owners have converted FCKs to Zigzag kilns. Despite this banning, FCK still continues to be operated in brick production.

Table 8.1: Annual Production & Market Share Comparison of Different Brick Kiln Technologies

Kiln Type	Number		Percentage of total		Annual Production (billions)		Percentage of total production	
	2009	2017 (June)	2009	2017 (June)	2009	2017 (June)	2009	2017 (June)
FCK	4,500	2373	92.21	35.19	13.5	7.1	89.46	31.16
Zigzag	150	4247	3.07	62.97	0.5	12.7	2.98	55.76
HHK	30	61	0.61	0.90	0.5	1.1	3.58	4.81
Tunnel	0	58		0.86	0.0	1.7	0.00	7.62
Others	200	5	4.1	0.07	0.6	0.2	3.98	0.66

Total	4880	6744			15.1	22.8		100.00
<i>Source: Bangladesh Brick Manufacturers Owners Association (BBMOA)</i>								

According to the information provided by the Department of Environment, there were 105 HHKs in the country in 2015 many of which were run by natural gas. However, with the dwindling gas supply and support from financial institutes and donor agencies, their number continues to decrease each year and stood at only 61 in 2017. On the other hand investment in modern and automatic Tunnel Kilns increased in recent years.

8.2.1.1. Fixed Chimney Kiln (FCK)

FCK is essentially a modified Bull's Trench Kilns with a 120 ft long fixed chimney. It has an elliptical shape shaped dugout area. The bottom and the sidewalls of the kiln are lined with bricks keeping the top open. Sun dried bricks are sacked in the kiln in an orderly fashion leaving enough room for fuel stoking and air circulation. After arranging the bricks in the kiln, the top of the kiln is covered with fired bricks and pebbles. The bricks are fired from the top and the fire moves forward towards the chimney. The air hole and the chimney are located at the two ends in such a way that combustion air is preheated by taking heat from the fired bricks and the green bricks to be fired are preheated by the flue gas on its way out of the chimney. The bricks are fired all around the kiln, which means that the chimney and the air hole must be progressively moved forward, until all bricks in the trench are fired. The tall chimney creates a stronger draft thereby improving the combustion process and releases the flue gas at a height 120 ft above the ground thus providing faster and better dispersion. The kiln has underground piping to divert the flue gas from anywhere in the kiln to the fixed chimney. The FCK has better insulation than BTK in the sidewall, which reduces heat loss to the surroundings. The cost of construction of the chimney is nearly 50% of the total cost of a FCK.

8.2.1.2. Zigzag Kiln or Hawa Bhatta

The Zigzag Kiln is rectangular in shape, measuring 250 ft by 80 ft. The kiln has a 55 ft high fixed chimney located on one side of the kiln. At the bottom of the chimney there is a blower, which draws the flue gas from the kiln and discharges it to the atmosphere. The kiln is divided into 44 to 52 chambers, which are separated from each other in such a way that the hot gases move in a zigzag path through the kiln. While some utilize a natural draft, others use a fan to draw the fire and heat through the zig-zag stacking pattern. This firing process requires a set of highly trained and skilled workers to operate and maintain the kiln. The Zigzag Kiln is reported to be 10-15% more fuel efficient than the FCK.

8.2.1.3. Improved Zigzag Kiln

The improved Zigzag Kiln is a modified version of the traditional Zigzag Kiln or 'Hawa Bhatta'. It is elliptically shaped with well insulated permanent side walls and roofs and arched firing chambers that allow easy air flow. The kiln is versatile in size ranging from 22 to 42 chambers. Clay and coal is mixed together to form into bricks. After sun drying, the green bricks are loaded into chambers which are fired through stoke holes in the roof until the temperature rises to about 800oC. Air required for the combustion process is forced from behind by a centrifugal draft fan since the zigzag path giving long distance and high obstacles for the flue gas to pass. As air reaches the line to be fired, it is already preheated from the previous firing zone thus reducing firing time to about 1m/hour. A water scrubbing system is installed inside the chimney that filters before releasing into atmosphere through the chimney.

8.2.1.4. Hybrid Hoffman Kiln (HHK)

Hybrid Hoffman Kiln is a rectangular shaped annular circuit with an arched roof covered with a shade to protect it from rains. It has a firebrick lining on the inside surface. The thick walls of the kiln and good insulation minimize heat loss to the surrounding. The chimney is 76 feet high with a blower at the bottom which forces the air required for combustion from behind. The green bricks are stacked in the kiln almost similar fashion as that in the FCK. Bricks are fired from the top by introducing the fuel (natural gas) into the combustion zone. The burners are transferred forwarded from section to section as the fire progresses. Fired brick are unloaded at the back while green bricks are loaded in from of the firing zone. The flue gas is conveyed towards the chimney through a network of channels just below the kiln.

8.2.1.5. Tunnel Kiln

The tunnel kiln is considered to be the most advanced brick making technology. In a Tunnel Kiln, green bricks produced by mixing powdered fuel with clay are loaded on cars and then pushed in the kiln, a horizontal tunnel. The firing of products occurs at the central part of the tunnel. Fuel is fed into the firing zone of the kiln through feed holes provided in the kiln roof. Cold air enters the kiln for the car exit and cools the fired bricks while getting heated as it proceeds towards the firing zone. After combustion, the hot flue gases travel towards the car entrance end losing a part of the heat to the green bricks entering the kiln. Hot air/gases are extracted from the tunnel kiln at several points along the length of the kiln and are supplied to the drying tunnel/chamber.

8.2.2. Emission Comparison of Different Kiln Technology

The thick black smoke that everyone associates with BTKs and FCKs is emitted during coal charging. After the completion of coal feeding, the flue gas color changes from grayish black to milky white and remains white until the next coal charging. In Zigzag

Kiln, the flue gas moves in a zigzag path and most of the coarse particles are retained in the kiln preventing them from being discharges into the atmosphere. It employs a scrubber- the flue gas is drawn into an underground water reservoir and scrubbed before being release into the atmosphere. However, its performance is strongly dependent on regular changing of the scrubbing water. It is reported that brick makers often do not bother to do that, and as a result, the pollution is only marginally abated.

Table 8.2: Emission Comparison of Different Types of Brick Kilns

Kiln Type	Coal Consumption (ton/100000 bricks)	Particulate Matter mg/cm3	CO2 Emission ton/100000 bricks	Annual Production (million)
FCK	20-22	>1000	47-52	3.5-4
Zigzag	16-18	600-900	38-43	3.6
Improved Zigzag	14	65	33	5.4
HHK	12-14	20.3	28-33	24
Tunnel	18-22	16	50	24-48

Source: Bangladesh Brick Manufacturers Owners Association (BBMOA)

8.2.3. Unique Advantages of Tunnel Kiln Technology

Tunnel kiln has a number of advantages. Some are mentioned below:

1. Continuous production, short production cycle, high yield and high quality.
2. It adopts countercurrent principle, and therefore high thermal efficiency, fuel economy. Since the use of heat and waste heat to maintain very well, it saves fuel.
3. Advantages of tunnel kiln include labor saving, improved condition, reduced environment pollution, easy to operation. The loading device is easy to realize mechanization and lighten work strength.
4. The firing time is shorter, common large kiln from the kiln to the loading space require about 3-5 days, but the tunnel kiln is about 20 hours to complete.
5. The firing operation is simple, loaded kiln and kiln operations are carried out in the kiln. So it is also very convenient, improves the working conditions of the operator, and reduces labor intensity.
6. The temperature of three parts, preheating zone, firing zone and cooling zone often maintain a certain range, it is easy to grasp its firing rules, so the quality is also good with less breakage.

7. The tunnel kiln and the equipped devices are durable. The tunnel kiln is with high cold-resistance and heat resistance comparing with Hoffmann kiln. So the kiln has long using life and does not need to overhaul within 5 years.
8. Comparing with Hoffmann kiln, the product quality is increasing, it reduces the secondary reshipment and the firing temperature can be adjusted and controlled. It is easy to grasp the firing rule and the breakage is much lower.
9. The tunnel kiln saves 2/3 space comparing with Hoffmann kiln on the same capacity and specification.
10. The construction material and equipped devices are different for those two kilns. The investment cost for tunnel kiln is higher but the production cost is lower.

CHAPTER-9: ENVIRONMENTAL, OCCUPATIONAL AND SOCIAL MANAGEMENT PLAN

9.1. Environmental Management Plan

The environmental management program should be carried out as an integrated part of the project planning and execution. It should be focused as an activity for monitoring and regulating activities against a pre-determined checklist of required actions. It must interact dynamically throughout project implementation process to deal with environmental impacts, both expected and unexpected.

A project specific Environmental Management Plan (EMP) has been developed which is outlined in this chapter. However, EMP may require updating considering the local environmental changes and technological modifications during operation phase. The primary objective of this environmental management and monitoring strategy is to record environmental impact resulting from the project activities and to ensure implementation of the 'mitigation measure' identified earlier in order to reduce adverse impacts and enhance positive impacts from specific project activities. Besides, it would also address any unexpected or unforeseen environmental impacts that may arise during construction and operation phases of the project.

Major objectives of the proposed EMP for this project are mentioned below:

- Mitigation measures to reduce or eliminate negative impacts
- Enhancement measures to maximize positive impacts
- Monitoring requirement and
- Monitoring indicators

The plant authority may require modifying the suggested outline of the EMP proposed in this report.

Table 9.1: EMP Impact-Mitigation Matrix

Key Issues	Probable Impacts	Mitigation/enhancement measures
Air Quality	Pollution effects on nearby community people	- Arrange for sufficient buffer zone - Tree plantation in the buffer zone area - Raise boundary wall around the project area
	Pollution due to dust, smoke etc.	- Adapting air pollution control measures

Key Issues	Probable Impacts	Mitigation/enhancement measures
		- Ensure the hot air is properly used for brick drying
	Odor	- Arrange for sealed container, masking agent etc. - Store the transported coal properly to prevent spill
Surface & Ground Water	Pollution due to domestic waste	- Construct effective safety tank and soak pit - Dispose all domestic waste water through septic tank - Construction of appropriate wastage treatment plant for sewerage wastage
	Pollution due to industrial liquid waste	- Construction of appropriate sewerage treatment plan caused for the industrial liquid wastage
Noise & Vibration	Sound pollution	- Ensure proper acoustic design for the tunnel kiln - Take necessary action to control sound pollution (such as insulator, muffler, silencer)
	Vibration created by various machinery	- Adequate measures for controlling vibration (such as shock absorber, damper/isolator, spring isolator)
Waste Management	Pollution of the environment and work place because of hazardous waste	- Treatment of hazardous waste - Burning in an inclinator - Maintained properly
	Pollution from solid waste	- Adequate facilities for waste separation/storage - Training of workers on waste management - Collect wastage regularly in an environment friendly manner - Returning lead acid battery only to the specified dealers - Deposition of solid waste to specific dump site or sanitary land fill

9.1.1. Environmental Monitoring

Environmental monitoring is conducted to compare the change between baseline condition and after project scenario, by testing some environmental parameters of air, water and noise and in case of necessity soil is tested. The monitoring program is required to maintain compliance with national environmental standards. It is also undertaken to ensure that the plant does not create adverse environmental changes in the area and to provide a database of operations and maintenance, which can be utilized if unwarranted complaints are made.

9.1.1.1. Monitoring Indicators

Post construction monitoring is limited to a number of impact parameters to see the actual performance of the project. Some monitoring may be necessary during the operation period. The plant management authority would be responsible for overall environmental monitoring during the operation phase of the project. The environment monitoring should primarily be focused on addressing the following issues:

Table 9.2: Environmental Monitoring Guideline

Monitoring Issues	Parameters	Location	Monitoring Frequency
Ambient air quality	CO, NO _x , SO _x , PM ₁₀ , PM _{2.5} ,	Around the project site (1/2 km radius)	Quarterly/ yearly
Noise level	Limits in dBA	Around the project site and nearest receptor	Quarterly/ yearly
Ground & Surface water quality	pH, Temperature, DO, BOD, COD, TDS	At project site	Half-yearly/ once in a year

9.1.1.2. Environmental Monitoring Budget

Since testing and analyzing environmental parameters require sophisticated instruments, it is suggested to outsource the monitoring activity to ensure accuracy and timeliness. Gradually, the project should purchase required instruments to maintain continuity of environmental monitoring. However, a tentative environmental monitoring budget has been proposed below:

Table 9.3: Environmental Monitoring Budget

Activity	Unit	Estimated Cost (in BDT)
Firefighting and suppression equipment, training and annual fire safety drill	<i>Lump-sum</i>	250,000
Cost of occupational health and safety equipment	<i>Lump-sum</i>	250,000
Quarterly test of ambient air quality (SPM, SO _x , NO _x)	<i>Parameter based</i>	100,000
Half yearly test of surface water (pH, Temperature, DO, BOD, COD, TDS)	<i>Parameter based</i>	25,000
Half yearly test of ground water (pH, Temperature, DO, BOD, COD, TDS)	<i>Parameter based</i>	25,000
Quarterly noise monitoring	<i>Parameter based</i>	50,000
Environmental Training & Resources	<i>As required</i>	50,000
Sub-total		750,000
Contingency	<i>As required</i>	100,000
Total		850,000

9.2. Occupational Health & Safety and Social Management Plan

The project would ensure occupational health and safety practices during both construction and operation phase to minimize accidents and work related ill health. Improved health and safety management can bring significant benefits to the business. It would also reduce individual and human costs of accidents and ill health, direct and indirect cost to the business and improve customer perception, company reputation and workers' morale.

9.2.1. Proposed Requirements

In Bangladesh, the main law related to occupational health and safety is Labor Law 2006. The law has provisions on occupational hygiene, occupational diseases, industrial accidents, protection of women and young persons in dangerous occupation. The key salient features which should be mentioned as general requirements for the workers' health and safety stated in this law are presented in the following:

Table 9.4: Proposed standards requirements for Occupational Health and Safety

Issues	Requirements
Health and Hygiene	• Cleanliness • Proper ventilation and temperature • Protection against dust and fumes • Disposal of wastes and effluents • Proper illumination • Provision of adequate latrines and urinals • Sufficient spittoons and dustbins
Safety	• Safety for building and equipment • Precautions in case of fire • Fencing of machinery • Floor, stair and passage way • Precautions during work on or near machinery in motion • Monitoring against carrying of excessive weights
Compensation for accidents at work	• Owner's responsibility for compensation • Amount of compensation • Report on fatal accident and treatment • Compensation on contract and contract

Issues	Requirements
	registration • Scope for appeal
Dust and Fumes	• For any dust or fumes or other impurities likely to be injurious to the workers, effective measures shall be taken to prevent its accumulation and its inhalation by workers
Overcrowding	• No work room in any factory shall be overcrowded • Minimum space requirement for every worker employed in a work room
Latrines and urinals	• Sufficient latrines and urinals shall be provided • Shall be maintained in clean and sanitary condition • Shall be adequately lighted and ventilated
Precautions in case of fire	• Shall be provided with means of escape in case of fire • Effective measures shall be taken to ensure that all the workers are familiar with the means of escape • Firefighting apparatus should be provided and maintained
First aid	• First aid facility should be provided and maintained. • Ensure one first aid box for every one hundred and fifty workers • Shall be kept with a responsible trained person who shall be available during the working hours
Disposal of wastes and effluents	• Provide with proper disposal system for solid waste and effluents. • In case of a factory where no public sewerage system exists, prior approval of the arrangements should be made for the disposal of wastes and effluents

Issues	Requirements
Compensation	If personal injury is caused to workmen by accident arising in the course of employment, employer shall be liable to pay compensation. Monthly payment as compensation for temporary disablement are proposed below: - Compensation should be paid for the period of disablement or for one year whichever period is shorter - Such compensation shall be paid at the rate of full monthly wages for the first two months - Two thirds of the monthly wages for the next two months and at the rate of the half of the monthly wages for the subsequent months - In case of chronic occupational diseases, half of the monthly wages during the period of disablement for a maximum period of two years shall be paid

9.2.2. Proposed Health Hazard Mitigation Measures

The construction and operation of the proposed project are not expected to cause any major health impacts. Though stress can be caused by working in shifts, high work load and poor living condition of workers, a quantification of the measure of severity in health hazards is not well defined. Since the project plant will be operated round the year, the entrepreneurs have agreed to provide sanitary latrine with septic tanks for the workers under community benefit plan. Adequate hygiene practices will also be promoted among the workers. Considering probable and unprecedented impacts, we propose to adopt the following measures to minimize the hazards if arose at any phase of the project:

- Providing Required Safety Instruments including:
 - Safety spectacles
 - Gloves
 - Strong boot
 - Helmet
 - Ear plug
- Informing the workers about the potential health impacts;
- Arranging proper medical examination prior to and during employment, as well as tests and analyses necessary for the detection of diseases;
- Providing adequate protective gear to the workers exposed to large amounts of dust, fly ash and coal;
- Frequent spraying of water to minimize dust pollution;

- Providing access to amenities for welfare and personal hygiene needs such as sanitary toilets, potable drinking water, washing facilities, and shelter sheds etc;
- Provision of proper disposal of waste and sludge;
- Providing health and hygiene education to the workers.
- Providing health inspection among workers on monthly or quarterly basis

9.2.3. Proposed Occupational Health and Safety (OHS) Plan

Safety implies the reduction of risk of accidents at the work site. Accident prevention is more valuable than any compensatory measures. This may be achieved through strict rules and procedures for the execution of specific tasks, enforcement of the rules, and discipline amongst workers, maintenance of machineries used and by providing all necessary gear or equipment that may enhance the safety of the workers.

Table 9.5: Impact-Mitigation Matrix of OHS Plan

Key Issues	Probable Impacts	Mitigation/enhancement measures
Soil & Dust	Dust from the cleaning of area, construction work and earth work	- Regularly spray water in the earth road/open earthen area - Remove earth/mud from the truck before leaving the project area - Carrying goods with covered triple in the truck - Provide temporary fencing around the construction area
	Removal of earth from the surface of the land after construction of earth work, connecting road etc.	- Stock the surface earth in a safe place and create a lair on the top of the filled in area - Planting in the construction area as much possible
	Evolution of earth from the open space because of removal of earth and digging of the area	- Carry out construction work during the dry season - Establishment of barrier net
Water & Waste	Siltation of the drain or water sheds from the open land piles	- To prevent siltation, temporary silt trap to be established/dig up pond - Pile up the spoiled earth away from the drain in a plain land - To use the spoiled land in filling up the low land

Key Issues	Probable Impacts	Mitigation/enhancement measures
	Pollution of the nearby water sheds because of the removal of the construction waste	- Construction of temporary shed for waste within the construction area and removal of solid waste properly - Arrange for sufficient toilets - Arrange to properly abide by construction rules for removal of waste and sanitation by the contractors and labors
Road Safety	Increase the rate of accidents	- Arrange for strict observance of the road safety measures during construction period

9.2.4. OHS Plan Implementation Guidelines

The following guidelines should be followed to maintain the safety of the workers:

- Orientation of workers about the safety procedures related to their respective jobs;
- Ensuring sufficient lighting in the area where a person performs construction work or may be required to pass through, including access ways and emergency exit or passage without risk to health and safety;
- Providing safe access at construction site to and egress from all places where they may be required to work or pass through. This includes the provision of emergency access and egress route that must be free from obstructions;
- Installing adequate perimeter fencing on the site before construction work commences and that should be maintained during the construction work and operation period;
- Ensuring all electrical equipment are properly designed, installed, insulated (as required) used, maintained and tested to eliminate the risk of electrical shock, burns, fire or explosion;
- Maintaining access ways clear of materials and debris and also in a non-slippery condition;
- Storing materials in an orderly manner so that it does not pose any risk to the health or safety of any person;
- Storing hazardous materials in different places with proper shelter against rain and any form of water;
- Limiting access to hazardous storage place and making the area as hazardous material storing place;
- Making of first aid facility accessible when construction and operation works are being undertaken.

CHAPTER-10: EMERGENCY RESPONSE/DISASTER MANAGEMENT PLAN

10.1. Approaches to Emergency Response

For this project, emergency response systems should be in place to deal with dangerous goods uncontrolled releases of dust and gaseous emission, accidents like fires burns and injuries. Development of specific contingency plans and availability of incidence specific equipment packages in place to cope with these types of emergencies are recommended and advised. In case of an emergency incident occur, immediate action must be taken to mitigate the impacts.

The initial response to an incident is a critical step in the overall emergency response. Emergency Response Procedures will identify who does what and when in the event of an emergency. Responsibility of person is in charge and their coordination of emergency actions shall be identified. Probable emergency & hazardous situations likely to occur are categorized as following:

Emergency Situations

1. Fire
2. Explosion
3. Death of labor for dangerous work or serious injury
4. Discharge/leakage of poisonous gas
5. Discharge of harmful products for environment

In order to minimize the possibility of injury to the responders and others it is important that emergency responders follow a specific sequence of pre-determined actions.

Table 10.1: Arrangements to be made to prevent or mitigate emergency situation

Emergency situation	Preventive measures	Mitigation/ Control measures
Fire	- Fire exit - Keep water in the water pot - Fire hydrant	- Safe rescue of workers - Health services at safe places - Communicate with

	- Emergency light/indicator - Organize regular fire drill	- hospital/Civil Defense - Fire extinguishing using fire extinguisher
Explosion	- Checking plant equipment regularly - Setting alarm creating equipment - Manual preparation and training on safety issues of plant operations - Arrangement of safe places for transferring during emergency situation - Arranging primary treatment	- Quickly closing plant operation - Safe rescue of workers - Health services at safe places - Communicate with hospital/Civil Defense
Discharge of hazardous products and poisonous gases	- Checking plant equipment regularly - Setting alarm creating equipment and automatic shut-down of plant during discharge of hazardous products and poisonous gases - Manual preparation and training on safety issues of plant operations - Provision of required medicine to tackle hazardous products and poisonous gases	- Quickly closing plant operation - Quickly safe rescue of workers - Health services at safe places - Communicate with hospital/Civil Defense
	- Regular inspection of discharge line of liquid	- Quickly closing plant operation

Discharge of liquid/ gaseous products harmful to environment	and gaseous products - Regular checking and maintenance of liquid waste treatment plants - Regular checking and maintenance of equipment setting for air quality control - Provision of required chemical products, spare parts and alternative electric supply	- Informing Department of Environment - Informing local authorities - Providing required compensation - Taking pollution control measures in consultation with Department of Environment
Death or injury of labor	- Automation of risky works which may cause injury or death of labor - Manual preparation and training on occupational health risk reduction	- Providing primary health care - Transferring quickly to hospital - Compensation as per legal requirement

10.2. Approaches to Disaster Management

Natural disasters are always uncertain and terrible in terms of effect. Appropriate management plan should be taken by the project authority to mitigate impacts of any unexpected natural calamity. Some types of natural disasters that can affect the project considering its location are given below:

- Flood,
- River bank erosion,
- Earthquake/ tsunami,
- Storm/ cyclone / tornados, and
- Cloud burst lightning.

In case of any natural disaster there would be provision to stop the production immediately and leaving the project site. Moreover, some preventive measures would be adopted to minimize impact during disaster. Following precautions are proposed to reduce damages:

- Secure items that can create severe damage (e.g., heavy equipment, heating/cooling units, pipes, storage tanks, hazardous chemicals).
- Secure things that can cause significant economic or cultural loss, cause injury, or block exits.
- Avoid objects that can be torn away, fly away due to cyclone/high winds.

The disaster management strategy of the project authority should include but not limited to the following:

Formulation and strict implementation of safety codes and measures

Declaring the factory site a “no smoking zone”

Mock drills by the firefighting cells/ groups

Provision of periodic inspection of firefighting equipment and fire hydrant system in all the sections

Proper training of the employees about the importance of codes and handling of delegate machineries

Organize awareness building trainings including employees and nearby community members about the actions to be taken during an accident, disaster etc.

Figure 10.1: Disaster Management Strategies

CHAPTER-11: GRIEVANCE REDRESS MECHANISM (GRM)

Grievance Redress Mechanisms should be a part and parcel of the machinery of any administration if accountability is desired and expected. Grievance redress system is nothing but an institutionalized and organized method consisting of specified roles, rules, and procedures for systematically resolving complaints, grievances, disputes, or conflicts. In this project, a grievance can be defined as any sort of dissatisfaction, which should be redressed for constructive advancement of project activities.

Objectives of establishing an effective grievance redress mechanism are mentioned below:

- To give affected communities the leverage to negotiate mutually acceptable agreements under which their concerns can be addressed
- To enhance the ability of the project to justly address community concerns and employee complaints
- To ensure fairness, equality and justice.

To minimize grievance, the project management will adopt Stakeholder engagement that includes disclosing information through community consultation, anticipating and preventing conflicts and also forming partnerships with community and other local stakeholders.

11.1. Types of Grievance to be Addressed

The project authority intends to address a grievance of any type ranging from problems regarding promotion to discharge and dismissal, and suspension but it is mandatory that the grievance should be work related and not personal. We recommended that the grievance must fall under the following category to be considered one:

- Amenities
- Compensation
- Conditions of work
- Workplace environment
- Disciplinary action
- Fines
- Leave
- Medical benefits
- Nature of job
- Payments
- Promotions/ increments
- Environmental safety
- Other relevant issue

The list is indicative and not comprehensive since grievances vary based on various relative factors i.e. people, culture, socio-economic condition, project authority and supervisors, compensation and benefits, unavoidable impacts and accepted mitigation measures etc.

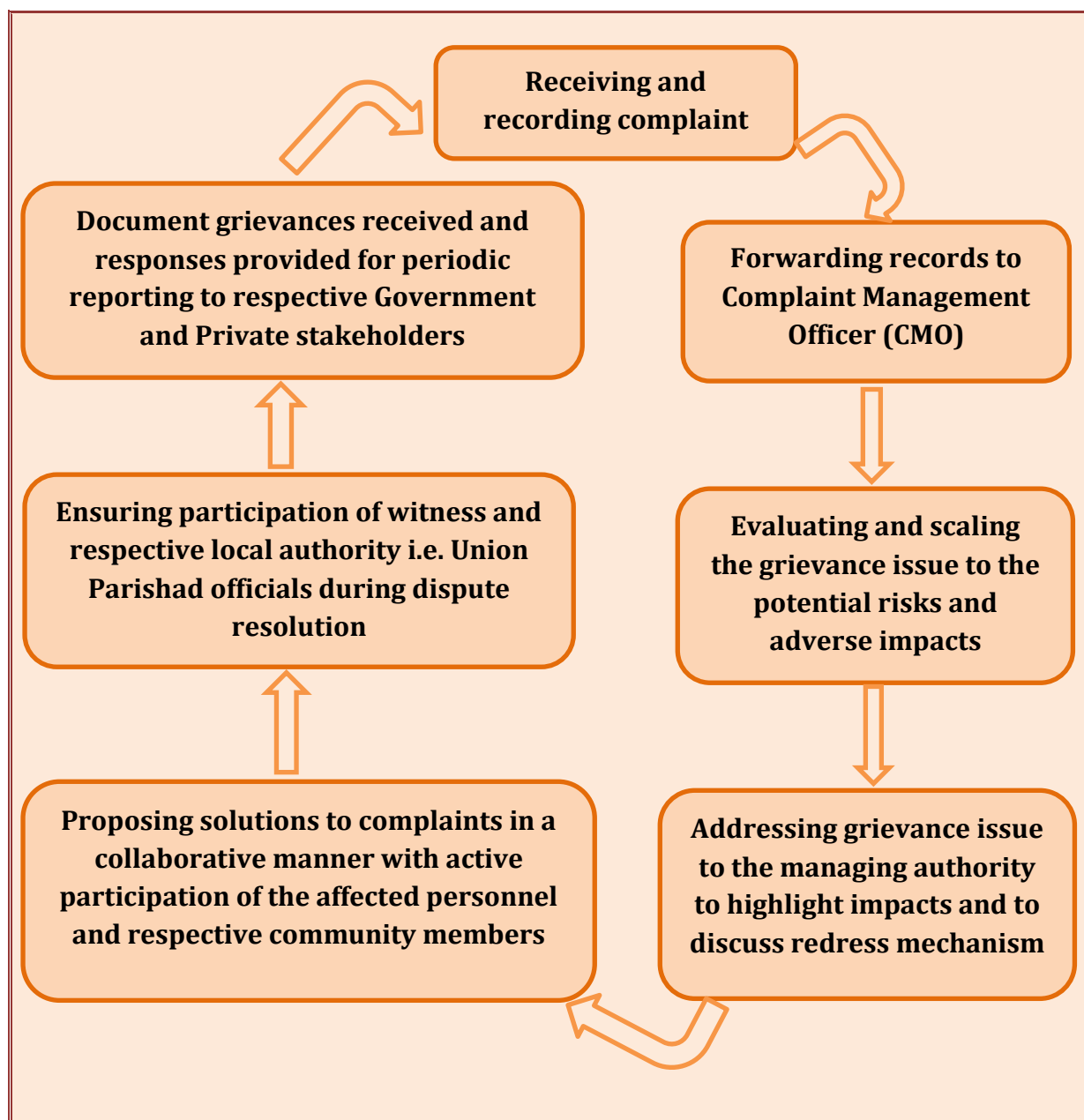
11.2. GRM Selection Guideline

- Avoid any sort of discrimination considering genders and vulnerable groups.
- Address concerns promptly, using an understandable and transparent process that is readily accessible to all segments of employees and community members.
- Take into consideration customary and traditional methods of dispute resolution.
- Be consistent with the judicial and administrative mechanisms followed in the country for resolution of disputes and do not impede any unethical or illegal means.

11.3. Proposed Grievance Redress Mechanism

Following international best practices and national guidelines, we propose the following grievance redress mechanism to ensure utmost efficiency and transparency:

Table 11.1: Grievance Redress Matrix



In order to implement the mechanism effectively, key focal personnel should be designated to address and resolve grievances received following the above mechanism. The project authority has agreed to implement grievance redress mechanism from the initial construction phase to the complete operational life cycle of the project.

Brief elaboration of the principles and measures on grievance redress mechanism are mentioned below:

- Establish a procedure for receiving, recording/documenting, and addressing complaints that would be easily accessible, culturally appropriate, and applicable for project interventions.
- Consider seeking solutions to complaints in a collaborative manner with the involvement of the affected personnel.
- Scale the grievance issue to the potential risks and adverse impacts of the project.
- Address concerns promptly, using an understandable and transparent process that is readily accessible to all segments of employees and community members.
- Ensure participation of witness and respective local authority i.e. Union Parishad officials
- Avoid any sort of discrimination considering genders and vulnerable groups.
- Take into consideration customary and traditional methods of dispute resolution.
- Assign experienced and qualified personnel with responsibility for responding to grievances in an unbiased manner with segregation of socio-economic factors.
- Document grievances received and responses provided and report back periodically to the Govt. and Private stakeholders and also to the local community members.
- Be consistent with the judicial and administrative mechanisms followed in the country for resolution of disputes and do not impede any unethical or illegal means.

CHAPTER-12: CONCLUSION AND RECOMMENDATION

12.1. Recommendations

This report contains recommendations as proposed mitigation measures in regard to potential impacts that ought to occur due to implementation of the proposed project. Key focus areas include Environment Management Plan, Emergency & Disaster Management Plan, Occupational Health Safety Plan and Grievance Redress Mechanism. Proposed measures are based on investigation, analysis and assumptions. The project management should adopt changes following needs and demands of the project during implementation and best interest of the community stakeholders.

Industrialization is closely integrated with environmental hazard. Though there are no methods to neutralize such effects, certain measures can minimize the effects to acceptable range for the environment and civilization. The UABL management has to maintain continuous improvement of their operational policy and procedure in order to mitigate possible environmental, social and occupational impacts that may create throughout the operational life cycle of the project. The mitigation plans proposed in this report would provide a guideline in adopting best practices for the workplace and surrounding community. But these require continuous development following the changing pattern of the surroundings and demands of the project.

The environmental impact assessment study reinforces that the project can be set-up and operational as per proposed plan, technology and plant location. The environmental impacts forecasted are of limited nature which can certainly be mitigated following standard and suggested procedure. In addition, the social and economic benefits of the project are much more contributory to local community as well as national economy.

12.2. Conclusion

The proposed project of USA Agro and USA Auto Bricks Limited (UABL) will significantly contribute to meet the increasing demand of machine bricks which is a key beneficial factor for rapid industrialization and urbanization trend of our country. In addition, the project will create jobs and income opportunities for rural poor people who are considered as Bottom of the Pyramid. Thus the proposed project can be considered as of high significance due to its potential economic and social contribution at the rural level which will certainly create greater impact in national economy.

The project entrepreneurs have been maintaining standard environmental, social and technological guidelines advised by both Government Bodies and Donor Agencies. They have conducted this ESIA study to identify scope for improvement during both construction and operation phase. The unique combination of excellent characteristics of tunnel kiln technology, state of the art equipment and machinery and international standard operational practices make the proposed automatic machine brick manufacturing project as an ideal, viable and beneficial one to all investors and shareholders.

This ESIA report has been prepared through identification of the current condition, evaluation of possible impacts and accordingly recommendation of possible mitigating and enhancing measures for negative and positive results, respectively. We would like to advise the project authority to integrate ESIA findings and recommendations in the overall implementation of the project to minimize environmental damages and accelerate social advancement.

Our investigations conclude that UABL will play a noteworthy role in economic development of the project region and the country as a whole. Finally, we would like to mention our sincerest gratitude to UABL management and IDCOL officials for their sincere cooperation and such remarkable contribution in economic development of our country.

ANNEXURE

List of Focus Group Discussion Participants (Male)

Sl.	Name	Father's name	Occupation	Cell phone no.
1.	Md. Sobuj Hawlader	Late Abdul Mojid Hawlader	Agriculture	017992197633
2.	Md. Rubel Khan	Late Moslem Kha	Truck Driver	01725607353
3.	Md. Mojibur Rahman	Late Hamed Helal	Salesman (various necessities)	01828115526
4.	Ali Azgar Hawlader	Late Amir Hossain	Autorickshaw Driver	01709287490
5.	Monirul Islam	Late Mizanur Rahman	Agriculture	01712054215
6.	Md. Jalal Hawlader	Late Gani Hawlader	Business (sand selling)	01788912268
7.	Md. Shohidul	Late Md. Altaf Hossain Hawlader	Service (NGO)	01917133808
8.	Kuddus Hawlader	Late Sobhan Hawlader	Business (cattle)	01735777146
9.	Sultan Mollah	Late Hatem Mollah	Agriculture	01739152450
10.	Chan Shorif	Late Golam Ali Shorif	Retired Service Holder	01917574383
11.	Musa Mirah	Late Moksed Mirah	Grocery Shop	01715018047
12.	Khalek Mollah	Late Yakub Ali Mollah	Autorickshaw Driver	01626016622
13.	Barek Molla	Late Reazuddin Molla	Agriculture	01782616157
14.	Md. Mojibur Rahman Molla	Late Jobbar Molla	Business (saw-mill)	01720265757
15.	Abdus Sattar Molla	Wahezuddin Molla	Retired Teacher	01712661551
16.	Ismail Fakir	Late Sobhan Fakir	Agriculture	01947753734

List of Focus Group Discussion Participants (Female)

Sl.	Name	Husband's name	Occupation	Cell phone no.
1.	Nurjahan Begum	Khalek Mollah	Housewife	01626016622
2.	Shahida Begum	Musa Mirah	Housewife	01715018047
3.	Lutfu Begum	Chan Shorif	Housewife	01917574383
4.	Momtaz	Kuddus Hawlader	Housewife	01735777146
5.	Rani Begum	Md. Sobuj Hawlader	Housewife	017992197633
6.	Asia Begum	Sultan Mollah	Housewife	01739152450
7.	Parvin Akter	Md. Mojibur Rahman	Housewife	01720265757
8.	Fatema	Barek Molla	Housewife	01782616157
9.	Morium	Ismail Fakir	Housewife	01947753734
10.	Shahnaz Begum	Md. Shohidul	Housewife	01917133808
11.	Selina Begum	Monirul Islam	Housewife	01712054215
12.	Jahanara	Md. Mojibur Rahman	Housewife	01828115526
13.	Rina Begum	Ali Azgar Hawlader	Housewife	01709287490

List of Key Information Informants (KII)

Sl.	Name	Designation	Organization	Contact
1.	Md. Shahin Hossain	Branch Manager	BRAC	01729593023
2.	Md. Giasuddin	Regional Manager	ASA	01720330232
3.	Md. Johirul Islam	Branch Account Manager	Uddipan	01759367934
4.	Sultan Ahammed Hawlader	Chairman	Angaria Union Parishad	01718721056
5.	Firoz Talukder	Office Assistant	Angaria Union Parishad	01712324882
6.	Tarun Hawlader	Agriculture Officer	Angaria Union (Ward: 1,2,3)	01730911043
7.	Fatema Khanom	Headmistress	No. 33 Dumki Satani Govt Primary School	01718652610
8.	Md. Bashir Uddin	Assistant Teacher	No. 33 Dumki Satani Govt Primary School	01712572891
9.	Md. Shahidul Islam	Director	USA Agro & USA Auto Bricks Limited	01788912268
10.	Md. Jahangir Alam	Manager	USA Agro & USA Auto Bricks Limited	01744988296