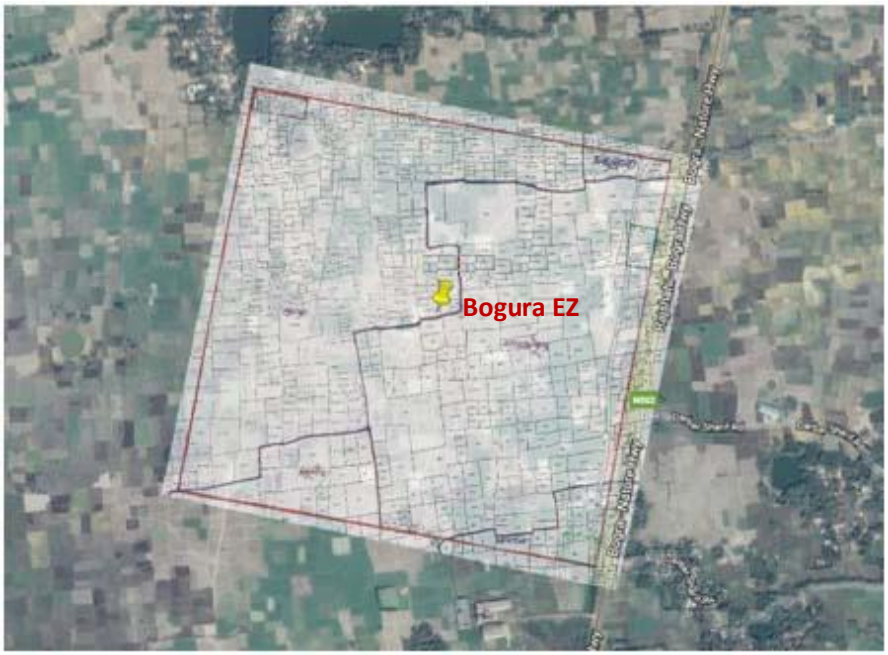
Bangladesh Economic Zones Authority

Pre-feasibility Study Report

Bogura Economic Zone



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Abbreviations

API	:	Active Pharmaceutical Ingredients
BASIS	:	Bangladesh Association of Software and Information Services
BBS	:	Bangladesh Bureau of Statistics
BCTMA	:	Bangladesh Cosmetics and Toiletries Manufacturers Association
BEIOA	:	Bangladesh Engineering Industry Owners Association
BEMMA	:	Bangladesh Electrical Merchandise Manufacturers Association
BEPZA	:	Bangladesh Export Processing Zones Authority
BEZA	:	Bangladesh Economic Zones Authority
BGMEA	:	Bangladesh Garment Manufacturers and Exporters Association
bn	:	billion
BSCIC	:	Bangladesh Small and Cottage Industries Corporation
BDT	:	Bangladesh Taka
CAGR	:	Compound Annual Growth Rate
EPB	:	Export Promotion Bureau
EPZ	:	Export Processing Zone
ETP	:	Effluent Treatment Plant
EZ	:	Economic Zone
GDP	:	Gross Domestic Product
GoB	:	Government of Bangladesh
ICT	:	Information and Communication Technology
IRR	:	Internal Rate of Return
LNG	:	Liquefied Natural Gas
mn	:	million
NEZ	:	Natore Economic Zone
PMO	:	Prime Minister's Office
PPP	:	Public-Private Partnership
RMG	:	Ready Made Garments
SEZ	:	Special Economic Zone
SFB	:	Standard Factory Buildings
TPE	:	Total Number of Persons Employed
USD	:	US Dollar

Executive Summary

Pre-feasibility Study Report
Bogura Economic Zone

Bangladesh Economy. Growth in Bangladesh has been underpinned by a stable and prudent macro-economic policy, rising industry and service outputs and a continued high level of remittances. Going forward, the Government of Bangladesh's (GoB) objective is to develop a growth trajectory that will support an overall increase in real GDP growth of 8% per annum and reduce poverty from 40% to 15% by 2021.

Bangladesh achieved more than 6% economic growth on average in the last five years. In spite of prolonged global economic downturn, the economy of Bangladesh has been maintaining high and sustainable growth rates. GDP growth of 7.28% during 2016-2017 was based on 10.2% growth in industry sector followed by 6.7% growth in service sector and 3% growth in agriculture sector. The growth of industries in 2017 was largely driven by higher manufacturing activities and growth in export earnings[1]. The growth of the industrial sector is dominated by exports earning in RMG, which has been growing at an average of 20%[2] over the last five years. In reorganization of the long-term development challenges, the government has adopted Bangladesh Vision 2021. Bangladesh plans to achieve lower-middle income status by 2021, which requires the economy to grow by 8 to 10%[3] per annum. Share of manufacturing is expected to grow from 17% in 2009 to 28% in 2021. Decline in share of agriculture is projected to be compensated by increased share of industry and manufacturing while share of services would remain steady.

Manufacturing is the predominant and leading sector within broad industry accounting for 77%[4] of all industrial units located across the country followed by construction (15%). Out of total 9,49,590, 27.6%[5] manufacturing units are located in Dhaka Division, 22.6% in Chittagong Division and 14.2%[6] in Khulna Division. The sector recorded average 9.38% annual growth rate during 2006-2017. In 2008-09, it grew by 6.6% fuelled by 8.1% growth in small and cottage industry and 6.2% growth in medium and large industry. The growth increased to 10.3% in 2015-16.

As per Bangladesh Economic Review 2017, the contribution of manufacturing industries to national GDP was 21.7% in 2016-17, of which medium and large-scale industries contributed 18% to GDP and small-scale industries contributed only 3.7% to GDP. Foreign trade of Bangladesh has registered sustainable growth since 2008-09 due to initiation of economic reforms and adoption of an export-biased liberal foreign trade policy. In 2015-16, the earning from international trade was USD 79bn (Imports USD 41.2bn and exports USD 37.81bn resulting in a negative trade balance of USD 3.39bn). Government has been pursuing an export led economic development strategy to stimulate export earnings. Promotional campaign and industry assistance are being given under export diversification program.

[1] Bangladesh Economic Review, 2017 and Bangladesh Bank annual report, 2016-17
[2] Bangladesh Bank
[3] Perspective Plan 2010-2021
[4] Preliminary Report on Economic Census 2013
[5] Same as above
[6] Same as above

GoB has successfully provided serviced land, infrastructure, and a good business environment via the Export Processing Zones (EPZs) Program. Since 1993, EPZs have triggered impressive growth in exports, mainly in the RMG sector, at an average annual rate of 23%. Bangladesh Economic Zones Act, 2010 was passed in Parliament in August 2010, providing the overall framework for establishing economic zones throughout Bangladesh. To support commitment to economic zones, BEZA intended in undertaking pre-feasibility study of Natore Economic Zone (NEZ). In this regard, BEZA has engaged Infrastructure Investment Facilitation Company (IIFC) for conducting this pre-feasibility study.

Approach and Methodology. A series of initial meetings with BEZA, local authorities, and key industry stakeholders were undertaken and visits were made to investigate and make assessment on the site, connectivity, availability of labor, existing industrial base, social infrastructure especially level of education, Industrial policy and business environment, fiscal levies and taxation policies, financial markets, trends of investments and exports and so on. The past trend of investment in the relevant sectors in Bogura, Natore, Dhaka, Pabna, Chapainawabgonj was also anlysed and tried to assess the potential investment in the future that was required in estimating the *demand for the land*.

A long list of industrial sectors was prepared, that existed as 'manufacturing" under Bangladesh government economic sector classification and then the sectors were shortlisted based on labor availability; presence of raw materials/ backward linkage industries; presence of forward linkage industries as well; growth prospect/export competitiveness; and suitability with respect to existing local demand for the products. A scoring exercise of the short-listed sectors was carried out to prioritise the space allocation for each sector in the EZ based on suitability of the sector for the EZ. A separate demand projection was prepared for the site for each shortlisted sector.

Bogura. Bogura is a northern district of Bangladesh, widely known as an industrial cum-commercial city where many small and mid-sized units are sited. The present Bogura district was carved out from Bogura Sadar Sub-division in 1983. The land use pattern of the proposed EZ area falls under agriculture zone and aquaculture zone. The project site is situated adjacent to the Bogura – Natore highway. Existing road may be improved and used as an access road to the project site. The Bogura railway station is located at a distance of 7.5 km (approximate) from proposed EZ. The proposed site for the development of BEZ is located at Shahjahanpur Upazila of Bogura district. Out of total 41,950 acres of land, 4% (1,822 acres) low land, 30% (12,605 acres) Medium land and 66% (27,523 acres) are High land. The land types of proposed BEZ are arable low flat land.

Competitiveness of Bogura. Bogura[7] is known as the industrial city of the North Bengal and a communication hub. Agriculture and livestock sectors play a vital role in the economy of this district. About 57% are agro-based farms that produce varieties of crops, namely local HYV paddy, jute, sugarcane, wheat, tobacco vegetables, pulses and others cash crops and minor cereals.

Examining the data by economic activities, it is observed that the wholesale and retail trade and transportation has appeared as the two largest sectors while manufacturing holds the third position with number of establishments 56,000 and TPE 181,000. Out of the total manufacturing establishments, the significant%age 90.48% sell their product entirely at local market while

[7] IIFC analysis till 2017 based on Economic Census, 2013, BBS (District Report Bogura) and District Statistics, 2011, Statistical Pocket Book Bangladesh 2016

0.38% do exclusively export and the lowest portion 0.11% sell their goods both at local and foreign markets.

It is apparent that economic activities in Bogura have experienced a significant downfall in recent period. This is due to less focus on the district and therefore, reduced enthusiasm of local entrepreneurs. In other words, it shows that a diversity of economic activities is needed by reducing focus on Dhaka and giving more attention to the districts which shows high prospects like Bogura. Most of the industries in Bogura are cottage based, which implies that the raw material and experienced labor is available in the district, however, due to entrepreneurship being on a down trend, the raw materials and labor is not being utilized in medium and large scale industries. In other words, despite potentials the district is passing a slump in economic activities, which deserves an enhanced attention from the government.

Bogura BSCIC. For promotion and extension of small and cottage industries in the private sector, Bogura BSCIC (Bangladesh Small and Cottage Industries Corporation) industrial complex was established in 1964 on 14.50 acres of land. Later on in 1980 it was extended up to 33.17 acres of land. This industrial estate complex consists of various industries. The industry mix represents an ideal combination to be assumed for future planning of EZs in Bogura and shows the prospect of different industries. It means that light engineering, RMG, furniture, pharmaceutical, food processing etc. are the most prospective sectors for Bogura.

Potential Industry Sectors for the Site. Since the EZ is located at Bogura, the site specific exercise was carried out to identify the potential industry sectors and it was decided to carry out the survey among industries located at Bogura and its surrounding areas. It was also decided to survey manufacturing industries at Dhaka for assessing willingness to expand business to proposed EZ at Bogura. In this regard, a list of industries were collected from Bogura Chamber of Commerce, Bogura BSCIC and trade associations at Dhaka.

The existing industries in the area/region of the BEZ were also analysis to understand industry trend to identify potential industry/sectors which may be attracted for the BEZ. Based on the examination the following types of industries located in Bogura, Natore, Dhaka, Pabna and Chapainawabganj, were identified for conducting the investor survey.

Light Engineering. Growth prospect and import substitution prospect is high in the light engineering industry. This sector contributes to growth in various related sectors and a wide range of economic activities.

There are strong backward and forward linkages between the light engineering industries and other sector such as agriculture, automobile, and transportation in Bangladesh. The Sector is experiencing positive export performance in recent time, and achieved 14.10% export growth in 2015. Export earnings from the light engineering sector stood at USD 510mn in 16.

The sector produces mainly spare parts of machineries of transport, agriculture, power, automobiles and pharmaceutical sector, and electrical switches and accessories. Most of light engineering industries are located at Dhaka, Chittagong, Narayangong, Bogura, Gazipur, Kishorganj. Number of export quality light engineering products is going to foreign market on direct and subcontracting means. The bicycle and bicycle parts export industry has emerged relatively recently in the industrial landscape of Bangladesh. Foreign direct investment was critical to the emergence of the bicycle export sector. A domestic trading group, Meghna, was

the next firm to enter the bicycle export manufacturing industry. Bicycle exports are the single largest product export within Bangladesh's light engineering sector, contributing to about 7.5% of engineering exports.

Textile and RMG Industry. The textile and apparel industries provide the single source of economic growth in Bangladesh's economy. The export oriented industry started in 1980s. The apparel industry is Bangladesh's biggest export earner with value of over USD 28.15bn *of exports in 2016-17, contributing 80.7% of total export earning of the country.*

Currently the industry has around 4,500 *companies, employing around 4mn amongst which 90% are women.* Bangladesh Garment Manufacturers and Exporters Association (BGMEA) has set a goal to attain USD 50bn export earnings by 2021 from the apparel sector. *EU is Bangladesh's highest RMG export destination constituting 58% of total export followed by US market with export of 23%.*

Bangladesh has recently diversified into emerging export markets including Australia, Brazil, China, Japan, and South Africa accounting for 14% of total export

Furniture Industry. It is estimated that, by 2018 Bangladesh will earn export potential of crafts furniture accessories worth of USD 20mn along with furniture worth USD 60mn. Furniture sector was included in the Export Policy, 2009-2012 as a Special Development Sector and in Export Policy, 2012- 2015, it has been upgraded as a Highest Priority Sector due to extreme export potentials. The total export growth target for 2013- 14 was nearly 13% from USD 28bn last fiscal. According to Export Promotion Bureau data, in 2009-10, the furniture export volume was USD 19 million, while it amounted to USD 21 million in 2010-11 and USD 27 million in 2011-12. In 2016-17, the total export volume was USD 53 million..

Pharmaceuticals. With 194 operating companies, the pharmaceutical industry provides 97% of the total medicinal requirement of the local market. The industry also exports medicines to global markets, including Europe. Nearly 80% cumulative growth in the last three years means that the Bangladesh pharmaceutical market has doubled. The domestic retail market is growing at 25% per year. Bangladesh is also going to establish an API park where 40 API industries are expected to operate. Current market size is approximately BDT 76,500mn per year. The industry contributes 1% of the GDP. At present, there are 15 companies in Bangladesh manufacturing 40 APIs. The industry imports APIs mostly through sea and air.

Food Processing. Food processing sector is one of the growing sectors in Bangladesh in terms of production, growth, consumption, and export. Comprised of 200 companies, the processed food industry provides most of the requirements of the local market. The total turnover of the industry is estimated to be USD 2.5 bn.

Demand for Industrial Land. Much of the demand for space in the proposed EZ will likely be from companies that will relocate operations from Dhaka and Chittagong. Multiple indicators were looked at published information about growth trends, and estimated number of business enterprises in operation in Bangladesh.

The number of new business enterprises created each year ranges between 5 to 8%, based on published data. Industrial lands are unavailable here, and all business enterprises, from leather workshops to garments industries, are scattered throughout residential areas without proper planning. There are governmental pressures to move business enterprises away from Dhaka.

The demand has been forecasted based on the following scenario assumptions.

Years Needed for Full uptake	Base case	Aggressive Case	Conservative Case
Light Engineering	6	4	8
Furniture	6	4	8
Food Processing/Auto Rice Mill	7	5	9
RMG	7	5	9
Pharmaceutical	8	6	10

Master Planning Considerations. BEZA's vision is to make master plan and accordingly develop industries for every EZ. In the BEZ area master plan layout make various types of industries on about 251.43 acres of land. The broad category of land use for *i.e.* RMG, pharmaceuticals, light engineering, furniture, plastic industry, Auto rice mill and ICT, commercial area, fire services CETP, CSTP, water treatment plants, power plant etc in the proposed EZ along with excellent state of the infrastructure facilities and professional management to attract and support investments in the industrial sectors. It focuses on development of medium and small –scale industries as well as trading and Services. The processing activities are prime activities and the efficiency of production is enhanced by a number of other activity zones. These include post-harvest activities, linking infrastructures, marketing infrastructure, R&D services, community facilities and green spaces.

Environmental and Social Review: The environmental and social baseline is the existing status of environment and society around the proposed project site. It has been analyzed through assessment of environmental components like air, water, land, noise, soil, etc. The baseline provides the basis for assessment of impact (potential changes in the baseline conditions) due to the development of proposed BEZ.

Air Quality: Shajahanpur Upazila is not heavily industrialized. The present ambient air quality of the concerned area, as a result, is not much contaminated. All the air quality parameters were within the acceptable range prescribed by Environmental Conservation Rules (ECR), 1997.There are several sources of air pollutants like stake emissions, emissions from different processing units, emissions from vehicles, emissions from landfill discharge, emissions from natural gas use, emissions from electricity consumption etc.

Noise: The baseline noise environment in the project area was within the range accepted by Bangladesh Environmental Quality Standard (Noise Pollution (Control) Rules, 2006). The main sources of the noise are the construction equipment, traffic movement and also for the neighbor residential areas.

Water quality: Water sampling and analysis were undertaken to understand the overall baseline water quality characteristics of the surface and groundwater in the project area. The surface water sampling was based on the identification of the major surface water body and its interaction with the project. Ground water sampling locations were selected to obtain representative water samples from various zones within the project area.

Land Types: Based on depth of inundation during monsoon season, land type of Bangladesh has been classified. In terms of depth of flooding, five classes of land type are recognized, these are high land (above flood level), medium highland (flooding depth 0-90 cm), medium lowland (flooding depth 90-180 cm), low land (flooding depth 90-270 cm) and very lowland (flooding depth >270 cm). The land type characteristics are uniform within the study area, although the land types of Bogura district are not uniform. Out of total 41950 acres of land, 4% (1822 acres)

low land, 30% (12605 acres) Medium land and 66% (27523 acres) are High land. The land types of proposed BEZ are the combination of Highland and Medium high land.

Socio-economic Condition: The total population of Shajahanpur Upazila is 2, 90,000 with a population density of 1,307 per square km. Among the total population, 1, 50,000 are male and 1, 40,000 are female; the sex ratio (male/female) is 106. There are 72685 HHs with average size of a HH 3.86. Based on religious identity, 2, 78,139 are Muslim, 11,557 are Hindu, 42 are Buddhist, 41 are Christian and 25 are of other religions.There are various kinds of livelihood are existed in the project area. However, most of the population of the project area are agriculture dependent. The order of occupations of Shajahanpur Upazila is Agriculture (55.48%) > Commerce (13.01%) > Services (10.98%) > others (7.09%) > Transport and communication (6.49%) > Non-agricultural laborer (2.52%) > Construction (2.50%) > Industry (1.37%) > Rent and remittance (0.39%) > Religious service (0.17%).

Financial Analysis: The financial analysis demonstrates financial results considering two choices of investment; Government/BEZA led model and PPP model under three different demand options namely base case, aggressive case and conservative case. Considering the different choices and options the financial analysis has been made. The project IRR was derived from the projected cash flow to the project and equity IRR from the projected cash flow to equity as follows:

Output	Government led Model	PPP Model
Equity IRR (after tax)	10.06%	15.15%
Project IRR (after tax)	10.03%	13.93%
DSCR		
Average	1.00	1.40
Maximum	2.29	3.28
Minimum	0.10	0.07
Equity Payback Period (year)	14	12
Project Payback Period (year)	11	10

Scenario Analysis. Scenario analysis of different options demonstrates that the difference in financial indicators in the base case, aggressive case and conservative. Financial results for different investment models are given below.

		Government led Model	PPP Model
Equity IRR	*Base Case*	10.1%	15.2%
	Aggressive Case	11.7%	17.9%
	Conservative Case	8.5%	12.6%
Project IRR	*Base Case*	10.0%	13.9%
	Aggressive Case	11.2%	15.7%
	Conservative Case	8.9%	12.2%
Average DSCR	*Base Case*	1.0	1.4
	Aggressive Case	1.2	1.6
	Conservative Case	0.9	1.2
Equity Payback Period, years	*Base Case*	14	12
	Aggressive Case	13	10
	Conservative Case	15	13
Project Payback Period, years	*Base Case*	11	10
	Aggressive Case	10	9
	Conservative Case	12	11

Financial analysis shows that the equity and project IRR are 10.1% and 10.0% in base case of government led model. PPP led model shows equity and project IRRs are 15.2% and 13.9% respectively. It will take more than half of the project tenure to recover the investment in both government and PPP led model. Both equity and project IRR of PPP led model is comparatively attractive.

Sensitivity. Various factors affect the equity IRR of the EZ project. In order to understand the importance of project parameters in determining the viability of the project, it is important to carry out a sensitivity analysis. The following factors have significant effect on the equity IRR:

i) Capital Cost
ii) O&M Cost
iii) Lease Rate

Each of the above factors was varied by 10% in both directions and the effects on the equity IRR were observed.

Sensitivity of Equity IRR

Capital cost, O&M cost, lease rate have been analyzed for examining their impact on IRR. They were varied by 10% in both directions and the effects on the equity IRR were observed.

Government led Model

	-20%	-10%	0%	10%	20%
Capital Cost	13.3%	11.5%	10.1%	8.8%	7.6%
O&M Cost	10.4%	10.2%	10.1%	9.9%	9.8%
Lease Rate	7.1%	8.6%	10.1%	11.4%	12.6%

PPP Model

	-20%	-10%	0%	10%	20%
Capital Cost	18.8%	16.9%	15.2%	13.7%	12.3%
O&M Cost	15.5%	15.3%	15.2%	15.0%	14.8%
Lease Rate	11.5%	13.4%	15.2%	16.8%	18.4%

Based on reasonable assumptions after tax equity IRRs 10.1% and 15.2% have been derived for Government led Model and PPP Model respectively. The Equity IRR varies significantly with changing the key factors, capital cost and lease rate, whereas O&M cost variation has insignificant effect on equity IRR.

Net Present Value (NPV): NPV has been calculated using the cost of capital/hardle rate of 9%. The computation shows the NPV in Government led model and PPP model are Tk. million 876 and Tk. million 3,418 which are positive and indicates the project is viable in both cases.

Economic Analysis: The economic IRR is 12.86% with a Benefit to Cost ratio of 1.18 considering a discount rate of 10% in base case. The economic IRR of 12.86% shows that the project is an economically viable one. It is going to create a positive impact on the economy of the nation as a whole.

Overall Findings with respect to suitability of site. The strengths of BEZ are availability of labor, manufacturing of quality products, low price of land, availability of raw materials, available transportation and business oriented people of Bogura. Insufficient gas and water and need of a domestic airport may act as obstacles to rapid growth. The opportunities may be in the forms of expansion of business, employment creation, and use of domestic products (raw materials); while risks are associated with higher interest rate of bank loan for investors, weak and inadequate power and infrastructure facilities, dearth of skilled labor.

Pre-feasibility Study Report Bogura Economic Zone

1 Introduction

Growth in Bangladesh has been underpinned by a stable and prudent macro-economic policy, rising industry and service outputs and a continued high level of remittances. Going forward, the Government of Bangladesh's (GoB) objective is to develop a growth trajectory that will support an overall increase in real GDP growth of 8% per annum and reduce poverty from 40% to 15% by 2021.

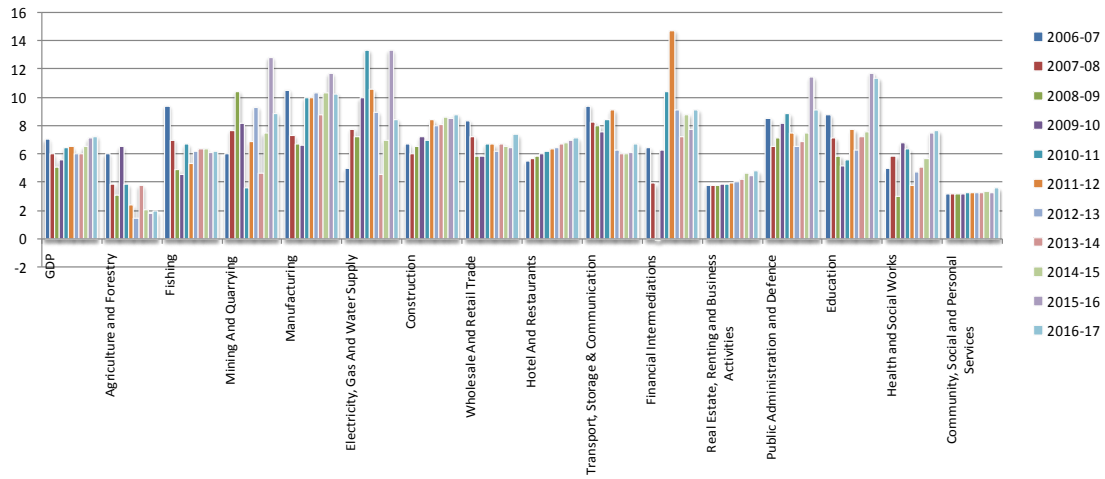
Bangladesh sustained an annual GDP growth of approximately 6.3% during the period of 2005-09, despite the global financial crisis and global food price shock. Growth in Bangladesh has been underpinned by a stable and prudent macroeconomic monetary policy, rising industry and service outputs and a continued high level of remittances. Going forward, the Government of Bangladesh's (GoB) objective is to develop a growth trajectory that will support an overall increase in real GDP growth of 8% per annum and reduce poverty from 40% to 15% by 2021.

1.1 Bangladesh Economy

As already mentioned, the Bangladesh economy has been experiencing steady growth over the last decade and prospects are looking better for the coming years, with a booming industrial sector, flourishing remittance flow, record high foreign currency reserve and growing interest of international investors' in Bangladesh.

Bangladesh achieved more than 6%[8] economic growth on average in the last five years. Most of the global economies including the Asian economies were severely affected by the global economic crisis and their growth rates experienced significant decline since 2009. Even after the five years of financial crisis, the global economics are still struggling to revive their economies. Inspite of global economic downturn, the economy of Bangladesh has been maintaining high and sustainable growth rates.

Figure 1.1: Sector-wise Growth Rate[9]



[8] Ministry of Finance
[9](At constant price) Annual Report, Bangladesh Bank, 2017

IIFC

GDP growth 7.28% during 2016-2017 was based on 10.2% growth in industry followed by 6.7% growth in service sector and 3% growth in agriculture. The growth of industries in 2017 was largely driven by higher manufacturing activities and growth in export earnings[10]. The growth of the industrial sector is dominated by exports earning in RMG, which has been growing at an average of 20%[11] over the last 5 years.

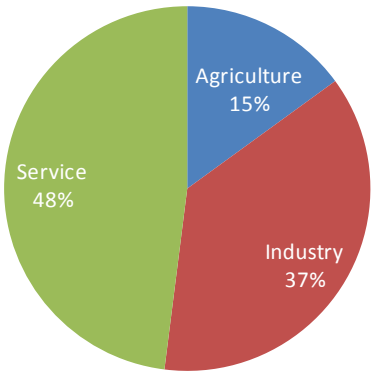
The growth that had occurred in the service sector of the economy was fueled by growing importance of education, health and social activities. Income growth had been dominated by wages and salaries in incorporated firms. The life span of the population continued to increase with more urbanization and more apt to live in a modern life. The later trend is particularly helping to reduce poverty level.

In the past decade, the economy has apparently become more stable. Living standards, as measured by per capita GDP, had improved at a higher rate. Internal and external balances were in good shape. Unemployment rate remained at a reasonable level. The economic stability and business prospects that prevailed in this particular period have generated significant confidence that may be a cause for good economic development in the near future.

1.2 Vision 2021

In reorganization of the long-term development challenges, the government adopted Bangladesh Vision 2021. The vision and the associated Perspective Plan 2011-21 have set solid development targets for Bangladesh by the end of 2021. Bangladesh plans to achieve lower-middle income status by 2021, which requires the economy to grow by 8% to 10% per annum. Bangladesh economy has sustained modestly high growth in the last 10 years. Achieving the targeted robust growth will require a major spur in the rate of investment.

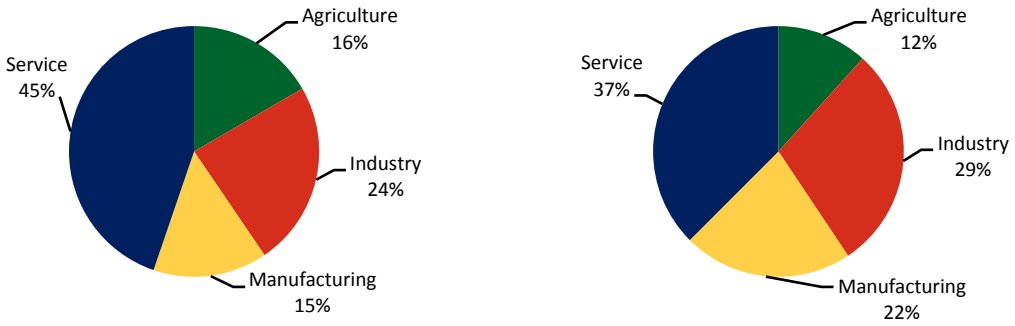
Figure 1.2: Target Share of GDP by 2021[12]



Promotion of structural transformation in the economy has been cited as one of the important strategic goals of the Perspective Plan. In the structural transformation process, within the time of Perspective Plan 2011-21, agriculture's share will decline from 16% (2004-09 average) to 12% by the end of Seventh Five Year Plan and share of manufacturing will grow from 15% (2004-09 average) to 22% in 2021.

[10]Bangladesh Economic Review, 2017 and Bangladesh Bank annual report, 2016-17
[11]Bangladesh Bank
[12]Perspective Plan of Bangladesh 2010-2021

Figure 1.3: Strategic Structural Change: Share of GDP (percent)



Average (2004-09) **Target 2021**

As a strategic option, Seventh Five Year Plan explicitly has chosen the path of boosting manufacturing for creating productive high-income jobs and development. It is found that decline in share of agriculture is projected to be compensated by increased share of industry and manufacturing while share of services remains steady.

1.3 Labor Force

The sustained growth in Bangladesh's labor force (nearly 2mn a year) is an asset that nevertheless increases the country's vulnerability. Creating productive employment will largely depend on creating an environment conducive to private sector investment, particularly within the labor-intensive manufacturing and service sectors.

1.4 Industrial Zone Regime

GoB has successfully provided serviced land, infrastructure, and a good business environment via the Export Processing Zone (EPZ) Program. EPZs have been used as a "strategic instrument" for attracting FDI and dealing with the shortcomings in the overall investment climate, business registration, and licensing, etc. environment. Bangladesh Export Processing Zone Authority (BEPZA) was established in 1980, with the first EPZ built in Chittagong in 1983. The EPZ program was the first systematic initiative to provide fully serviced land and a better business environment for investors, targeting large scale, export-oriented manufacturing. Since 1993, EPZs have triggered impressive growth in exports, mainly in the RMG sector, at an average annual rate of 23%, reaching nearly USD 2.9bn by 2010, and employing almost 28,000 people.

Bangladesh's current EPZ model, however, has had its limits, both in terms of cumulative impacts and spillovers into the domestic economy. As an exporting enclave, EPZs have provided little in the way of linkages with the domestic economy, up-stream or down-stream, resulting in low technology and efficiency spillovers, which normally accompany foreign investment. Investments in other sectors beyond the low capital investment of the RMG segment have also not materialized.

The GoB's objective is therefore to maximize the potential direct and indirect impacts through a more modern regime of Economic Zones (EZs). As such, the government has launched an effort to develop a new EZ paradigm in Bangladesh drawing from numerous successful examples from around the world, as well as Bangladesh's own positive experience with the EPZ model. In addition, the GoB is expecting additional spillover effects to local firms stemming from new foreign direct investment and from more investment within value chains. This will in turn

stimulate the procurement of more local products and produce better linkages between firms and educational institutions. A faster adaption to international environmental and social practices would also be encouraged through this new EZ policy regime.

The new EZ regime provides for a new approach both in management and investment. The policy allows the Government to develop and pilot an approach that is less reliant on Government and fiscal subsidies, while leveraging comparative advantages and private sector capability, where possible.

Bangladesh Economic Zones Act, 2010 was passed in Parliament in August 2010, providing the overall framework for establishing EZs throughout Bangladesh. Under this Act, the Bangladesh Economic Zones Authority (BEZA) was established under the Prime Minister's Office (PMO) and governed by a Board chaired by the Prime Minister. The law provides the legal coverage for attracting and leveraging private investment in the development of zones as zone developers or operators, and in the provision of providing infrastructure services, such as power, effluent treatment, wastewater treatment etc. The law also allows for development of EZs and support infrastructure through a Public-Private Partnership (PPP) mechanism.

2 Approach and Methodology

2.1 The Assignment

To support commitment to economic zones, BEZA intended in undertaking pre-feasibility study of Bogura EZ. In this regard, BEZA engaged IIFC for conducting this pre-feasibility study. The time-frame for the assignment was 6 months. The approach undertaken to comply with the ToR is described in the following section.

2.2 Approach

The methodology reflected the specific requirements of the project's scope and terms of reference as set out in the agreement. Efforts were given to satisfy these requirements and achieve project objectives. Our approach has been based on the following elements:

- an approach and work plan based on careful allocation and scheduling of tasks to ensure an efficient and seamless delivery of outputs in the desired timeframe; and
- a focus on producing practical and useable deliverables, rather than a more traditional focus on production of substantial reports on theory and recommendations. Whilst reports will be provided at key milestones, the emphasis of the project will be very much on practical approaches, workshops and inter-working between the consultants and the counterpart team

To accommodate within the timeframe of our engagement, a it prioritization was needed. A zone could not be a stand-alone initiative; rather it has to be integrated with other developments in the region. Especially it has to take care of the existing power operations and connectivity with the existing network of roads, power, telecommunication and ICT networks. In addition, the area development plan of local authorities and national authorities were also looked at, so that the EZ project can be harmonized with the development plan of the government.

2.3 Component 1: Competitive and Comparative Advantage

2.3.1 Task 1: Due Diligence

Stakeholder Meetings

Key BEZA staff and local trade associations and industries of Bogura (Bogura Chamber of Commerce and industry and BSCIC Bogura) to discuss the project and to understand their concerns and interests. The stakeholders are aware of the project and eager to find the direct and indirect employment opportunities in the project.

Collection of Background Documents/Data on the Project/Site.

All available background information/data, relevant laws, policies, maps, existing studies and reports previously undertaken were reviewed to understand the key development issues for the proposed EZ site.

Inception. The following activities were carried out as part of inception.

Kick-off meeting with BEZA

At the kick-off meeting, the following issues were covered:

- discussed the project approach and update the deliverables and timeframes. The purpose of this step was to discuss BEZA's priorities and to ensure that the deliverables of this project meet BEZA's objectives;
- established the day-to-day working processes between IIFC and the BEZA counterpart team, including communication, consultation, reporting and obtaining of documents and data needed for the project;
- discussed and obtained direction from BEZA on the Government's policy objectives for the sector; and
- obtained input from BEZA on key issues impacting the project objectives, tasks and deliverables.

Initial meetings

A series of initial meetings with BEZA, local authorities, and key industry stakeholders were undertaken. As the team already had an understanding of the EZs and key problems and constraints, through our team members' previous involvement with BEZA, it benefitted in revisiting the issues and obtaining first hand input and feedback from the industry players.

2.3.2 Task 2: Benchmarking the Economic Zone

Competitiveness Analysis. The site's potential competitiveness in different industrial sub-sectors was benchmarked vis-à-vis in other countries of the region such as India, China and other similar countries on the following key issues:

- *Infrastructure and utilities – availability, reliability and cost*
- *Availability of labor, existing industrial base, social infrastructure – especially education*
- *Industrial policy and business environment in state/country, fiscal levies and taxation*
- *Financial markets, trends of investments and exports*

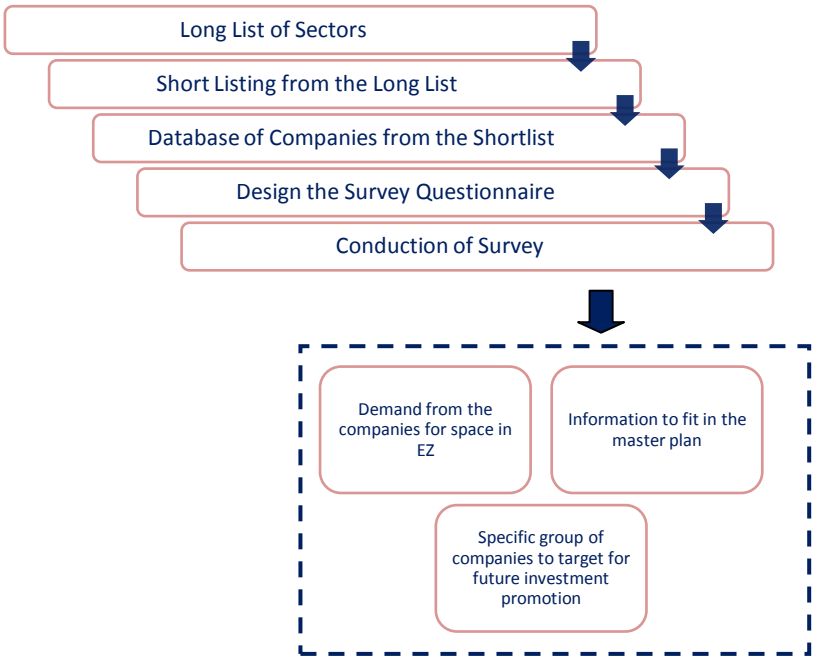
2.3.3 Task 3: Industry Assessment

Identification of Potential Industry Sectors. To identify the potential industry sectors, manufacturing sectors were identified and then short-listed by parametric analysis. A database of companies was subsequently prepared to survey and a questionnaire was administered to receive the data from the relevant companies to determine if there was sufficient demand from the companies for space in the EZ and to gather information to fit in the master plan; *e.g.:*

- projected size of plots;
- requirements for electric power, waste water treatment, potable water, and other infrastructure and services' and
- desired incentives including duty-free and other typical incentives, etc.

The following figure illustrates the overall methodology:

Figure 2.1: Overall Methodology of Industry Survey



Short listing of suitable sectors. A long list of industrial sectors, which exists as 'manufacturing" under Bangladesh government economic sector classification, was first reproduced. These are as follows:

Long list of sectors

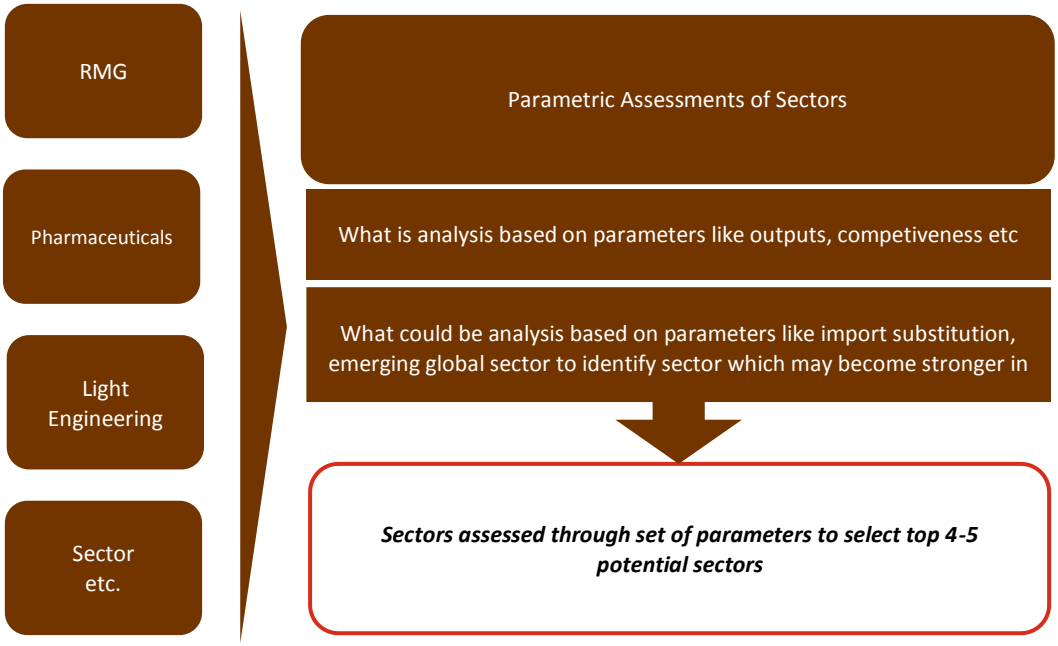
1. Textile and RMG Industry
2. Pharmaceutical
3. Leather Footwear
4. Shipbuilding and Repair
5. ICT Industry (computer, electronic and optical products and software)
6. Light Engineering
7. Frozen Fish
8. Food Processing
9. Cement
10. Wood and products of wood and cork
11. Paper and paper products
12. Printing and reproduction of recorded media
13. Refined petroleum products
14. Chemicals and chemical products
15. Rubber and plastics products
16. Non-metallic mineral products
17. Basic metals
18. Fabricated metal products
19. Electrical equipment
20. Machinery and equipment
21. Motor vehicles, trailers and semitrailers
22. Furniture
23. Ceramics products

From the above long list, shortlisted them on a priority based on the following parameters:

1. suitability with respect to land per unit of value addition;
2. suitability for proximity to port facility;
3. environmental suitability;
4. labor availability in the region;
5. presence of raw materials/ backward linkage industries in the region;
6. presence of forward linkage industries as well;
7. growth prospect/export competitiveness;
8. import substitution prospect; and

9. suitability with respect to existing local demand for the products.

Figure 2.2: Broad Framework for Short-listing of Suitable Sectors



Short list of sectors:

Bogura EZ

- RMG
- Pharmaceutical
- Light Engineering
- Food Processing
- Furniture

A scoring exercise was carried out of the short-listed sectors to prioritise space allocation for each sector based on suitability. The scoring system with respective weights for different parameters was as follows:

Table 2.1: Scoring Table of Each Sector

	Parameter	Weightage	Suitability (High/Low/ Medium)	Score	Weighted Score
1.	Suitability with respect to Land per unit of Value Addition	25%			
2.	Suitability for proximity to Port Facility or Sea	15%			
3.	Environmental Suitability	15%			
4.	Labor availability in Dhaka region	10%			
5.	Presence of Raw materials/ Backward Linkage Industries in Dhaka Region	10%			
6.	Growth Prospect/Export Competitiveness	10%			
7.	Import substitution Prospect	10%			
8.	Suitability with respect to existing Local Demand of the Products	5%			
	Total Score				

Scores: High 10, Low 0, Medium 5

The above box has been filled up for each sector to find the total score and then they were ranked by total scores. Space allocated on the basis of total scores so that the viable sectors receive highest consideration for potential investment.

Investor Survey

Apart from the above theoretical exercise, a survey was conducted to ascertain the demand for industrial spaces/plots in the EZ. The purpose of the demand survey was to:

(a) determine if there exists satisfactory demand for space in the zone;

(b) determine the sectors for which there is demand in the site;

(c) gather information to feed directly into the master plan and pre-feasibility study (*e.g.*, projected size of plots, requirements for electric power, waste water treatment, potable water, and other infrastructure and services, desired incentives including duty-free and other typical incentives); and

A database of 200 companies as created in the priority sectors with the following characteristics:

- Target companies that are potential zone end-users.
- Relatively even distribution by industry
- Full information on the name and nature of the company; identify the focal persons with their full contact details, base country and structure of capital (by country), website, etc.

The survey questionnaire was drafted to bring together the following information;

- Name and contact details of the respondent
- Size and annual revenue of the company
- Exact products or services, sales value, sales destinations (in-country sales vs. exports and which exact country destinations)
- Expansion plans, potential interest in investing in Bangladesh (for foreign companies), and at which site (both foreign and local companies), and which of Bangladesh sites would be the preferred choice (ranked), given the current location, available infrastructure, and conditions of investment; destination markets for the expansion.
- Requirements for additional conditions
- Reasons for expansion, criteria for choosing a site etc.
- Projected timeframes for the expansion, and projected needed size and configuration of land, electric power, and water including wastewater treatment, solid waste removal, telecommunications, and any other physical and infrastructure needs.
- Projected needs for personnel, sub-categories of personnel, infrastructure and service needs, and requirements for labor pool size, proximity to urban area, universities, etc,
- Preferences for purchasing land, renting land and constructing their own building, or renting space in a standard factory building (ranked)

One-on-one investor/demand surveys were conducted in the physical presence of the company representatives.

Synthesize the Findings from Investor Survey

The findings from the demand survey have been provided in the industry assessment chapter. The analysis of the data from the demand survey pulled information with regard to:

- The sectors and sub-sectors that have the greatest demand, and therefore should be targeted
- Which sectors and sub-sectors demonstrate little demand and should be eliminated or receive low priority
- Whether the respondents to the survey from the priority sectors have expressed a preference for locating in the zone and are willing to pay additional charges/fees, if the zone is "special"
- In the zone, which incentives and services are most important (ranked)
- The site is coming out the strongest for which sectors
- Some basic recommendations on specific facilities for development (such as, projections on plot requirement amount, plot/factory sizes, industry-wise yearly water consumption, electricity requirements, training facilities, and working strength, etc. for each industry/sector over a 20-year period)

Determine the Target Industries

IIFC analysed data acquired from survey to identify industry sector requirements, barriers to investment and potential interest in the EZ. The data were also qualified against the information received from face to face to interview to maintain the accuracy of the analysis.

Industry profile for Each Identified Sector

A profile for each short listed sector was prepared and provided in Section 5.5.

2.3.4 Task 4: Demand Forecast

Twenty-Year Demand Forecast

Demand Analysis. The study of the macroeconomic scenario in Bangladesh with s*pecial focus on potential industry sectors* constituted an important part in our approach. The demand assessment was conducted through the following two methods viz. top-down approach and the bottom-up approach to validate the top-down approach. This was followed by sector specific studies. An important part of this activity was to identify the *chief sources of raw materials/other key inputs* for the industry and assess the existing and proposed linkages. The past trend of investment in the relevant sectors in Natore, Natore, Dhaka, Pabna, Chapainawabgonj was also analysed and tried to assess the potential investment in the future that was required in estimating the *demand for the land*.

The analysis proceeded to the next step by preparing a 20-year demand forecast for the site. The demand projections were developed in three scenarios: (i) conservative case, (ii) base case, and (iii) aggressive case. The findings of the demand forecasts highlighted, in each year interval, the amount of land required by sector.

2.4 Component 2: Master Planning

2.4.1 Task 5: Transport and Off-site Infrastructure Assessment

Transport and Offsite Infrastructure Assessment of EZ Site and Influence Area. Under this activity, a comprehensive transport and offsite infrastructure assessment was carried out for EZ site and its area of influence. The proposed assessment was include:

(i) a review of the national transport modes (airports, roads, railway, seaports), current and proposed modal split, and offsite infrastructure networks that currently support the proposed EZ development;

(ii) a detailed assessment of existing offsite transport infrastructure and its conditions to identify opportunities, constraints or critical problems;

(iii) a list of offsite transport and offsite infrastructure network improvements/ upgrades required to make the EZ a viable transport/ logistics platform.

The transport and infrastructure improvements/ upgrades were taken into account the industry sector infrastructure requirements to be proposed for the EZ site.

Based on the GIS data, transport pattern was studied to assess proximity to national highway, major and minor roads traversing the proposed economic zone area. This Information on existing railway lines, airport, major settlements, and infrastructure linkages were considered. Further

the data was utilized as a guiding tool for proposing the transportation network to support the proposed development.

The study also looked into if there is any feeder power line available nearby the proposed site, in near future if PGCB will provide 132KV transmission line. Internal networking is considered within the EZ to provide electricity to the customers. Each economic zone will have its own power plant to address shortage of power from national grid.

Site Assessment. A physical inspection of the proposed site was conducted, which included the boundary demarcation, type of land, pattern of land use, water bodies, trees and other natural resources.

Connectivity Assessment. The transportation and communication system to the BEZ site, required to bring raw material, machinery, workers and other logistic units to the area and send finished products to the customers, which is very crucial in the development of an industry, was examined.

Develop an Action/Implementation Plan for Upgrading Transport and Off-site Infrastructure Networks. Support to the new EZ as required for upgrading of offsite infrastructure and improvement of potentially important transport assets.

2.4.2 Task 6: Planning Regime for the Proposed Economic Zone

Best Practice Master Plan

The master plan has been developed for the zone based on the outcomes of Industry Assessment, Sector Profiles, and the Demand Forecast in Component 1, and the results of the transport and offsite infrastructure assessment in Component 2 .

It was done at a broad level and following aspects were looked into:

- Boundary shape
- Physical site features
- Area availability
- Environmental considerations
- Social issues
- Micro climatic conditions
- Compatibility issues
- Surrounding areas
- Buffer requirements
- Accessibility
- Security
- Logistic requirements
- Transportation issues
- Functional requirements
- Visibility

Land Use Plan

The land use pattern of the economic zone has been determined considering the land requirement for various processing units, logistics requirements, research, capacity development, skill development, residential facilities, schools and various social amenities etc.

Apart from general infrastructure, varieties of small and large plots have been considered in the master plan to meet the varied needs of the industrialists.

A concrete surface road has been proposed for internal roads in the zone for protection against heavy rain and heavy truckload that is very common in economic zones. The main road has been planned from the entrance crossing through factory plots in the industrial zone. Water distribution network inside the zone has been considered to deliver water to each factory along the roads, coming through the tower and tank at several places built inside the zone. A gravity feed system will be used to supply water to the water supply pipeline located along the footpath of the road inside the EZ project areas.

Zoning Plan

A zoning plan has been prepared as an integral part of the master plan which would logically delineate specific zone as commercial area, processing area and non-processing area. The zoning plan is envisaged to attract foreign investors due to modern infrastructure such as an efficient drainage system, a reliable power supply plant, a water supply treatment plant replenished by river water and rainwater as source, a CETP and communication systems equipped to international standards. These strategically designed infrastructure elements will be equally accessible to the local as well as foreign investors.

Phasing Plan

Phasing plan is include in the master plan to rationalize the sequencing of of the development and construction of the zone. The EZ phasing plan will also correspond with the 20-year demand forecast. In the plan, the consultant identified the land requirement for each phase.

2.4.3 Task 7: On-site Infrastructure Concept Plans and Cost Estimates

On-site Infrastructure Concept Plans

The infrastructure concept plans has been prepared including the following on-site networks, among others: i) roads, ii) water, iii) power (electricity and gas), iv) drainage/storm water, v) sewerage/wastewater, vi) wastewater/ effluent treatment plant, street lighting and fencing, and viii) telecommunication. All infrastructure plans has been prepared in CAD format at a scale.

Develop Cost Estimates for Infrastructure, Utilities and Buildings

Cost estimates are based on the premise that land development, land filling, external/ off-site infrastructure (which include connectivity infrastructure like road, gas or power outside the zone premises) are borne by the government. The social infrastructure ensures proper living conditions of the people inside the zone, which includes administrative buildings, a mosque, a vocational training center and commercial facilities. The cost estimates also include the commercial facilities like shops, restaurants, banks, etc. are essential for day-to-day life of the tenants inside the zone. Cost has been estimated both at the base year (2018) and subsequently at the point when they will be incurred with escalation during time elapsed.

2.4.4 Task 8: Environmental and Social Review of EZ and Area of Influence

Environmental Review. The environmental baseline is the existing status of environment around the proposed project site. It has been analyzed through assessment of environmental components like air, water, land, noise, soil, etc. and environmental characteristics like physical, biological and socio-economic status of the study area, within the 10 km radial zone of the project site. Physical environment includes topography, land, soil, meteorology, air, water, noise, etc. and the biological environment includes flora and fauna.

Social Review. The social baseline is the existing status of society around the proposed project site. Socio-economic environment of the study area includes demography, ethnicity, religion, education and employment opportunity, occupation, income, poverty, social relations, etc. Baseline environmental conditions are based on the data collected from various related agencies and the secondary documents from published sources and websites. The baseline provides the basis for assessment of impact (potential changes in the baseline conditions) due to the development of proposed BEZ.

2.5 Component 3: Financial and Economic Modeling

The project was analysed from both *economic and financial point of view* as well as funding requirements with sources:

- ***Financial Analysis –*** estimate financial costs and benefits and evaluate financial viability using net present value and internal rates of return in constant prices with sensitivity analysis for at various key variables.
- ***Economic analysis*** – estimate economic costs and benefits for the project in terms of rates of return on investment and net present value, with sensitivity analysis for various key variables.

Financial Model

The key objectives of preparing a financial model for financial analysis was:

- to demonstrate the financial viability of development of the zone based upon demand forecast, expected lease rates, cost estimates, planning parameters and other information.
- to illustrate the sensitivity of the financial and commercial viability to key parameters and to identify the areas which could be adjusted (lease rates or other parameters) to influence the profitability of the project.
- to determine the requirement of initial support and later on to implement project on a commercial footing.

The main approach was to determine the financial viability of the project on the basis of an assessment of demand forecast for industrial plots, revenue collection from commercial areas, capital cost estimate for the project, revenue projection and financing structure.

Financial analysis of the project took into consideration, such factors as:

- Short and long-term financial obligations;

- projected revenue stream, projected costs (fixed and variable), depreciation schedule and asset construction schedule;
- Demand forecast for leasable area of the zone;
- Lease rate structure and the impact of amendments in that structure;
- Sources and cost of capital

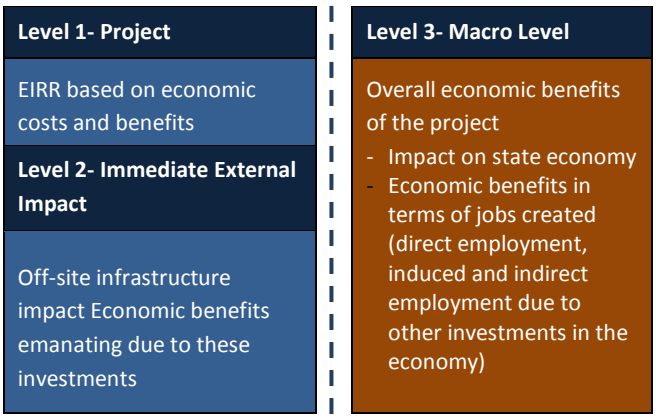
The financial model covered the following:

a) Determination of the revenue projection, projection income statements and cash flow statements over the life of the project.
b) Calculate various matrices such as IRR, payback periods and debt-service coverage ratio for assessment of project viability.
c) Sensitivity analysis on the major parameters including capital cost, O&M cost, lease rate etc. in order to explore its sustainability under different changing situations.

Financial analysis on options for cost recovery of capital investments and recurrent costs under different demand forecast scenarios.

Economic Model

The purpose of the economic analysis was to quantify the economic and social benefits of the project with its costs of implementation and operations. In conducting the economic impact analysis of the zone, an Economic Model was built to identify and quantify costs and benefits associated with the Zone Development business. The outputs of the model are the Economic Rate of Return (ERR), Benefit Cost ratio (BCR) and Net Present Value (NPV) of the project. The unquantifiable benefits linked with the project were also identified to evaluate the overall economic and social impact of the project. The approach and methodology of the economic analysis of the zone is shown below:



a) *Comparison between scenarios where Project is implemented and where Project is not implemented:* To identify the benefits and costs of the zone, a matrix was designed to portray the economic and social impacts of implementing the project. The matrix helped to identify the service and facilities gap as well as to assess the needs of the project.

b) *Compare Benefits with Costs:* Project investment decisions involve large up-front costs, with benefits that are achieved over time. The costs and benefits of the proposed EZ were identified and relevant benefits and costs into two subcategories were found: (a) quantifiable and (b) not quantifiable. Then a framework was developed to define the value and to measure the quantifiable benefits and costs associated with the economic zone. It is envisaged that the industries which will be set up in the zone will be able to achieve higher efficiencies and hence better productivity.

c) *Prepare Economic Model incorporating Results of Financial Model:* The financial profit/(loss) (considering capital expenditure, operational expenditure, revenue) was converted into economic equivalent terms in designing the economic model. Economic benefit was estimated and added to the financial profit. Costs, including economic costs and taxes, were subtracted to attain the net economic benefit of the project.

d) *Discounting Benefits and Costs to Present Values:* The economic model was designed to calculate the Economic Rate of Return (ERR) and Cost Benefit ratio. In this context, the corresponding costs and benefits which would be generated during the development of the zone were quantified. Thereafter, all pertaining quantifiable future costs and benefits were converted into present value terms by applying Net Present Value (NPV) principle.

3 About Project Location

3.1 Bogura District

Bogura is a northern district of Bangladesh under Rajshahi Division. It is called the gateway to the north Bengal. Bogura district is an industrial cum- commercial city of north Bengal where many small and mid-sized industries are sited. It was a part of the ancient Pundravardhana territory and was the capital of 'Pundravardhana'. Bogura is famous for its historical values with Pundravardhana as former capital, which is now known as 'Mahasthangarh'. It is generally believed that the district was named after the name of Sultan Mohammad Nasiruddin Bughra Khan who was an independent Ruler of Bengal during 1279 - 1282 A.D. The then greater Bogura became a zila in 1821. The present Bogura district was carved out from Bogura Sadar Sub-division in 1983.

Figure 3.1: Bogura District

Profile. Bogura district was established in 1821 consisting of 9 thanas, of which four from Rajshahi district (Adamdighi, Bogura, Sherpur, Nawkhila), 3 from Dinajpur district (Lalbazar, Badalgachhi, Khetlal), and two from Rangpur district (Gobindaganj, Dewanganj). In 1983, Bogura district was divided into two districts (Bogura and Joypurhat). Bogura district consists of 5 municipalities, 48 wards, 166 mahallas, 11 upazilas, 109 union parishads, 1,782 mouzas and 2,706 villages.

Area. 2,919 km^2 *Population.* 2.98mn

Geographical Location. Bogura district is bounded by Gaibandha and Jaypurhat districts on the north, Sirajganj and Natore districts on the south Jamalpur and Sirajgonj on the east and Naogaon and Joypurhat districts on the west. Bogura district is located 89.00 degree east to 89.40 degrees East longitude and 24.30 degree north to 25.10 degrees north latitudes.[13]

Economy. In recent years, there has been substantial infrastructural development in Bogura. The roads are reconstructed and upgraded into two lanes through a new city plan. The soil is very fertile and there is abundant grain production. Over the last few years, the production of red pepper in Bogura has increased greatly, which has become a business of BDT 1bn or so. Along with the growth of business, the new levels have come to the banking system.

Municipalities. Adamdighi, dhupchanchia, Bogura sadar, sherpur, and sariakandi

Thanas. Bogura city has 12 thanas under its jurisdiction. They are; Adamdighi, Kahaloo, Gabtali, Dhupchanchia, Dhunat, Nandigram, Bogura sadar, Shahjahanpur, Shibganj, Sherpur, Sariakandi and Sonatala.

Rivers. Karatoya, Jamuna, Nagar, Bangali, and Ichamati.

Climate. The climate of Bogura district is tropical. In winter, there is much less rainfall in Bogura than in summer. This location is classified as Aw by Köppen and Geiger. The driest month is December, with 6 mm of rain. With an average of 397 mm, the most precipitation falls in July. June is the warmest month of the year. The temperature in June averages 28.9 °C. January has the lowest average temperature of the year. It is 18.3 °C. There is a difference of 391 mm of precipitation between the driest and wettest months. During the year, the average temperatures vary by 10.6 °C[14].

Physiography. Bogura district shares borders with Gaibandha and Joypurhat to the north, Sirajgonj and Natore to the south, Jamalpur to the east and Naogaon to the west. There are quite a few rivers in the Bogura District. Karatoya is the central divider of water-channel of the district; the other rivers may be classified into the eastern and western systems. The names of the some important rivers of this district are Bangali, Karatoya, Jamuna, Nagar and Tulshiganga. Annual average temperature of the district is maximum 30.27°C, minimum 20.31°C; average annual rainfall 1,762 mm[15].

Archaeological heritages and relics. The Bogura district of archaeological heritages, Kherua Mosque at Sherpur, remnants of the historical Mahasthangarh, Bara Masjid, Mazar (tomb) of Shah Sultan Balkhi, Gokul Medh, Parshuram's Palace and Vasu Vihara are the notable.

[13] http://www.Bogura.gov.bd
[14] http://Boguradistrictinformation.blogspot.com/2016/03/climate-in-Bogura.html
[15] https://en.wikipedia.org/wiki/Bogura_District

3.2 Shahjahanpur Upazila

Shajahanpur Upazila is an upazila of Bogura District, formed on 21 January in 2003. It is the newest upazila in the district. Total area of Shahjahanpur Upazila is 221.69 sq km, located in between 24°41' and 24°50' north latitudes and in between 89°16' and 89°29' east longitudes. It is bounded by Bogura sadar upazila on the north, sherpur upazila on the south, gabtali and dhunat upazilas on the east, kahaloo and nandigram upazilas on the west.

Administration. Shahjahanpur has 10 unions/wards, 131 mauzas and 131 village. Bogura Municipality falls mainly within Bogura Sadar Upazila, but a small part of the municipality (one ward, portions of two others, Majhira Cantonment, and Jahangiraba Cantonment) lies inside Shajahanpur Upazila. These wards are divided into 18 mahallas. The remainder of the upazila is divided into nine union parishads: Amrool, Aria Bazar, Asekpur, Chopinagar, Gohail, Kharna, Khotta Para, Madla, and Majhira. The union parishads are subdivided into 120 mauzas and 166 villages

Figure 3.2: Shahjahanpur Upazila

Educational Institutions. Average literacy rate and educational institutions Average literacy 48.59%, male 51.93%, female 45.10%. Educational institutions: BEd college 1, agricultural college 1, technical institution 3, college 5, secondary school 31, primary school 121, madrasa 62

Communication Facilities. Pucca road 116.30 km, semi-pucca road 15.43 km and mud road 240.49 km

Health Centers. Upazila health centre 1, union satellite clinic 2, maternity and child welfare centre 10, community clinic 30.

Land use. The land use pattern of the proposed EZ area falls under agriculture zone and aquaculture zone. It was observed during our site visit that 2 crops are being cultivated at the land parcel throughout the year.

3.3 Project Site

The proposed site for the development of BEZ is located at Shahjahanpur Upazila of Bogura district. The site is adjacent to the western side of the Bogura-Natore highway in five mouzas namely Chakjorra, Jorra, Partekur, Birgaon and Chak Valley.

The mouza map of proposed EZ provided by BEZA is shown in the figure 3.4. Mouza map superimposed on google map is presented in figure 3.5 and figure 3.6. Reconfirmation of the site details are shown further in the table below.

Table 3.1: Reconfirmation of the Site Details

Parameters	Details
Site Co-ordinates	$24^0$47'13.02"N $89^0$20'49.55"E
Site Boundaries	
East	Bogura-Natore highway
West	Agricultural land
North	Agricultural land
South	Agricultural land
Total area of the site	251.43 acres
Mouza Details	Chakjorra, Jorra, Partekur, Birgaon and Chak Valley
Land tenure details	Government owned and private land
Existing land use	Agriculture

Type of land. Based on depth of inundation during monsoon season, land type of Bangladesh has been classified. In terms of depth of flooding, five classes of land type are recognized (SRDI, 1988), these are high land (above flood level), medium highland (flooding depth 0-90 cm), medium lowland (flooding depth 90-180 cm), low land (flooding depth 90-270 cm) and very lowland (flooding depth >270 cm). The land type characteristics are uniform within the study area, although the land types of Bogura district are not uniform. Out of total 41950 acres of land, 4% (1822 acres) low land, 30% (12605 acres) Medium land and 66% (27523 acres) are High land. The land types of proposed BEZ are arable low flat land.

Figure 3.3: Area Fill Image of Bogura EZ

Figure 3.4: Mouza Map

IIFC

Figure 3.5: Mouza Map Superimposed on Google Map

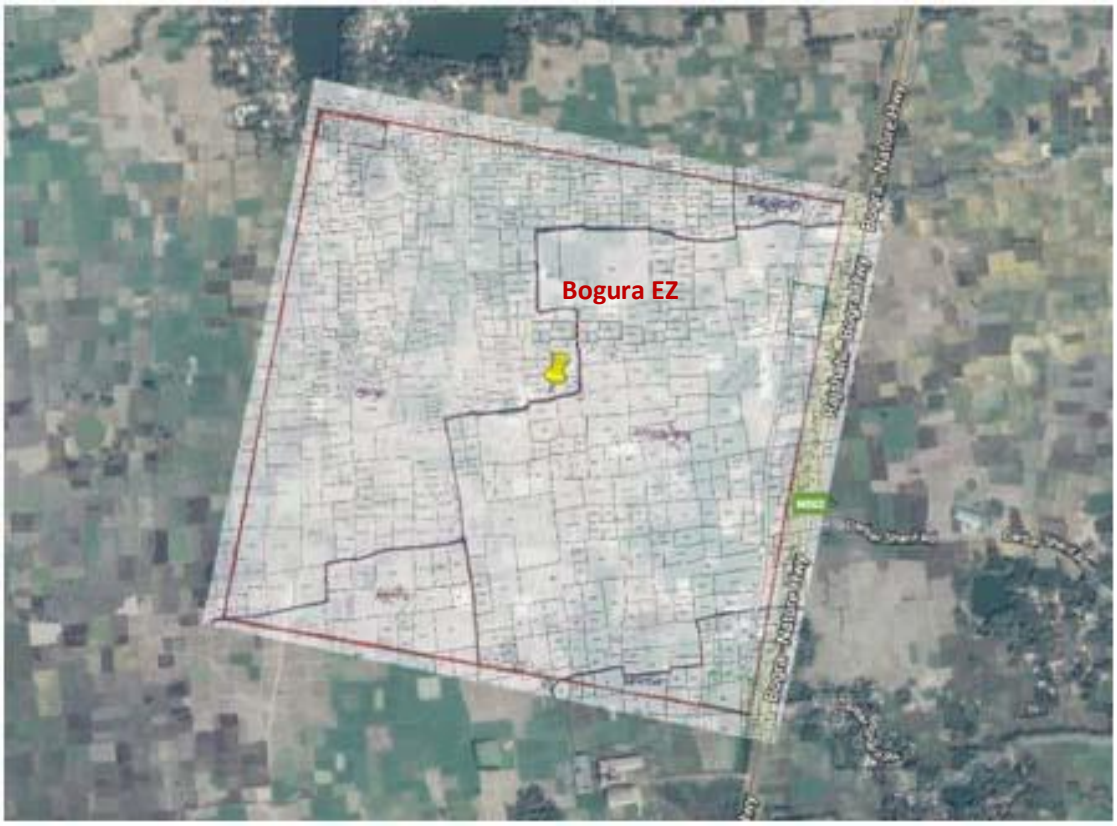


Figure 3.6: Mouza Map Superimposed on Google Map

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Figure 3.7: Proposed Bogura EZ

Current condition inside proposed site

High-voltage power line inside proposed site

Current condition inside proposed site

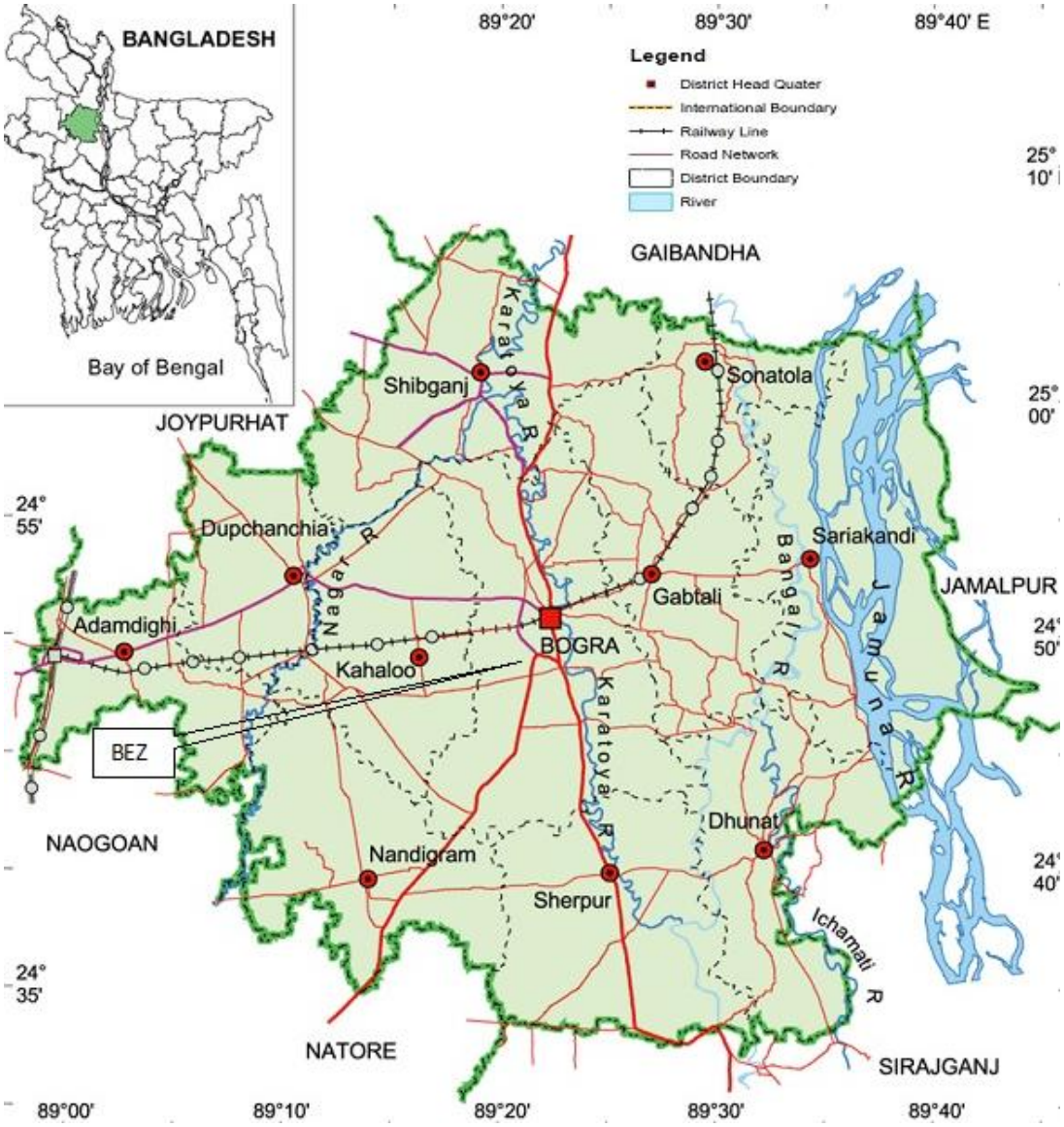
Current condition inside proposed site

3.4 Existing Off-site Infrastructure: Road and Rail

The project site is situated adjacent to the Bogura – Natore highway. Existing road may be improved and used as an access road to the project site. This however will need widening. It is located 11 km away from the zero-point of Bogura city. The road distance between the centre of Shajahanpur upazilla and the proposed EZ is about 3 km (approximately). Proposed EZ is located about 3.5 km away from Bogura – Rangpur highway, 9 km away from Bogura DC Office, 7.5 km away from Railway Station, 8.5 km away from central bus terminal and 183 km from Dhaka by road.

Bogura is connected with the rail network to other parts of the country. The Bogura railway station is located at a distance of 7.5 km (approximate) from proposed EZ.

Figure 3.8: Road and Rail Connectivity



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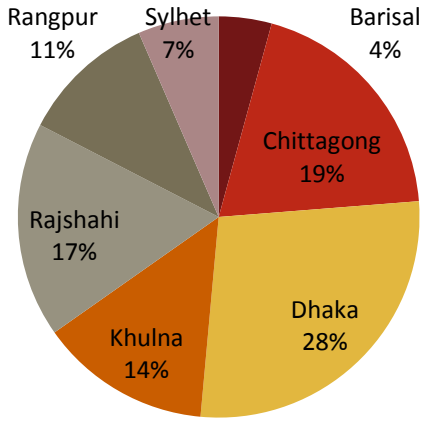
4 Competitveness Assessment

4.1 Bangladesh Economy

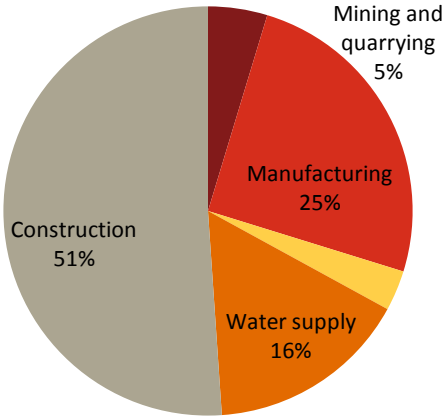
Vision 2021 of the GoB stipulates that Bangladesh will attain middle-income status by 2021. In order to achieve this goal, the government has set its economic growth target at 8% in 2016 and 10% in 2021 with an average 7.3%[16]. To fulfill this vision it is envisaged that the manufacturing sector will play a central role. The strategy of the government has been to facilitate a dynamic, vibrant, pro-export and competitive manufacturing sector that would eventually contribute some 30% to national income and be able to absorb 20% of the work force. Since 1990s, government has been pursuing a market-oriented industrial strategy. The policy regime for manufacturing improved significantly in the 1990s, based on investment deregulation, trade liberalization, better exchange rate management and improved financial sector performance. The result is evident from the higher share of industry in GDP as agriculture continues to decline.

The geographical distribution of economic units by division and economic sector is shown in the following figure:

Figure 4.1: Distribution of Economic Units by Broad Industrial Classification and Division[17]



Intensity of Economic Activity by Divisions



Intensity of Economic Activity by Sectors

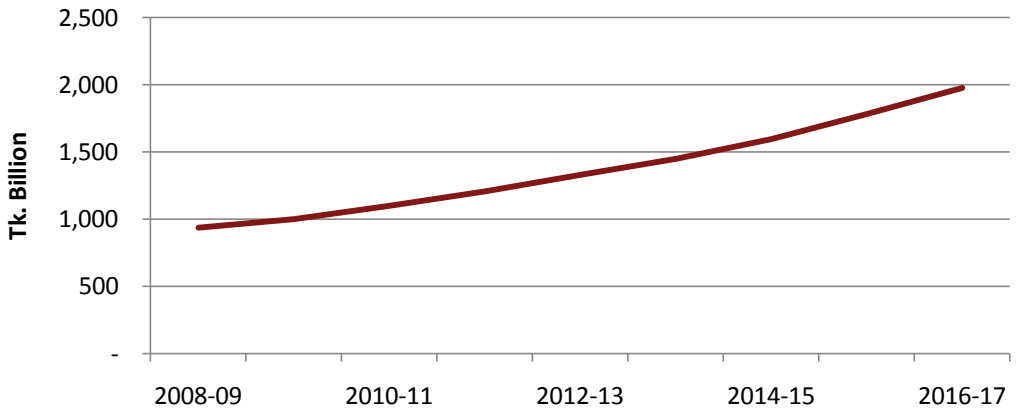
As depicted, manufacturing is a leading sector after construction within broad industry accounting for 25% of all economic units. Around 28% manufacturing units located in Dhaka Division, 19% in Chittagong Division and 14% in Khulna Division.

4.1.1 Manufacturing Sector

Manufacturing has been a major driver of industrial growth in Bangladesh. However, it is narrow-based to only few industries: readymade garments and textiles, fish and seafood, leather, fertilizer and pharmaceuticals.

[16] Seventh Five Year Perspective Plan
[17] Economic Census, Bangladesh Bureau of Statistics

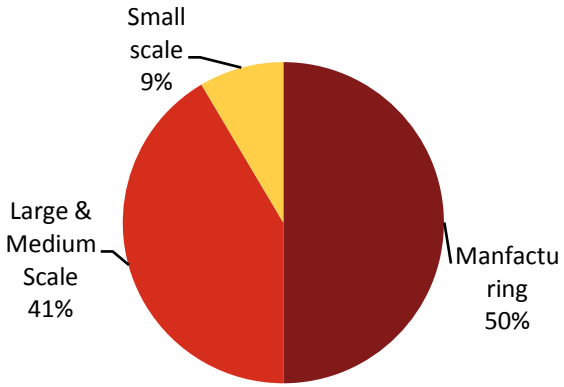
Figure 4.2: Volume of Manufacturing Sector[18]



In 2015-16, the sector grew overall 12% fueled by 12% growth in medium and large industry and 9% growth in small and cottage industry. Rapid growth in medium and large-scale industry units mainly propelled by readymade garment and knitwear uplift. However, in 2016-17 the sector grew by 11%.

As per Bangladesh Economic Review 2017, the contribution of manufacturing industries to national GDP was 21.7% in 2016-17, of which medium and large-scale industries contributed 18% to GDP and small-scale industries contributed only 3.7% to GDP. The share of manufactured goods to GDP has been increasing over the years.

Figure 4.3: Share of Manufacturing in GDP[19] in 2016-17



[18]Bangladesh Economic Review 2017 (At constant prices of 2005-06)
[19]Bangladesh Economic Review 2017

4.1.2 Raw Materials of Manufacturing Industries

The following table illustrates the sources of raw materials of the industries:

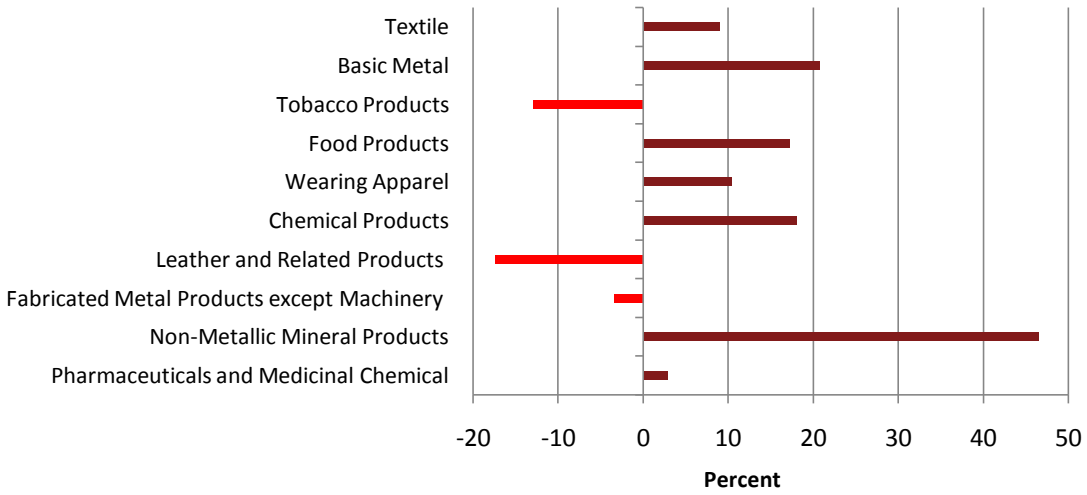
Table 4.1: Sources of Raw Materials[20]

Sectors/Industries	Raw Materials
Light Engineering	• Ship scraps as raw materials are used for this sector without testing its composition, at the same time competing finished products are also imported.
Food Industry	• The industry is local raw material dependent
Furniture	• The main varieties of furniture are produced from wood, processed wood, melamine board, Medium Density Fiber Board (MDF), particleboard, steel etc. On average 60% of raw materials of furniture sector are imported from different countries.
Textile and RMG	• The backward-linkage industry supplies around 90% raw materials to the knitwear subsector and 40% to the woven sub-sector. • 60% woven raw fabrics are imported, mainly from China and India to meet the demand of woven sub sector.
Plastic Industry	• Polymers use as main raw material. Industry uses imported raw materials of polymer granules
Pharmaceutical	• Bangladesh pharmaceutical production is very import-intensive as raw materials like API, packaging, and materials are imported from abroad. Around 50% of the total pharmaceutical import comes from China, 30% from India, and the rest from other countries.

4.1.3 Medium and Large Manufacturing Industries

The medium and large scale industries comprises a wide range of sectors such as textile and apparel industry, pharmaceutical industry, food products, chemical products, leather industry, tobacco industry etc. Indices that recorded increase and decrease in 2015-16 compared to the same period of the preceding year are as follows:

Figure 4.4: Growth of Industrial Production[21]

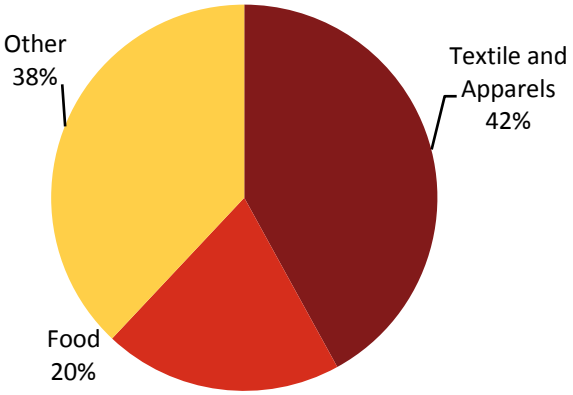


[20] Ministry of Industries, 2015
[21] Bangladesh Bureau of Statistics, July 2016

4.1.4 Geographical Concentration

In Bangladesh, there are around 50,000 units of major industries mainly located at Dhaka, Chittagong and different industrial zones. Out of the total industrial units, 98.68% units are under private sector and 1.32% of them are run by the government.

Figure 4.5: Key Industrial Units Distribution



Textile and apparels units account for 42%[22] and food sector accounts for 19.81%[23] of manufacturing units of the country.

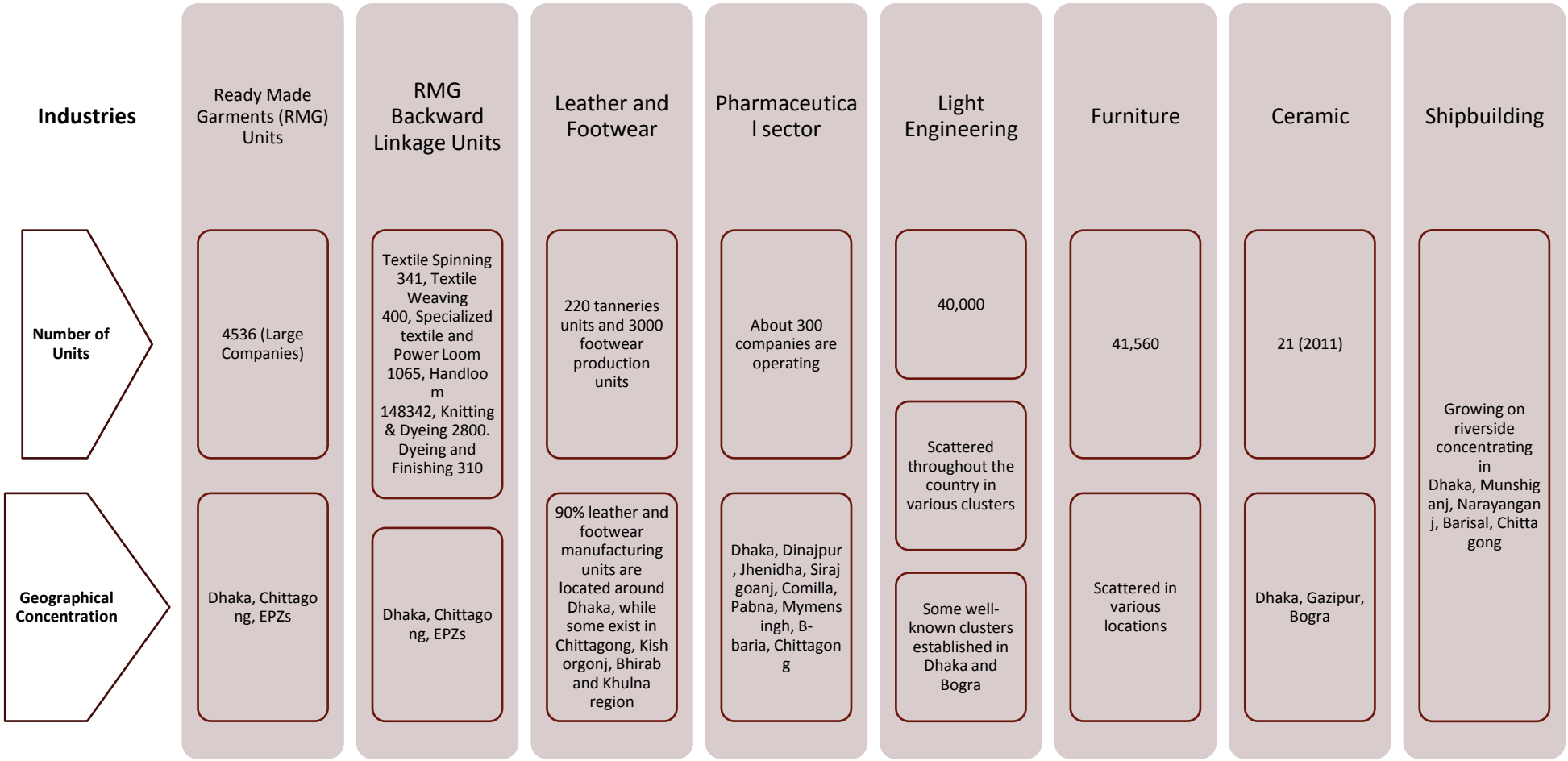
Table 4.2: Data on Major Industrial Units[24]

Number of Total Key Industries	42,592
Textile and apparels	17,967
Food	8,441
Private Ownership	98.68%
Government Ownership	1.32%
Number of Fully Government Owned Companies	103
Foreign Ownership	263
Joint Venture (Local and Foreign)	263
Government and Private Ownership	35

The following figure depicts the geographical concentration of major medium and large industries in Bangladesh:

[22] Economic Census 2013, Bangladesh Bureau of Statistics
[23] Same as above
[24] Same as above

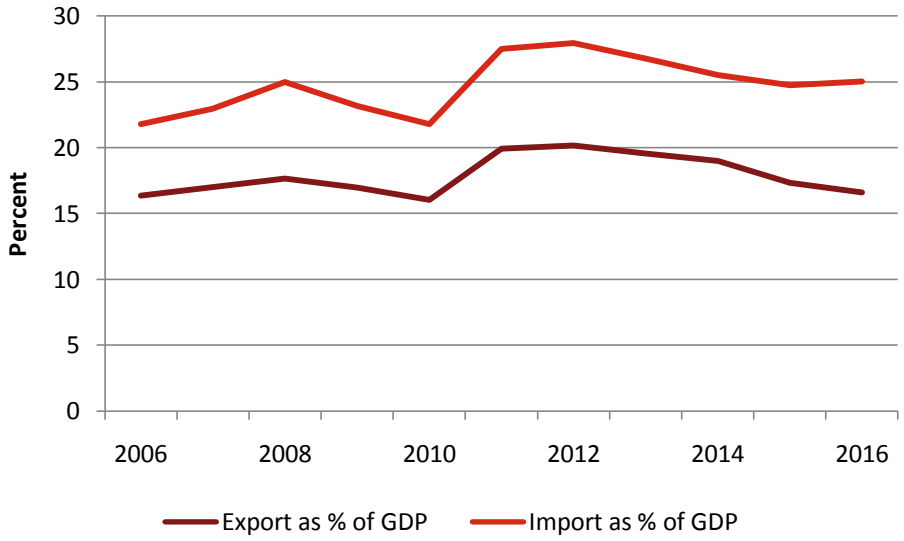
Figure 4.6: Geographical Concentration of Major Small, Medium and Large Industries



4.1.5 Foreign Trade

In 2006, export accounted for only 16% of GDP where as its share steadily increased to 17%[25] of country's GDP by 2016. On the other hand the contribution of Import to GDP is higher than export that revealed that Bangladesh experienced trade deficit, imports exceeded exports. However, the trade deficit, as a share of GDP gradually decreased due to strong surge in export volume of the country.

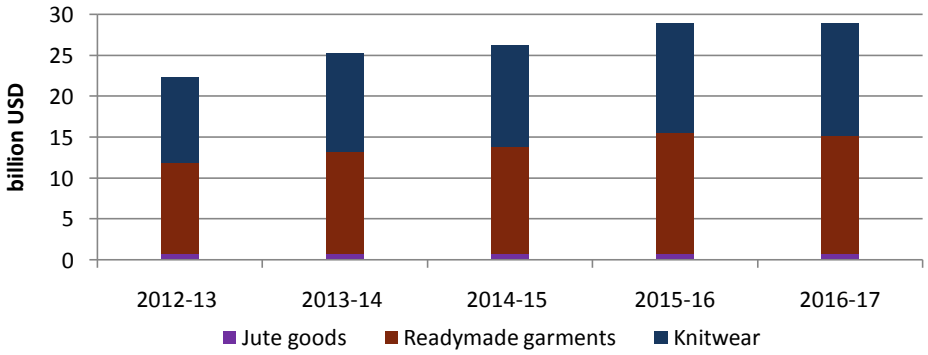
Figure 4.7: Share of Foreign Trade to GDP[26]



4.1.6 Export Trend

Bangladesh export's has been experiencing a shift from the agricultural products to manufactured goods. The main export items are RMG and knitwear, leather and leather products, paper, furnace oil, urea, ceramic products, raw jute and jute products. In 1983-84, manufactured goods accounted for 65.2% of total export volume of the country. Manufacturing dominated over 92% of total export of the country since 2003-04 till now[27].

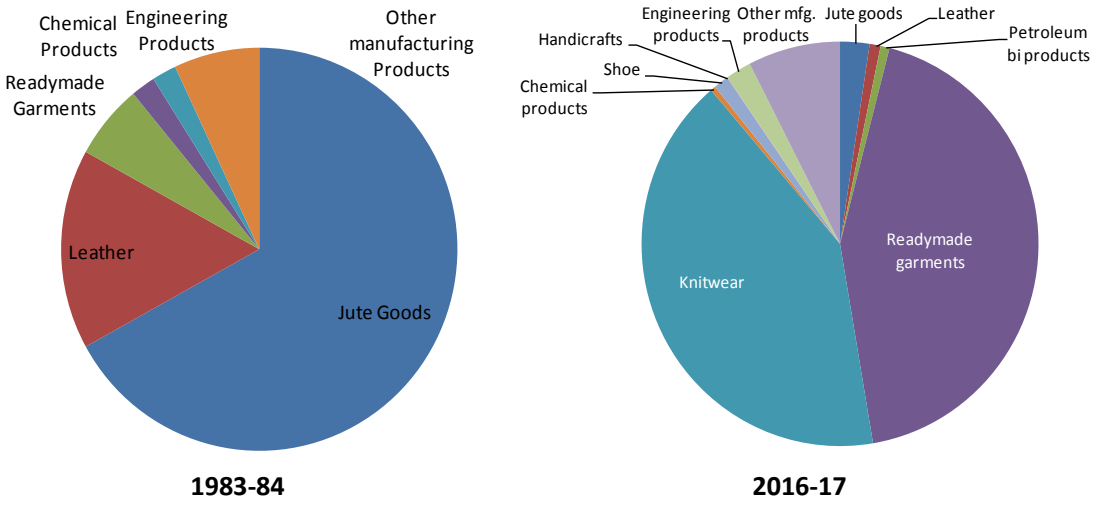
Figure 4.8: Export of Major Commodities[28]



[25] Bangladesh Economic Review, 2017
[26] The World Bank, http://data.worldbank.org/indicator
[27] Same as above
[28] Export Promotion Bureau

In 1983-84, export of manufactured commodities dominated by jute goods that were accounted for 67.48% and in 2015-16, its share downed to only 2.48%[29].

Figure 4.9: Share of Manufacturing to Export[30]

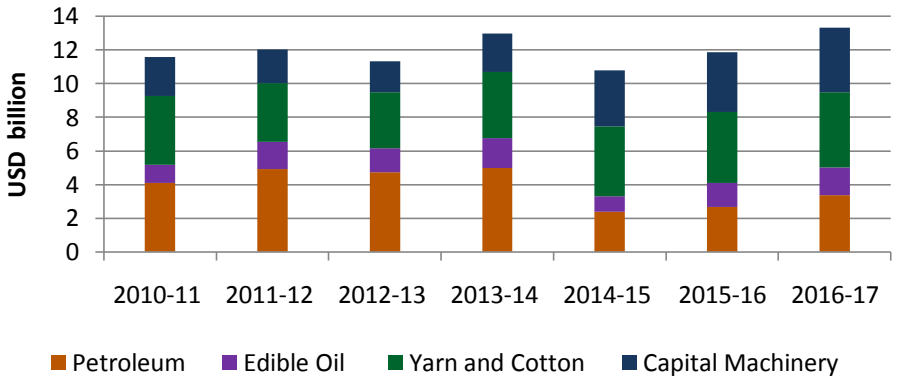


On the other hand, export of textile and apparel items continued to rise. Over the periods, Bangladesh has achieved robust growth in this sector. The sector contributed more than 83%[31] of the total export earnings. To reduce the excessive dependence of single basket export government has taken initiative to diversify the export focusing on leather and footwear, engineering products, shipbuilding and pharmaceutical products.

4.1.7 Import Trend

Bangladesh's economy depends on the import of both consumer items and industrial raw materials. Major import products are raw cotton, crude petroleum, wheat, oil, seeds, edible oil, petroleum products, fertilizer, yarn, capital goods, staple fibres, iron and steel. The following figure provides the imports by major commodities. It implies maximum import of yarn and cotton, capital machinery and petroleum products.

Figure 4.10: Import by Major Commodities[32]



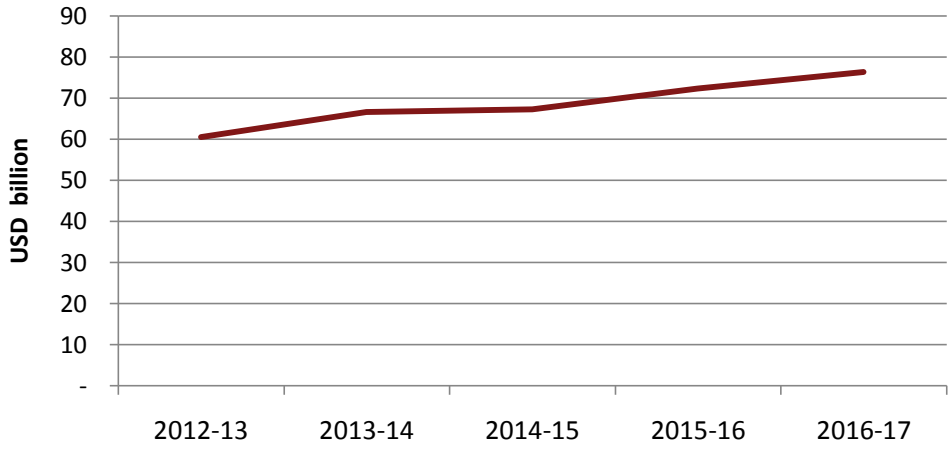
[29] Bangladesh Economic Review, 2016
[30] EPB; Bangladesh Economic Review 2016
[31] Bangladesh Garment Manufacturers and Export Association (BGMEA)
[32] Bangladesh Economic Review 2016

4.1.8 Increase in Foreign Trade

Foreign trade of Bangladesh has registered sustainable growth since 2008-09 due to initiation of economic reforms and adoption of an export-biased liberal foreign trade policy. Bangladesh's economy has benefited from its growing share of the global RMG market. Government has been pursuing an export led economic development strategy to stimulate export earnings. Promotional campaign and industry assistance are being given under export diversification programme.

In 2012-13, the total export was around USD 26 bn. By 2016-17, the earning from international trade increased to USD 34bn. Imports in 2012-13 was USD 42.3bn and in 2016-17 it was USD 37.81bn resulting in a total foreign trade of 76 bn. The following figure shows the volume of foreign trade (*i.e.* import plus export) over years. In 2016-17, the foreign trade grew by 6% while average growth of last five years was also 6%.

Figure 4.11: Volume of Foreign Trade[33]



4.2 Competitiveness of Bogura[34]

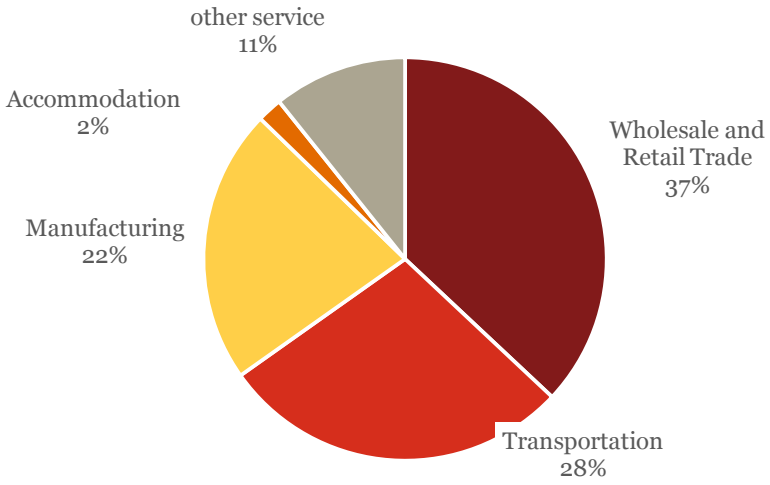
Bogura is known as the industrial city of the North Bengal and a communication hub. Agriculture and livestock sectors play a vital role in the economy of this district. About 57% are agro-based farms that produce varieties of crops, namely local HYV paddy, jute, sugarcane, wheat, tobacco vegetables, pulses and others cash crops and minor cereals. Various types of fruits like mango, jack fruit, guava, litchis etc. are grown in the district. Bovine animals, goat, sheep and poultry rearing generate an additional income to the rural people. Pisciculture and fish catching has also some share in the rural economy of the district. Besides farming activities, non-farm economic activities also provide some economic benefits to the households.

The following figure shows type and numbers of establishments together with persons engaged in those establishments are shown below:[35]

[33] Monthly Economic Trends, Bangladesh Bank (Table IIIA) Summation of import and export
[34] IIFC analysis till 2017 based on Economic Census, 2013, BBS (District Report Bogura) and District Statistics, 2011, Statistical Pocket Book Bangladesh 2016
[35] IIFC analysis till 2017 based on Economic Census 2013

Examining the data by economic activities, it is observed that the wholesale and retail trade and transportation has appeared as the two largest sectors while manufacturing holds the third position with number of establishments 56,000 and TPE 181,000.

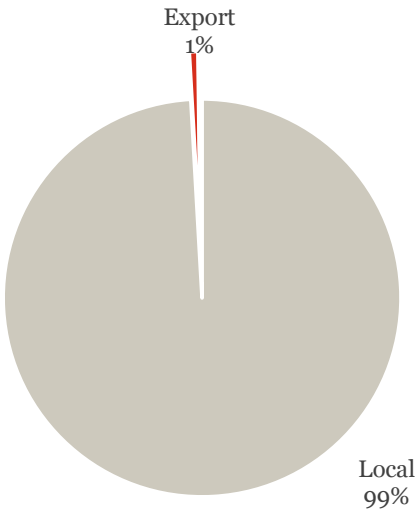
Figure 4.12: Share by Economic Activities in Bogura



4.2.1 Manufacturing Establishments

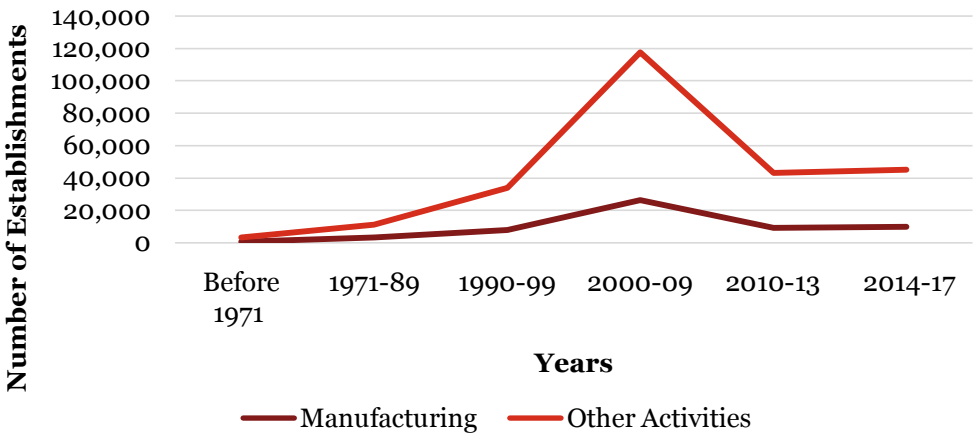
The following figure provides the data on number of manufacturing establishments by market.

Figure 4.13: Market Share of Manufacturing Establishments



In Bogura, of the total manufacturing establishments, the significant %age (90.48%) sell product entirely at local market while 0.38% do exclusively export and the lowest portion 0.11% sell both at local and foreign markets.

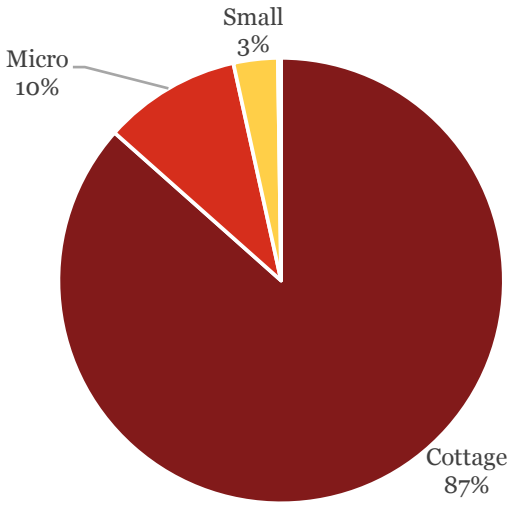
Figure 4.14: Growth and Fall of Economic Activity in Bogura[36]



It is apparent that economic activities in Bogura have experienced a significant downfall in recent period. This is due to less focus on the district and therefore, reduced enthusiasm of local entrepreneurs. In other words, it shows that a diversity of economic activities is needed by reducing focus on Dhaka and giving more attention to the districts which shows high prospects like Bogura.

Establishments have been categorized into five such as Cottage, Micro, Small, Medium and Large strictly following the categories described in the *National Industrial Policy 2010.*

Figure 4.15: Number of Manufacturing Establishments by Category



The above figure shows that most of the industries in Bogura are cottage based, which implies that the raw material and experienced labor is available in the district, however, due to

[36] Economic Census 2013, District Report- Bogra

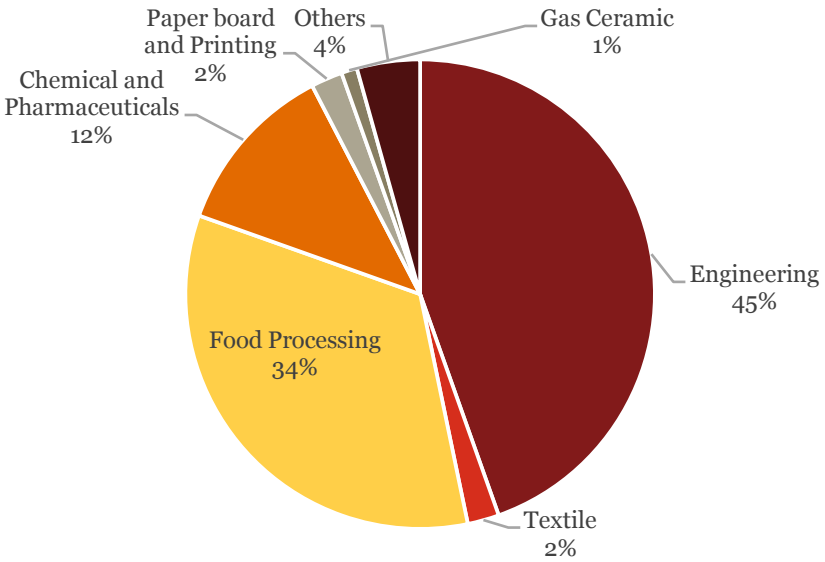
entrepreneurship being on a down trend, the raw materials and labor is not being utilized in medium and large scale industries. In other words, despite potentials the district is passing a slump in economic activities, which deserves an enhanced attention from the government.

4.2.2 Bogura BSCIC

For promotion and extension of small and cottage industries in the private sector, Bogura BSCIC (Bangladesh Small and Cottage Industries Corporation) industrial complex was established in 1964 on 14.50 acres of land. Later on in 1980 it was extended up to 33.17 acres of land. It is located almost 3 km from proposed EZ in Bogura Sadar upazila just adjacent to Korotoa River. It runs supporting activities through which potential entrepreneur receives various facilities. Likewise existing industrial organisations also gets necessary co-operation in corresponding fields.

Total plots in the industrial complex are 233 and around 5,950 (male 5,260 and women 690) labours are employed in the same. Presently around 92 units are under operation stage. This industrial estate complex consists of various industries as follows. The industry mix represents an ideal combination to be assumed for future planning of EZs in Bogura and shows the prospect of different industries. It means that engineering and food processing are the most prospective industries in Bogura. Engineering industries mean mostly caste iron products, which is supplied from Bogura to the whole Bangladesb to around 80%, according to BSCIC sources.

Figure 4.16: Industry Mix in Bogura BSCIC

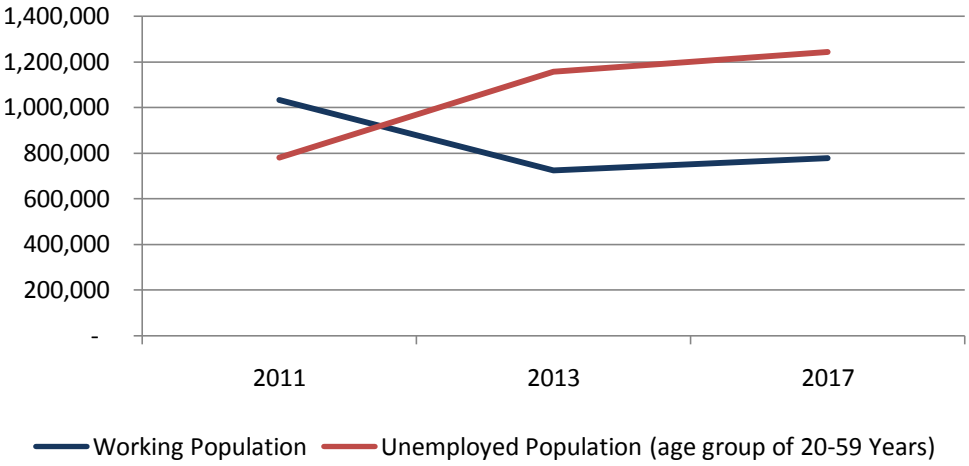


Besides the existing industrial complex, management of Bogura BSCIC is planning to establish two separate industrial complexes at Chandihara - Shibgonj upazila on 50 acres of land for agro based industry and Sabgram – Bogura Sadar upazila on 150 acres of land for general industry.

4.2.3 Employment Prospect in Bogura

In a district where once there was a culture of entrepreneurship, and currently there is a declining manufacturing trend, this is an ideal situation where skilled and semiskilled labor is readily available. In fact the whole set of labor who was laid off due to closure of industries during 2010-13, are eagerly looking for jobs for a more comfortable livelihood.

Figure 4.17: Working and Unemployed Population in Bogura[37]



The total unemployed population in Bogura district is estimated at around 1.20mn which is around 59% of eligible working population. As laid out earlier, the labors who were working in industries which were laid off during the last 10 years, have joined the unemployed group. It indicates a large prospect of availability of labor in Bogura.

[37] 2011 data (Population and Housing Census 2011), 2013 data (Economic Census 2013) and 2017 data (IIFC's updated Estimate)

4.3 Competitive and Comparative Advantage of the Site

4.3.1 Benchmarking the Zone

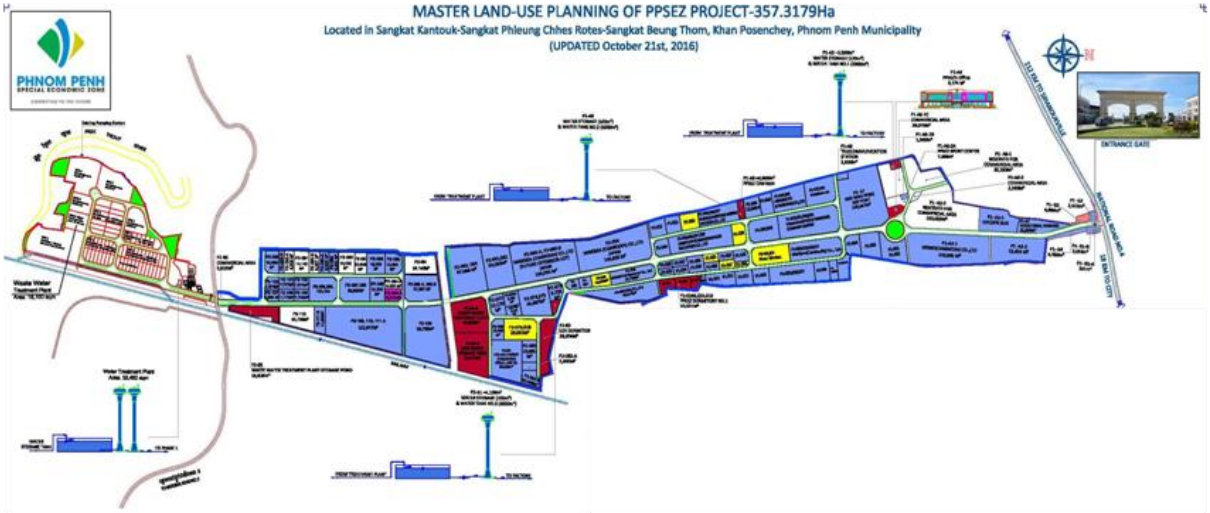
A comparative assessment has been carried out, which assembled a large number of quantitative investment or locational factors, and a scheme has been developed for aggregation across such variables. The objective of the benchmarking exercise is to identify the proposed EZ's main competitors and make comparison against each other. The following six EZs/Industrial Parks selected for the assessment:

	Name of the EZ/Industrial Park	Country
1.	Ishwardi EPZ	Bangladesh
2.	Phnom Penh SEZ	Cambodia
3.	Tien Son Industrial Zone	Vietnam
4.	Bitung	Indonesia
5.	Mingaladon Economic Zone	Myanmar

Ishwardi EPZ

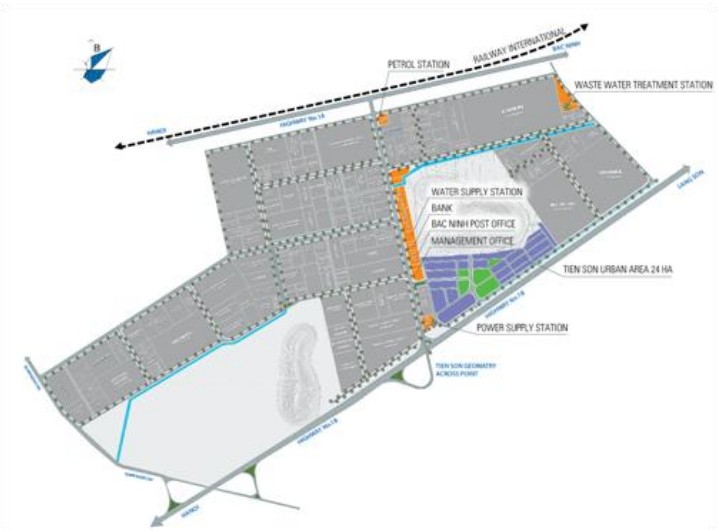
Ishwardi EPZ is situated 10.60 kms from Ishwardi Airport, 130 kms from Bangabandhu (Jamuna) Bridge, 220 kms form Dhaka, 280 kms from Mongla port, 110 kms from Rajshahi Airport and 484 kms from Chittagong port. The EZ has 309 acres of land accommodating around 9,500 workers. The EPZ has total 158 plots with an average plot size of 2000 sqm. The EPZ has also Space of Standard Factory Building of 20420 sqm. These plots has been allocated to various industries including integrated textile, light engineering (Part), electronics and electrical goods, chemical and fertilizer, tent, RMG and Plastic factory. There. The EPZ has its own water supply and also a Sub-station of 11 kv, 3 phase, 50 cycles / sec.

Phnom Penh Special Economic Zone



Phnom Penh is the capital city of Cambodia and the most populated city as well. Phnom Penh SEZ was established in 2006 on the outskirts of the capital Phnom Penh. There are around 100 companies located in Phnom Penh SEZ (10/2016) within a land area of about 357 hectares (approximately 890 acre), accommodating around 21000 workers. It operates under the authority of the Cambodia SEZ Board under the umbrella of the Council for the Development of Cambodia (CDC). It was was converted into a Public Limited Company (PLC) on July 7th, 2015. Key manufacturers and investors in Phnom Penh SEZ include Betagro, Coca Cola, Denso, Laurelton Diamonds, Minebea and Toyota amongst many others. Key Infrastructures includes flood-safe dyke and drainage system, electricity and telecommunication network, dry port, power station, independent water supplies etc.[38]

Tien Son Industrial Zone:



Tien Son Industrial Park is located in the area of Bac Ninh Province, Vietnam with the total area of 350 ha (865 acre). This is the first industrial park project in Bac Ninh Province. It is about 22 km away from Hanoi capital. With facilitated investment conditions and attractive preference policies, Bac Ninh has recently ranked the second in the North in terms of provincial competitiveness index, and reached top 10 in FDI attraction nationwide for years. The zone has adequate infrastructure support including power supply, water supply and drainage system, waste and waste water treatment etc. It was developed in two phases starting from 1999, first phase 134.76 ha (333 acre), second phase

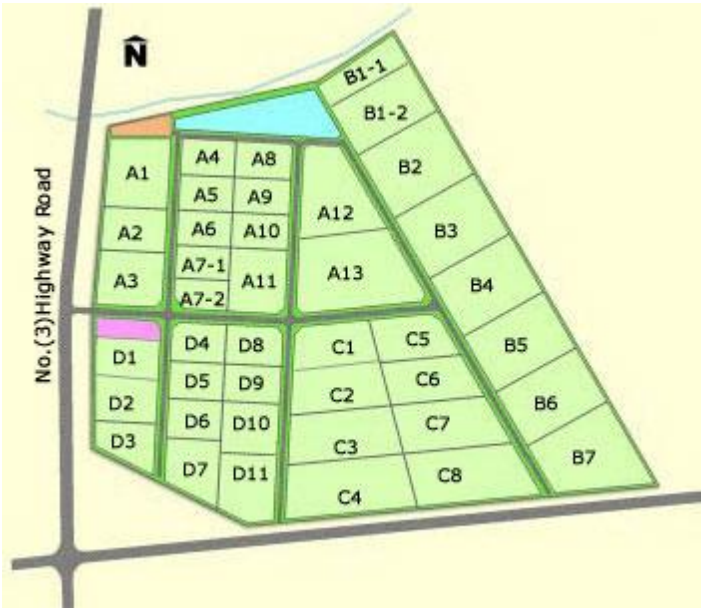
[38](Phnom Penh SEZ Website)

214.24 ha (530 acre). Primary sectors in this IP include electrical and electronic, steel, consumer goods and garment production, agricultural processing and foodstuff etc.[39]

Bitung Special Economic Zone

Bitung SEZ is newly launched by the Government of Indonesia in 2014. Bitung SEZ is managed by the provincial government of North Sulawesi and is designated by the Government as the centre of fishery, distribution, and logistic in Sulawesi Economic Corridor. It sits on an area of 534 hectare (1320 acre) at Tanjung Merah Bitung Village, North Sulawesi Province. Priority sectors in the area are logistics, herbal pharmacy, fish processing and coconut processing, creating more than 30,000 jobs in the area. It is governed by the The National Council for SEZ of Indonesia[40].

Mingaladon Industrial Park



Mingaladon Industrial Park (MIP), an ideal location for an industrial zone in the northern part of Yangon City, Union of Myanmar, had jointly been developed as the first international standard industrial park where as comprising 222 Acres of total land area in Phase I, by Mitsui & Co., Ltd. of Japan and the Department of Urban & Housing Development (DUHD, the previously DHSHD) Ministry of Construction of the Union of Myanmar. At Present, implementation of the development of MIP is being carried out by Department of Urban & Housing Development (DUHD) and the Kepventure Pte Ltd., Singapore and Project Management is being undertaken by The Tokyo Enterprise Co., Ltd. Mingaladon Industrial Park is situated 7 km from Yangon International Airport, 23 km from the

[39](Viglacera Website)

[40] KEK Website

IIFC

centre of Yangon City, 24 km from the Port of Yangon and 50 km from Thilawa Container Terminal.

The above sites will be assessed based on following criteria against the proposed zone.

4.3.2 Benchmarking Criteria

A total of twenty one criteria were chosen as being particularly relevant for this assignment at this prefeasibility stage[41]. The criteria are outlined below. Each criterion was given a mark ranging from 1-4 with four being least cost/best advantage and one being greatest cost/most disadvantageous. The marks allocated to each criterion for each of the sites is shown below. The overall score from the comparative analysis are then detailed. The sites with the highest overall marks were then ranked.

Figure 4.18: Benchmarking Criteria

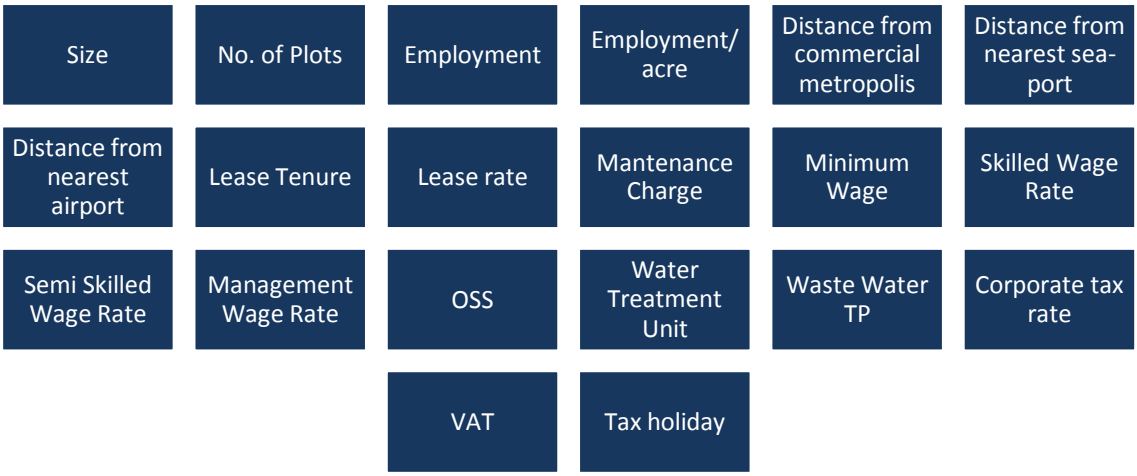


Table 4.3: Benchmarking Criteria – Allocated Marks

1. Size (Acre)			**11. Min. wage**	
Adequate with Expansion	4		Cheapest	4
Adequate no Expansion	3		Normal	3
Less than 500 Acre - possible expansion	2		Expensive	2
Less than 500 Acre no expansion	1		Most expensive	1
2. No. of plots			**12. Skilled wage rate**	
> 300	4		Cheapest	4
200 > 299	3		Normal	3
100 > 199	2		Expensive	2
> 100	1		Most expensive	1
3. Employment			**13. Semi-Skilled wage rate**	
> 50,000	4		Cheapest	4
35,000 - 50,000	3		Normal	3
20,000 - 35,000	2		Expensive	2
< 20,000	1		Most expensive	1
4. Employment/Acre			**14. Management wage rate**	
> 75	4		Cheapest	4
25-75	3		Normal	3

[41] Feasibility Study Reports of Mirsarai 2, Sherpur EZ and Dhaka SEZ

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15-25	2		Expensive	2
< 15	1		Most expensive	1
5. Distance from commercial metropolis			**15. OSS**	
10 km or less	4		Available	4
10 – 30 km	3		Not Available	1
30 - 70 km	2			
> 70 km	1			
6. Distance from nearest sea-port			**16. Water treatment unit (m^3)**	
25 km or less	4		< 5000	4
25 – 50 km	3		5000 – 10000	3
50 – 75 km	2		10000 – 20000	2
> 75 km	1		> 20000	1
7. Distance from nearest air-port			**17. Wastewater TP (m^3)**	
10 km or less	4		> 20000	4
10 – 30 km	3		15000 – 20000	3
30 - 60 km	2		10000 – 15000	2
> 60 km	1		< 10000	1
8. Lease tenure (yrs)			**18. Corporate tax rate (percent)**	
> 60	4		< 20 percent	4
41 – 60	3		20 percent - 25 percent	3
26 – 40	2		26 percent - 30 percent	2
< 25	1		> 30 percent	1
9. Lease rate			**19. VAT (percent)**	
Cheapest	4		< 10 percent	4
Normal	3		10 percent - 15 percent	3
Expensive	2		16 percent - 20 percent	2
Most expensive	1		> 20 percent	1
10. Maintenance charge/m2/month			**20. Tax holiday (yrs)**	
Cheapest	4		> 15	4
Normal	3		10 – 15	3
Expensive	2		5 – 9	2
Most expensive	1		< 5	1

The above competitive indicators come in two categories. There are the charges that need to be paid, like the land lease charges. The lower they are, the more attractive is the zone in question. In contrast, there are indicators, such as tax holiday, lease tenure. The higher they are, the more attractive is the zone in question.

Data

Efforts were given to collect information from the following sources:

i) web-sites, including those hosted by the authorities that run these comparator industrial parks or SEZs;

ii) research papers brought out by bilateral and multilateral agencies as JETRO, JICA, UNESCAP etc;

Weighting

As part of the benchmarking assessment a weighting, or rating, were applied to each criteria. This would enable those criteria considered more important to have a greater effect on the

overall score. For instance, size of the zone and lease tenure is highly attributed as these are considered for growth of industries at the zones. Consequently criteria 1, "Size" and criteria 4 "Leased Tenure", were given a higher weighting than the others. The weighting was then adjusted to a%age of 100% and this%age was multiplied by the mark previously given.

One of the key advantages of the method adopted is that different weightings can be applied to each of the criteria and the matrix marks and ranking updated automatically using a spreadsheet. It makes easier to assess and review the results of the evaluation process, as there is a greater difference between the marks applied to each site.

The data collected for each site is provided in following. The markings applied to each criterion, weighting and overall marks for each site are included in the overall results of the benchmarking process.

Limitations of the Assessment

The assessment has following limitations:

- The assessment is based on numerical data from available sources. It does not take into account the micro and macro factors related with the success or failure of an EZ.
- The operational efficiencies of the EZs have not been taken into account. If the industries are using automation then the employment generation will be less than the labour sensitive industries.
- The assessment is based on attributes of site, not the performance of the zone.

Table 4.4: Benchmarking Assessment – Collected Data[42]

	Items Compared	Bogura EZ	Ishwardi EPZ	Phnom Penh	Tien Son	Bitung	Mingaladon
General							
1	Size (Acre)	251	309	890	865	1320	222
2	No. of plots	179	158	103	90	48	41
3	Employment	31,000	9500	21,000	26,000	35,000	NA
4	Employment /Acre	123	31	24	30	27	NA
Location							
5	Distance from commercial metropolis (km)	119	29	18	22	43	23
6	Distance from nearest sea-port (km)	330	280	209	100	6	24
7	Distance from nearest air-port (km)	109	110	8	35	37	7
Cost							
8	Leased-tenure (yrs)	20	30	50	50	30	30
9	Lease rate (m2/year)	1.25	1.25	55	60	175	0.3
10	Maintenance charge (m2/month)	0.15	NA	0.06	0.5	0.06	NA
11	Min. wage (US$/month)	70	70	30	130	177	68
12	Skilled wage rate (USD/month)	uu87	87	180	325	414	145
13	Semi-Skilled wage rate (USD/month)	72	72	120	215	209	92

[42] Reference of figures of different foreign EZs

Mingaladon, Myanmar
http://www.ide.go.jp/library/English/Publish/Download/Brc/pdf/06_chapter5.pdf
Lease Term
http://www.mingaladon.com/land_use_plan_lease_terms.htm
Infrastructures
http://www.mingaladon.com/infrastructure_services.htm
Incentive
http://www.mingaladon.com/investment_incentives.htm
http://www.ide.go.jp/library/English/Publish/
Download/Brc/pdf/06_chapter5.pdf

Phnom Penh, Cambodia
Governverment Policy
http://www.business-in-asia.com/cambodia/economic_zones.html

Tien Son, Vietnam
http://ipcn.vn/setting-up/locations/d_23/129/tien-son-industrial-zone.html
http://en.viglaceraip.com/investment-incentive-of-tien-son-ip
Salary, Tax, Incentives
http://en.viglaceraip.com/wp-content/uploads/Tien-Son-IP-English.pdf
Power, Waste and waste water treatment
http://en.viglaceraip.com/technical-infrastructure-of-tien-son-ip
VAT
https://www.healyconsultants.com/vietnam-company-registration/free-zones/
Ishwardi EPZ
http://www.bepza.gov.bd/pages/epzdetails/ishwardi-export-processing-zone
http://www.bepza.gov.bd/pages/epzdetails/ishwardi-export-processing-zone/utility-services-3
http://www.bepza.gov.bd/pages/epzdetails/ishwardi-export-processing-zone/location-4
Bitung, Indonesia
https://kppip.go.id/en/bitung-industrial-special-economic-zone-national-tourism-strategic-locationkspn-north-sulawesi/

	Items Compared	Bogura EZ	Ishwardi EPZ	Phnom Penh	Tien Son	Bitung	Mingaladon
14	Management wage rate (USD/month)	301	301	700	700	995	600
Facility Services							
15	OSS	1	1	1	0	1	1
16	Water treatment unit (m^3/day)	30,000	NA	5,300	7,000	72,000	5,000
17	Wastewater TP (m^3/day)	17,025	NA	4,500	4,000	64,800	NA
Government Policy							
18	Corporate tax rate (%)	35	35	20	22	25	30
19	VAT (%)	15	15	10	0	10	0
20	Tax h'day(yrs)	10	10	9	2	15	5

Table 4.5: Benchmarking Assessment – Comparative Analysis

Items Compared	Bogura EZ	Ishwardi	Phnom Penh	Tien Son	Bitung	Mingaladon	Max Marks	Weighting	Percentage
	Bangladesh	Bangladesh	Cambodia	Vietnam	Indonesia	Myanmar			
Size (Acre)	1	1	3	3	3	1	4	15	9
No. of plots	2	2	2	1	1	1	4	10	6
Employment	2	1	2	2	2	0	4	10	6
Employment /Acre	4	3	2	3	3	0	4	10	6
Distance from commercial metropolis (km)	1	3	3	3	2	3	4	10	6
Distance from nearest sea-port (km)	1	1	1	1	4	4	4	10	6
Distance from nearest air-port (km)	1	1	4	2	2	4	4	10	6
Leased-tenure (yrs)	1	2	3	3	2	2	4	10	6
Lease rate (m2/year)	3	3	2	2	1	4	4	10	6
Maintenance charge (m2/month)	3	0	4	1	4	0	4	5	3
Min. wage (US$/month)	3	3	4	2	1	3	4	10	6
Skilled wage rate (USD/month)	4	4	2	2	1	3	4	5	3
Semi-Skilled wage rate (USD/month)	4	4	2	1	2	3	4	5	3
Management wage rate (USD/month)	4	4	2	2	1	3	4	5	3
OSS	4	4	4	1	4	4	4	10	6
Water treatment unit (m^3/day)	1	0	3	3	1	3	4	5	3
Wastewater TP (m^3/day)	3	0	1	1	4	0	4	5	3

Items Compared	Bogura EZ	Ishwardi	Phnom Penh	Tien Son	Bitung	Mingaladon	Max Marks	Weighting	Percentage
	Bangladesh	Bangladesh	Cambodia	Vietnam	Indonesia	Myanmar			
Corporate tax rate (%)	1	1	3	3	3	2	4	5	3
VAT (%)	3	3	3	4	3	4	4	5	3
Tax holiday (yrs)	3	3	2	1	3	2	4	10	6
	49	**43**	**52**	**41**	**47**	**46**	**80**	**165**	**100**

Table 4.6: Benchmarking Assessment – Overall Score

Items Compared	Bogura EZ	Ishwardi	Phnom Penh	Tien Son	Bitung	Mingaladon
	Bangladesh	Bangladesh	Cambodia	Vietnam	Indonesia	Myanmar
Size (Acre)	9	9	27	27	27	9
No. of plots	12	12	12	6	6	6
Employment	12	6	12	12	12	0
Employment /Acre	24	18	12	18	18	0
Distance from commercial metropolis (km)	6	18	18	18	12	18
Distance from nearest sea-port (km)	6	6	6	6	24	24
Distance from nearest air-port (km)	6	6	24	12	12	24
Leased-tenure (yrs)	6	12	18	18	12	12
Lease rate (m2/year)	18	18	12	12	6	24
Maintenance charge (m2/month)	9	0	12	3	12	0
Min. wage (US$/month)	18	18	24	12	6	18
Skilled wage rate (USD/month)	12	12	6	6	3	9
Semi-Skilled wage rate (USD/month)	12	12	6	3	6	9
Management wage rate (USD/month)	12	12	6	6	3	9
OSS	24	24	24	6	24	24
Water treatment unit (m^3/day)	3	0	9	9	3	9
Wastewater TP (m^3/day)	9	0	3	3	12	0
Corporate tax rate (%)	3	3	9	9	9	6
VAT	9	9	9	12	9	12
Tax h'day(yrs)	9	9	9	12	18	12
Total Score	**221**	**206**	**261**	**212**	**236**	**227**

Table 4.7: Competitive Advantages of the Sites

Name of EZ	Competitive Advantage
Bogura EZ	• Arable flat land • Very Well connected with the nearby airport, rail station and commercial hub • Lowest labour rate in the region • Ease of establishing industries • Investor friendly rules and regulations
Ishwardi EPZ	• Very Well connected with the nearby airport, rail station and commercial hub • Attractive incentive package • One stop service • Investor friendly rules and regulations
Phnom Penh SEZ	• Located centrally in the heart of the region's east-west corridor • Comprehensive and high-standard infrastructure • One-stop services in partnership with relevant government authorities • Competitive investment incentives • Investment protection agreements with key markets • Efficient infrastructure and strategic location • A young and motivated workforce
Tien Son IZ	• Synchronized infrastructure construction • Large investments for manufacturing in the electronics sector • Entrepreneurial dynamism allow several small and medium sized enterprises to flourish • Proximity to highly developed Infrastructure • Attractive business environment
Bitung SEZ	• Strategic location as the centre of fishery, distribution, and logistic in Sulawesi Economic Corridor • Attractive fiscal exemptions and incentives • Top priority program in the national development planning • Connected with all major regional infrastructures • One Stop Service System (OSS) to accelerate permit process for businesses • Streamlined and hassle free procedure of setting up business
Mingaladon	• An ideal location for an industrial zone in the northern part of Yangon City • Planned future expansion • Streamlined one stop service • Very close to Yangon International Airport (7 km) • Only 24 km from the Port of Yangon • Vicinity to the labor population

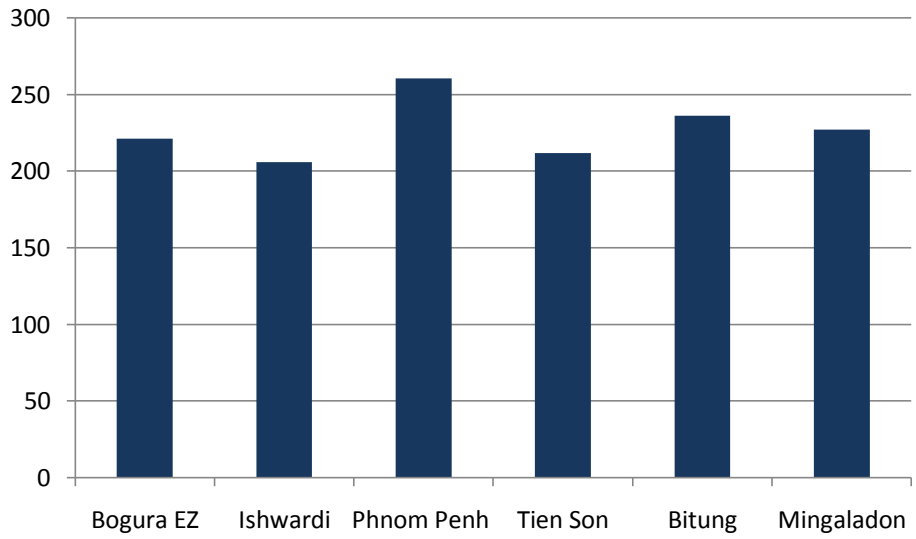
4.3.3 Results of Benchmarking Assessment

After applying the benchmarking evaluation criteria, the sites were ranked in the following order.

Table 4.8: Results of Benchmarking Assessment

Name of Ezs	Country	Overall Score
Bogura EZ	Bangladesh	221
Ishwardi	Bangladesh	206
Phnom Penh	Cambodia	261
Tien Son	Vietnam	212
Bitung	Indonesia	236
Mingaladon	Myanmar	227

Figure 4.19: Results of Benchmarking Assessment in Graphical Form



5 Industry Assessment

5.1 Potential Industry Sectors for the Site

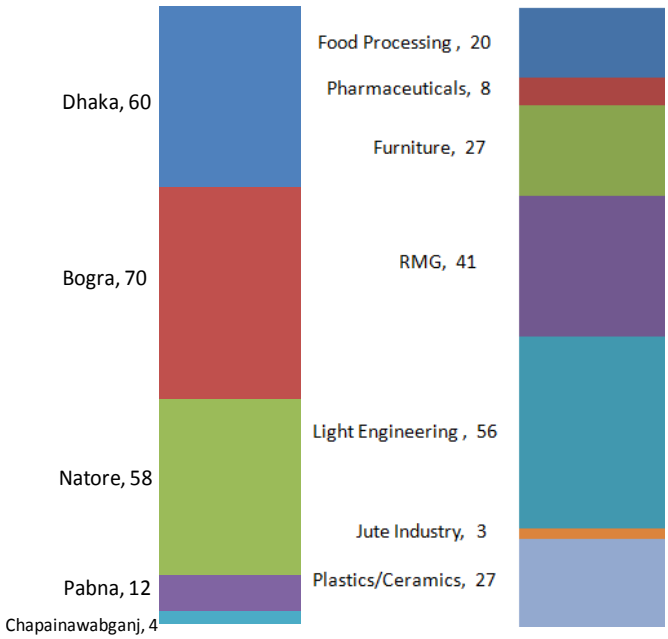
Since the EZ is located at Bogura, the site specific exercise was carried out to identify the potential industry sectors. Industries located at Bogura and its surrounding areas were surveyed. Manufacturing industries at Dhaka were also surveyed for assessing willingness to expand business to the proposed EZ at Bogura. In this regard, a list of industries from Bogura Chamber of Commerce, Bogura BSCIC and trade association at Dhaka was prepared.

Industry trend in the area was examined for identifying the potential industry sectors which may be attracted to BEZ. Based on the examination, the following types of industries located in Bogura, Natore, Dhaka, Pabna and Chapainawabganj were identified for conducting the survey. A sample size of 204 was considered. The businesses are categorized into the following types:

1. Light Engineering
2. Food Processing
3. Jute Industry
4. Furniture
5. Plastic
6. Pharmaceutical
7. ICT Industry
8. Leather
9. RMG

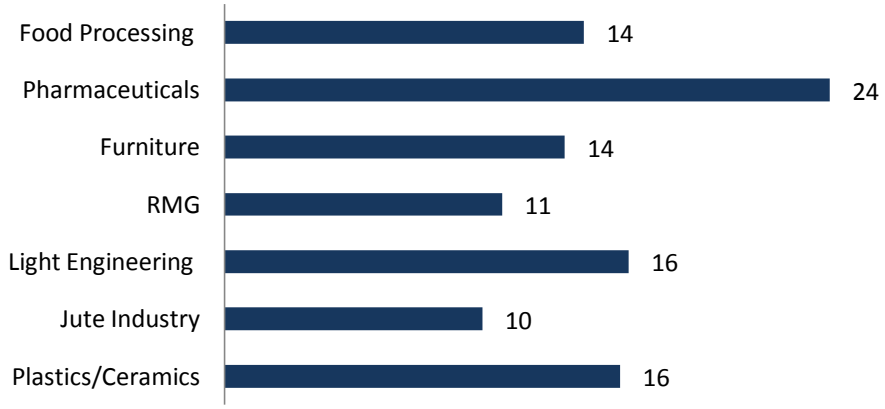
5.2 Sample Characteristics of Industry Survey

Industry survey was carried out based on the above categories and locations. Number of industries was surveyed according to location and sector is presented in the following figure.



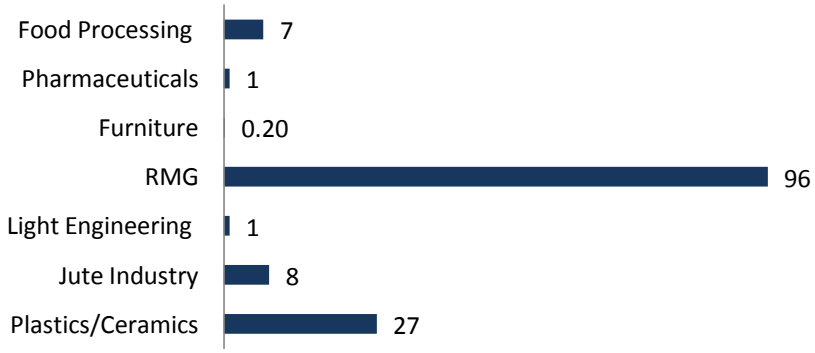
The following figure represents the number of years in operation of the surveyed industries. It appears from the figure below that the designated Industries are in operation ranges from 10 to 24 years.

Figure 1: Number of Years in Operation



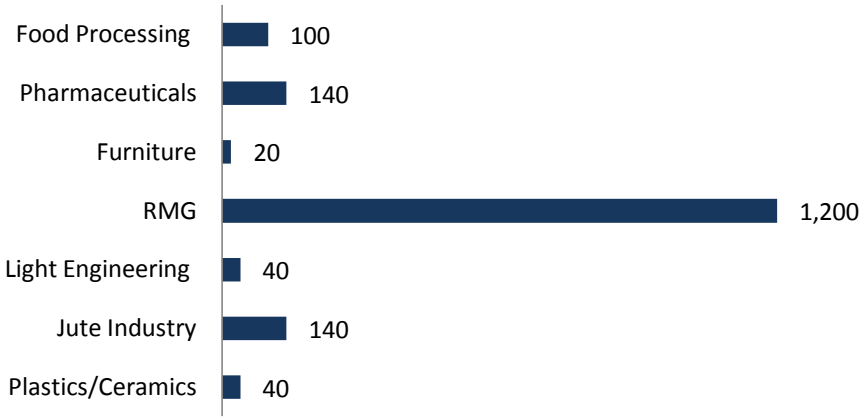
The following figure illustrates the capital strength of surveyed industries by sectors. RMG sector dominates in investment.

Figure 2: Capital Base of Industries Surveyed



The following figure shows the data on number of employees of the surveyed industries by sectors. RMG industries surveyed have maximum number of employment as it is labor intensive.

Figure 1: Number of Employees of the Industries Surveyed by Sector



5.3 Investor Survey

Investor survey was carried out with industries in the designated sectors based in Bogura, Natore, Dhaka, Pabna and Chapainawabganj through individual, in-person interviews. The survey was conducted to identify industry sector requirements, barriers to investment and potential

interest in the EZ. A questionnaire was filled up by the consulted individuals. The purpose of the consultation was threefold:

- To understand motivations for desiring a new operating location;
- Gauge interest in existing business enterprises to move to a new location;
- Collect data on the operating parameters—current and desired—of business enterprises, including land, buildings, utilities, and workforce.

Table 5.1: Suitability of Industries

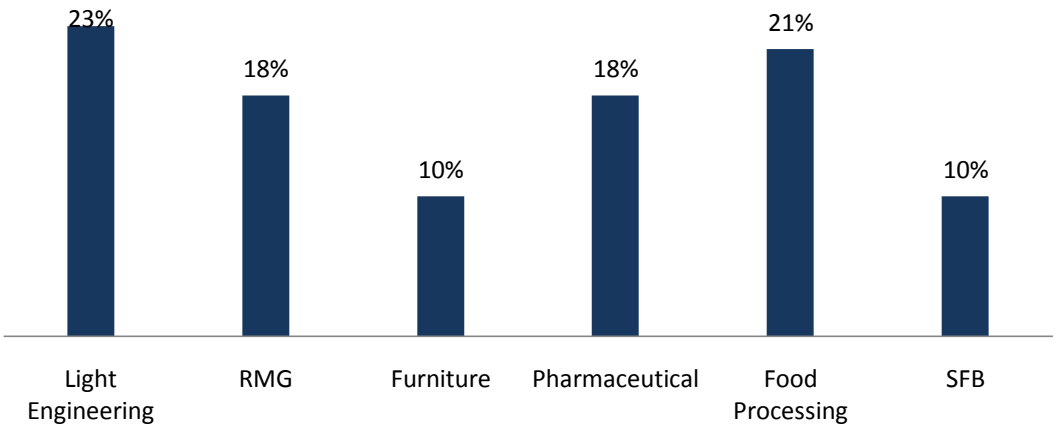
	Parameter	Weightage	Suitability	Score	Weighted Score
1) Light Engineering					
1	Suitability with respect to Land per unit of Value Addition	25%	High	10	2.50
2	Suitability for proximity to Bogura and Dhaka	15%	High	10	1.50
3	Environmental Suitability	15%	High	10	1.50
4	Labour availability in the Bogura region	10%	High	10	1.00
5	Presence of Raw materials/ Backward Linkage Industries in Bogura Region	10%	High	10	1.00
6	Growth Prospect/Export Competitiveness	10%	High	10	1.00
7	Import substitution Prospect	10%	High	10	1.00
8	Suitability with respect to existing Local Demand of the Products	5%	High	10	0.50
	Total				**10.00**
2) RMG					
1	Suitability with respect to Land per unit of Value Addition	25%	High	10	2.50
2	Suitability for proximity to Bogura and Dhaka	15%	High	10	1.50
3	Environmental Suitability	15%	Medium	5	0.75
4	Labour availability in the Bogura region	10%	High	10	1.00
5	Presence of Raw materials/ Backward Linkage Industries in Bogura Region	10%	Medium	5	0.50
6	Growth Prospect/Export Competitiveness	10%	High	10	1.00
7	Import substitution Prospect	10%	Medium	5	0.50
8	Suitability with respect to existing Local Demand of the Products	5%	Low	0	-
	Total				**7.75**
3) Furniture					
1	Suitability with respect to Land per unit of Value Addition	25%	Medium	5	1.25
2	Suitability for proximity to Bogura and Dhaka	15%	Medium	5	0.75
3	Environmental Suitability	15%	Medium	5	0.75
4	Labour availability in the Bogura region	10%	Medium	5	0.50
5	Presence of Raw materials/ Backward Linkage Industries in Bogura Region	10%	Medium	5	0.50
6	Growth Prospect/Export Competitiveness	10%	Low	0	-
7	Import substitution Prospect	10%	Medium	5	0.50
8	Suitability with respect to existing Local Demand of the Products	5%	Medium	5	0.25
	Total				**4.50**

	Parameter	Weightage	Suitability	Score	Weighted Score
4) Pharmaceutical					
1	Suitability with respect to Land per unit of Value Addition	25%	High	10	2.50
2	Suitability for proximity to Bogura and Dhaka	15%	High	10	1.50
3	Environmental Suitability	15%	Medium	5	0.75
4	Labour availability in the Bogura region	10%	Medium	5	0.50
5	Presence of Raw materials/ Backward Linkage Industries in Bogura Region	10%	Medium	5	0.50
6	Growth Prospect/Export Competitiveness	10%	High	10	1.00
7	Import substitution Prospect	10%	Medium	5	0.50
8	Suitability with respect to existing Local Demand of the Products	5%	High	10	0.50
	Total				**7.75**
5) Food Processing					
1	Suitability with respect to Land per unit of Value Addition	25%	Medium	10	2.50
2	Suitability for proximity to Bogura and Dhaka	15%	High	10	1.50
3	Environmental Suitability	15%	Medium	5	0.75
4	Labour availability in the Bogura region	10%	High	10	1.00
5	Presence of Raw materials/ Backward Linkage Industries in Bogura Region	10%	High	10	1.00
6	Growth Prospect/Export Competitiveness	10%	High	10	1.00
7	Import substitution Prospect	10%	High	10	1.00
8	Suitability with respect to existing Local Demand of the Products	5%	High	10	0.50
	Total				**9.25**
6) SFB					
1	Suitability with respect to Land per unit of Value Addition	25%	Medium	5	1.25
2	Suitability for proximity to Bogura and Dhaka	15%	High	10	1.50
3	Environmental Suitability	15%	Medium	5	0.75
4	Labour availability in the Bogura region	10%	Low	0	-
5	Presence of Raw materials/ Backward Linkage Industries in Bogura Region	10%	Low	0	-
6	Growth Prospect/Export Competitiveness	10%	High	10	1.00
7	Import substitution Prospect	10%	Low	0	-
8	Suitability with respect to existing Local Demand of the Products	5%	Low	0	-
	Total				**4.50**

5.4 Nature of the Zone with Respect to Suitability of Industries

Based on the above industry analysis, a suitability assessment of different industries for the zone has been carried out. They wered scored in a table depending upon suitability for the zone.

Figure 5.2: Suitability Mix of Industries



The above figure shows that there is a significant level of suitability of the zone for establishing light engineering, food processing, RMG, furniture and pharmaceutical industries. Light engineering is the best fit for Bogura, considering its strong local entrepreneurial and labor base. Food processing is also a suitable industry for the zone, as Bogura and other nearby region are rich in agricultural resources like paddy, pulses, fruits, oil seeds and spices. The labor in the RMG industries in Dhaka is mostly gathered from the northern districts. Bogura itself has a large labour base of cottage industries. There is also demand for SFBs which would be readily available for small industries to be set up without much investment of time and money from the investors. With the above background and understanding the space allocation for different sectors has been designed for the zone.

5.5 Findings from the Investor Survey

The consultants have analysed data acquired from survey and have also qualified and acquired data against the secondary data available in various national and international sources to maintain the realisticity of the analysis. The raw data was compiled for each of the industries surveyed, as appropriate. The findings of the survey are presented below.

Out of total 204, around 46% shown interest for setting up industries in BEZ. Total land requested for BEZ is 129 acres out of 251.43 acres. Floor space requested in standard factory building is around 179,500 sft.

Figure 5.3: Percentage of Interest to Set up Industries in BEZ

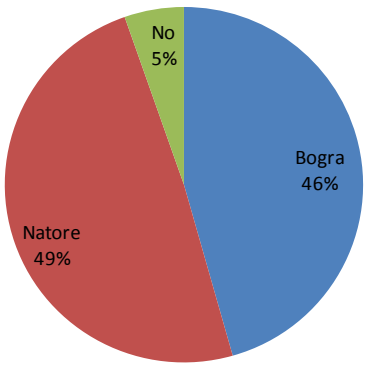
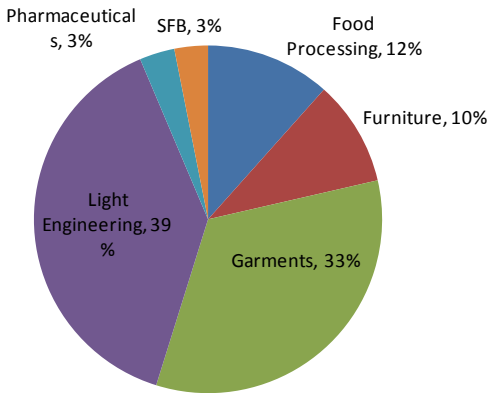


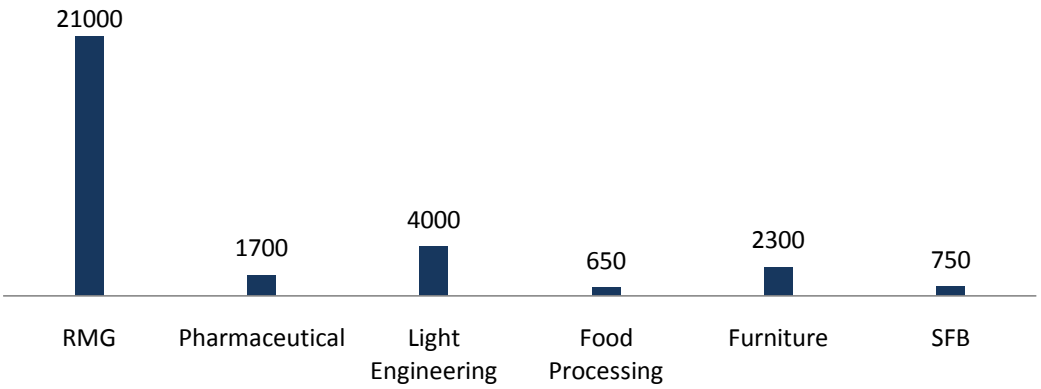
Figure 5.4: Percentage of Responses by Industry (Land Requirement)



Light engineering and RMG industries expressed interest to take up 39% and 33% of the total required land derived from survey. It has been observed that the requirements are close to the size of BEZ from those industries which are mostly interested to set up business in this EZ.

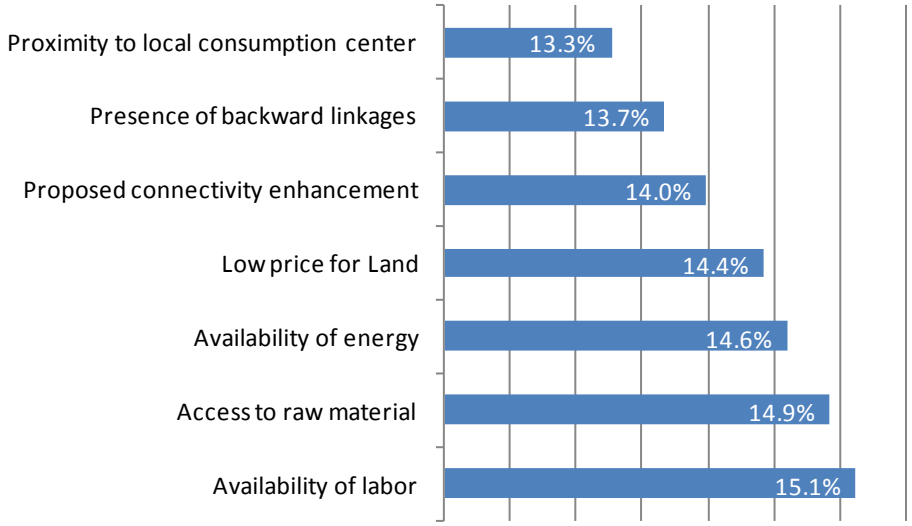
Industry survey was carried out with industries in the designated sectors which are in operation in munumum 10 years. The average number of years in operation, average capital (Tk. crore) and existing of industries for all sectors are shown in the following figure.

Figure 5.5: Employment Generation



RMG is a labour sensitive industry, the employment generation of this industry is comparatively much higher than the other sectors. RMG sector will create employment for around 21,000 people which is highest compare to all other industries in the BEZ and all the industries are estimated create employment for 31,000 people.

Figure 5.6: Rationale for Interest



Availability of labour, access to raw materials, availability of energy and the low price of land are the main reasons for the interest of industries in BEZ.

5.6 Target Industries and Industry Profile

The target industries for each sector was determined based on the analysis carried out of the investor survey and review of secondary data. A profile for each short listed sector was also

prepared, which includes typical land, power, and water requirements, and typical employment requirements. The following chapters present a brief analysis of different industries and their suitability for the zone. The target industries for the BEZ are:

1) Light Engineering
2) RMG
3) Furniture
4) Pharmaceutical
5) Food Processing

Light Engineering

Growth prospect and import substitution prospect is high in the light engineering industry. This sector contributes to growth in various related sectors and a wide range of economic activities.

- *It is estimated that there are more than 40,000 units of light engineering industries producing 10,000 different items, and employing 7mn persons[43].*
- *The sector is currently contributing 2% to the GDP[44]*
- *There are strong backward and forward linkages between the light engineering industries and other sector such as agriculture, automobile, and transportation in Bangladesh.*
- *The Sector is experiencing positive export performance in recent time, and achieved 14.1% export growth in 2015. Export earnings from light engineering stood at USD 510mn in 2016[45].*
- *In the 7th Five Year Plan, GoB has given emphasis to attract FDI in the light engineering sector, for greater and easier market access, and for easier transfer of technology[46].*
- *To facilitate FDI in the sector, the government is planning to set up several SEZs and hand over these SEZs to investors from Japan, China, India and other countries*

The sector produces mainly spare parts of machineries of transport, agriculture, power, automobiles and pharmaceutical sector, and electrical switches and accessories. The sector is attributed to manufacturing spare parts "from aircraft to bicycles."

Most of light engineering industries are located at Dhaka, Chittagong, Narayangong, Bogura, Gazipur, Kishorganj. Number of export quality light engineering products are going to foreign market on direct and subcontracting means. These are spare parts of paper and cement mills, bicycle, fancy light fitting, construction equipment, battery, voltage stabilizer, iron chain, cast iron article, carbon rod, automobile spares, electronics items, and stainless steel wares.

[43] http://www.bpc.org.bd/lepbpc_current_sector_profile.php
[44] As above
[45] http://www.lged.gov.bd/UploadedDocument/UnitPublication/1/322/11.%207th%20Five%20Year%20Plan (Final%20Draft).pdf
[46] As above

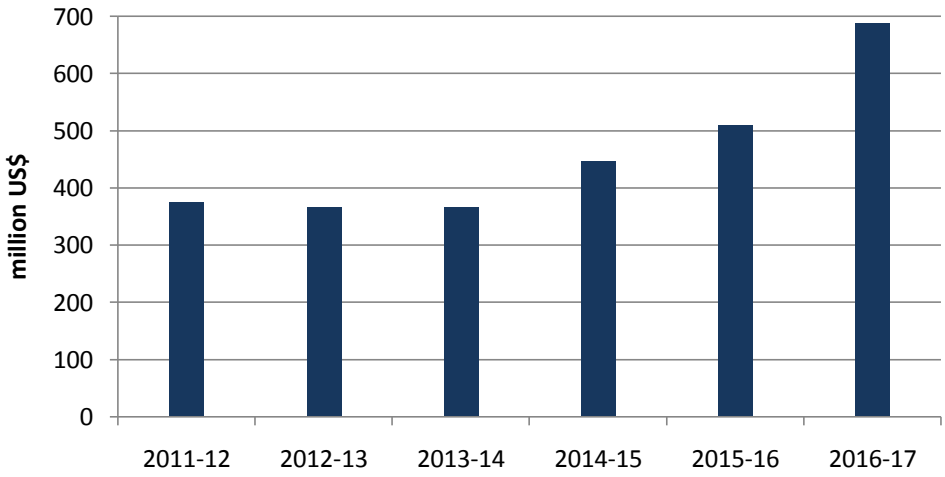
The bicycle and bicycle parts export industry has emerged relatively recently in the industrial landscape of Bangladesh. Foreign direct investment was critical to the emergence of the bicycle export sector. Malaysian investors were the first to seize the EU market opportunity by establishing the first bicycle-exporting firm in Bangladesh in 1995. A domestic trading group, Meghna, was the next firm to enter the bicycle export manufacturing industry. Bicycle exports are the single largest product export within Bangladesh's light engineering sector, contributing to about 7.5%[47] of engineering exports.

Meghna Group is the largest bicycle manufacturer and exporter (90%). It has nine factories, including two for handling exports, two for meeting local demand and five to produce bicycle components. They currently produce six types of bicycles. Alita Bangladesh, a Taiwan based company, is one of largest bicycle exporters. Pran-RFL Group is the latest entrant with a manufacturing capacity of 500,000 bicycles annually. Side by side with the export-oriented bicycle industry, Bangladesh also has a cottage industry of small-scale bicycle assemblers, parts manufacturers and retailers, which had its beginning during the 1970s.[48] The Bongshal market of Dhaka is the hub of this bicycle cottage industry in the country, employing about 2,000 people in businesses related to bicycle assembling, component manufacturing and retailing.

Bangladesh exported bicycles worth USD 689mn during 2016-17 and USD 510mn during 2015-16, thereby earning for itself the tenth position in the global ranking of bicycle exporters.

Total volume of light engineering export is about USD 689 million in 2016-17 which is higher than the previous years. Major export destinations of the light engineering products include European Union, Japan, India, Australia, Africa etc.

Figure 5.7 Volume of Light Engineering Export from Bangladesh[49]



[47]The World Bank
[48] do
[49] Calculation from EPB data

Light Engineering Industries of Bogura

There are currently more than thousand light engineering industries in Bogura including 29 foundries with an annual turnover of BDT 4bn are in limbo due to high prices of raw materials and lack of government support. These light engineering industries may be the potential clients for LE Industry for BEZ. The sector has been providing around 85% of the total requirements of ago-equipment in the country since 1980, according to a preliminary survey by the Ministry of Commerce[1].

Railway Market (Bogura) is a famous cluster for supplying necessary machineries and equipment to the agricultural sector of Bangladesh. This cluster is situated in northern part of the country. From its inception, the cluster has been contributing significantly to economic development of the country. It supplies agricultural products and repairing services to all around the country. Quality products, cheap product price, customized service, and semi - skill workers made the cluster as a distinctive cluster. But the cluster has been struggling with different problems like high prices of hard coke and pig iron, lack of working capital, high interest rate for loan, high prices of raw materials, lack of land to expand business, shortage of power supply, lack of government support, lack of training facilities, competition with foreign products, etc.[1]

Large amount of metals are used by the light engineering clusters as raw materials. Most of the raw materials are basic metals and are using old machineries imported from India. Hence Meghalaya can be a critical route for importing raw materials for LE.

Textile and RMG Industry

The textile and apparel industries provide the single source of economic growth in Bangladesh's economy. The export oriented industry started in 1980s. Since then it has been acting as the backbone of our economy and as a catalyst for the development of the country. The "Made in Bangladesh" tag has also brought glory for Bangladesh, making it a prestigious brand across the globe. The apparel industry is Bangladesh's biggest export earner with value of over USD 28.15bn *of exports in 2016-17, contributing 80.7% of total export earning of the country.*

Currently the industry has around 4500 *companies*[50]*, employing around 4mn amongst which 90% are women. Much of the tremendous growth of the sector and its role as an economic powerhouse for the country is attributed to the availability of "cheap" labour.*

Bangladesh Garment Manufacturers and Exporters Association (BGMEA) has set a goal to attain USD 50bn export earnings by 2021 from the apparel sector. Bangladesh currently is second to China, the world's second-largest apparel exporter of western brands. Sixty% of the export contracts of western brands are with European buyers and about forty% with American buyers.

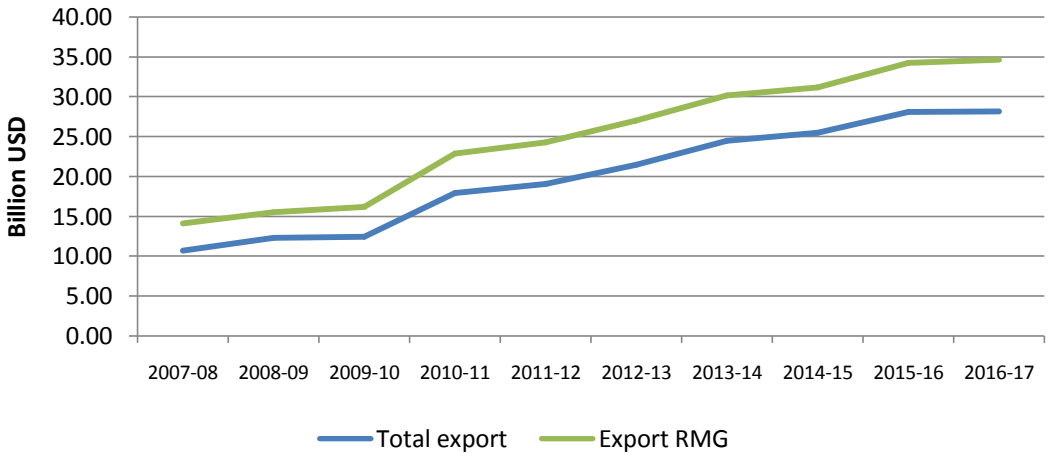
[50] BGMEA

Only 5% of textile factories are owned by foreign investors, with most of the production being controlled by local investors[51].

The textile and apparel industry encompasses textile processes from spinning; weaving; knitting including hosiery and knit dyeing; dyeing and finishing; yarn dyeing; and sewing thread; up to the final outputs, including ready-made garments and nonwovens such as technical textiles.

- *There is a concentration of manufacturing activity in and around the capital city of Dhaka, Narayangonj, and Chittagong and a growing garment manufacturing presence in the country's export processing zone;*
- *EU is Bangladesh's highest RMG export destination constituting 58%[52] of total export followed by US market with export of 23%[53]*
- *Bangladesh has recently diversified into emerging export markets including Australia, Brazil, China, Japan, and South Africa accounting for 14%[54] of total export*
- *The 4.0mn garment workers in the county have created an annual local market of BDT226.5bn for different services and commodities[55]*
- *80% of American and European clothing companies planned to move their outsourcing from China, where wages had risen, and were considering Bangladesh as the "next hot spot" making it the "next China."*

Figure 5.8: Export Growth of Textile and Apparel Industry[56]



The growth of RMG and textile industries mostly attributed to the availability of "cheap" labour. Besides other factors like land availability, backward and forward linkages facility plays an equal significant role to growth of this industry. Considering the land availability, raw material availability, transportation facility, cheap labour force and availability of land ports adjacent to this area along with infrastructure facilities such as electricity, gas, transportation, and telecommunication indicates that RMG industry has a typical prospect in BEZ.

Industry currently facing land constraints indicates a low prospect growth in Dhaka region. More than 4,000 woven and knitwear garment factories are under pressure from western buyers to

[51] BGMEA
[52] Light Castle Investment Study Bangladesh
[53] Same as above
[54] Same as above
[55] BGMEA
[56] BGMEA

improve workplace safety to global standards by June 2018[57]. Relocating the industry to a suitable adjacent location to Dhaka is a critical need for the industry. There is a growing demand for the industry to transform it into a best world class performing ones at the same time, building a proper infrastructure throughout the country in and around RMG factories.

RMG Backward linkage. More than 80% of the foreign currencies are earned from RMG sector. Such big growth in the industry naturally creates a demand and prospect for enormous backward linkage. Though Bangladesh has reached quite success in upgrading backward linkage industry over the decade still there are opportunities where the sector can grow far more. The backward linkages of RMG sector are spinning mill, weaving mill, knitting mill, Fabric dyeing mill, printing mill, interlining and lining manufacturer, poly bag manufacturer, sewing thread manufacturer, zipper manufacturer, button manufacture, label manufacturer, embroidery factory, washing factory, elastic manufacturer, carton manufacturer, hanger manufacturer etc.

Prospect of Bogura for RMG

Bogura can be a substantial location for growing backward linkage of RMG sector since the representatives from RMG industry shown their interest during industry survey to relocate or set up a new industry in this location. Bogura district along with Sirajgonj, Gaibandha and Pabna district, approximately has 14mn population which assures an adequate supply of labor force, vital to run the industry. As Dhaka is becoming over dense both in terms of population and industry therefore any place near Dhaka which provides equal facilities of the like is a rewarding option for the industry. Buyer's continuous demand for standard compliance factory can easily be achieved in Bogura. Considering the other infrastructural facilities and geographical position BEZ can be an Industrial Hub for RMG backward linkage.

Bangladesh is almost self-sufficient for knit fabric as more than 90% of knitwear fabric is manufactured in Bangladesh. Some industries like Square, Beximco, Pallmall, Viyellatex are example of true market leader. "In 2013-14, the contribution of knitwear in national export earnings is 39.81% . The direct contribution of knitwear sector on GDP of Bangladesh is almost 7%, but the backward linkage sector of knitwear sector has another 2% contribution to GDP[58]".

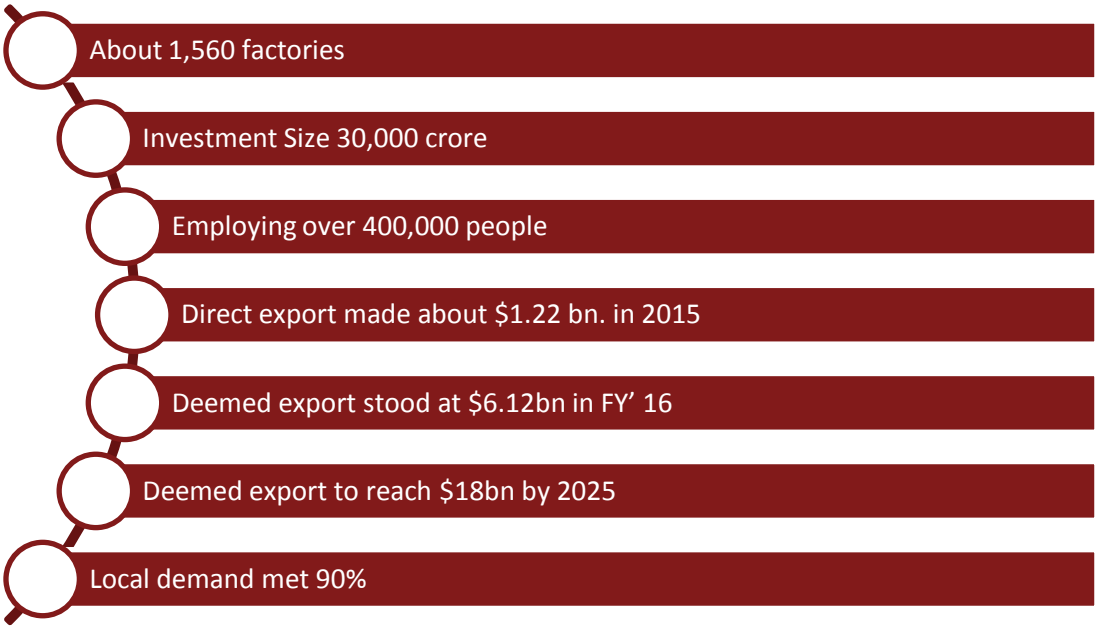
Woven fabric manufacturing and processing capacity is also growing rapidly that has reached 2bn meters per annum. Currently around 9mn spindles are installed that can produce up to 1.7bn kgs of yarn per year[59]. There is a demand of approximately threebn meters of woven fabric considering the current consumption for export per year. Every year the country is spending almost 4bn USD to import fabric[60]. Besides In-house demand is increasing every year since demand for yarn for the locally sold clothing items are also potentially increasing.

Denim production as backward linkage is also showing a significant progress. Now there are in total 30 denim mills, which produce 25mn meters fabric per annum. Denim washing plants are coming up very fast too. So combining both Bangladesh is considered to be the future denim hub of the world. Bangladesh is now number 1 jeans exporter in Europe and number 3 in USA. It is expected that shortly Bangladesh will be in number 1 in USA[61].

[57] https://www.textiletoday.com.bd/overview-bangladesh-rmg-2016/
[58] BKMEA
[59] http://www.bgmea.com.bd/blog/story/2
[60] BKMEA
[61] https://www.denimsandjeans.com/denim/eighth-edition-denimsandjeans-bangladesh/26975

The growth of trims and accessories sub-sector is taking on more importance for Bangladesh with the start of direct exports to global brands. The sub-sector works closely with the RMG sector as a strong backward linkage industry. According to BGAPMEA, the accessory sector earned USD 6.12 bn in the 2016 fiscal year, of which USD 1.12 bn came from direct exports. The remaining USD 5 bn were deemed indirect exports. However, the earnings are likely to increase to USD 12bn towards the end of 2018 and could hit USD 18bn by 2025.There are about 1,500 factories producing garment accessories and packaging items in Bangladesh, employing over 400,000 people[62]. Products include labels, zippers, tags, tapes, thread, ribbon, buttons, rivets, laces, hooks, transfer film, paper, and ink. In recent years, several new global retailers have started sourcing accessory products directly from Bangladesh. Local manufactures are now producing for "world-standard" garment accessories for many reputable international brands such as Tesco, Kik, Ferari, C&A, H&M, Next, and Uni Label. Destination countries include the Netherlands, South Africa, Pakistan, India, China, Ethiopia, Indonesia, Italy, Sri Lanka, Turkmenistan, Germany and Austria.

Figure 5.9: Bangladesh Garment Accessories Industry[63]



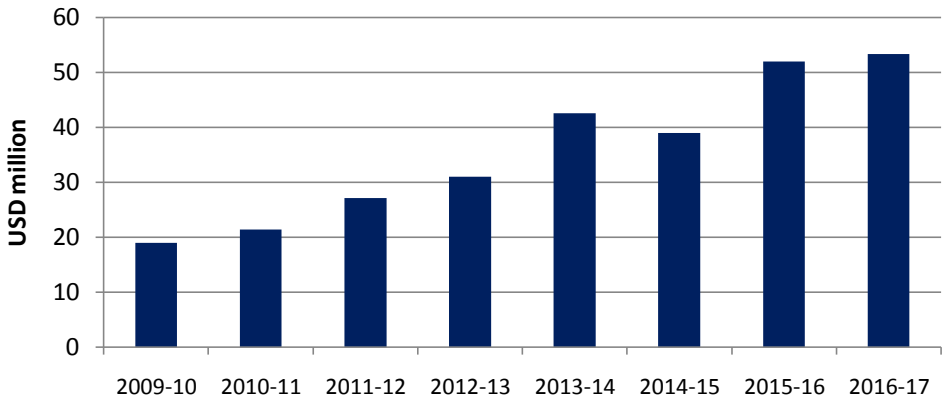
Furniture Industry

At present, Bangladesh is producing a wide variety of international standard quality furniture. The furniture industry is no more confined within only timber products; in fact businesses are now accommodating modern machineries, innovative designs and use of per materials. Despite a huge quantity is imported every year mainly from China, proliferation of the furniture industry is a call of time for this huge import substitute and also to capture the lucrative global furniture market.[64]

[62] http://www.dhakatribune.com/business/2017/06/06/garment-accessories-open-new-export-window/
[63] BGAPMEA

There is good potential for the export of furniture based on the export trend.[65] It is estimated that, by 2018 Bangladesh will earn export potential of crafts furniture accessories worth of USD 20mn along with furniture worth USD 60mn. Furniture sector was included in the Export Policy, 2009-2012 as a special development sector and in Export Policy, 2012- 2015, it has been upgraded as a highest priority sector due to extreme export potentials.[66]

Figure 5.10: Export of Furniture from Bangladesh



The figures showed, that in 2009-10, the furniture export volume was USD 19mn, while it amounted to USD 21mn in 2010-11 and USD 27mn in 2011-12. In 2016-17, the total export volume was USD 53mn.[67]

Table 5.2: Overview of the Furniture Industry

Firm Size	Micro and Small	Medium	Total
Number of Enterprises	70,953	81	71,034
Local Market Share at Sales Price (BDT bn)	42.2	24.45	66.65
Manpower involved (mn)	1.77	0.03	1.8

There are around 70,000 enterprises engaged in this industry created 2.5mn employment made us so many export destinations such as USA, Canada, Australia, UK, Middle East, Gulf countries, and other south Asian and east Asian countries. Also, the local customer demand is rising from the corporate offices and apartments.[68]

The furniture industry in Bangladesh has been experiencing healthy growth over the last 6 years. The domestic market is exhibiting an upward trend and is currently worth BDT 67bn.[69] In the last fiscal, Bangladesh earned USD 7mn from the furniture export to the US market and then USD 5mn from the Swedish market. Meanwhile, the Ministry of Commerce has set a furniture export target of about USD 38mn with 20% growth for the current financial year. In wood furniture

[64] Export diversification and the furniture industry, Textile Today.
[65]Selim H. Rahman, Chairman and Managing Director of Hatil. Furniture industry can emerge as the country's second largest employment generating sector after RMG, if right government policies are implemented on the market., IDLC Monthly Business Review, August, 2017.
[66] IDLC Monthly Business Review, August, 2017.
[67]Same as above
[68]according to AHM Shahedin, a senior officer of Partex Particle, The daily star, April 5, 2015
[69]EU Technical Report, 2012

manufacturing, labour accounts for up to 40% of the total costs. In Bangladesh, labour costs account for 20% of the production.

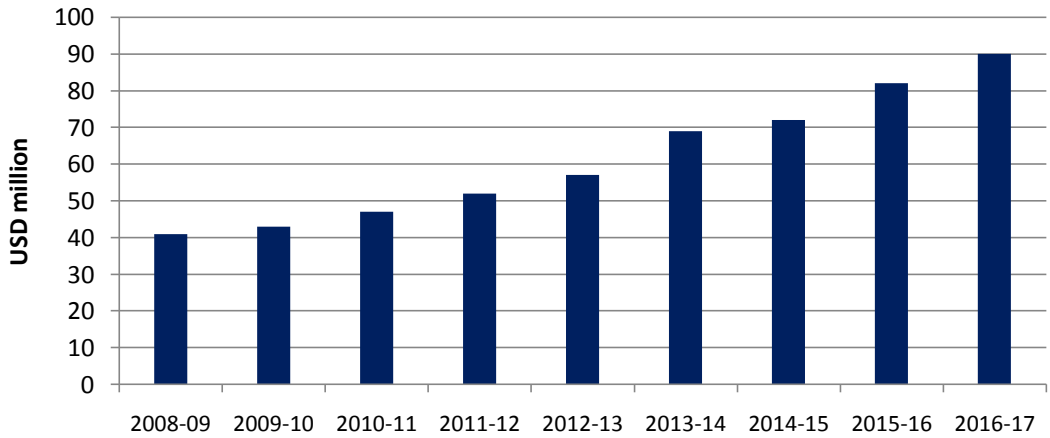
On average 60% of raw materials of furniture sector are imported from different countries. Of those, timber, wood coating materials, hardware and accessories, world class fabrics etc. are major importable items. Bangladesh ranks 3 in Asia`s least tree filled countries. As a result, most of the wood will have to import from other countries. For furniture industry Natore can be an extra advantage since Meghalaya, a state of India is neighbouring and there are enough trees and forest in that region. To import raw materials from this state will require less distance and time with less procedure. Furniture industry of Bangladesh is also shifting its focus from dependency on raw timber to processed wood and other contemporary furniture materials to capture new export markets rapidly.

Pharmaceuticals

With 194 operating companies, the pharmaceutical industry provides 97% of the total medicinal requirement of the local market. The industry also exports medicines to global markets, including Europe.

The industry started flourishing with the promulgation of Drug Control Ordinance (1982). Nearly 80% cumulative growth in the last three years means that the Bangladesh pharmaceutical market has doubled[70]. About 5,600 brands of medicines are manufactured in different dosage forms in Bangladesh. The domestic retail market is growing at 25% per year[71]. Bangladesh is also going to establish an API park where 40 API industries are expected to operate[72]. Current market size is approximately BDT 76,500mn[73] per year. The industry contributes 1%[74] of the GDP.

Figure 5.11: Export of Medicine from Bangladesh



[70]BIDA, 2015
[71]Same as above
[72]Same as above
[73]Eskayef Bangladesh Ltd
[74]Growth of Pharmaceutical Sector of Bangladesh: www.bangladesh-corporate-world.blogspot.com

In 2016-2017 Bangladesh exported pharmaceutical products worth USD 89.82mn against USD 82.11mn in 2015[75]. According to the EPB, Bangladesh currently exports pharmaceutical products to 107 countries, of which Myanmar imports the highest quantity of medicines worth USD 11.5mn followed by Sri Lanka with USD 8.3mn, the Philippines with USD 6.4mn, Vietnam USD 5.3mn, Kenya USD 3.7mn, Afghanistan USD 3.3mn, Slovenia USD 3.4mn and Nepal USD 1.3mn[76].

The pharmaceutical industry also set a target of exploring 30 new destinations during the current financial year. BEXIMCO Pharmaceuticals has become the first Bangladeshi pharmaceutical company to be approved by the US Food and Drug Administration (US FDA) following the successful inspection of its oral solid dosage facility at Tongi, during 19-22 January 2015. The Company received the establishment inspection report (EIR) from the US FDA on 22 June, 2015 stating the audit was formally concluded[77].

APIs consist a significant part of the manufacturing cost of a drug. Approximately 80%[78] of the APIs are imported and 75–80%[79] of the imported APIs are generic. At present, there are 15 companies in Bangladesh manufacturing 40 APIs[80]. Companies are still dependent on import from India and China. The government has taken initiative to set-up a park for active pharmaceutical ingredients (API) with a focus on developing synthetic chemistry skills.

The industry imports APIs mostly through sea and air. Therefore, proximity to sea and airport is a significant factor, for consideration of setting up pharmaceutical industries in Bangladesh. It also depends upon consumer concentration in the proximity. All these have resulted that the majority of the pharmaceutical industries are located in Dhaka region. *Dhaka accommodates the highest concentration of medicine users and it has an international airport, which is emerging as a busy international airport. This indicates a high degree of suitability of the pharmaceutical industries for setting up in the zone.*

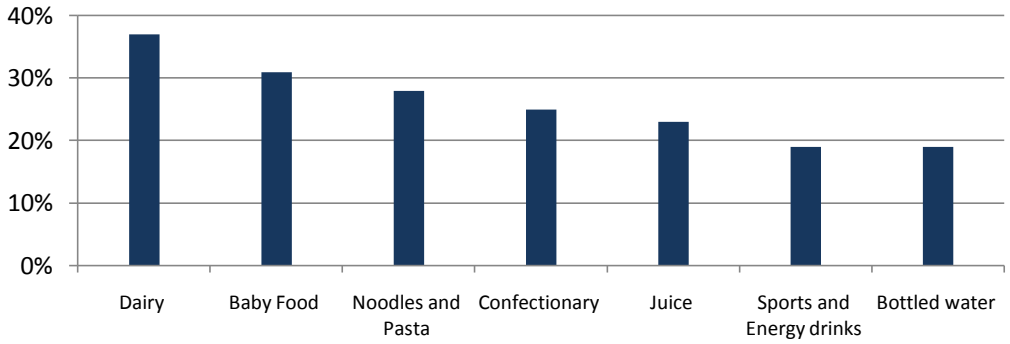
Food Processing

Food processing sector is one of the growing sectors in Bangladesh in terms of production, growth, consumption, and export. The demand for processed foods is picking up because of rising income and busy lifestyle of domestic population. Increasing disposable income[81] and growing urban middle class are contributing to the growth of this industry. The growing number of restaurants, hotels and supermarkets are also driving the demand for processed foods.

[75]http://www.eblsecurities.com/AM_Resources/AM_ResearchReports/SectorReport/Pharmaceuticals%20Industry%20of%20Bangladesh.pdf
[76]Same as above
[77]http://www.biospace.com/News/beximco-pharmaceuticals-receives-u-s-fda-approval/382497
[78]The World Bank, 2012
[79]Same as above
[80]http://www.pharmajogot.com/api-in-open-market-behind-drug-manufacturers/
[81]Mr. Kamruzzaman Kalam, the marketing director of PRAN-RFL group

Comprised of 200 companies, the process food industry provides most of the requirements of the local market. The total turnover of the industry is estimated to be worth USD 2.5bn. Products are being exported to 130 countries, including Australia and US. The industry has been expanding and is also expected to continue.

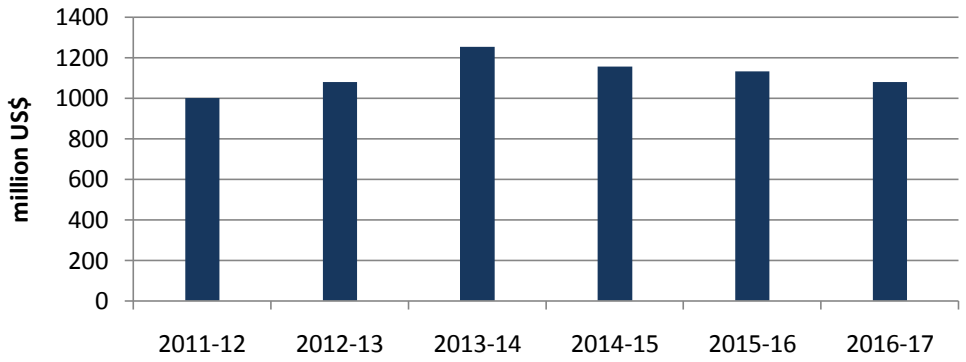
Figure 5.12: Compounded Annual Processed Food Growth Rate



Overall sales of processed foods are anticipated to grow at a Compound Annual Growth Rate (CAGR) of 17% a year over 2013-2018, reaching a value of USD 21.2bn in 2018.[82]

In 2011-12, food processers shipped USD 1532.68mn worth of process food. The amount escalated to USD 1,794.05mn in 2014-15, then it went downward and USD 1,631.04mn and USD 1,079mn in 2015-16 and 2016-17 according to data compiled by Bangladesh Export Promotion Bureau. It is observed that frozen food, shrimps and fish contributed a major portion of the export in all these years.

Figure 5.13: Food Export Performance



The increase in number of processed food makers, cash incentive benefits provided by the government, better pricing and the quality of the locally made foods facilitated the growth. There are 100 manufacturers being engaged as exporters and nearly 250 firms involved in food processing.

Major exporters of food products- Pran, Sajeeb, ACI, Alin Foods, Partex, Globe Soft Drinks, Bombay Sweets, Starline Food, Akij Foods. Those firms earned nearly BDT 20 bn from exports in 2015-2016. The major export destinations of those products are African countries, Middle East, France, Italy, Germany and England. Among those companies, Pran exports products to 130 countries including 40 African nations and earned around BDT 14bn from exports in 2015-2016.[83]

[82]The Daily Star, 18 September 2015, Euromonitor International
[83] The daily star, November,2016

6 Demand Forecast

The demand forecast is the most important element of the feasibility study, and draws upon findings from the industry analysis, stakeholder consultation, and open source data and published studies. The demand forecast identifies: a) the type of industries most likely to locate in the zone, b) the number of tenants proposed, and c) the land and infrastructure requirements of units over a 20-year period. Assumptions were made according to three demand scenarios—Base Case, Aggressive Case and Conservative Case. The result is three demand estimates, one conforming to each of the three sets of assumptions. This will provide public officials, physical planners, and investors with realistic views of interest of the business enterprises in the zone, infrastructure requirements, suggested timeframe of the project, and marketing and promotional recommendations to meet anticipated demand.

6.1 Purpose of Demand Forecast

The demand forecast has broad and important applications throughout the feasibility study:

- *Forecast Demand.* Estimate the number of companies that will locate in the zone over a period of 20 years.
- *Financial Analysis.* Estimate the costs and revenues associated with developing and operating the zone, and project the internal rate of return (IRR) of developing and operating the project.
- *Economic Analysis.* Suggest effects the zone will have on society, and estimate the economic rate of return (ERR) to the government based on its financial and in-kind contributions to zone development and operation.

6.2 Sources of Data

The demand forecast draws upon numerous sources of data and information—both quantitative and qualitative in nature. Specifically, these include:

- *Stakeholder Consultation.* The stakeholder consultation was conducted. The consultation provides information on the interest of firms in relocating to or establishing new industries in the zone, the operating costs and parameters of these companies, the growth potential of business enterprises, and other data pertinent to the demand forecast.
- *Business Enterprise Association Consultations.* **C**onsultations with industry associations were carried out.[84] The information provided by the associations include testimonials on actual and perceived demand for space in the zone, as well as information on operating conditions faced by association members that may influence proclivity to relocate.
- *Open Source Data and Analysis.* The demand forecast employed data from the Bangladesh Bureau of Statistics (BBS) with respect to the number of firms in each sector, and also drew upon open source analysis from the World Bank, IFC, and previous analysis of industries.[85]

[84] These associations include: Bangladesh Engineering Industry Owner Association (BEIOA), Bangladesh Electrical Merchandise Manufacturers Association (BEMMA), Bangladesh Plastic Goods Manufacturers and Exporter Association (BPGMEA), and the Small and Medium Enterprise Foundation (SMEF). Notes taken during consultations with these organizations are included in Appendix G of this report.

[85] General analysis of SME industry sectors is included in Section 4 of this report.

6.3 Demand Forecast Methodology

Demand estimations for EZs provide calculations of the likely intent on new and existing companies to locate—or relocate—operations in a particularly defined zone. The forecast represents an approximation based upon several "pillars" that provide evidence to substantiate the demand estimation. This section defines those pillars that constitute the methodology behind the demand forecast, and discusses the evidence each of them provides in detail.

- *Assumptions.* Demand for space in the zone is contingent upon policies and conditions that were assumed at the outset of the study.
- *Investment Trends.* The demand forecast considers new company formation trends and viability of existing business enterprises as a way to establish a baseline upon which the demand estimations are based.
- *Relocation Trends.* The EZ will be heavily marketed to attract companies wishing to relocate from Dhaka and Chittagong. As such, these firms' were explored and stated willingness—and actual proclivity—to locate or relocate, external pressures to move, and analyzed the types of firms that would actually move.
- *Uptake Rates in Bangladesh.* The demand forecast reviewed actual land uptake rates of other EZs in Bangladesh in support of high demand for serviced industrial space.

Utilizing the above facts, data were gathered and analyzed to understand trends, economic pressures, and policies and to determine the likely number of companies that would be located in the zone.

6.4 General Assumptions

The following broad assumptions define the parameters against which the demand forecast was made. A change in any of these assumptions could affect the demand estimations in a positive or negative manner.

- Business enterprises in the designated sectors will be the target groups to locate in the zone, regardless of their export status. The zone will be open to any in these sectors that desires land and/or building space in the sizes offered. The business enterprises in the zone will be allowed to have sales to the Bangladeshi domestic market as well as export.
- The zone will offer a streamlined approval process for establishing business enterprise units at a one-stop office within the zone. This will include services such as business registration, licensing, permitting, environmental clearances, work permits, and others.
- Law and order within the EZ will be maintained at the desired level to maintain a peaceful business environment.
- A power plant will be constructed in the zone. This will provide a dedicated power supply for tenants in the zone.
- Additional utilities such as LNG, water, waste treatment, and telecommunications will be available to zone tenants at market-rate tariffs.
- Business enterprises will have the option to lease serviced land, or rent pre-constructed SFBs or the warehouses.

6.5 Investment Trends

Much of the demand for space in the proposed EZ will likely be from companies that will relocate operations from Dhaka and Chittagong. However, it is also necessary to examine the formation of new business enterprises to understand growth and, hence, potential demand from new firms. Consultants looked at multiple indicators, published information about growth trends, and estimated number of business enterprises in operation in Bangladesh.

6.6 Growth Trends

The number of new business enterprises created each year ranges between 5 to 8%, based on published data[86]. The growth rate of business enterprises changes quite often depending on government policies, particularly with respect to taxation. Overall the consultation found that there was a great potential for growth. The single factor most likely to hamper growth, according to firm, is the shortage of gas and electrical power. An indirect effect has arisen from the lack of gas supply at the national level. These industries form a major customer base for the zone. Therefore, the gas shortage has negative impact on the growth of industries.

6.7 Rationale for Relocating from Dhaka City

Congestion. Business enterprises currently operating in Dhaka are under pressure to relocate away from the congested city. Industrial lands are unavailable here, and all business enterprises, from leather workshops to garments industries, are scattered throughout residential areas without proper planning. Consolidation could save time and technical pressures, and lower the average cost of doing business as well as the per-unit cost of business enterprise products.

Safety and environmental hazard: A fire at a garment factory in a Dhaka suburb killed 112 workers in 2012[87]. In 2013, a commercial complex near Dhaka housing five garment factories collapsed, killing 1,135 people[88]. In September 2016, a boiler exploded and triggered fire at a packaging factory near Dhaka, killing at least 30 workers and injuring dozens[89]. The relocation process of tanneries in Hazaribagh is ongoing to save the river and the locals from the environmental hazard[90].

Governmental mandate and social pressure. There are governmental pressures to move business enterprises away from Dhaka. The recent incidents mentioned above created a backlash against industrialists that operate in the congested old parts of the town, often without proper permits or sanitation. These points, perhaps, to the difficulty associated with relocation of small and medium-sized firms.

6.8 Reasons Business Enterprises Remain in Dhaka City

Despite the pressures to relocate away from Dhaka, there are also valid reasons that keep business enterprises in their current place of business. These are discussed in the following paragraphs.

[86] International Journal of SME Development, Small and Medium Enterprise Foundation, April 2014
[87] http://www.independent.co.uk/news/world/asia/bangladesh-factory-fire-at-least-23-killed-and-dozens-injured-after-blaze-in-tongi-a7236476.html
[88] Same as above
[89] Same as above
[90] http://www.theindependentbd.com/printversion/details/50368

Forward and Backward Linkages. Dhaka is attractive because business enterprises' customer base is there, including both retail outlets and industrial intermediaries. Businesses have access to raw material supplies as well as services trade—repair, accounting, and the like. This naturally developed value chain cannot be easily replicated elsewhere. The connectivity inside Dhaka is still better compared to the other areas, even if it takes longer time moving from one place to another inside the city.

Worker Availability. Dhaka being the capital city attracts labour force of all levels from the surrounding areas. However, as the project site is only 25 km away from Dhaka, and it is expected that accommodations for workers will develop in the zone and surrounding areas, access to workforce will be less of a problem.

6.9 Willingness to Locate to the Proposed Economic Zone

This interest is in response to cramped conditions in Dhaka and Chittagong, dangerous working conditions, and governmental pressures to move industrial business activities elsewhere. light engineering industries and garments industries, for instance have a strong demand to move to an EZ, as they want to simultaneously upgrade technology, and require the space to do so. They are now finding it difficult to secure financing for capital improvements because of the sub-standard conditions of their current factories. Interviews with industry associations confirm the strong interest in the zone elucidated in the stakeholder consultation.

6.10 Past Uptake Rates of other Industrial Parks

The industrial estates provided by BSCIC in Natore, Dhaka and Chittagong demonstrate a near 100 percent occupancy level. Older sites in the environs of Dhaka and Chittagong demonstrate a 100 percent occupancy rate. While developing the demand forecast the fact was recognised. It was also recognized that rental and utility services, good governance like one-stop service and other facilities that would be provided in the zone, would trigger more demand.

6.11 Demand Forecast Scenarios

This section of the pre-feasibility study presents the demand forecast calculations under three distinct growth scenarios—Base Case, Conservative, and Aggressive. In addition to calculating the number of tenants likely to locate in the zone, extrapolations of the utility and land requirements, as well as employment generation was carried out.

Base Case

The Base Case Scenario makes the following assumptions with regard to firms actually locating in the proposed EZ.

- Interest from business enterprises remains strong, being actually interested and capable of relocating to the zone.
- Pressure from international buyer of RMG to establish compliance factory remains strong.
- The government of Bangladesh takes action or incentives to encourage industrial enterprises to establish new industries in the zone and relocate/expand away from city. BEZA promises to provide facilitation services such as training, one-stop bureaucratic services, and other amenities inside the zone.

- The zone contains a dedicated source of power generation, water, effluent treatment, and solid waste disposal.
- New EZs may be built or expanded during the next 20 years.

Aggressive Case

The Aggressive Scenario assumes more positive assumptions about economic and political conditions in the country and streamlined approval process under the new EZ regime. It differs from the Base Case Scenario with respect to the following aspects:

- The proposed zone will contain more newly formed firms than in the Base Case Scenario. This will arise due to the greater ease to start and operate a company.
- All regulatory approvals, especially those for establishing the business enterprises in the zone, will be provided and regulated within the zone itself. This differs from the Base Case, whereby all consents must be obtained from the central authorities.
- The political conditions will remain peaceful, for at least first five years of operation.
- The linked projects for offsite infrastructure needed for the zone, will be completed on a fast track basis by the government, while the Base Case assumes that the operation of the zone will continue in parallel with the period while the entire required off-site infrastructure may not be complete. The zone can start operation, with a slim access road first, then widening works may go on while the operation of the EZ is continued. However, it assumes that the power plant will be built on an urgent basis.
- The proposed zone will be aggressive in marketing and promotion of the zone to business enterprises.
- Raw material and services suppliers will be allowed to locate inside the zone on a first-come, first serve basis.

Conservative Case

The Conservative Scenario differs from the other two scenarios in the following manner.

- There are delays in preparing necessary offsite infrastructure for the zone.
- Business enterprises remain in city as pressures to relocate lessen.
- Business enterprise, industry associations are not able to effect enmasse relocation, and are not able to arrange for the necessary financing options for business enterprises.

Table 6.1: Twenty-Year Demand Forecast for the Zone (plot take up over the years)

Base Case

Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Light Engineering	20%	22%	25%	50%	75%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Furniture	15%	20%	25%	50%	75%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Food Processing/Auto Rice Mill	20%	22%	25%	50%	75%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
RMG	12%	15%	15%	25%	50%	75%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Pharmaceutical	12%	15%	15%	25%	50%	75%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
SFB	12%	15%	25%	50%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%

Aggressive Case

Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Light Engineering	22%	25%	50%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Furniture	20%	25%	50%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Food Processing/Auto Rice Mill	20%	25%	50%	75%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
RMG	20%	25%	50%	75%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Pharmaceutical	20%	25%	50%	75%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
SFB	25%	50%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%

Conservative Case

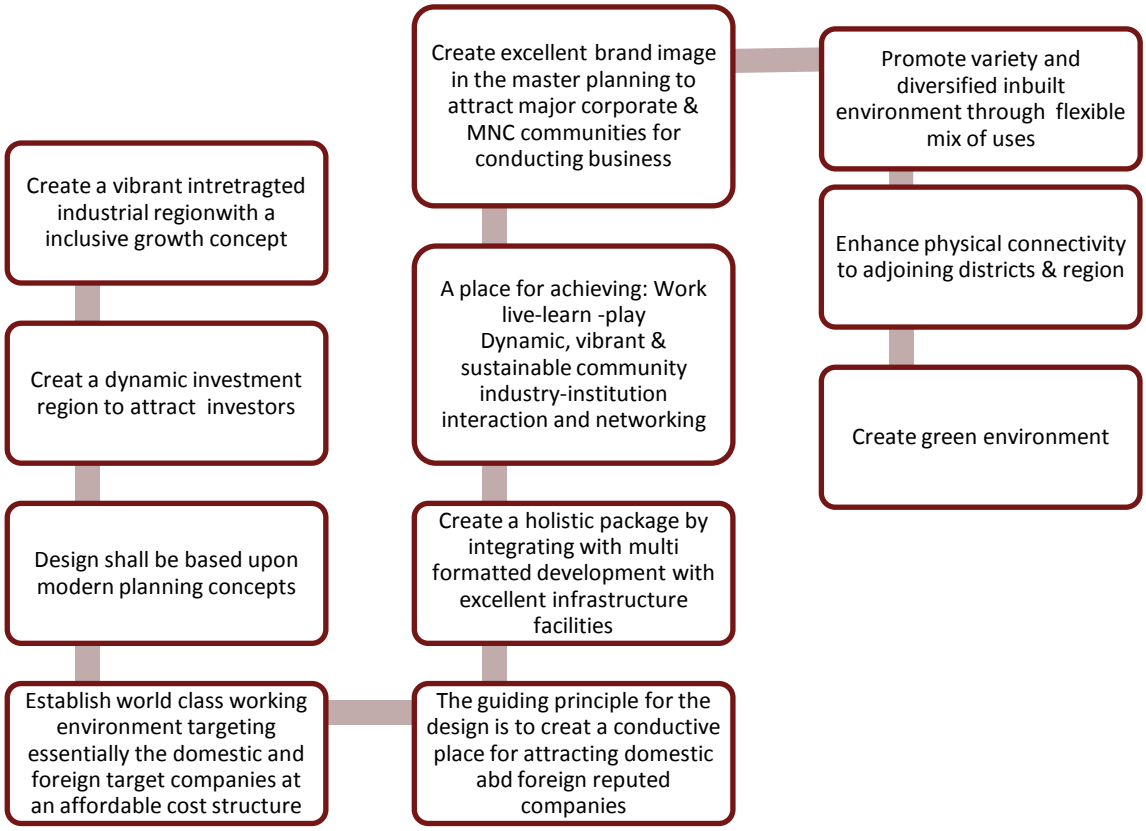
Years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Light Engineering	0%	5%	15%	25%	50%	75%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Furniture	0%	5%	15%	25%	50%	75%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Food Processing/Auto Rice Mill	0%	0%	5%	15%	25%	50%	75%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
RMG	0%	0%	5%	15%	25%	50%	75%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
Pharmaceutical	0%	0%	5%	15%	25%	50%	60%	75%	90%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%
SFB	0%	5%	15%	25%	50%	75%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%	95%

7 Master Plan

7.1 Master Planning Considerations

BEZA's vision is to make master plan and accordingly develop industries for every EZ. In the BEZ area master plan layout make various types of industries on about 251.43 acres of land. The broad category of land use for *i.e.* RMG, pharmaceuticals, light engineering, furniture, food processing and SFB on the processing area and commercial area, fire services CETP, CSTP substitution administration buildings, custom house, high class resident, low class residents, secondary school, dormitory buildings, central track stand, mosque, club house, day care centre, vocational training, QA 4 QC lab, Water treatment plant, etc. in proposed BEZ along with the excellent state of inside and offside Infrastructure facilities and professional management to attract and support investments in the industrial sectors.

Figure 7.1: Economic Zone Planning Concepts

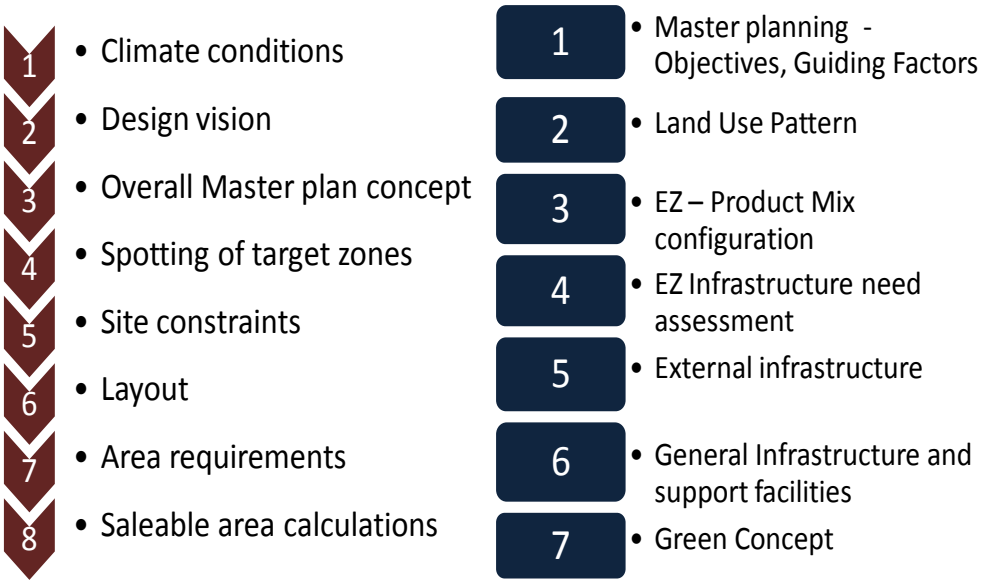


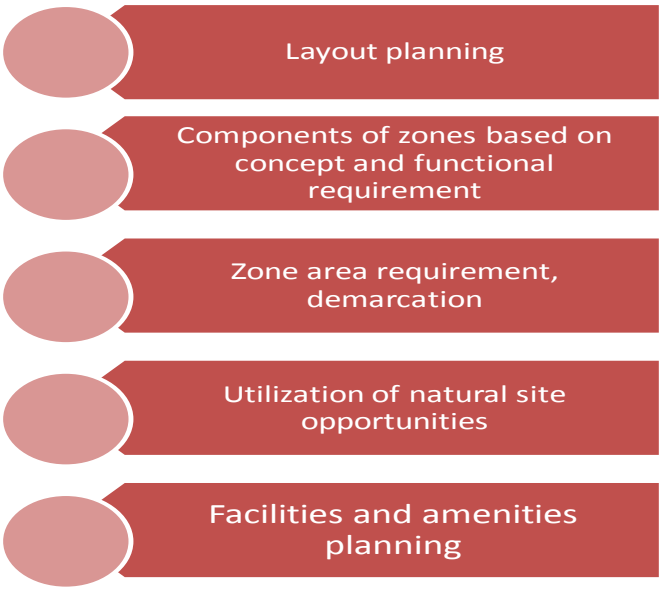
Hence EZ in the form of prepared land is proposed with general and specialized infrastructure facilities. It focuses on development of medium and small –scale industries as also trading and Services.

Thus, the proposed BEZ will function as an integrated package having the required services and facilities and for future growth option and proposed expansion also. The EZ shall be self–contained region with a "Sustainable–Holistic–Smart intelligent–eco-comic Zone". An integrated planning exercise has been done to position the project taking into account the geographic, demographic, availability of raw materials, industrial, economic and social characteristics of the

region and it is in this context Master Planning of the project. The proposal is to create a thriving place where industrialists in the targeted sectors, entrepreneurs, venture capitalists, Bank investments can work. It is important to develop the Master Plan to accommodate both the user industries area requirements and requirements of the various indentified developments of the proposed BEZ.

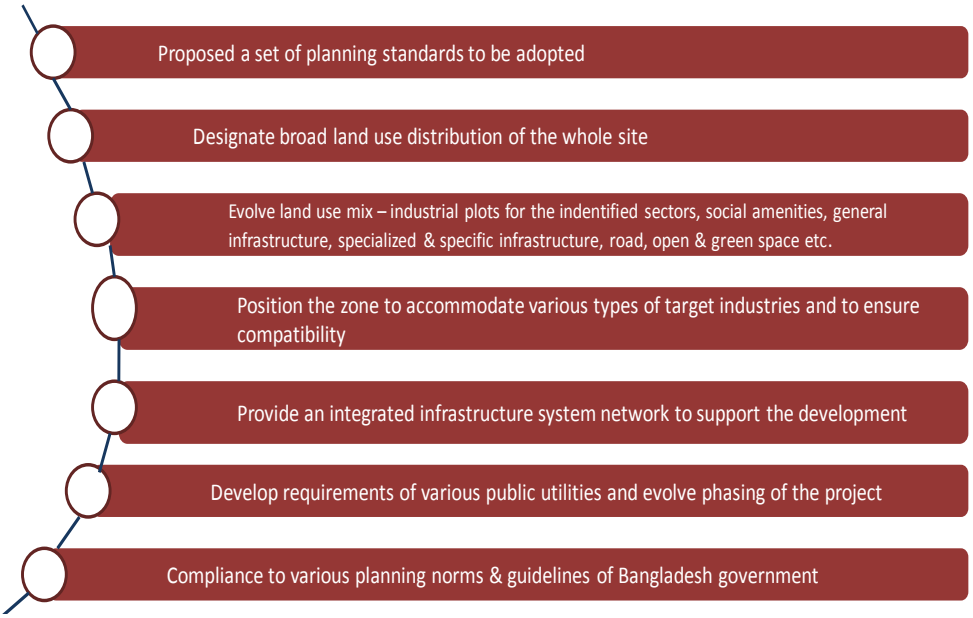
Figure 7.2: Master-Planning Considerations





For implementing this uniquely conceived EZ into a fully integrated functionally best facility and for promoting a new 'industrial cluster image in Bogura region as well as Bangladesh to develop confidence for foreign and local investors for undertaking the development of the project and subsequent operation of their businesses, certain planning objectives / principles are envisioned. The planning is based on the broad objective of establishing a world-class business environment targeting high-growth manufacturing and processing industries.

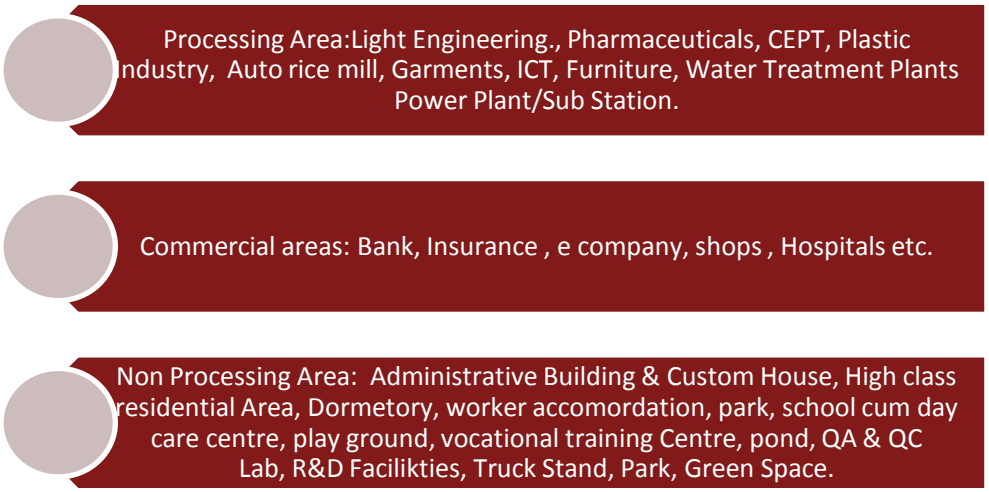
Figure 7.3: Planning Principles and Objectives



The whole area will be divided into various zones. Each zone within the BEZ shall be dedicated to specific sub-sectors and would be self-sufficient units in terms of facilities, ability to attract investors and revenue generation. From the planning point of view, the EZ is a package of number of land uses. The processing activities are prime activities and the efficiency of production is enhanced by a number of other activity zones. These include post- harvest activities, linking infrastructures, marketing infrastructure, R&D services, community facilities and green spaces. The zoning design is done in order to have a smooth pedestrian circulation by simplifying the movement patterns and allow the inter-zone movement. Parking is planned at strategic locations catering to the visitor's vehicles.

Social and commercial amenities are also planned to provide convenience to visitors as well as to the working people within the EZ. The project will be housed in a lush green environment and accordingly, landscaping and greenery are planned. While planning the EZ, the following vital issues were addressed along with strategies for successful implementation and sustained operation of EZ.

Figure 7.4: Broad Zone Demarcations

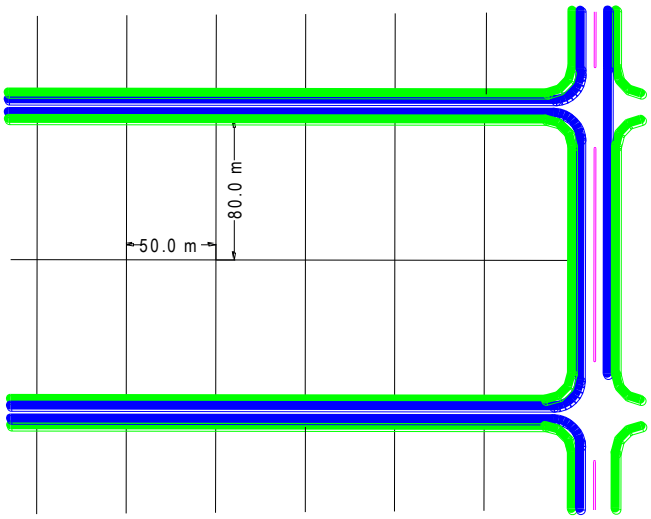


7.1.1 Plots inside the Zone

The standard factory plot is designed as 1.0 acres (0.47 ha) parcel. The factory lot dimension excluding the front setback (main road: 20m, minor road: 15m) becomes approximately square which forms a desired factory wall line. The road network is planned in order to divide the factory lot block by approximately 200m x 600m, on average, for optimizing the traffic flow inside the economic zone.

In addition, the plot layout is designed to be adjustable for increasing or decreasing, as desired. Tenants will be able to take lease of any large lot by adding a standard lot or, any small sized piece by dividing the standard lot into smaller pieces of 2000 m^2

Figure 7.5: Standard Factory Block and Road Network



Minimum setback from plot boundary is as follows:

- Frontage: 20m for the main road, 15m for the minor road
- Side Yard: 8m (on both sides)
- Back Yard: 10 m

The followings are regulations on the ground coverage.

- Nothing can be constructed on the set back area on the side of the building for the fire fighting. It should be properly landscaped with small sized trees.
- 30% of the setback area on the backyard can be used for services (generator room, prayer room, etc.)
- 65% of the frontage can be used for parking, loading unloading, security booth, walkway, driveway etc.
- 35% of the setback at the frontage should be landscaped with trees and properly grassed.

Figure 7.6: Setbacks for Tenant Buildings on Major Roads

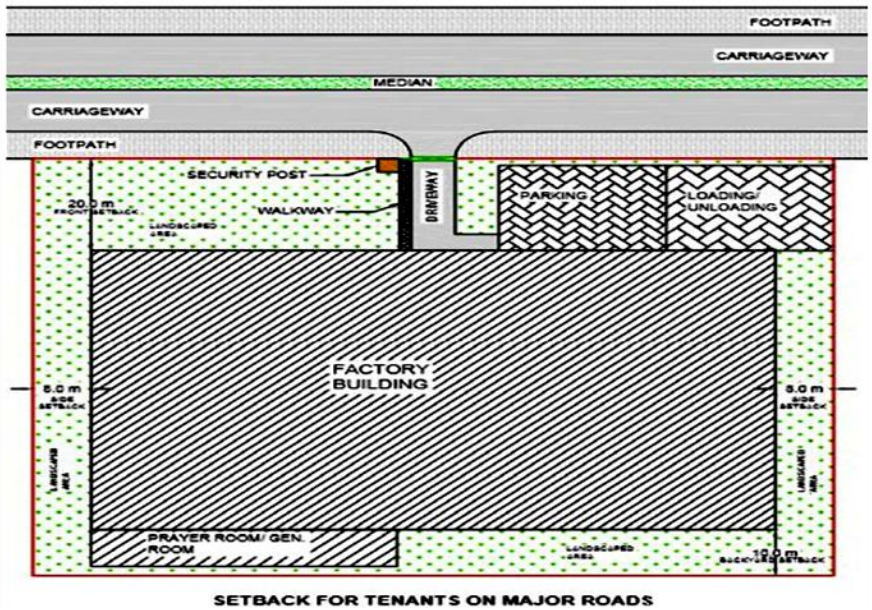
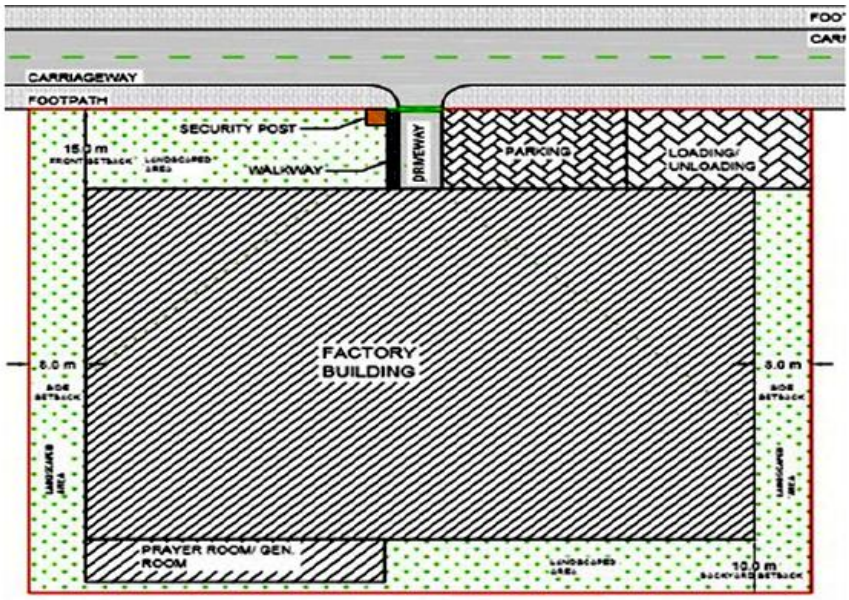


Figure 7.7: Setbacks for Tenant Buildings on Minor Roads



7.1.2 Fences

Each tenant will build the fence surrounding own leased land. The maximum height of fences shall be 2.2m from the ground level. For the front side, the upper half portion should be open type and the lower half portion should be closed type. The standard sample is shown below:

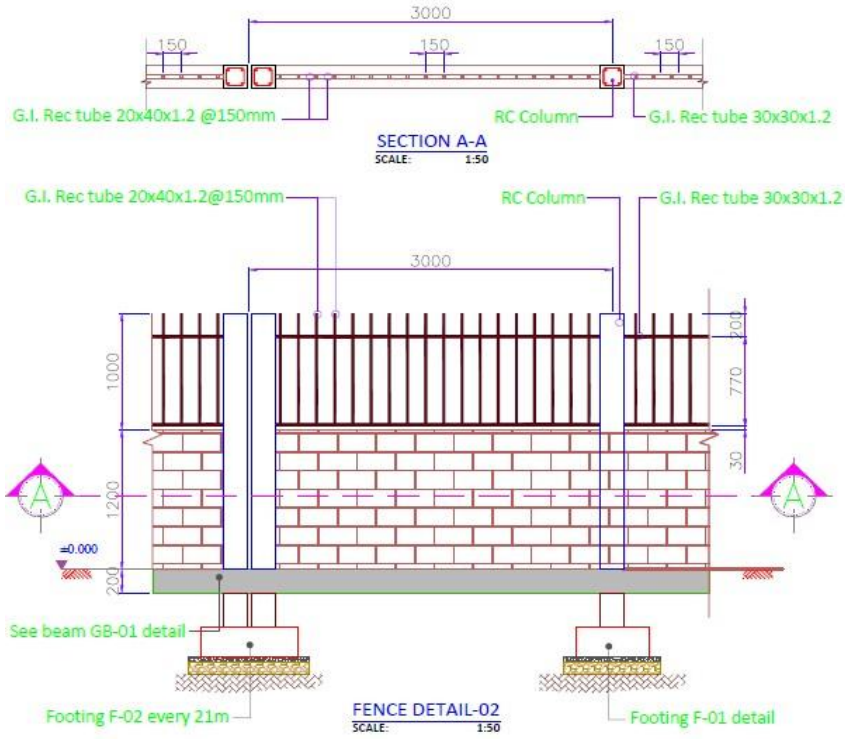
1) The fences facing the front road shall be open-type fences made of iron bars or galvanized chain- link fencing material framed with galvanized pipes and other similar types of fences. Details of colour and material should be discussed with the zone administration.

2) No concealing fences shall be erected facing the roads. On the other hand, the structure of the side and back fence should be closed type for security purposes.

3) The fence between two adjoining plots could be built rightly on the plot division line with agreement of both tenants of plot and the cost of the fencing could be shared by the two tenants.

4) The setback of 3.281 feet (1m) is required between the u-channel and the fence. This is for necessary maintenance of the fence foundation in the future. The setback should be grassed for the landscape purpose.

Figure 7.8: Standard Front Fence



7.1.3 Parking

- Parking for industries and other facilities is to be developed within the plot. Noon-street parking will be allowed within the Zone (EZ).
- 30% of the set back area on the front can be used as open parking.
- 30% of the setback area on the front can be used for loading and unloading.
- All plots will have a minimum parking space allocation of 1 standard sized automobile (2.5mx4.6m) per 200 m^2 of floor space.
- An extra 5% of ground coverage is permissible for construction of automated multi-level/multi-level parking with ramp parking structures for additional needs.
- In the case of basement parking, it cannot exceed the set back line and maximum 20% of the ground coverage. It should be kept as service area (prayer room, generator room etc.).
- Space Standard for parking:

Table 7.1: Equivalent Car Space (ECS) in Different Type of Parking

Parking Type	Area in m^2 Per ECS
Open shed	23
Basement	32
Multi-level with ramp	30
Automated multi-level	16

- For bicycle parking, one space per 500 sqm floor space is to be provided.

- The dimension of parking area and turning radius will be fixed in accord with the following table below:

Table 7.2: Recommended Dimensions for Parking Area Design

Type of vehicle	Parking width (m)	Parking length (m)	Internal turning radius (m)	External Turning radius (m)
Car	2.5	4.6	-	-
Truck	3.6	10.0	8.7	12.8
Trailer	3.6	18.0	6.9	13.8

7.1.4 Gate System

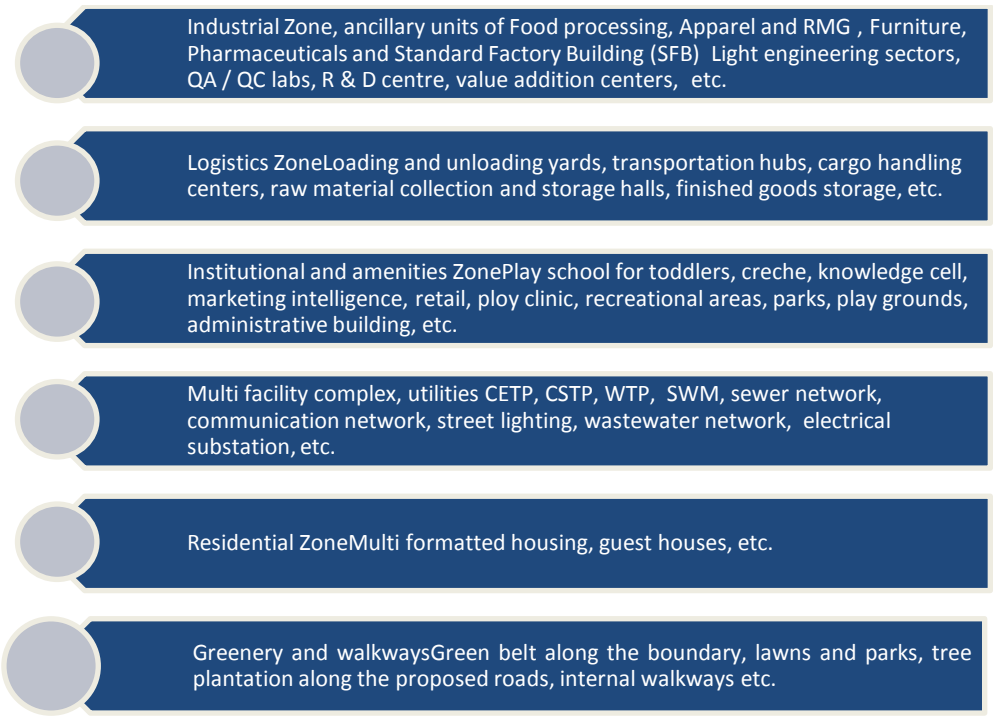
The gate system of proposed Bogura Economic Zone (BEZ) is carefully considered and the following items are the key system:

1. Gate 1 (main gate) located at entry point
2. Gate 2 (main gate) located between processing zone and non processing zone

7.1.5 Land Use Pattern within the Zone

The land use pattern of the zone is determined considering the land requirement for various processing units, logistics requirements, research, capacity development, skill development, residential facilities, schools and various social amenities etc. A well-balanced land use is perceived with a judicial mix of business, commercial, social and residential zones as illustrated in the following figure:

Figure 7.9: Zone Demarcations



Based on the above zone demarcation the following land use map has been drawn:

Figure 7.10: Land Use Map

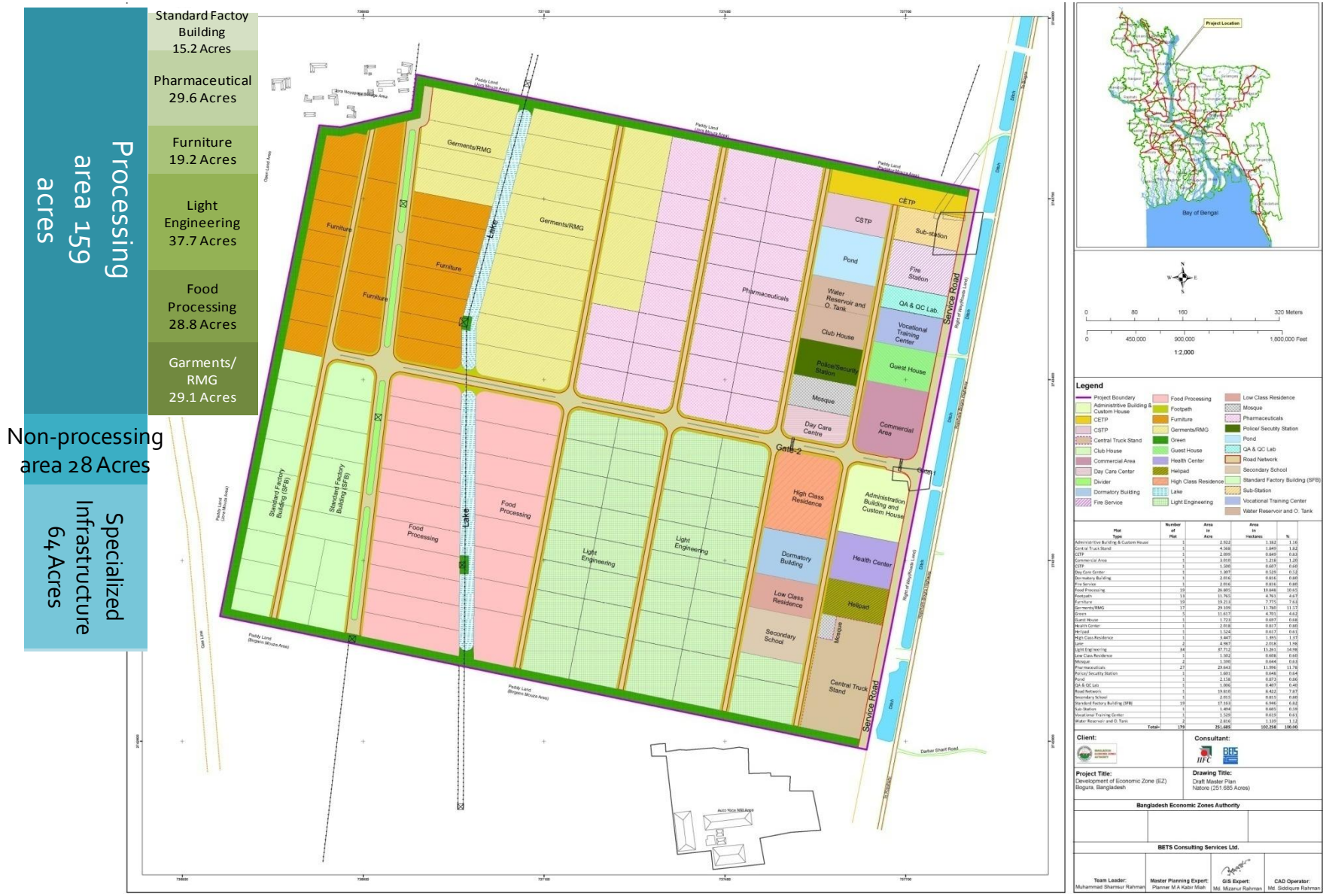
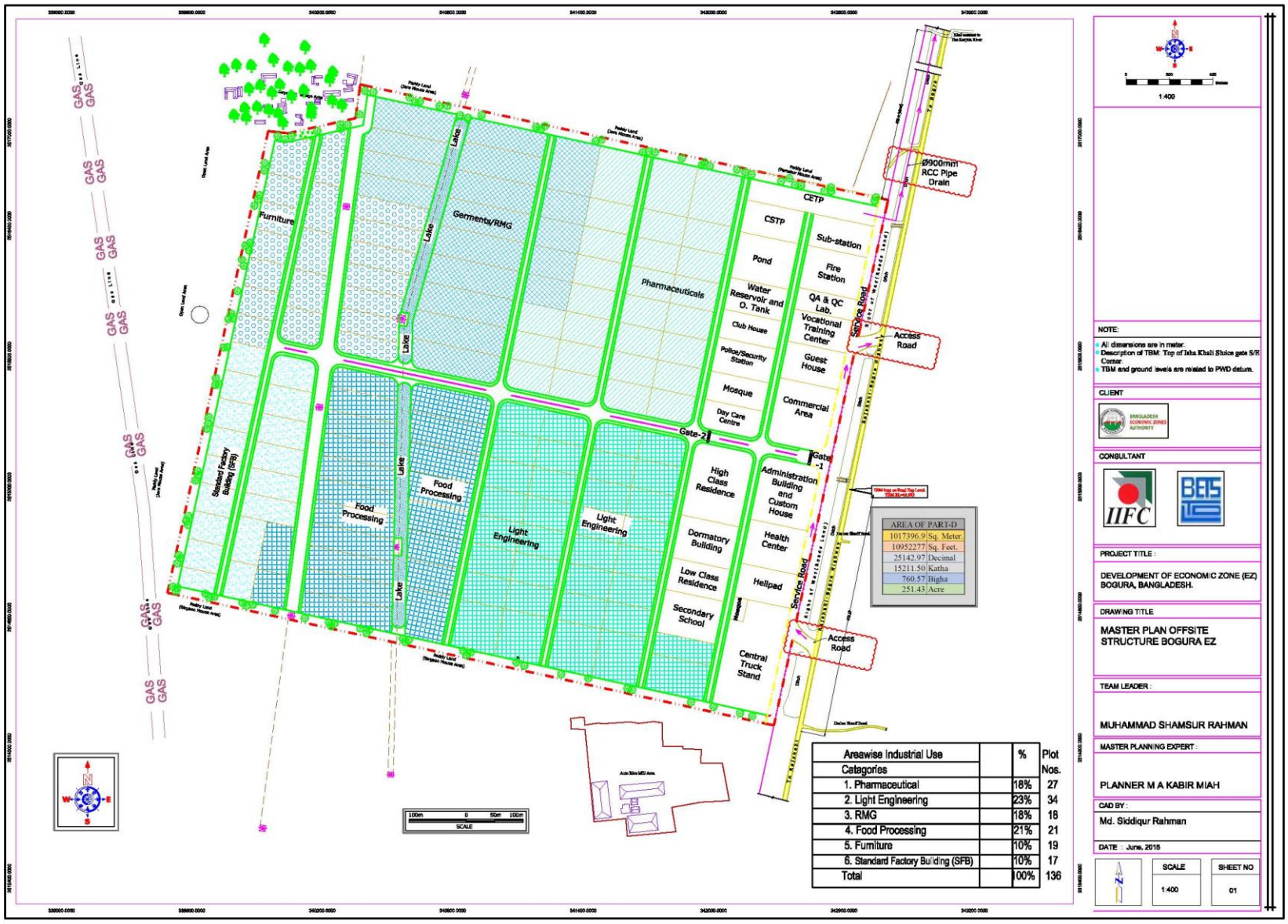


Figure 7.11: On-site and Off-site Infrastructure



Areawise Industrial Use Catagories		%	Plot Nos.
1. Pharmaceutical		18%	27
2. Light Engineering		23%	34
3. RMG		18%	18
4. Food Processing		21%	21
5. Furniture		10%	19
6. Standard Factory Building (SFB)		10%	17
Total		100%	136

The following tables provide the land use pattern for Bogura Economic Zone (BEZ).

Table 7.3: Land Use Pattern of BEZ

Land use Category	Plot Type	No of Plots	Area Acre	Area Hectare	%
a. Processing Area (PA)	Food Processing	21	26.81	10.85	10.65
	Furniture	19	19.21	7.78	7.63
	Garments/RMG	17	29.11	11.78	11.57
	Light Engineering	34	37.71	15.26	14.98
	Pharmaceuticals	27	29.64	12.00	11.78
	Standard Factory Building	17	17.16	6.95	6.82
Sub Total			**159.65**	**64.61**	**63.43**
b. Specialized infrastructure	Central Truck Stand	1	4.57	1.85	1.82
	CETP	1	2.10	0.85	0.83
	Commercial Area	1	3.01	1.22	1.2
	CSTP	1	1.50	0.61	0.6
	Day Care Center	1	1.31	0.53	0.52
	Dormitory Building	1	2.02	0.82	0.8
	Fire Service	1	2.02	0.82	0.8
	Lake	2	4.99	2.02	1.98
	Mosque	2	1.59	0.64	0.63
	Police/ Security Station	1	1.60	0.65	0.64
	Pond	1	2.16	0.87	0.86
	QA & QC Lab	1	1.01	0.41	0.4
	Water Reservoir and O. Tank	2	2.82	1.14	1.12
	Green	5	11.62	4.70	4.62
	Road Network	1	19.81	8.42	7.87
	Vocational Training Center	1	1.53	0.62	0.61
Sub Total			**63.63**	**26.155**	**25.3**
c. Non Processing Area	Admin Building and Custom House	1	2.92	1.18	1.16
	Footpath	13	11.77	4.76	4.67
	Guest House	1	1.72	0.70	0.68
	Health Center	1	2.02	0.82	0.8
	Helipad	1	1.52	0.62	0.61
	High Class Residence	1	3.45	1.40	1.37
	Low Class Residence	1	1.50	0.61	0.6
	Secondary School	1	2.02	0.82	0.8
	Sub-Station	1	1.49	0.61	0.59
Sub Total			**28.41**	**11.50**	**11.28**
	Total (a+b+c)	**179**	**251.69**	**102.26**	**100**

From the proposed land use distribution, it can be seen that industrial usage is the predominant land use. Besides offering a pleasant environment for people to work, the zone will offer a variety of ready to use land plots complete with infrastructure to construct their own factory buildings. The standard size of the plots has been designed depending upon the types of

industries to be accommodated. Occupant units can merge or sub-divide the prepared land into appropriate sizes to meet their own requirements. Conversely, the larger plots can be subdivided by introducing some minor roads to meet any demand for small plots. Prominent sites that normally command a slightly higher land premium are reserved for industrial brand names and Multinational Companies (MNCs) who desire these prime locations for enhancement of their corporate image and are ready to pay a premium price for the same. Apart from general infrastructure, specialized infrastructure required for a particular zone is also envisaged.

7.2 Onsite Infrastructure

The infrastructure is the key requirement for sustainable operation of the EZ. Infrastructure requirements are categorized as follows:

1) Infrastructure within EZ
2) Specialized infrastructure
3) External connectivity and offsite infrastructure for EZ.

The objectives of providing various types of infrastructure in the zone are illustrated in the following figure.

Figure 7.12: EZ Infrastructure Objectives

7.2.1 Road Network Inside the Zone

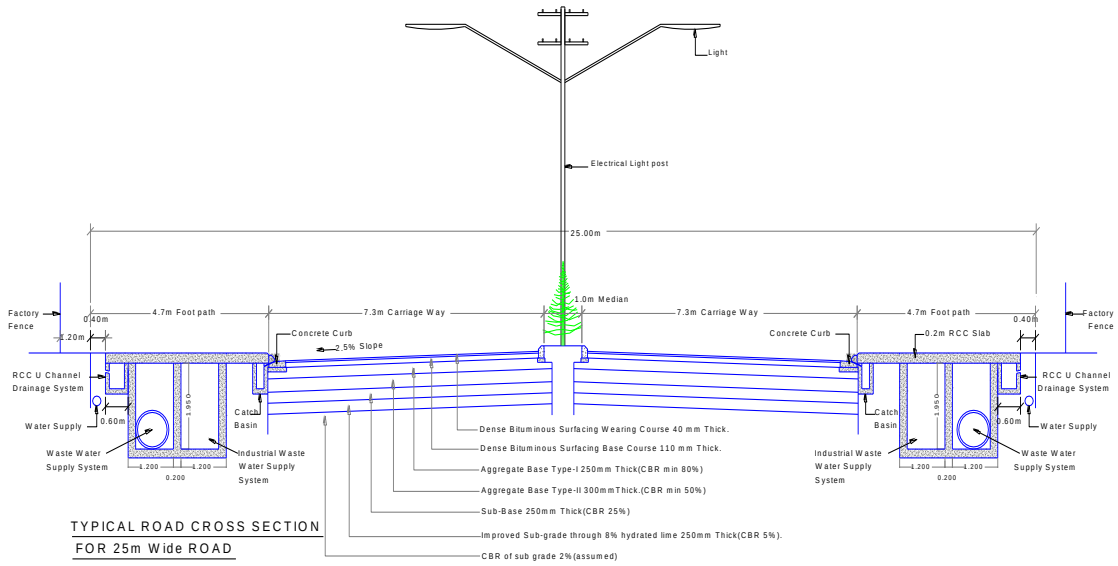
A flexible pavement/road is selected for the internal road in the economic zone. Three types are selected for the road network design; main road (width: 25m), minor road 1 (width: 15m) and minor road 2 (width: 30m to use under high tension line). The main road is divided by the central median. The carriageway of each direction of traffic is 7.3 m. A 4.7 m sidewalk is also provided for on both sides of the road. Plants are provided on the median and street lightings are provided on the median of the main road.

The minor-1 road is supposed to be an undivided 2-lane type which carriageway is 7.3 m. A 3.85 m sidewalk is to be also provided on both sides of the road. Street lightings are to be provided on both sides of the sidewalk.

The minor-2 road under high tension line is divided by the central garden/median. The carriageway of each direction of traffic is 6.15 m. A 3.85 m sidewalk is also provided on both sides of the road. Plants are provided on the garden/median and street lightings are to be provided on both sides of the sidewalk. The cross section of the roads is shown in the following figures. The main road is planned from the entrance crossing into factory plots in the industrial zone. The road network is designed surrounding the factory lot block to optimize the traffic flow. Two Access Road has been considered for entry and exit of the traffic from Bogura-Natore road. The access roads have been connected to a one-way service road in order to smooth operating of the traffics.

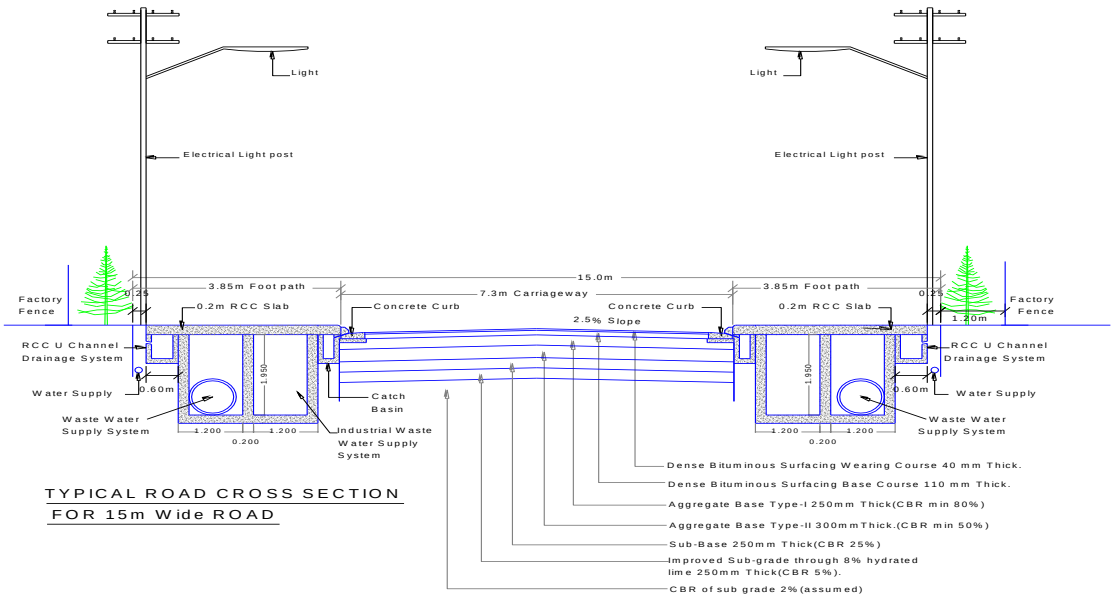
Figure 7.13: Typical Cross Sections of Major and Minor Roads

Major Road



TYPICAL ROAD CROSS SECTION
FOR 25m Wide ROAD

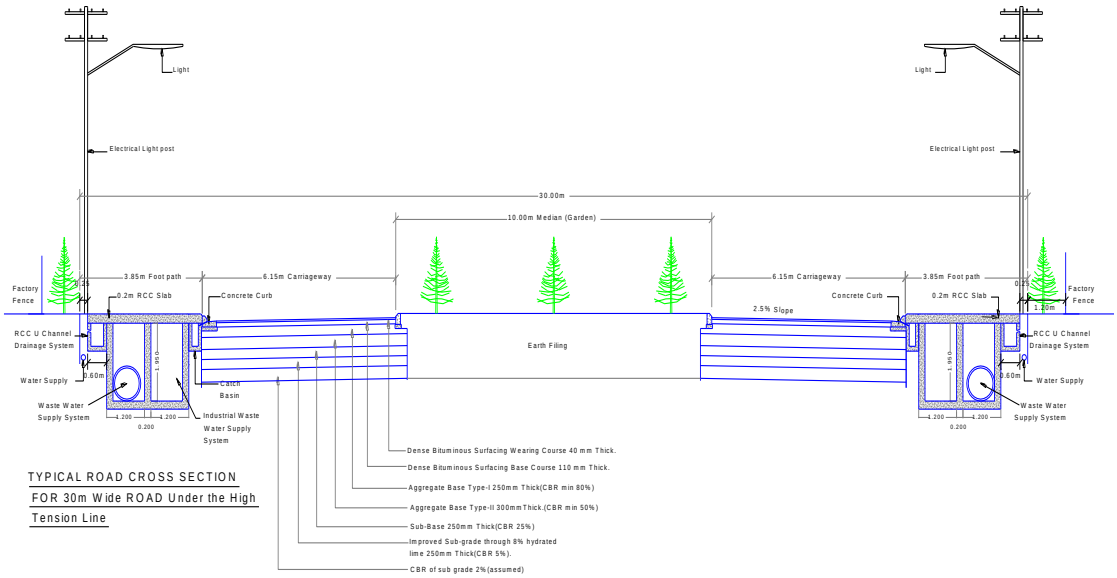
Minor Road-1



TYPICAL ROAD CROSS SECTION
FOR 15m Wide ROAD

IIFC

Minor Road-2



7.2.2 Power Supply System

It is estimated to be 15.47 MW with diversity. Light engineering set ups with 34 nos of plots form the largest entity for 6.42 MW load while pharmaceutical industry set ups with 27 nos of plots and 2.77 MW, RMG with 18 plots and 2.05 MW, food processing with 21 nos of plots and 0.48 MW and furniture Industries with 19 nos of plots and 1.16 MW are other major loads for Economic Zone. Total power requirement for this site is 19.79 MW. Hence two substations having 10 MVA capacities each can cater for the power demand of EZ. For exclusive power supply without dependence on outside source and to reduce cost eventually, 20 MW HFO based captive power station can be envisioned in future for unhindered power supply to this economic zone.

In the first option, the industrial set ups may be provided power by the prospective REB sub-stations planned to be set up inside the EZ zone which is only 1.0 km away from the existing REB sub-station. In the second and better option is to construct a new power station with 20 MW capacity, based on HFO fuel for the long term benefit of stable and low cost power supply.

The EZ will have to have one 2x10/14 MVA, 33kV/11KV sub-stations with11KV distribution lines, 11/0.4KV substations and 0.4/0.23KV lines according to the load requirement, covering the whole area of the respective zone with the required capacity to meet the load demand.

Table 7.4: Load Estimate for Bogura Economic Zone

	Plot Type	Number of Plots	Area Acre	Area Hectre	Total Power Consumption MW	Net Power Consumption MW
01	**Processing Area(PA)**					**15.72**
	CETP	1	1.07	0.43	0.07	
	CSTP	1	0.75	0.30	0.06	
	Light Engineering	34	37.77	15.30	6.42	
	Pharmaceutical	27	29.75	12.05	2.77	
	Food Processing	21	29.88	12.10	0.48	
	SFB	17	15.70	6.36	1.46	

	Plot Type	Number of Plots	Area Acre	Area Hectre	Total Power Consumption MW	Net Power Consumption MW
	Garments/RMG	18	29.71	12.03	2.05	
	Furniture	19	20.49	8.30	1.16	
	Power Plant/ Sub-Station	1	0.74	0.30	0.04	
	Commercial Area (Bank, Insurance, Restaurant, Health services etc.)	2	4.99	2.02	1.21	
03	**Non Processing Area (NPA)**					**4.05**
	Administrative Building and Custom House	1	2.95	1.19	0.72	
	Dormitory	1	2.00	0.81	0.12	
	Fire Services	1	2.01	**0.82**	0.49	
	Green		10.37	4.20	0.02	
	Helipad	1	1.50	0.61	0.15	
	High Class Residence	1	3.63	1.47	0.32	
	Lake		5.30	2.15	0.00	
	QA / QC Lab	1	0.50	0.20	0.20	
	Road		20.15	8.16	0.24	
	Secondary school	1	2.00	0.81	0.10	
	Day Care Center	1	1.35	0.55	0.33	
	Club House	1	1.34	0.54	0.06	
	Guest House	1	1.71	0.69	0.28	
	low class residence	1	1.48	0.60	0.10	
	Truck Stand	1	4.78	1.93	0.06	
	Vocational Training Center	1	1.52	**0.61**	0.25	
	Tank	1	2.15	0.87	0.52	
	Mosque	1	1.31	0.53	0.06	
	Water Reservoir and O/tank	1	1.59	0.64	0.00	
	Worker Accommodation	1	1.59	0.64	0.03	
	Total	17	**240.05**	**97.22**		**19.77**

7.2.3 Existing Utility Condition

Existing REB 33/11 kV substation is located 1 km (approximately) from the proposed EZ. This substation could be utilized for the initial phase of small load requirements by mutual discussion with REB authority. At present, electricity is supplied to the area by the Rural Electrification Board (REB) by 11 KV lines.

7.2.4 HFO based Power Plant inside the EZ

Basic information about the proposed HFO based power plant project is as follows.

The proposed capacity of the plant: 20MW±10%

Mode of operation: Base load, Fuel: HFO (Furnace Oil)

Properties of HFO System: HFO, also known as "residual fuel oil", is based on the high viscosity, tar-like mass. As a residual product, HFO is a relatively inexpensive fuel – it typically costs 30% less than distillate fuels (MDO/MGO) (Verlinkung). It thus became the standard fuel for large marine diesel engines during the oil crisis in the 1970s and 1980s, and it required extensive adaptation of the injection system and other components of low and medium speed engines – which are still the only reciprocating engines capable of running on HFO.

Reciprocating Engine Generator: The Facility will include the complete (HFO) based reciprocating engine generator units, constructed with new and unused materials and equipment, having a total net power generation capacity of 24 MW to 27 MW at the Reference Site Conditions, to operate as a fully dispatchable plant.

It is required that the net capacity of each engine generator will be not less than 5 MW.

Facility will be operated using HFO (furnace oil) as fuel. The Project Sponsor will arrange the supply and delivery to the site of required quantities HFO for Bangladesh Petroleum Corporation or any other Fuel Supplier for use as fuel to the power generation facility. The fuel supply arrangements will be required to ensure an adequate and reliable supply of fuel and shall, along with the Fuel Supply Agreement. Fuel storage facility for operating the Facility for at least 15 days continuously at 80% plant factor shall be constructed by the Company at its own cost before Commercial Operations Date and the Company shall maintain this stock of fuel for all time.

Each reciprocating engine shall be of heavy duty, industrial type, of proven design, directly coupled to a 50 Hz generator. Each reciprocating engine generator shall be installed within an acoustic, ventilated enclosure incorporating fire detection and protection facilities. Each reciprocating engine shall be provided with all associated ancillary and auxiliary equipment and systems for the safe, efficient and reliable operation.

Generators: Generators shall have a minimum short circuit ratio of not less than 0.5. Each generator shall comply with IEC 34 and BPDB requirements and shall be rated to match the engine output over the full range of ambient temperatures specified. Generator and exciter windings shall possess insulation that is non-hydroscopic and of Class F type complying with IEC 85, but having a temperature rise not exceeding that of Class B under any operating condition within the specified output.

Quality of the management of the generator and accessories shall be in accordance with the requirements of ISO 9001, EN 29001 or BS 5750 Part 1 and other similar equivalent International quality standards. Anti-condensation heaters shall be provided for the air circuits, generator windings, excitation system and control cubicles. Heaters shall be capable of maintaining the air temperature above that of dew point to prevent condensation. These heaters shall automatically switch on when the generator is taken out of service.

Temperature detectors shall be provided to monitor the maximum operating temperature of the machine. The generators shall be capable of supplying rated power within 48.5 Hz and 51.5 Hz and ±10% of nominal rated voltage within the power factor range 0.85 lagging and 0.95 leading at the Delivery Point.

A continuous fast acting automatic excitation control system of a proven design shall be provided to control the generator voltage without hunting/instability over the entire operating range of the generator. The excitation system shall be provided with a fast-acting MVAr limiter so as to prevent the generator output falling below its safe limit. A power system stabilizer shall be incorporated in the excitation system of each generator. The Automatic Voltage Regulator (AVR) shall also be provided with but not be limited to Quadrature Droop Compensation, and Cross Current Compounding. Protection features as part of the system shall include over-voltage, over current, VT fuse failure, diode failure, over fluxing, and AVR power supply failure. A field shorting or discharge switch feature shall also be included in the system as protection against overstressing the generator insulation in the event of a fault. Manual excitation control facilities shall be provided as a backup to the automatic control, and shall have an adequate range to allow for control of excitation for testing purposes. A true null balance shall be provided to allow for smooth excitation transfer between manual and automatic control.

Cooling System: Method of cooling is to be design based on the availability of water and other Site condition.

Water Treatment Plant: A water treatment plant shall be provided to meet the Facility demand (if required). A water treatment plant will be provided to treat raw river water that will provide plant cooling water, service water, and de-mineralized water. The water treatment plant will comprise both primary (sand and activated carbon filters or micro filtration) and secondary treatment (combination of reverse osmosis, mixed bed and/or ion exchange)

Wastewater Treatment Plant: A wastewater treatment shall provided for the Facility to ensure that any water discharged from the Facility streams meets the Bangladesh and World Bank Group environmental standards or any internationally accepted Environmental standards. See GOB Environment Conservation Rule (1997) for the Bangladesh water discharge standards.

Liquid Fuel System: It will be needed to arrange a liquid fuel supply to the Facility. Required necessary arrangement for operation of the Facility with HFO including fuel transportation, receiving and handling, construction of jetty, pipe line up to the Facility storage, fuel measuring system, internal fuel supply system, fuel heating and purification/treatment system as per requirement of the offered plant shall be responsibility of the Company at its own cost.

Fuel storage facility for operating the plant for at least 15 days continuously at 80% plant factor shall be constructed by the Company at its own cost before COD and Company shall maintain this stock of fuel for all time thorough out the Term.

Environmental Requirements: The facility will be designed to be capable of complying with the laws of Bangladesh and the Environmental guidelines as applicable such as World Bank Group and Asian Development Bank environmental and social guidelines or any internationally accepted Environmental Guideline.

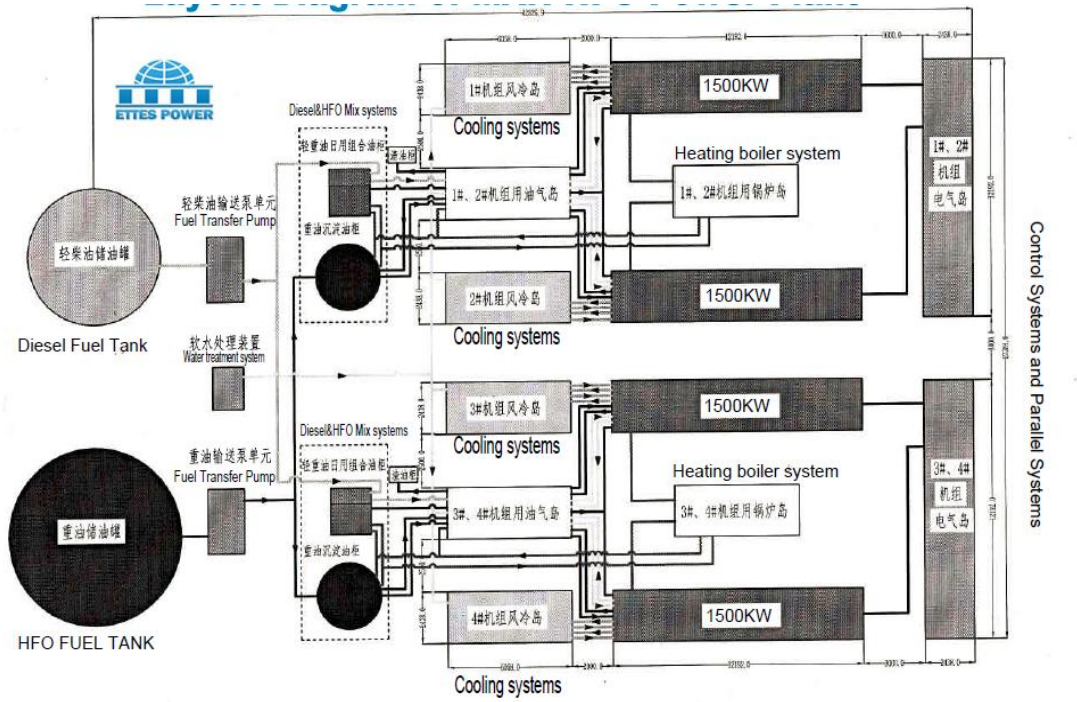
When the demand is about to be 7 MW both the power plants may start production (total 8MW). After completion of its construction later the total demand for power in the EZ will be about 15 MW when the full capacity of the power plant can be utilized in the zone.

Sanitary and Sewer Facilities: The Company shall provide for adequate sanitary facilities during facility construction and Facility operations, and treat sanitary sewer prior to discharging it to comply with applicable discharge standards of the GOB or the World Bank Group or any internationally accepted Environmental Guideline.

Drainage: Oily water and chemical drains shall be treated to an approved quality before discharge. All drains and other liquids, if discharged from the Facility shall at all times comply with appropriate environmental regulations and meet the quality standards specified in GOB Environment Conservation Rule (1997).

Exhaust Liquid Fuel Emissions and Air Quality: Exhaust Liquid Fuel emissions shall not exceed the emission rates allowed by those Bangladesh standards and the World Bank Group guidelines or any Internationally accepted Environmental Guideline can be followed for Stack emission Limits under all ambient conditions. The required air quality should be maintained by controlling emission limits and selecting appropriate stack height. It is the responsibility of the Project Sponsor to fully investigate the timing and possible changes in the proposed standards and include appropriate provisions in the design of the Project. Typical layout diagram is depicted in the next page for HFO based power plant:

Figure 7.14: Layout Diagram of MAN HFO Power Plant



7.2.5 Cost Estimate for Power Systems

Option 1: If power supply option is considered from REB, inside power Infrastructures will be as follows. Cost of outside power Infrastructures will be borne by REB due to their own benefit of prospective revenue.

	Description	Quantity	Unit Price BDT million	Total BDT million	Remarks
1.	33/11 kV substation, 2x10/14 MVA	1	126.50	126.50	Indicative price
2.	11 kV line, single circuit	6.0 km	1.13	6.80	
3.	0.4/0.23 kV line	6.5 km	0.81	5.27	
4.	Distribution transformers	10	0.62	6.20	
	Total			**144.77**	

Option 2: If the option of power supply from economic zone owned power plant is considered, only inside power Infrastructure will be needed. The costs are be as follows:

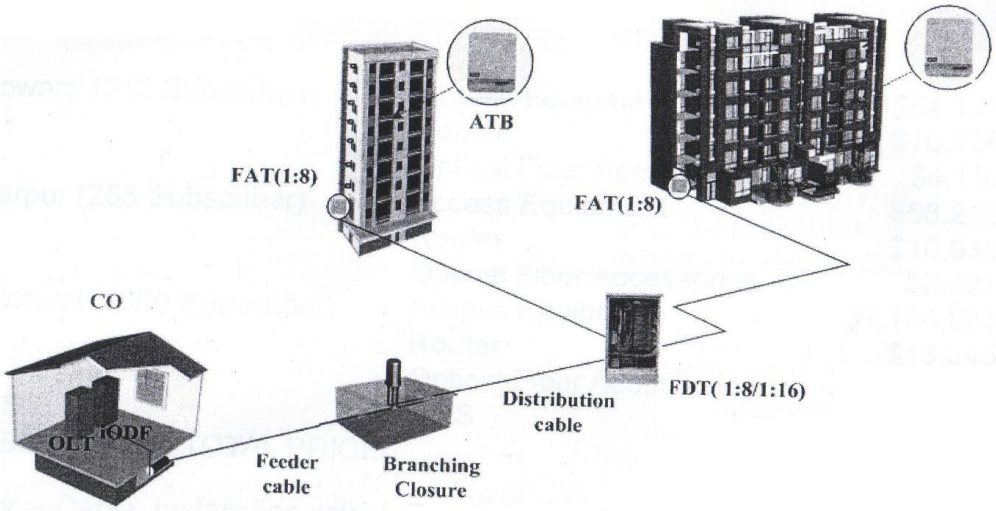
Item No	Description	Quantity	Unit Price BDT million	Total BDT million	Remarks
1.	20 MW HFO fired Power Plant	1	1,320	1,320	Indicative price
2.	33/11 kV substation, 2x10/14 MVA	1	126.50	126.50	
3.	11 kV line, single circuit	6.0 km	1.13	6.80	
4.	0.4/0.23 kV line	6.5 km	0.81	5.27	
5.	Distribution transformers	10	0.62	6.20	
	Total			**1,464.77**	

7.3 Telecommunication System

7.3.1 Connection (On-site)

Considering 6 telephone lines per industry and other connections, such as, connections in the BEZA administrative office, customs office, proposed power plant, and power supply office and some residential connections, the total numbers of telephone connections is estimated to be 700 LU and the number of distribution points is considered to be 300. The capacity of the telephone exchange, considering future expansion in the surroundings, is assessed to be 7,000 LU and effective number of connections in the 1st Phase will be 2,500LU, proportional internet connections. The number of industries may be more or less than the number of plots. Some of the big industries may sometimes need more than one plot. On the other hand, more than one small industry may sometimes share one plot.

Figure 7.15: Connection Diagram (On-site)



Transmission System in Bangladesh: Bangladesh is a reverie country, as the country's long distance transmission systems are mainly composed of microwave, UHF and VHF radio links. The Optical Fiber is also used in city and some district headquarter areas for interconnecting local exchange and Remote Switching Units (RSU) in multi exchange networks and also for interconnections between switching exchanges and microwave station. As in all EPZs in Bangladesh, BTCL has PSTN network, it is recommended that telecom works in EZs shall be requested from BTCL. The entity has two modes of financial systems, a) Contributory work, and b) Self financed work.

a) Contributory work: When a corporate body asks BTCL to establish a telephone network, BTCL submits estimates for the contribution of funds. After placing of a fund by a corporate body, BTCL expands the network as required.

b) Self financed work: when BTCL finds that an area is under development, BTCL includes expansion work in ongoing or in future sand expands their net work for expansion of own business from their own fund.

BEZA may write to BTCL, requesting to include the Bogura proposed EZ in their future expansion plan. Information can also be given to approved private PSTN operators, mobile phone operators

and ISPs so that they can expand their network. It is recommended that GrameenPhone and other operators should be offered to establish their network as well.

7.3.2 Telecommunications (Off-site)

If Bangladesh Telecommunication Company Limited (BTCL) fixed phone network is to be installed in Bogura EZ site, a Fiber Optic Cable (FOC) connection will be established between Bogura EZ site and Bogura main exchange at upazilla. Also telephone exchange/exchanges of BTCL shall be installed at EZ site and the local network will be expanded according to need. Local network by copper cable will not be difficult with single exchange. To cover the network by copper cable, a BTCL exchange needs to be installed. By copper cable, subscribers can be connected up to a distance of 4 km. The cost of a telecommunications system is calculated most modern soft switching (SS) technology, as in near future technologies are being changed very rapidly. Since power transmission lines in the EZ site will be overhead, the FOC line can be hung overhead to reduce the local network expansion cost.

7.3.3 Data Communications Network

In Bangladesh there are two types of national networks: Radio Link and OFC Link. BTCL has both types. Power Grid Company Bangladesh also has an OFC overhead network throughout Bangladesh along the high tension power transmission towers.

Band connection/leased line connection: BTCL have copper, optical fiber and microwave networks almost all over the country. BTCL introduced Digital Data Network (DDN) service in the year 2000 to allow point to point domestic data connectivity and International Private Leased Circuit (IPLC) termination inside Bangladesh. 64kbps to 2Mbps data circuits are available through DDN nodes. Subscriber is connected through telephone cable (copper local loop DSL). Transmission backbone among exchanges consists of optical and microwave network. DDN service is available in 41 district headquarters through 71 nodes. Present capacity is more than 1000 high speed point to point leased line internet and corporate connectivity, 60% of which is in use.

Bogura EZ may be brought under the DDN service since it will fulfil the eligible criteria of the DDN connectivity- Producers of same types of goods and services.

7.4 Water Supply System

In Bogura, the water consumption demand will be about 10,000 cubic meters per day. Per day volume of water requirement is given bellow for Bogura EZ:

Water Requirement: 10,000 m^3/Day

Ground Water: There is no surface water source for water supply of Bogura EZ. Water is to be drawn by installing production tube wells in the project area to meet the water demand. Each tube well can supply 500 cubic meter of water per day. Around 20 tube wells are recommended to be set in Bogura EZ. The BWDB report has not considered sea water as a source. The supply system of the pipe network is shown in the Figure 7.17.

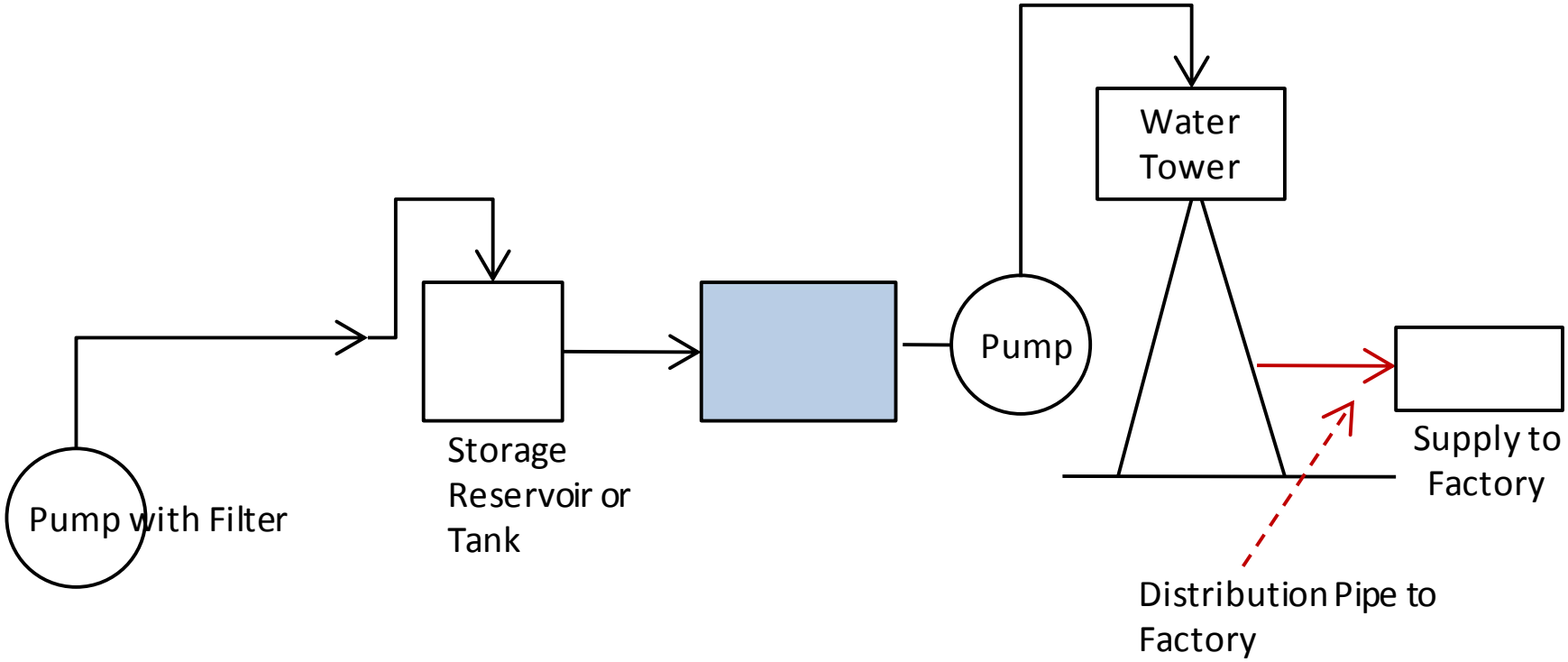
Water Distribution Network: Water Distribution Networks deliver water to each factory along the roads, coming through the tower and tank at several places built inside the zone. The treatment system is composed of the following:

- ground water intake
- Reservoir
- Treatment Plant
- Tank and Tower
- Distribution Pipe Network

A gravity feed system will be used to supply water to the water supply pipe line located along the footpath of the road inside the Project. The size of main water supply pipe will be from 150 mm. –350 mm. and water supply pressure is in the range of 1.0 – 3.0 bars. Main water supply pipe will be of high density polyethylene (HDPE) if available, to avoid corrosion as well as breaking in the future.

Basic Concept Drawing of Water Supply System: The basic water supply system is shown in the following figures.

Figure 7.16: Water Supply Distribution Network



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7.5 Drainage

The rain discharging flow has been designed using the engineering analysis. As a first step, rain fallen on the ground and factory roofs are expected to flow into the u- channel along the road. Next, the rainwater flows into the ditch/khal north-east side of the EZ. Finally, the rainwater will flow out to the korota river by existing channel. The flow system of the u-channel drain is shown in the Figure 7.18.

7.6 Fire Protection System

For the fire protection system, besides a fire station and a fire truck, a pond wand water body has been considered to collect water for fire service according to the local standard to supply water in case of fire protection need.

7.7 Data Connectivity

A robust infrastructure for high-speed internet connectivity is essential for ensuring the sustainable operation of the zone. On top of that, it is imperative to have connectivity from multiple operators to maintain high uptime and seamless service levels to the tenants. An operator with sufficient capability may provide network connectivity inside the zone and maintain clientele among tenants independently.

7.8 Industrial Effluent Treatment System

The industrial effluents will be collected from the industries through an effluent pipe network and will be treated in the CETP. Total volume of industrial effluent 14,400 m3/Day. The Waste water collection pipe network for Industry is shown in the following figure. The industries will be responsible to do preliminary treatment for their industrial effluent. Maximum value for some critical wastewater parameters that can be discharged to the central effluent treatment plant will be set up to prevent overloading of the treatment operation.

Industrial effluent will be collected and transported via a network of drains to the effluent treatment plant. Effluent treatment involves following stages:

7.8.1 Pre-treatment

Pre-treatment stage is the first stage of effluent treatment process of CETP, where materials that can be easily collected from the raw wastewater before they damage or clog the machineries will be removed:

Screening: In screening, large objects or floating solids will be removed from the influent water. This will be done with a bar screen which are cleaned manually. The solids will be collected and later disposed in a landfill or incinerated.

Grit removal: In grit removal, pre treatment may include a sand or grit channel or chamber where the velocity of the incoming wastewater will be carefully controlled to allow sand, grit and stones to settle.

7.8.2 Primary Treatment

In this stage, the effluent will be converted to a homogeneous liquid capable of being treated biologically. The effluent will be taken to equalization tank through a lift pump for chemical dosing. The chemical dosing is usually done by using alum, ferric chloride, calcium hydroxide or sodium hydroxide. Then the effluent is taken to mixing tank. The pH of the effluent will be corrected here.

7.8.3 Secondary Treatment

The secondary treatment will be done to degrade the biological contents of the effluent. Through aeration secondary treatment will be done. The purpose of secondary treatment is to reduce the organic compounds of the effluent through bacteria formation and help in coagulation of the compounds to create removable solids.

Activated Sludge: This process will be used for aeration. Activated sludge plants encompass a variety of mechanisms and processes that use dissolved oxygen to promote the growth of biological floc that substantially removes organic material.

The final step in the secondary treatment stage is to remove the biological flocs or filter material and produce effluent containing very low levels of organic material. In this purpose, the effluent will be passed to clarifier through lift pump. Later on, it will be passed through bio-filter.

Bio-filter: Bio-filter includes a reactor filled with a filter media. The media either is in suspension or supported by a gravel layer at the foot of the filter. The dual purpose of this media is to support highly active biomass that is attached to it and to filter suspended solids. Then the final treated effluent will be passed through final outlet.

7.8.4 Sludge disposal

When a liquid sludge is produced, further treatment may be required to make it suitable for final disposal. Typically, sludge is thickened (dewatered) to reduce the volumes for disposal. Near the settling tank, there is a sludge drying bed. By dewatering the sludge, sludge cake will be produced. The sludge cake will be used to make clay bricks. The following figure shows the sketch for effluent treatment system.

Figure 7.17: Water Supply Distribution Network

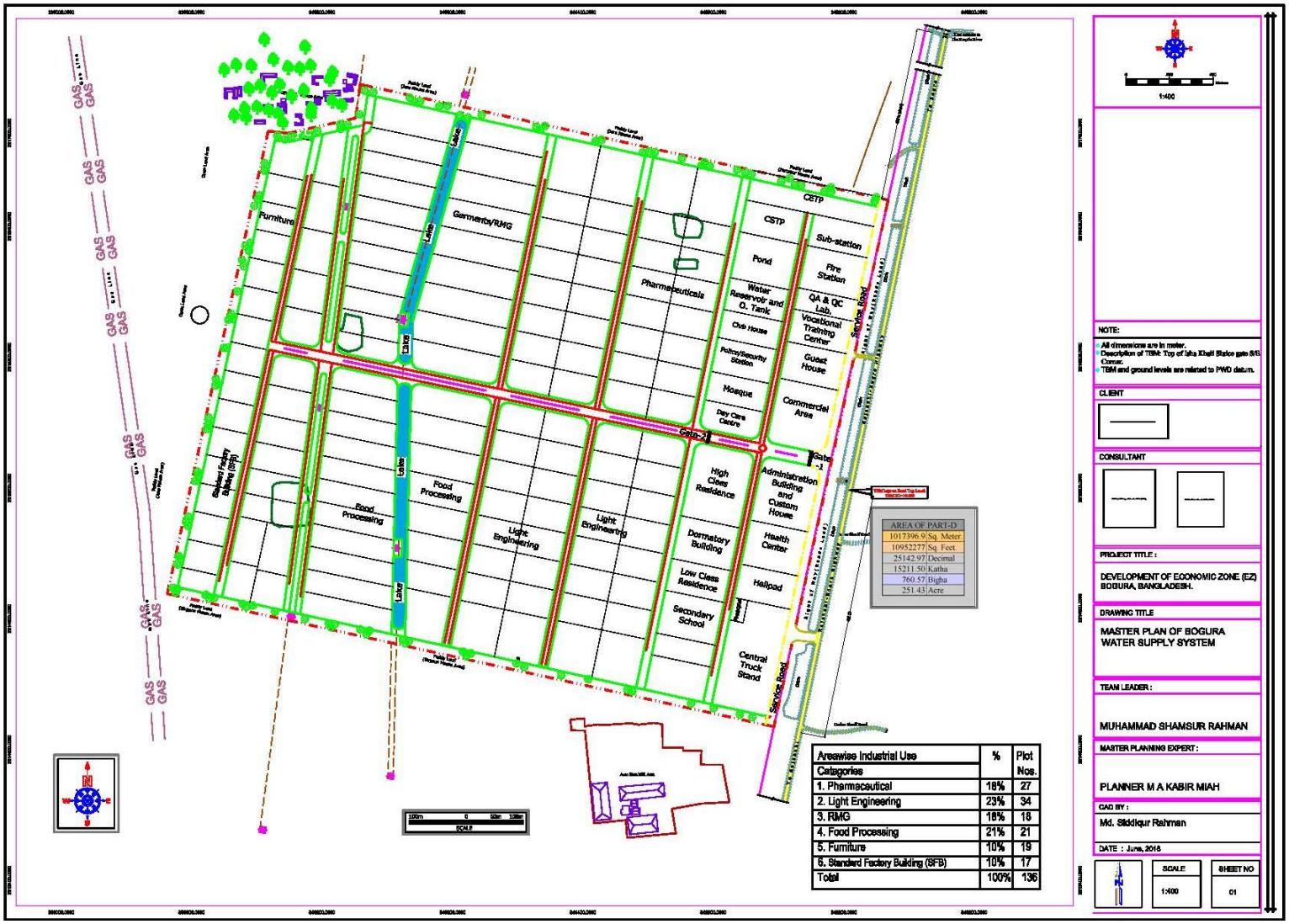


Figure 7.18: Flow System of the u-Channel Drain

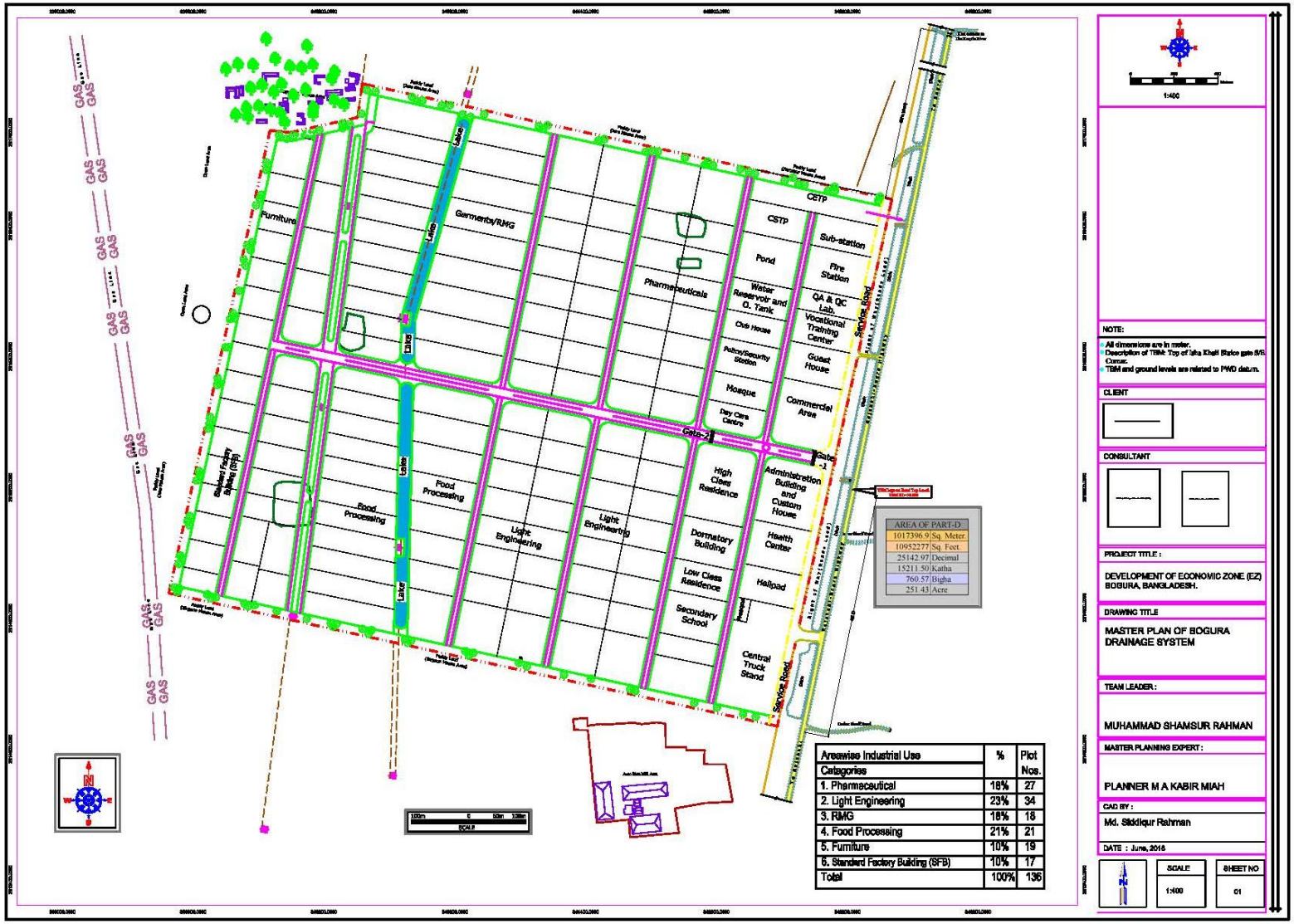


Figure 7.19: Effluent Treatment System

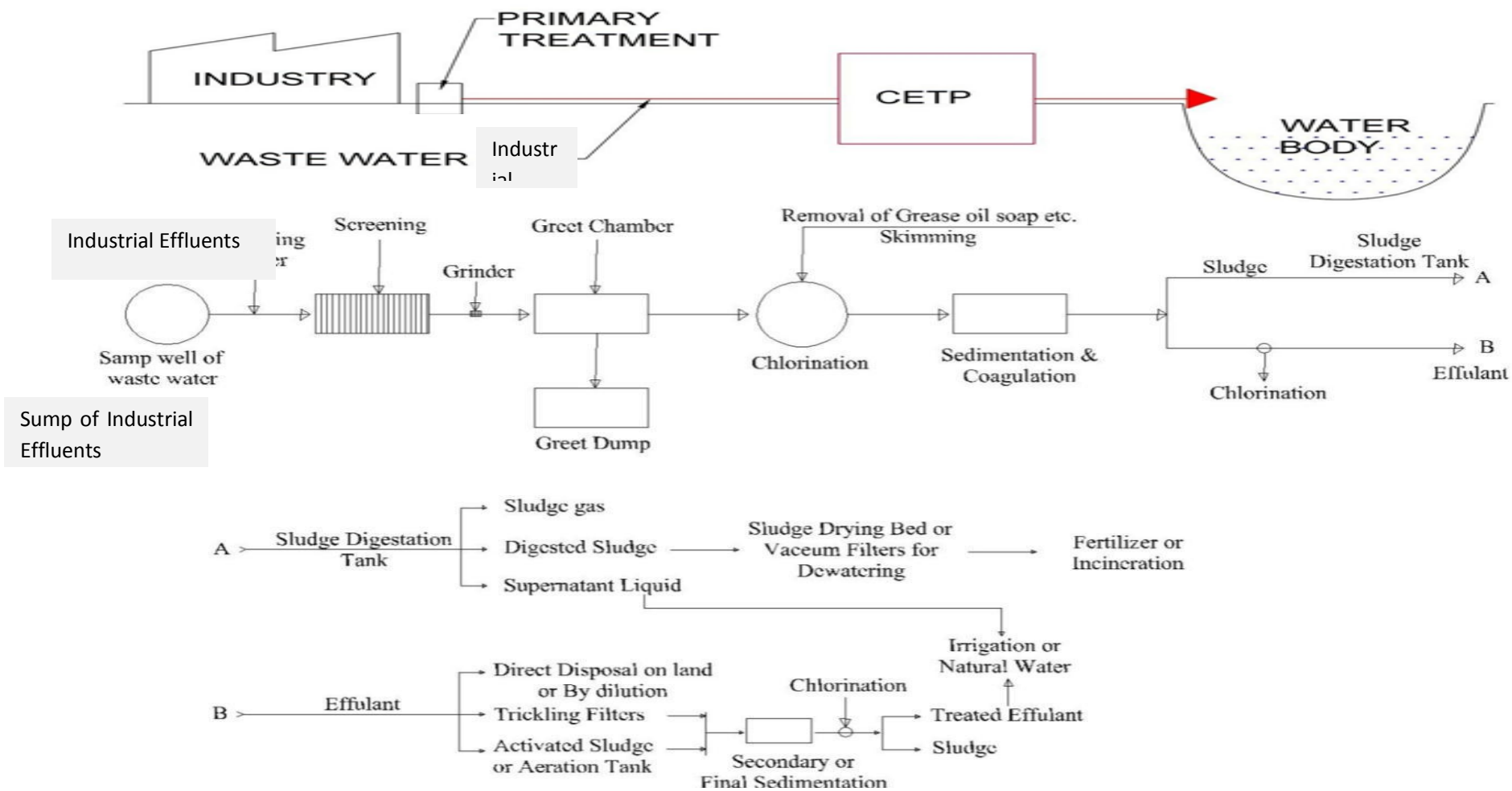


Table 7.5: Recommended First and Second Level Standard for the Zone

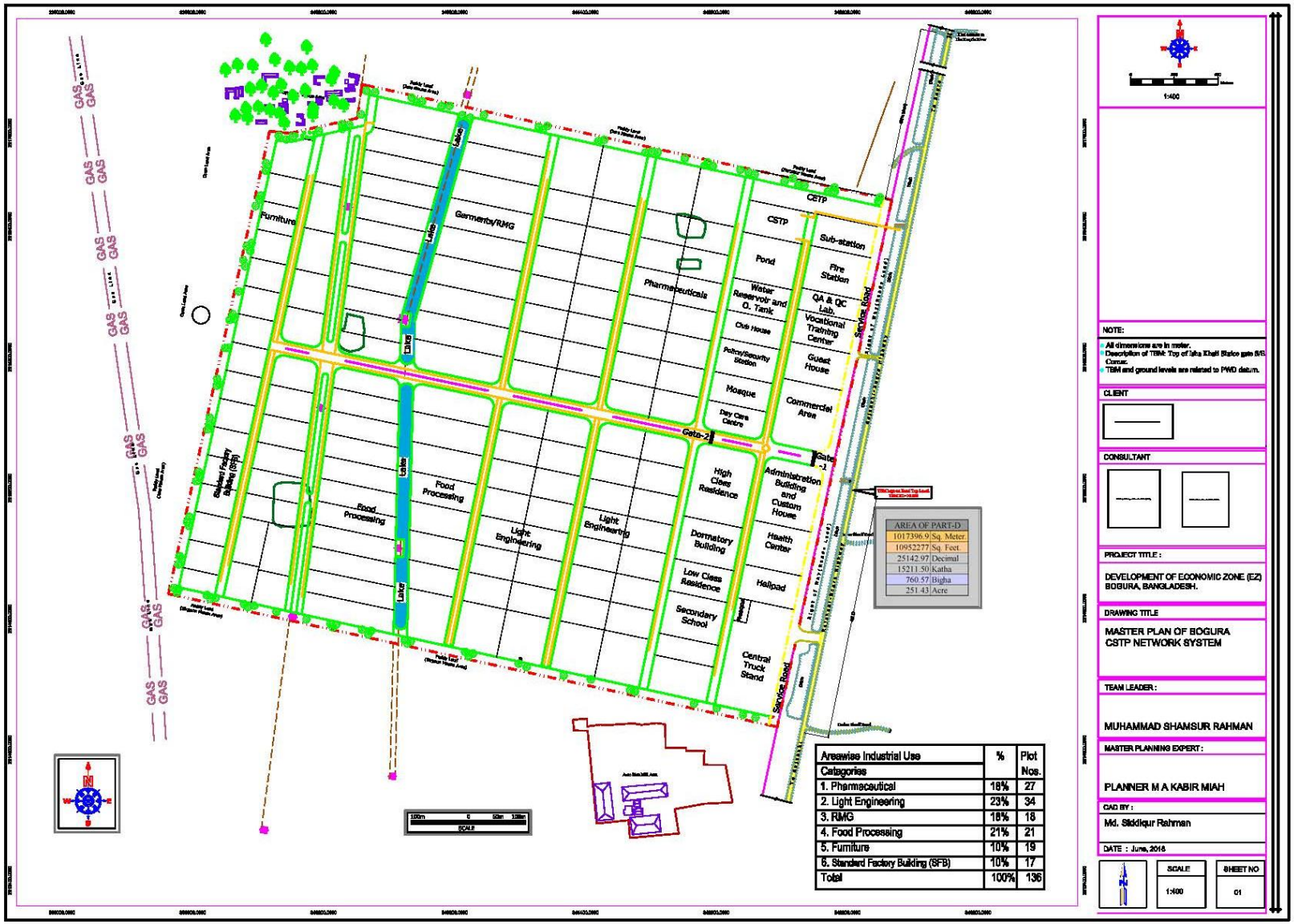
	Parameters	Unit	First Level Standards for the Industries	Standards for CETP
1	Temperature	0C	<45	40
2	pH		10	8-Jun
3	BOD5 (5 days at 20 °C)	mg/l	<50	<30
4	COD	mg/l	<50	<30
5	Total Suspended Solids	mg/l	<50	<30
6	Total Dissolved Solids	mg/l	<1,200	<1,000
7	Grease and Oil	mg/l	<10.0	<5
10	Nitrate (NO3)	mg/l	<15	<10
12	Chloride (ion)	mg/l	<600	<500
13	Sulphate (as SO4)	mg/l	<400	<400
14	Sulphide (as Sulphur)	mg/l	<1	<0.75
15	Phosphate (PO4)	mg/l	<5.0	<3.0
16	Cyanide (CN)	mg/l	<1	<0.75
18	Arsenic (As)	mg/l	<0.10	<0.03
20	Iron (Fe)	mg/l	<3.0	<1.5
21	Boron (B)	mg/l	<2.0	<1.0
22	Manganese (Mn)	mg/l	<5.0	<3.0
23	Cadmium (Cd)	mg/l	<0.1	<0.05
24	Chromium (Cr)+3	mg/l	<1.0	<0.5
25	Chromium (Cr)+6	mg/l	<1.0	<0.5
26	Copper (Cu)	mg/l	<2.0	<1.5
27	Lead (Pb)	mg/l	<1.0	<0.3
28	Mercury (Hg)	mg/l	<0.005	<0.002
29	Nickel (Ni)	mg/l	<2.0	<0.5
30	Selenium (Se)	mg/l	<0.1	<0.05
32	Zinc (Zn)	mg/l	<15.0	<10.0
34	Ammonia (NH3)	mg/l	<8.0	<5.0
35	DO	mg/l	>2.0	>7.0

7.9 Domestic Waste Treatment

The individual industrial units will carry out own domestic waste treatment through small treatment facilities on their own.

Wastewater Collection System: The basic process of waste water treatment was explained in the previous section (sewerage system). Waste water should be treated at a primary treatment facility equipped by the tenants and the waste water flows into the underground pipes along the road. The lifting stations are necessary to lift the waste water to arrive at the central treatment plant. Eventually the dimension of the collection pipes is increased. The waste water collection pipe network is shown in the following figure.

Figure 7.20: Waste Water Collection Network



7.10 Solid Waste Treatment and Management

The management of waste is a key component in a business' ability to maintaining ISO14001 accreditation. Companies are encouraged to improve environmental efficiencies each year by eliminating waste. The following solid waste management plan for the proposed industries like light engineering, RMG, furniture, pharmaceutical and food processing in BEZ need to be addressed.

7.10.1 Inventory of Hazardous Waste Generation

Since industries change their products, processes and capacity of production, and new industries get established periodic, updating of inventories is required. It should be made mandatory on the part of industries to report changes/additions in hazardous waste generation and steps taken to reduce generation of waste per unit of production. Industries will be required to store hazardous waste for a period not exceeding 90 days and shall maintain a record of sale, transfer, storage, recycling and reprocessing of such wastes like Iron chips, waste iron, Jhuta, cotton, polythene, paper, steel, aluminum, copper, cardboard materials, waste accessories, wood, unused drugs, pressurized containers, air pollution control equipment, packaging wastes and laboratory wastes, food wastes, leaves, peels, pomace, skins, rinds, cores, pits, pulp, stems, seeds, twigs, and spoiled fruits and vegetables unless agreed by DoE and BEZA. The waste could either be recycled /reused or disposed of in captive or common Treatment, Storage and Disposed Facilities (TSDF) available in the country, or be incinerated. Inventories of 'end of life' consumer products such as e-waste are also required to be made.

7.10.2 Waste Avoidance and Waste Minimization at Source

In the hierarchy of waste management, waste avoidance and waste minimization have to be attempted first, for which dissemination of information on technological options should be a continuing exercise. Promote implementation of recovery of resources such as solvents, other reagents and by-products as well as re-generation of spent catalysts in a time frame manner.

7.10.3 Reuse, Recovery and Recycling of Hazardous Waste

Industrial associations/industries should explore options/ opportunities of reusing, recovery and recycling of hazardous waste in an environmentally sound manner. Establishment of 'Waste Exchange Banks/ Centers' should be encouraged to provide information on wastes and promote reuse, recovery and recycling technologies which upscale the quality of resource recovery. Introduce payback scheme as part of extended corporate responsibility in case of lead-acid batteries. Develop a system for channel sing of wastes containing toxic metals for recovery, such as mercury from thermometers and fluorescent tube lights, cadmium from batteries etc.

7.10.4 Encourage Cleaner Production and eco-design Practice

Encourage cleaner production and eco-design practice within each manufacturing sector:

This is a process which minimizes environmental impact across the product life cycle, whilst producing a high quality, cost-effective product.

7.10.5 Encourage the use of Environmental Product Labeling

Encourage the use of Environmental Product Labeling on products to enable consumers to make informed choices about the products they buy.

7.10.6 Encourage the implementation of Environmental Management Systems (EMS)

Encourage the implementation of Environmental Management Systems (EMS), which can result in better resource efficiency and increased awareness of waste prevention and recycling practices throughout staff, the DoE and BEZA, will promote the implementation of EMS through the provision of guidance, advice and leading by example.

7.10.7 Safe Disposal of Hazardous Waste

For the waste which cannot be recycled/ reused, safe and environmentally sound disposal should be adopted depending upon waste category. Design and operation norms of disposal facilities should be strictly adhered to as per the guidelines to be framed by DoE. Supervision of such facilities by DoE and BEZA during construction stage is required to ensure quality of construction as per guidelines, including post closure monitoring.

7.10.8 Setting up of Common Treatment, Storage and Disposal Facilities (TSDFs)

Setting-up of TSDFs should be considered within industrial estates/ EPZs. The Government may consider providing financial support for establishing such treatment facilities. The TSDFs shall cater to meticulously delineated hazardous waste catchments areas taking into consideration their distance from the generators and availability of wastes. DoE and BEZA shall ensure that in a given hazardous waste catchments area, there are no multiple operating TSDFs. Unit Investor will be encouraged to establish TSDFs.

7.10.9 Transportation of Hazardous Waste

BEZA will develop on-line tracking system for movement of hazardous waste from generation to the disposal/ recovery/ recycle stage. Industries have to pay for collection and transportation of waste for treatment and disposal outside the industries own premises.

7.10.10 Use of Cement Kilns for Hazardous Waste Incineration

Use of hazardous wastes (such as ETP sludge from dyes & dye intermediates, tyre chips, paint sludge, Toluene-Die-Isocynate tar residue and refinery sludge) as supplementary fuels in cement kilns need to be promoted.

7.10.11 Illegal Dump Sites and Remediation

To take care of illegal dumping, surveillance both by enforcement agencies and industry associations needs to be stepped up. The approach for site remediation of dump sites would vary from site to site depending on nature of pollutants, future damage potential

and remedial cost. The remediation strategy should focus on the 'Polluter Pays Principle' which needs to be strictly enforced. In such a case, the polluter has to reinstate or restore the damaged or destroyed elements of the environment at his cost. To take care of cases of remediation wherein polluters are not traceable, a dedicated fund needs to be created by MoEFCC.

7.10.12 Strengthening the Infrastructure of Regulatory Bodies

For effective enforcement of regulations, DoE has to be strengthened in terms of manpower, equipment, instruments and other infrastructure facilities. The Government may support DoE by adequate funding, training and awareness programmes, periodically. BEZA, in this case, would co-operate the DoE.

7.10.13 Disposal of Date Expired Drugs and Pesticides

In order to deal with such hazardous wastes, as well as disposal in a facility as per following options should be permitted:

- To have these processed wherever possible by the industry.
- To appropriately incinerate either through dedicated incinerators of individual industry or through incinerators available with common facilities.

7.11 Administration/One-stop Service Building and Other Supporting Buildings

The administrative/One-Stop Service Building shall be built at the left side of the entrance with four storied building having 11,824 m^2 (2,956 m^2 on each floor). The following functions shall be included:

- One-Stop Service Division (about 10 staffs)
- Economic Zone Administration Division (about 30 staffs)
- Security Office (10 staffs: 24 hours)
- Presentation/Seminar Room (50 people can be accommodated)
- Meeting Rooms (3 Rooms)
- Custom House

The commercial building shall be built at the right side of the entrance with five storied building having 15,226 m^2 (3,045 m^2 on each floor). The following functions shall be included:

- Banks
- Insurance companies
- Shopping mall/market
- Restaurants
- Residential hotel

7.12 Standard Factory Building

The Standard Factory Buildings shall be built at the west side of EZ with four storied building of different sizes for commercial use of EZ.

7.13 Supporting Buildings

Fire station: The fire service building shall be three storied building with gas metering station having 2,448 m^2 (816 m^2 on each floor). All the function shall be included as per fire service requirements or demand.

Police/security station: The police/security building shall be two storied building having 1,295 m^2 (648 m^2 on each floor). All the function shall be included as per security requirements or demand.

Training Center: The training center building shall be three storied building having 1,856 m^2 (619 m^2 on each floor). All the function shall be included as per vocational training requirements or demand.

Secondary School: The school building shall be four storied building having 3,840 m^2 (960 m^2 on each floor). All the function shall be included as per education requirements or demand.

Health and Daycare Center: The Health and Daycare building shall be four storied building having 26,911 m^2 (6,728 m^2 on each floor). All the function shall be included as per health requirements or demand.

8 Environmental Review

The environmental and social baseline is the existing status of environment and society around the proposed project site. It has been analyzed through assessment of environmental components like air, water, land, noise, soil, etc. and environmental characteristics like physical, biological and socio-economic status of the study area within the 10 km radial zone of the project site. Physical environment includes topography, land, soil, meteorology, air, water, noise, etc. and the biological environment includes flora and fauna. Socio-economic environment of the study area includes demography, ethnicity, religion, education and employment opportunity, occupation, income, poverty, social relations, etc. Baseline environmental conditions are based on the data collected from various related agencies and the secondary documents from published sources and websites. The baseline provides the basis for assessment of impact (potential changes in the baseline conditions) due to the development of proposed BEZ. The site is located at Shajahanpur Upazila of Bogura District.

The site is approximately 0.2 km away from the Rajshahi-Bogura Highway. Shahjahanpur Upazila headquarter is about 4.5 km away from the project site. Within the project influential area (10 km), a branch of Karatoya River is flowing just 4.27 km away from the project site. BSCIC industrial estate is about 8.8 km away from the project site. The following figures and tables show the project location, 10 km radius map and existing environmental settings respectively.

Figure 8.1: Location Map of Bogura Economic Zone

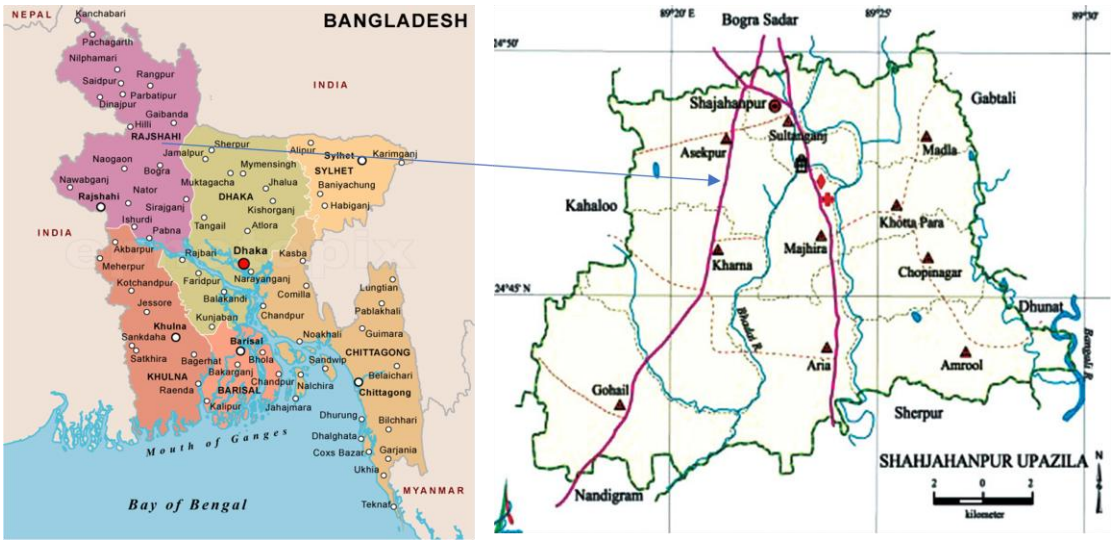


Figure 8.2: Objects within 10 km Radius of BEZ

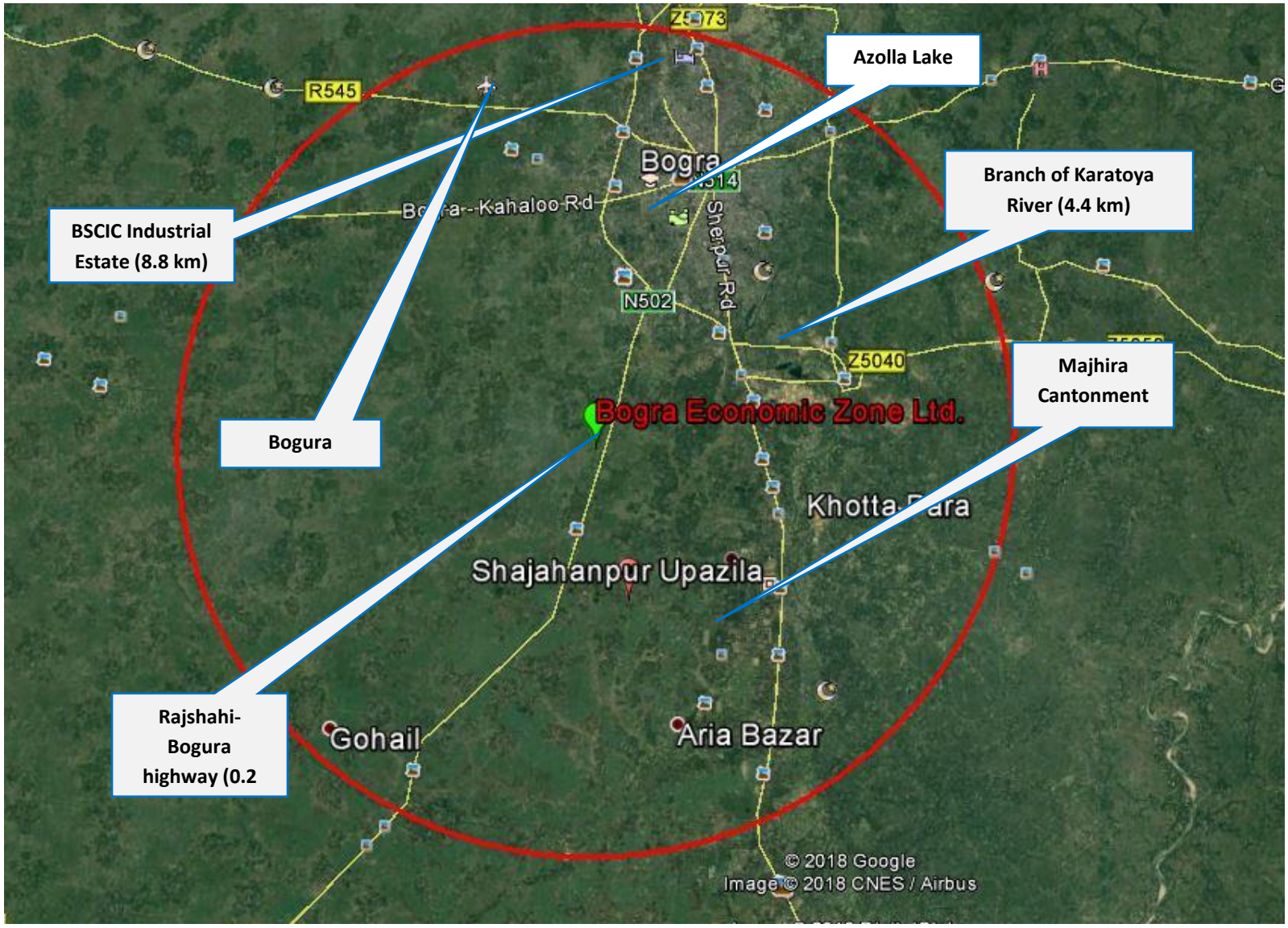


Table 8.1: Important Features of the BEZ at A Glance[91]

	Parameters	Description
1.	Climate	Bogura District is situated at a tropical monsoon climate zone. The annual average temperature varies maximum 35.6°C to minimum 9.5°C and the average annual rainfall ranged 1106 to 2157 mm. Average humidity normally varies in the range of 75-81% throughout the year.
2.	Ecologically Critical Area	No ecologically critical areas were found within the study area.
	Reserve/Protected Forests	No reserve or protected forests area was found within the study area.
3.	Predominant Geological Formations	Bogura District lies in the Rajshahi Division of Bangladesh which falls under a stable Precambrian Platform and is characterized by limited to moderate thickness of sedimentary rocks above a Precambrian igneous and metamorphic basement. The unit is geologically stable in relative terms and has not been affected by fold movement.
4.	Topography	The topography of the project area is arable flat land.
5.	Major Physiographic Units	The proposed BEZ is located mostly in Tista floodplain
6.	Major Soil Type	The soils are grey silt loams and silty clay loams on ridges and grey or dark grey clays in basins. Five general soil types occur in the region, of which non-calcareous grey floodplain and non-calcareous dark grey floodplain soils predominate. The soil is moderately acidic throughout. Organic matter contents are generally low in the cultivated layer of ridge soils and moderate in basins. General fertility is medium.
7.	Major crops	Like other areas of Bangladesh, agriculture is important part of the project area. The major crops in the project area are paddy, pulses, potato, corn, vegetables etc.
8.	Flooding	The proposed project area gets inundated with flood water during rainy season.
9.	Seismicity	The project area falls in the earthquake Zone-II of the seismic map of Bangladesh. This zone refers comparatively medium intensity of seismic effects.
10.	Environment and Social Hotspots	River, Canals, Homestead forests and vegetation, School, College, Madrasha, Mosjid, Mandir, Math etc.
11.	Major Settlement	Residential area, Commercial area, Industrial Area, Bus terminals, Institutional structures, etc.
12.	Major Industries/ Business Entrepreneurs	Rice mill, Jute mill, Loom, Textile industry, Small scale cottage industry, Bamboo and cane industry, Wooden furniture, Saw mill.

Table 8.2: Existing Environmental Settings of BEZ[92]

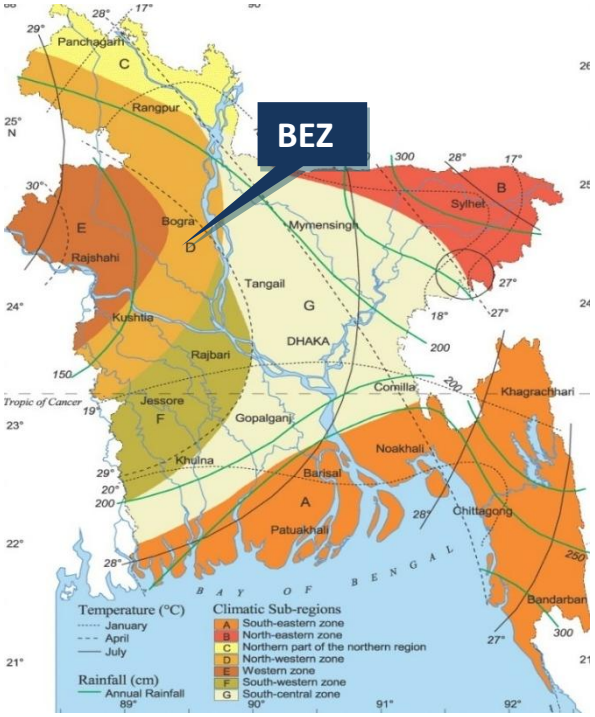
Particulars	Details
Location	Chokjora, Jora, Partekur, Birgaon and Chokveilmuzas of Shajahanpur Upazila under Bogura District.
Total Area	251.43 acres
Site Elevation	17.22 m from MSL

[91] BBS District Statistics of Bogura, 2011; Banglapedia, 2018 and Field Visit
[92] Google Earth, BBS District Statistics of Bogura, 2011andField Visits

Particulars	Details
Land Type	Combination of Highland and Medium high land
Nearest Airport	Shah Makhdum Airport (Approx.84.32 km away from the project site)
Nearest Railway Station	Bogura Railway Station (6.58 km away from the project site)
Nearest Port	Hilly land port (83.4 km from the project site), Sonamasjid Land Port (176 km from the project site)
Climatic conditions	**Temperature:** The annual average temperature varies maximum **35.6^{0}C** to minimum **9.5^{0}C** **Humidity:** Average humidity normally varies in the range of **75-81%** throughout the year. **Rainfall:** The average annual rainfall ranged **1106 to 2157 mm.**
Seismic Zone	Zone II (Seismic coefficient is 0.05 g)
Forests / National Parks	None within 10 km
Archaeological Site	Khadash Rajbari (Gohail), three doomed Gohail Jami Mosque built by Pandit Shah, Buddhist Math (Bergari), Jami Mosque (Ullah Akanda Para).
Water Bodies	Branch of Karatoya River (4.4 km away from the project site), Azolla Lake etc.

8.1 Meteorology

Figure 8.3: Climatic Sub-regions of Bangladesh Indicating the BEZ site



Bangladesh is located in the tropical monsoon region and its climate is characterized by high temperature, heavy rainfall, often excessive humidity and fairly marked seasonal variations. From the climatic point of view, three distinct seasons can be recognised in Bangladesh- the cool dry season from November to February, the pre-monsoon hot season from March to May and the rainy monsoon season which lasts from June to September. January is the coolest month with temperature averaging near 26^{0}C and April the warmest with temperatures from 33 to 36^{0}C. Most places receive more than 1525 mm rainfall in a year and areas near the hills receive 5080 mm. Most rain occurs during the monsoon (June-September) and little in winter (November-February). Moderate rains are also reported in Months of March, April and October. The climatic sub-regions of Bangladesh are presented in the following Figure and as per that, the Bogura District falls in two climatic sub-regions namely North-Western and Western Zones.

Climatic conditions of the study area were collected from the Bangladesh Meteorological Department at Bogura station. Rainfall, temperature, relative humidity and wind speed are described in the following sections.[93]

[93] http://www.agrislide.com/climatic-sub-regions-of-bangladesh/

Temperature: The period from February to March is marked by continuous increase in the temperatures. The monthly minimum average temperature varies from 9.5 to 27.1^{0}C during the period of 2003 to 2017. The monthly maximum average temperature varies from 21.3 to 35.6^{0}C over the period of 2003-2017. The monthly maximum and minimum average temperatures over the period of 2003 to 2017 has been given in the following tables at Bogura station.

Table 8.3: Monthly Minimum Average Temperature at Bogura Station[94]

Year	Monthly Minimum Average Temperature in Degree Celsius											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2003	9.50	15.20	18.4	23.1	23.9	25.7	26.8	26.8	26.1	24.1	18.1	14.6
2004	11.7	14.4	20.9	22.7	25.1	25.0	25.8	26.5	25.4	22.5	17.5	14.5
2005	12.1	16.0	20.6	22.8	23.2	26.3	26.2	26.7	26.2	23.5	18.1	13.9
2006	11.9	17.9	19.3	22.4	24.4	26.1	26.8	26.5	25.8	23.4	18.4	14.1
2007	10.7	15.5	17.8	23.3	25.3	25.4	26.3	26.7	26.1	23.8	19.1	12.9
2008	12.5	13.0	20.5	23.2	24.4	25.8	26.1	26.4	26.1	23.0	17.9	16.1
2009	13.1	13.9	19.1	23.7	24.1	26.0	26.7	26.2	26.3	23.2	18.8	13.2
2010	10.9	14.4	20.9	24.8	25.1	26.3	27.1	26.9	26	23.8	19.5	13.5
2011	10.1	14.7	20.1	22.4	23.6	26.1	26.5	26.3	26.2	24.2	18.0	13.0
2012	12.2	13.9	19.5	22.7	25.6	26.4	26.7	26.9	26.4	22.9	17.3	13.0
2013	10.3	15.1	19.9	22.8	24.5	26.8	26.9	26.5	26.6	23.8	17.4	12.2
2014	12.3	13.8	18.7	23.2	25.2	26.0	26.9	26.6	25.9	23.5	17.9	13.7
2015	12.6	15.3	18.8	21.4	23.7	25.9	25.8	26.1	25.9	23.1	18.8	13.7
2016	11.8	16.3	20.9	25.6	23.9	26.6	26.6	26.6	27.0	24.5	18.9	15.2
2017	12.8	15.4	18.9	23.0	24.7	26.50	-	-	-	-	-	-

Table 8.4: Monthly Maximum Average Temperature at Bogura Station[95]

Year	Monthly maximum average Temperature in Degree Celsius											
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2003	21.3	26.9	29.0	33.2	33.3	31.6	33.0	33.1	32.4	30.7	29.9	26.3
2004	-	27.9	32.1	32.1	35.0	32.5	31.5	33.0	31.1	30.8	29.7	26.8
2005	24.2	28.1	33.4	32.7	34.1	32.0	32.7	33.0	33.5	30.1	29.3	27.2
2006	24.2	30.1	32.3	32.5	33.7	33.1	33.3	33.5	32.6	32.7	29.4	26.9
2007	24.2	25.9	30.2	32.9	35.6	32.4	32.2	32.9	32.6	32.0	30.6	26.1
2008	24.0	31.0	25.9	34.0	34.4	32.1	31.8	32.2	33.1	31.9	30.3	25.6
2009	24.8	29.2	31.7	34.5	33.1	34.6	33.6	32.2	33.3	32.7	30.3	25.6
2010	22.9	28.5	33.5	34.3	34.3	33.2	33.5	33.3	32.9	32.8	30.7	26.5
2011	22.2	28.3	31.6	33.1	33.0	33.3	32.9	32.1	32.9	33.8	29.9	24.4
2012	23.9	28.1	32.6	33.4	35.2	33.4	32.0	33.3	33.0	33.3	29.3	23.1
2013	23.7	28.6	32.8	33.7	32.0	34.5	33.6	32.8	33.6	31.4	30.7	26.0
2014	23.3	25.8	31.5	35.5	35.1	33.1	33.2	33.4	32.4	31.4	30.9	25.0
2015	24.1	27.8	31.2	31.8	33.6	33.2	32.8	32.5	33.4	33.3	31.1	25.7
2016	24.4	29.1	32.5	35.5	33.2	33.8	32.8	33.7	32.9	33.0	30.0	27.6
2017	25.8	28.7	29.1	32.1	33.6	33.1	-	-	-	-	-	-

[94] BBS Yearbook of Agricultural Statistics (2012-17) and Statistical Bulletin (April 2015-December 2017)
[95] Same as above

Humidity: Due to heavy rainfall and proximity to Bay of Bengal, the humidity levels in Bangladesh remains high. Relative humidity in the project area varies 75-81% over the period of 2008-2017. March is the driest month with minimum humidity in the project site. The monthly variation of humidity patterns in the project area over the period of 2008-2017 has been given in the following table.

Table 8.5: Monthly Average Humidity at the Project Site[96]

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Annual
2008	79	72	73	71	74	84	85	84	82	81	74	82	78
2009	81	65	64	69	77	78	81	85	82	79	74	79	76
2010	80	66	64	75	74	82	81	82	83	81	74	74	76
2011	79	68	66	71	77	81	82	85	83	77	75	81	77
2012	74	63	60	70	71	80	83	82	83	78	74	84	75
2013	76	67	63	-	81	79	81	85	82	83	78	-	-
2014	82	72	62	62	72	83	83	85	85	79	73	83	76
2015	79	74	67	76	76	82	83	85	81	78	75	77	77
2016	79	67	62	68	74	76	85	77	85	80	74	81	81
2017	75	66	67	75	79	-	-	-	-	-	-	-	-

Rainfall: About 80% of the precipitation occurs during five monsoon months (May to September). Minimum precipitations are recorded during the month of November to February whereas aveage showering does occur in March, April and October. The monthly and yearly total rainfall at the project site during the period of 2003 to 2017 have been given in following Table. The total annual rainfall in the project area ranged 1106 to 2157 mm over the period of 2003-2017.

Table 8.6: Rainfall Characteristics of the Study Area, 2003-2017[97]

Year	Monthly and yearly total rainfall (mm)												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Yearly Total
2003	4	53	72	113	214	364	219	220	156	264	0	13	1,692
2004	0	0	45	90	137	638	529	261	206	251	0	0	2,157
2005	5	9	58	72	138	130	471	328	356	523	0	1	2,091
2006	0	0	12	143	193	184	192	138	174	69	1	0	1,106
2007	0	18	25	28	92	732	320	256	302	131	15	0	1,919
2008	27	0	20	22	213	393	474	374	109	159	0	0	1,791
2009	0	3	3	49	205	128	194	570	169	89	0	0	1,410
2010	0	0	0	29	185	286	92	225	244	190	2	20	1,274
2011	1	0	7	145	194	193	175	606	389	0	11	0	1,721
2012	19	0	0	74	94	147	186	164	345	74	36	1	1,140
2013	0	0	3	43	154	250	235	255	112	487	0	0	1,539
2014	0	54	0	43	206	580	181	2444	722	21	0	1	2,052
2015	12	72	21	202	220	310	213	293	198	40	0	0	1,581
2016	15	0	22	8	223	227	438	151	322	270	0	0	1,676
2017	0	0	99	174	223	227	-	-	-	-	-	-	-

[96] BBS Yearbook of Agricultural Statistics (2012-17) and Statistical Bulletin (April 2015-December 2017)
[97] Same as above

Evaporation: The highest and lowest evaporation of the project area were 137 mm and 71 mm, respectively in the month of January and November. The monthly evaporation pattern shows a static trend from January to June and increased at July to October and decreased further at November. The monthly evaporation pattern of the project area has been given in the following figure

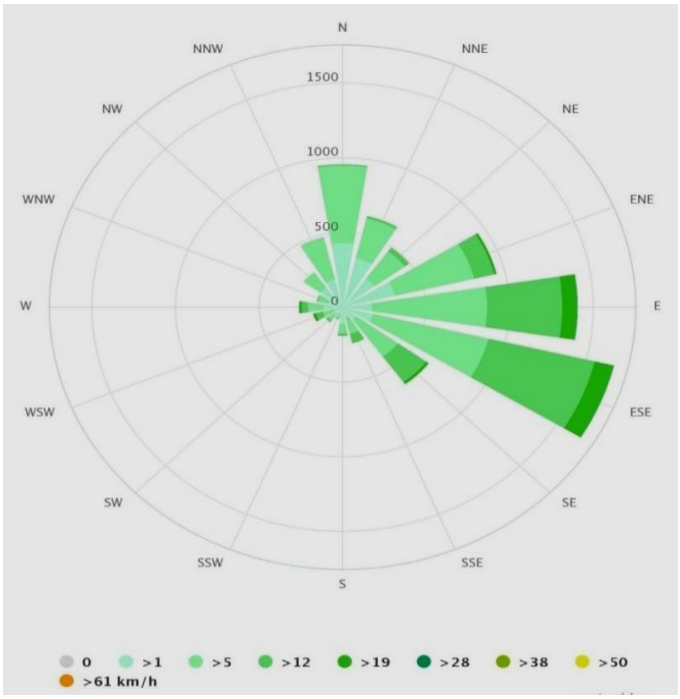
Figure 8.4: Average Monthly Evaporation (mm) over the Year at the Project Area[98]

Wind Speed and Direction: Bangladesh have sub-tropical climate with have seasonal variation of wind speed and direction. The annual normal wind speed of the project site is 2.02 m/s which are shown in the following table and figure.

Table 8.7: Annual Normal Wind Speed (m/s) of the Project Site[99]

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Bogura	1.29	1.58	2.17	3.07	3.12	2.90	2.65	2.38	1.90	1.20	0.96	1.05	2.02

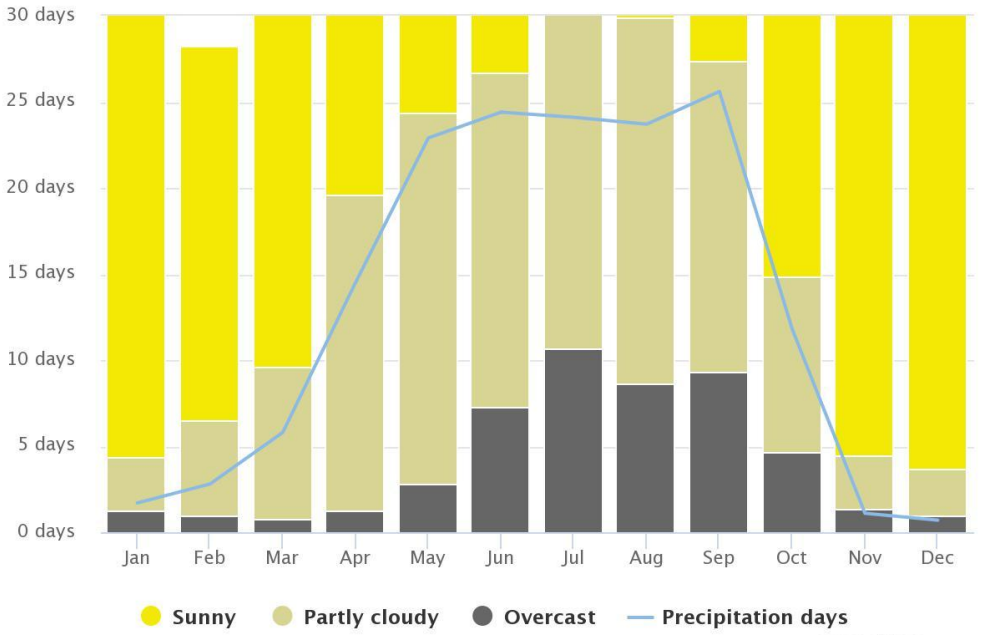
Figure 8.5: Wind Rose Map of the Project Area[100]



[98] BBS Yearbook of Agricultural Statistics (2012-17) and Statistical Bulletin (April 2015-December 2017)
[99] Same as above
[100] https://www.meteoblue.com/en/weather/forecast/modelclimate/Bogura_bangladesh_1337233

Sun Shine Hours: Sunshine duration or sunshine hours is a climatological indicator, measuring duration of sunshine in a given period (usually, a day or a year) for a given location on Earth, typically expressed as an averaged value over several years. It is a general indicator of cloudiness of a location, and thus differs from in solution, which measures the total energy delivered by sunlight over a given period. Sunshine duration is usually expressed in hours per year, or in (average) hours per day. In the project area, December is the sunniest, followed by January and November. July and August have the lowest amount of sunshine. The average monthly sunshine hours at the project has been given in the following figure.

Figure 8.6: Average Monthly Sunshine Hours in the Project Area[101]



8.2 Air Quality and Noise

8.2.1 Ambient Air Quality

Shajahanpur Upazila is not heavily industrialized. The present ambient air quality of the concerned area, as a result, is not much contaminated. To assess the present air quality of the area, one Ambient Air Quality Monitoring (AAQM) Stations were setup. The locations of the monitoring stations for air quality study were selected on the basis of meteorological data, topography, sensitive locations, stack height, etc. Predominant wind direction during the season is from south and south west. Monitoring was conducted in respect of the following parameters:

a. Total Suspended Particulate Matter (SPM)
b. Oxides of Sulphur (SOx)
c. Oxides Nitrogen (NO_x)

All the above-mentioned pollutants were monitored at the station. The equipments were placed at a height of 3 to 7 meters above ground level at the monitoring stations, thus negating the effects of windblown ground dust and free from vertical obstructions within a cone of 120^o from the actual position of the sampler, to avoid any impedance to the pollutants. The equipment was always placed at open space free from trees and vegetation which otherwise act as a sink of pollutants resulting in lower levels in monitoring results. The results were compared with respect

[101] https://www.meteoblue.com/en/weather/forecast/modelclimate/Bogura_bangladesh_1337233

to standard of ECR, 1997 for industrial and mixed area. Summary of the monitored air quality results are given below in the following table. All the air quality parameters were within the acceptable range prescribed by Environmental Conservation Rules (ECR), 1997.

Table 8.8: Determination of Air Quality of the Project Area[102]

Air quality parameters	SPM (µg/m3)	$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	SOx (µg/m3)	NOx (µg/m3)
Average concentration	30	10	15	20	25
Standard Limit (Draft, 2017)	200	35	150	120	200

8.2.2 Ambient Noise Level

Data indicates that the existing noise levels in proposed area are within the range of Bangladesh Environmental Quality Standard as well as WB General EHS Guidelines, 2007 for residential zone. This report uses the primary data as baseline data of noise environment.

Table 8.9: Noise Level in the Project Area[103]

Location	Noise level dB(A)	BD Standard dB(A) (Noise Pollution (Control) Rules, 2006)
	Day Time	Day Time
South-West Corner	25	75
North-West Corner	25	
South-East Corner	50	
North-East Corner	50	

The baseline noise environment in the project area was within the range accepted by Bangladesh Environmental Quality Standard (Noise Pollution (Control) Rules, 2006)

8.2.3 Air Pollution and Noise Sources from Existing and Known Sources

Existing and known sources of Noise: Noise attenuation is typically described as a set reduction in decibel level per doubling of distance from the source. Depending on the nature of the noise source, sound propagates at different rates. Measures of sound level from a source should specify the distance from the source. The standard reference distance for sound levels at the source is 50 feet. Natural factors such as topography, vegetation, and temperature can further reduce noise over distance. The two most common types of noise are point source and line source. Point source noise is associated with noise that remains in one place for extended periods of time, such as with construction activities. Line source noise is generated by moving objects along a linear corridor. Highway traffic is the best example of line source noise. The standard reduction for point source noise is 6 dB per doubling of distance from the source while for a line source it is 3 dB per doubling of distance from the source.

Construction Noise: One of the easiest things to identify and one of the hardest things to quantify is noise associated with the actual construction of the project. How much noise construction activities will generate, how often will it occur, and how long will it last are all questions that should be answered in the assessment. Construction is usually performed in a series of steps or phases, and noise associated with different phases can vary greatly. However,

[102] Bangladesh Environmental Engineering Training and Lab. Services Ltd.
[103] Same as above

similarities in noise sources allow typical construction equipment to be placed into one of three categories: heavy equipment, stationary equipment, or impact equipment.

Heavy equipment: Heavy equipment can be defined as earth-moving equipment, such as excavating machinery like excavators, backhoes, and front loaders, as well as handling equipment like graders, pavers, rollers, and dump trucks. Noise levels at 50 feet from heavy equipment range from about 72 to 97 dB. During the phase of construction using heavy equipment, noise is generated more or less at a constant level. Therefore, noise levels can be equated to an average hourly level.

Stationary Equipment: Stationary equipment such as pumps, power generators, and air compressors, Effluent treatment plant (ETP) etc., generally run continuously at relatively constant power and speed. Noise levels at 50 feet from stationary equipment can range from 68 to 88 dB, with pumps typically in the quieter range. An averaged noise level may be assumed for stationary equipment because of its fixed location and constant noise pattern.

Existing and known sources of Air pollutants: There are several sources of air pollutants like stake emissions, emissions from different processing units, emissions from vehicles, emissions from landfill discharge, emissions from natural gas use, emissions from electricity consumption etc.

8.3 Water Resources

Surface Water System: The nearest River of the project site is Karatoya River. Karatoya River an intriguing river, formerly the main channel of the tista, and perhaps a distributary of the brahmaputra. In the Siyar-al-Mutakhkhirin it is recorded that this river was three times the size of the ganges when bakhtiyarkhalji invaded the Northern Region. The Jamuneshwari-Karatoya flows in slight meanders south-southeast to Gobindaganjupazila where the main stream turns east through the Katakhali and falls into the bangali. The portion of the former river passing through shibganjupazila is dry most of the year. It effectively separates the Rangpur-Karatoya from the Bogura-Karatoya. The latter river flows south past Bogura town till it joins the Bangali to make Phuljhor river, which falls into the hurasagar. The maximum discharge of the Bogura-Karatoya is below 3,000 cusec and has declined rapidly since the construction of the Brahmaputra Right Embankment. The fourth part, the Pabna-Karatoya, is a moribund riverbed near Handial. Various other channels are also pointed out as parts of the old Karatoya.

Water quality Analysis: Water sampling and analysis were undertaken to understand the overall baseline water quality characteristics of the surface and groundwater in the project area. The surface water sampling was based on the identification of the major surface water body and its interaction with the project. Ground water sampling locations were selected to obtain representative water samples from various zones within the project area. The samples were collected from existing tube well (Hand pump being used by the villagers). A total of five (5) ground water samples were collected from the studied area. There were no surface water bodies within the project site. The samples were analysed for parameters covering physical, chemical and bacteriological characteristics as mentioned in the scope of works. Water samples were collected randomly in pre-washed sterile glass bottles. The surface water quality was compared with the Bangladesh ECR, 1997 standard for best practise classification criteria and has been given in the following table.

Table 8.10: Surface Water Quality of the Project Site[104]

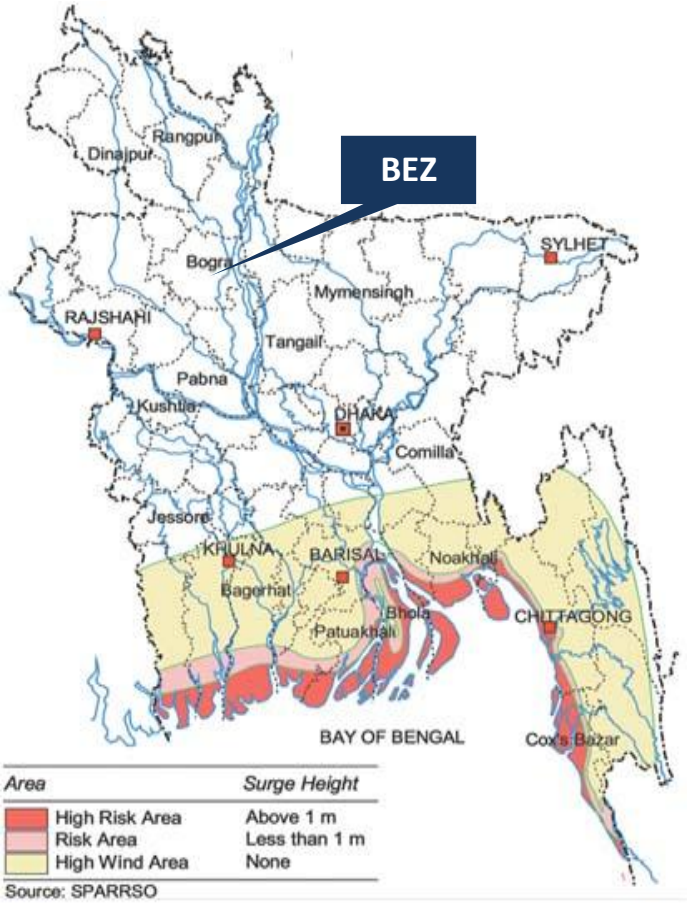
	Water quality parameters	Unit	Analysis Method	Analysis Result (Concentration)	Bangladesh Standards (Best Practise based classification) *					
					Sources of drinking water for supply only after disinfection	Water useable for recreational activity	Sources of drinking water after conventional treatment.	Water useable by fisheries	Water useable by industries	Water useable for irrigation
1.	Temperature	^{0}C	Digital Thermometer	22.50	-	-	-	-	-	-
2.	TDS	mg/L	TDS meter	95	-	-	-	-	-	-
3.	EC	µS/Cm^{-1}	EC meter	200	-	-	-	-	-	2250 µS/Cm^{-1} (at 25 ^{0}C)
4.	DO	mg/L	DO meter	8.0	6 or above 6.5-8.5	5 or above 6.5-8.5	6 or above 6.5-8.5	5 or above 6.5-8.5	5 or above 6.5-8.5	5 or above 6.5-8.5
5.	pH	-	pH meter	7.1	-	-	-	-	-	-
6.	Salinity	mg/L	Digital salinity meter	0.10	-	-	-	-	-	-
7.	BOD	mg/L	APHA, 1998	0.89	2 or less	3 or less	6 or less	6 or less	10 or less	10 or less
8.	COD	mg/L	APHA, 1998	26						
9.	Total coliform	CFU/100 ml	APHA, 1998	>200	50 or less	200 or less	5000 or less	5000 or less	5000 or less	5000 or less
10.	Fecal Coliform	CFU/100 ml	Membrane Filter methods	Nil	-	-	-	-	-	-
11.	Nitrate	mg/L	Ion Chromatography	0.71	-	-	-	-	-	-
12.	Nitrite	mg/L	Ion Chromatography	<0.05	-	-	-	-	-	-
13.	Manganese	mg/L	AAS	BDL	-	-	-	-	-	-
14.	Phosphate	mg/L	Colorimetric Method	0.59	-	-	-	-	-	-
15.	Iron	mg/L	AAS	0.20	-	-	-	-	-	-
16.	Turbidity	NTU	APHA, 1998	320	-	-	-	-	-	-
17.	Alkalinity	mg/L	APHA, 1998	220	-	-	-	-	-	-
18.	Chromium	mg/L	AAS	<0.01	-	-	-	-	-	-
19.	Arsenic (As)	mg/L	AAS	BDL	-	-	-	-	-	-

*BDD= Below Detection Limit; *CFU= Colony Forming Unit

[104] Bangladesh Environmental Engineering Training and Lab. Services Ltd.

Tropical Cyclones and Tidal Flooding: Natural hazards can be categorized into three broad categories in Bangladesh, like exogenic hazards caused by the earth surface processes (flood, riverbank erosion, coastal erosion, landslide, soil erosion and groundwater contamination); endogenic hazards caused by internal earth processes (earthquake and volcanic eruption); and, atmospheric hazards caused by atmospheric processes (storm, cyclone, northwester, tornado, hurricane, drought, etc.). On many occasions there are overlaps between these different events. Natural hazards can be profiled against seven basic criteria such as event magnitude, frequency of occurring, duration and areal extent, speed of onset, spatial dispersion and temporal spacing.

Figure 8.7: Position of BEZ with respect to Cyclone Affected Areas of Bangladesh[105]



Eighty%ages of Bangladesh are floodplain (the project area is also included), and it has an extensive sea coastline, rendering the nation very much at risk of periodic widespread damage. But, the cyclone risk map shows the location of BEZ is in a very safe zone. Due to a cyclone, rising of water level and tidal flooding from Rivers was not experienced before in the project area. Bangladesh is prone to seasonal flooding due to being situated on the Ganges Delta and the many distributaries flowing into the Bay of Bengal. Flooding normally occurs during the monsoon season from June to September. The convectional rainfall of the monsoon is added to by relief rainfall caused by the Himalayas. Melted water from the Himalayas is also a significant reason.

[105]https://www.thebangladesh.net/cyclone-maps-of-bangladesh.html#map-1

Figure 8.8: Position of BEZ with respect to Flood Prone Areas of Bangladesh[106]

The flood prone map of Bangladesh shows that proposed BEZ falls in River/Monsoon Flood Area.

Salinity: Salinity issues are mainly associated with coastal regions in Bangladesh.The figure given below shows the saline zones of Bangladesh which clearly indicates that the proposed BEZ site is in salinity free zone . The surface water of rivers are non-saline.

Figure 8.9: Salinity Zones of Bangladesh Indicating the Project Site[107]

[106] http://en.banglapedia.org/index.php?title=Flood
[107] http://en.banglapedia.org/index.php?title=Saline_Soil

Drainage Congestion and water logging: The proposed project site has several natural drainage systems. There is no possibility of water logging in that site. It will be developed proper drainage system for the site and preserved the natural water bodies. So, it is unlikely that the area would face drainage congestion and water logging.

Erosion and sedimentation: Millions of people of the country are affected by riverbank erosion every year that damages standing crops, farmland and homestead land. During monsoon, extensive overbank spills, bank erosion and bank-line shifts have become typical. The unpredictable shifting behaviour of the rivers and encroachments not only affect the rural floodplain population but also the urban growth centres and infrastructures.

Table 8.11: Occurrence of River Erosion during 2008-2011 in Various Upazila of Bogura[108]

Upazilas	2008	2009	2010	2011
Adamdighi	Yes	Yes	Yes	Yes
Bogurasadar	No	No	No	No
Dhunat	Yes	Yes	Yes	Yes
Dhupchanchia	No	No	No	No
Gabtali	Yes	Yes	Yes	Yes
Kahaloo	No	No	No	No
Nandigram	No	No	No	No
Sariakandi	Yes	Yes	Yes	Yes
Shajahanpur	***No***	***No***	***No***	***No***
Sherpur	No	No	No	No
Shibganj	No	No	No	No
Sonatola	Yes	Yes	Yes	Yes

From the above table it is evident that the project area is free from river bank erosion as there was no significant river beside the project.

Ground Water System: Hydro-stratigraphy is mainly reliant on the aquifer materials and its geometry which is the lateral and vertical extent of the aquifer. Generally subsurface geological cross section, multi-log section is satisfactory way in determining the location of the aquifers, aquifer geometry and variability of aquifer materials (Mukherjee et al., 2007). The lithology of borelogs consists of nine major types of unconsolidated sediments: clay, silty clay, very fine to fine sand, fine to medium sand, fine to medium sand with gravel, fine to coarse sand with gravel, medium to coarse sand, coarse sand, gravel. From the hydro-stratigraphic point of view, sand and gravel are considered as aquifer and clay and silty clay as aquitard.

Table 8.12: Ground Water Quality Data of the Project Site[109]

	Parameters	Unit	Concentration present	Bangladesh Standard for Drinking water (ECR, 1997)	Analysis Method
1.	Temperature	^{0}C	28	-	Digital thermometer
2.	P^H		6.82	6.5-8.5	P^H meter
3.	TDS	mg/L	600	1000	Conductivity meter
4.	Turbidity	mg/L	5.5	10	Turbidity meter
5.	EC	µc/cm	520.6	-	Conductivity meter
6.	Phosphate	mg/L	0.70	6	APHA, 1998

[108] BBS District Statistics Bogura, 2011
[109] Bangladesh Environmental Engineering Training and Lab. Services Ltd.

	Parameters	Unit	Concentration present	Bangladesh Standard for Drinking water (ECR, 1997)	Analysis Method
7.	DO	mg/L	2.76	0.3-1	DO meter
8.	Salinity	mg/L	0.10	-	Salinity Meter
9.	Alkalinity	mg/L	220	-	APHA, 1998
10.	Total coliform (TC)	CFU/ 100ml	Nil	Nil	Membrane Filter method
11.	Fecal Coliform	CFU/ 100ml	Nil	Nil	Membrane Filter method
12.	Arsenic	mg/L	0.01	0.05	AAS
13.	Chromium	mg/L	<0.01	0.05	AAS
14.	Lead	Mg/L	BDL	0.05	AAS

*CFU= Colony Forming Unit; *BDL= Below Detection limit

8.4 Land Resources

Agro-ecological regions: Agro-ecological Zones are land areas categorized on the basis of four elements such as physiography, soils, land levels in relation to flooding and agro-climatology. Physiography forms the primary element in defining and delineating the agro ecological regions in Bangladesh. Soils form the second element in defining and differentiating agro ecological zones as soil conditions determine important properties for plant growth, moisture supply, root aeration and nutrient supply. The third factor is land level in relation to flooding.

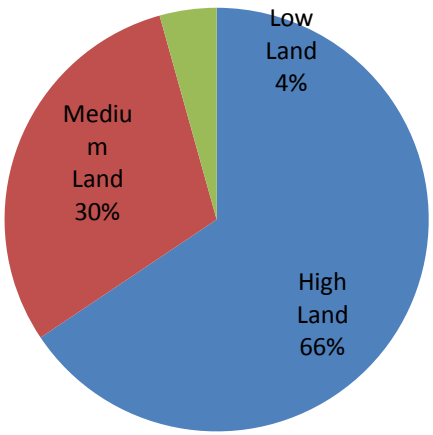
The last one is related to different agricultural products for different climatic conditions of the regions.[110] It is considered in identifying agro ecological zones in Bangladesh comprises the four climatic zones of the country. Agro-ecological zone indicates an area characterized by homogeneous agricultural and ecological characteristics. This homogeneity is more prominent in the sub-region and unit levels. The agro-ecological zones of Bangladesh have been divided in thirty regions. The proposed BEZ falls under Karatoya-Bangali Floodplain. Five general soil types occur in the region, of which non-calcareous grey floodplain and non-calcareous dark grey floodplain soils predominate. The soil is moderately acidic throughout. Organic matter contents are generally low in the cultivated layer of ridge soils and moderate in basins. General fertility is medium.

[110]Banglapedia, 2018

Figure 8.10: Agro-ecological Regions of Bangladesh including the Project[111]

Land Types: Based on depth of inundation during monsoon season, land type of Bangladesh has been classified. In terms of depth of flooding, five classes of land type are recognized, these are high land (above flood level), medium highland (flooding depth 0-90 cm), medium lowland (flooding depth 90-180 cm), low land (flooding depth 90-270 cm) and very lowland (flooding depth >270 cm). The land type characteristics are uniform within the study area, although the land types of Bogura district are not uniform. Out of total 41950 acres of land, 4% low land, 30% medium land and 66% are high land. The land types of proposed BEZare the combination of Highland and Medium high land. The following figures show the land types of proposed project.

Figure8.11: Land Types of the Project Area

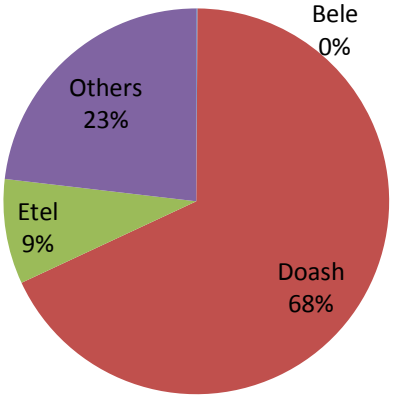


[111]http://en.banglapedia.org/index.php?title=Agroecological_Zone

IIFC

Soil Texture: Soil texture is known as a qualitative classification instrument used both in the field and laboratory for agricultural soils to determine classes based on physical texture. While classes are distinguished in the field and the class is then used to determine crop suitability and to approximate the soils responses to environmental and management conditions such as drought or calcium (lime) requirements. As a qualitative rather than a quantitative tool it is a fast, simple and effective means to assess a soil's physical characteristics. The proposed BEZ is located in Karatoya-Bangali Floodplain. Five general soil types occur in the region, of which non-calcareous grey floodplain and non-calcareous dark grey floodplain soils predominate. The soil is moderately acidic throughout. Organic matter contents are generally low in the cultivated layer of ridge soils and moderate in basins. General fertility is medium.[112] The soil classification map of Bangladesh shows that the soil texture of the project area is Ultisols.

Figure 8.12: Broad Soil Classification of the Project Area[113]



The figure given above represents the broad soil classification of the project area. The soil of the project area is the combination of Doash, Bele, Eteland others.

8.4.1 Land Use

Within the project area including directly benefited area, there are no substantial variations in land types and land use patterns. Land types of the Project area are mostly High land and medium high land. In terms of land use pattern, proposed BEZ area is barren and less fertile agricultural land.

[112] http://en.banglapedia.org/index.php?title=Bangladesh_Soil
[113] BBS District StatisticsBogura, 2011

But beside the project the land use patterns are different. There are agricultural and industrial area, water bodies (Rivers, canals, small canals, Ponds, etc.), and fallow land, etc. Total area of Shajahanpur Upazila is 215.64 sq km (Banglapedia, 2018). There is no reserve forest within the project area. The Bangladesh Bureau of Statistics, 2011, provided the land area based on utilization of Shajahanpur Upazila.

The total operated land area of Shajahanpur Upazila is 50298 acre, among them 396 acres, 40777 acre and9125 acres are permanent cropped area, temporary cropped area and others, respectively. Out of 25159 acre of temporary cropped area, 49 acres, 1200 acres, 30500 acre, and 9069 acres are current fallow, single, double and triple cropped area, respectively.[114] The following figure shows the agricultural land use map of Bangladesh indicating the project area.

8.5 Agricultural Resources

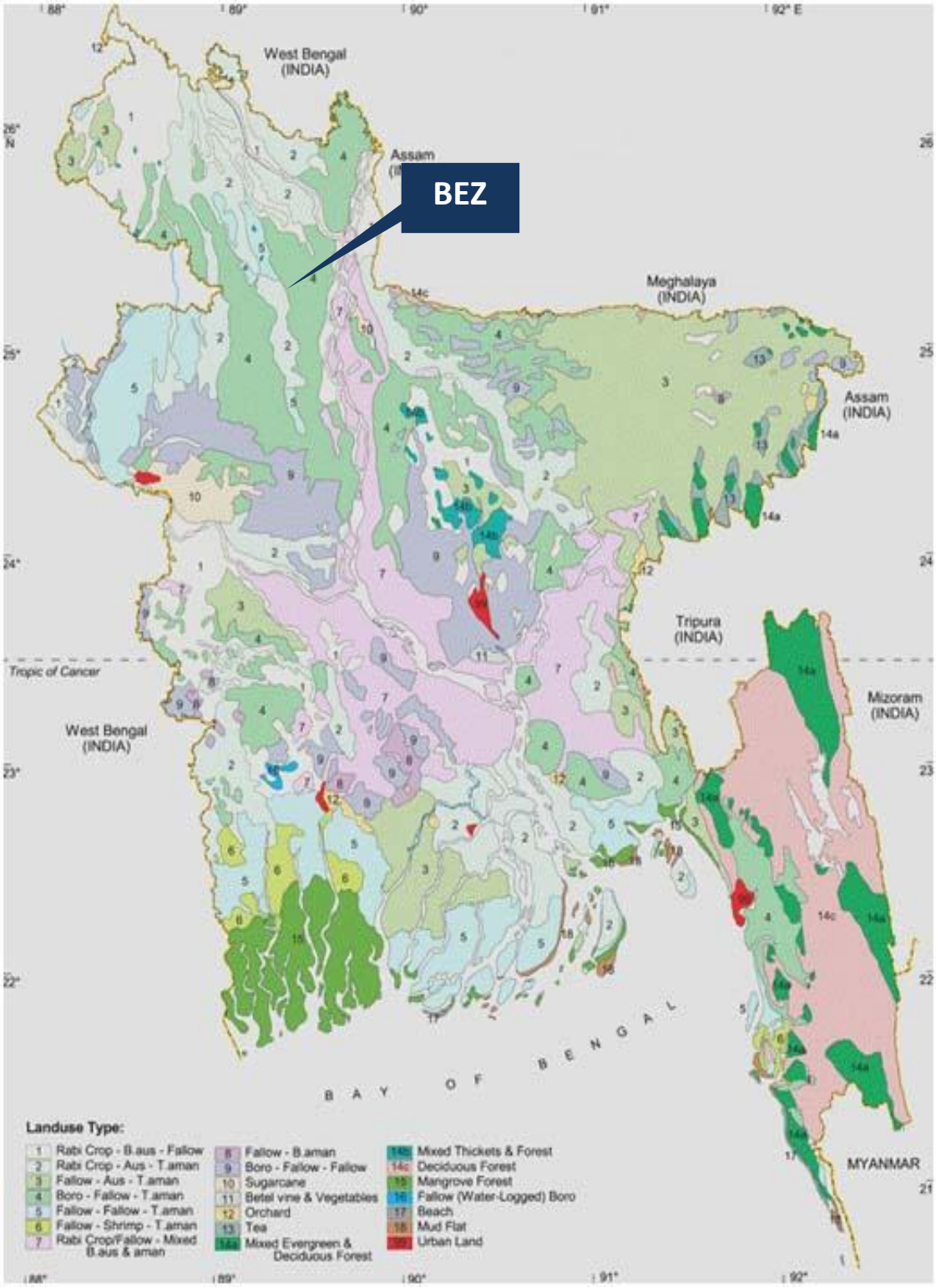
Farming Practice: Farmers cultivate crops using their perception and indigenous knowledge about the environment, especially the duration and magnitude of flood. The project area has a diversified farming practice like paddy, pulses, potato, corn, vegetables etc. Based on the ownership of agricultural land, Landowner is 57.35% and landless is 42.65% in ShajahanpurUpazila.[115] The following figure and table represent the land use types and major crops variety grown at the project site, respectively.

Table 8.13: Land Area Based on Utilization of the Project Area[116]

Name of the Crops	Areas (acres)	Production (m. ton)	Name of the Crops	Areas (acres)	Production (m. ton)
Wheat	105	872	Radish	123	848
Jute	736	648	Bean	131	399
Sugarcane	0	0	Pumpkin	117	675
Lentil (Masur)	0	0	Parble (Potol)	188	757
Mug	6	2	Cabbage	81	293
Maize	986	2,701	Brinjal	422	1,080
Gram	0	0	Lady's finger	70	506
Motor	7	9	Arum	51	354
Kheshari	0	0	Cauliflower	27	91
Mash-Kalai	47	15	Cucumber	55	310
Potato	11,082	16,129	Papaya	100	1,462
Sweet Potato	13	46	Guava	80	315
Rape and mustard	2,196	925	Lime and Lemon	20	1,635
Ground nut	0	0	Jackfruit	85	248
Til	0	0	Banana	217	1,562
Pepper	183	61	Pineapple	2	7
Onion	430	1,191	Mango	76	692
Garlic	79	80	Litchi	29	117
Turmeric	50	72	Blackberry	11	130
Ginger	21	39	Water melon/Melon (Bangi)	6	19
Tomato	63	197			

[114]BBS District Statistics Bogura, 2011
[115]Same as above
[116]BBS District Statistics Bogura, 2011

Figure 8.13: Agricultural Land use Map of Bangladesh[117]



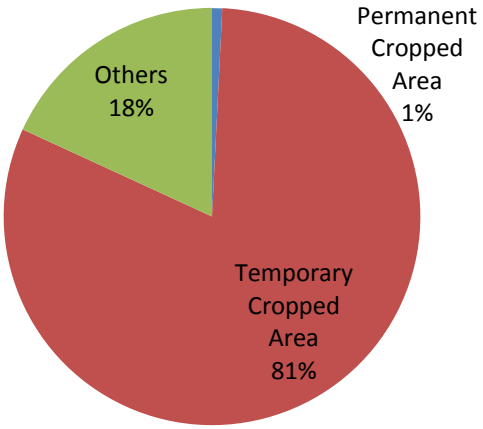
Cropping Pattern and Intensity: Cropping systems are highly diverse, intensive and complex in Bangladesh. The predominant cropping patterns are annual double- or triple crops of rice-rice, rice-wheat, rice-maize, potato-rice-rice, wheat-rice–rice, wheat-mungbean–rice, mustard-rice-rice and rice-rice-rice. Rice is grown in annual single-, double-, and triple-cropping patterns in the

[117]https://www.thebangladesh.net/agricultural-landuse-of-bangladesh.html

boro, aus, and aman seasons depending on inundation and land topography. The major cropping patterns of agriculture[118] in Bangladesh mostly consist of rice based cereal crops. More than 60% of the total cropped areas are covered by Boro-Fallow-T. The pattern of cultivating is two or more crops in a cropping season. Four types of 3-crop combination are found in 21 districts. The cropping intensity of Bogura district is 241% while the national cropping intensity is about 192%.[119]

Cropped Area: The total operated land area is 50298 acres, permanent cropped area is 396 acres, temporary cropped area is 40777 acres and other is 9125 acres in Shajahan Upazila. The following figure shows the cropped area of the project site.

Figure 8.14: Cropped Area in the Project Site[120]



There is no cropped area found within the project site. The project will not hamper the agricultural practices and development; rather the farmers could be benefited indirectly by promotion of economic growth of the area by the project.

Crop Production: The major crops in the project area are paddy, pulses, potato, corn, vegetables etc. The following table shows the rice production in the project area.

Table 8.14: Production of Rice in the Project Area During the Period of 2009-2011[121]

Year	Types of rice					
	Aus		Aman		Boro	
	Area	Production	Area	Production	Area	Production
	acre	*metric ton*	*acre*	*metric ton*	*acre*	*metric ton*
2009-2010	472	719	35,015	31,061	33,975	55,873
2010-2011	1,289	1,082	34,655	33,613	34,000	50,895

Crop Damage: Crop productions are damaged by different climatic threats like flood, rainstorm, heavy rainfall, untimely rainfall, river bank erosion etc. Among the threats, excessive rainfall and seasonal flood are the main causes of crop damage in the project area. Flooding is beneficial only within certain limits of timing, duration and magnitude. The Aus and Aman rice crop suffers damage due to sudden rain and seasonal flood. The project will not be a reason for crop

[118] Haque 1998
[119] Yearbook of Agricultural Statistics, 2016
[120] BBS District Statistics Bogura, 2011
[121] Same as above

damage.[122] The following figure shows the crop damage situation of the project area.

Table 8.15: Crop Damage in the Project Area during 2009-2011[123]

Name ofthe crops	Area Damaged (Acres)		Percentages of partial damage	Area in terms of full damage (caused by partial damage)	Total area damaged (Acres) (Col. 2+5)	Yield per acre (kg)	Production Loss in (Metric Ton)
	Fully	Partially					
HYV Aus	1,184	-	-	-	1,184	836	990
HYV-Aman	10,663	6,900	44.81	3,092	13,755	934	

Main Constraints of Crop Damage: Economic, environmental and other factors can constrain crop production in different ways. Economic demotivation and financial problem can cause initial pessimism in production decision. Environmental hostile factors like disasters and unwanted conditions can cause harms in latter stage of production. Main constraints of crop production in the project area are-

- Irregular irrigation facilities during winter season;
- Flood water submerged the land during rainy season;
- Lack of training for suitable cultivation and overcoming the loss of crop to the farmers
- Non-introducing the new high yielding varieties and new technologies;
- Lack of open market sell of seeds and fertilizer, quality seed and other inputs as demanded by farmers.

8.6 Livestock and Poultry

Livestock and poultry has been playing significant role in the economy of the study area, as in the agricultural share of economy of Bangladesh. Along with agriculture, it is an essential part of integrated farming system. Livestock provides supports for cultivation like threshing and crushing of oil seeds; cow dung as a source of manure and fuel; a ready source of funds; and meat, milk and eggs for household consumption. Agricultural by-products can be used as fodder and feed of Livestock and poultry. There are 71667 Cow and buffalo, 40408 goat and 7548 sheep in the project area. Moreover, there are also 256790 hen and cock, 70968 duck in the project site.[124]

Table 8.16: Status of Livestock and Poultry at the Project Area[125]

Particulars	Number
Cow and buffalo	71,667
Goat	40,408
Sheep	7,548
Hen and Cock	256,790
Duck	70,968
Others	12,714

[122] Ahmed, 2011
[123] Statistical year book, 2011
[124] BBS District Statistics Bogura, 2011
[125] Same as above

Most of the households in the project area have poultry and livestock, a practice that helps to reduces poverty through generating alternative income and employment. The common livestock and Poultry found in the Project area is Cow/bullock, Buffalo, Goat, Sheep, Duck, Chicken etc.

Feed and Fodder Shortage: Fodders and feed is the most important input of livestock rearing. Crop residues and naturally grown grasses alongside roads, river bank, char lands, etc. are the main feed for the cattle in Bangladesh. Shortage of fodder and high price of feed ingredients are affecting the small holders significantly. Dairy units are running off due to shortage of fodder or grazing land/ high price of feed ingredients. The pasture land has reduced significantly all over the country due to cultivation of High Yielding Varieties (HYV) of rice to meet the demand of growing population. Climate change is causing unusual behaviour in temperature, rainfall, flooding pattern etc., and affecting either in natural growth or damaging the pasture grasses. Besides, adulteration of commercial feed by the miller; Inadequate or no quality control system of commercial feed is traceable.

A potential threat to natural growth of grasses in the char lands for grazing of animals. Fodder cultivation is not generally practiced by the smallholders, because of land constraints belonging to them. However, private dairy farmers grow the fodder for cows either on their own land or lands leased from others. Most of the poor families do not have their adequate land to grow fodders. They have to depend on naturally grown grasses in alongside roads, embankments and polders and also on aquatic plants and suffer from shortage of fodder during cropping seasons. Seasonal variation is experienced by the farmers in availability of forages. Crop residues and a very little amount of green forages are given to animals throughout the year. The dairy farmers cultivate maize as fodders and fodders of exotic and high yielding varieties for their animals. Some of these are perennial type, such as: Napier, Para, German, Sudan grass, Jumbo, etc. However, fodder cultivation in cultivable land depends on opportunity costs with other crop.[126] Constraints of feeds and fodder availability in the project site for cattle can be summarized as follows:

- Scarcity of grazing land;
- Scarcity of land for fodder cultivation.
- Low quality and adulterated feed in the market
- Use of crop residues as household cooking fuel and other purposes.
- Change in cropping pattern
- Lack of standards and quality control system
- Lack of knowledge of feeding system
- Lack of coordinated effort.

Livestock/Poultry Diseases: Parasites and diseases cause serious losses in the livestock and poultry production. Compounding factors make the control of health problems difficult and they include:

- General low level of nutrition
- Large livestock population
- Warm humid climate
- Congestion of animals during annual flooding
- Difficult communications impede implementing control programs.

[126]Bangladesh Delta Plan, 2010

The government has estimated that losses due to internal parasites are far greater than losses caused by diseases but both are serious. Mainly, adequate levels of nutrition would significantly reduce production losses caused by parasites. The most frequently reported diseases among cattle and buffaloes are anthrax, black quarter and foot and mouth disease. Newcastle disease, fowl pox, fowl cholera and duck plague are common among poultry.[127]

The most crucial period is between July and October (rainy season) for outbreak of livestock and poultry diseases. The duck plague generally occurs in summer. However, some diseases prevail throughout the year. During monsoon season, the wet condition of the animal shelter promotes various kinds of diseases to the bullocks and cows. The unhygienic condition of the courtyards during this season may also spread the diseases to the poultry birds.

8.7 Fisheries

The inhabitants along the banks of the Karotoya River live on more or less fishing, but only a few exclusively fishing communities appear to exist in the district. The demand for fish being considerable, various modes of catching fish is practice. When the lands are inundated during the rainy months, fish is very scarce and the poor resort to the ditches and swamps. Many varieties of fresh water fishes are available in the district. Most of the supply comes from Rivers, ponds, canals and low-lying areas inundated by rain water. From the public consultation with the local people it was observed that the number of fisherman in the project area did not change significantly compared with the past. The information regarding fisheries in Shajahanpur Upazila is given in the following table.

Table 8.17: Fish Production information in Shajahanpur Upazila[128]

Particulars	Shajahanpur Upazilla
Number of Pond	3,379
Number of Dighee	0
Number of fisherman	250
Production of fish	2,109

Problems and Issues: Fish biodiversity is affected by morphological changes of River, disruption of ecology, intensive agriculture, indiscriminate fishing, and loss of River-khal connectivity for filling wetlands and water regulatory structures on khals on the project area. The key fisheries problems and issues identified during baseline survey are as follows:

- Unplanned and indiscriminate fishing using monofilament gill net, and overexploitation of fishes by using huge number of narrow meshed estuarine set bag nets for fishing;
- Interrupting fish migration and movement due to improper management and mal-functioning of the water regulatory structures along with encroachment and barriers;
- Siltation of internal khals, causing loss to the year round river-khal connectivity;
- Lack of quality fish seed and feed for the improved aquaculture practices;
- Insufficient loan facilities for aquaculture practices;
- Lacking of extension services and updated information;

[127] BARC, 1985
[128] BBS, 2011

- Poor market facility;
- Prevalence of fish diseases;
- Lack of technical knowledge on pond management; and
- Insufficiently trained farmers in the project area

Habitat Description: On the basis of habitat of fisheries of the study area are classified under two broad categories: capture fisheries and culture fisheries. Rivers and internal khals are considered under capture fish habitat; whereas the ponds: homestead ponds and commercial ponds are classified under culture fisheries. Fish habitat in rivers and internal khals is generally the open source of fisheries for local people like non-commercial professional and household level fishermen. It also enriches the inland closed water commercial and private culture of fisheries like ponds, leased beels, etc. especially during rainy season.

Fish Production and Effort: The annual fish production of Bogura in the fiscal year of 2014-15 was 61405 Metric Ton (Agricultural year book, 2015). Number of production of fish in Shajahanpur was 2109 metric ton in the year of 2010-11 and 2107 metric ton in the year of 2009-10.[129]

Aquaculture is expanding gradually in the area by converting the cultivated land, as well as the medium low lands of the area. Bogura is famous for its fish assets. Especially, different native variety fishes are caught here. Besides, there are numerous ponds, rivers, canals and open water bodies here. Following the advice of the fisheries department, native fishes including rui, katla, mrigel, pangash, bighead, and grass-carp are being cultivated in the district. On the other hand, more fishes are being cultivated in open water bodies under the government management. As a result, fish production is increasing here each year.

Fish Migration: Many types of fish migrate on a regular basis, on time scales ranging from daily to annually or longer, and over distances ranging from a few metres to thousands of kilometres. Fish usually migrate to feed or to reproduce, but in other cases the reasons are unclear. Migrations involve the fish moving from one part of a water body to another on a regular basis.

The open water fish species migrate for spawning and feeding to open and regulated khals as they use these khals for feeding and shelter ground. Most of the open water fishes choose still water during that time and the migration is very crucial for reproduction of fishes. Some fish species migrate horizontally to these water bodies as part of life cycle. Due to sedimentation channel bed and water control structures hamper the migration of fish and other aquatic biota. Fish species such as Tengra, Phaisa, Gulsha, Khorsula, etc. migrate horizontally to these water bodies as part of life cycle. A difference can be made between main channel migratory species, such as the major carps and the floodplain resident species that are often small and have accessory respiratory systems and prolific reproduction.

Fish Biodiversity: Fishes are abundant being represented by the members of all the major families found elsewhere in Bangladesh. However, their number is decreasing due to widespread use of insecticides and pesticides for agricultural purposes and also due to over catching. The following is a list of the principal fishes found in the rivers and ponds of Bogura district.

[129] BBS District Statistics Bogura, 2011

Table 8.18: List of fish Recorded in River and other Water Bodies at the Project Area[130]

	Local Name	English Name	Scientific Name
1.	Ilish	Hilsa	*Tenualosailisha*
2.	Rui	*Rohu*	*Labeorohita*
3.	Katla	*Catla*	*CatlaCattla*
4.	Mrigal	*Migal*	*Cirrhinusmrigala*
5.	kalbasu	*Orange-fin labeo*	*Labeocalbasu*
6.	Air/Aor	Long Whiskered cat fish	*Aorichthys(Mystus) aor*
7.	Tengra	Assamese Batasio	*BatasioTengana*
8.	Baghair	Gangetic Goonch	*Bagariusyanvelliisykes*
9.	Boal	*Indain Trout*	*Raiamas bola*
10.	Shol	Snake head murrel	*Channastriata*
11.	Gojar/ Gojal	Giant snake head	*Channamarulius*
12.	Pungash	*Yellowtail catfish*	*Pangasiuspagasius*
13.	Taki	Spotted snakehead	*Channa punctatus*
14.	Koi	Climbing perch	*Anabas testudineus*
15.	Boal	Wallago	*Wallago attu*
16.	Singi	Stinging catfish	*Heteropneustesfossilis*
17.	Puti	*Spottedsail barb*	*Puntius puntio(Hamilton)*
18.	Khailsha	*Banded gourami*	*Colisafasciata*
19.	Chitol	Humped Featherback	*Nototerusechitala*
20.	Bain	Tire track spiny eel	*Mastecembelusarmatus*
21.	Grass carp	Grass carp	*Ctenopharyngodonidella*
22.	Silver carp	Silver carp	*Hypophthalmicthys molitrix*
23.	Telapia	Indian telapia	*Oreochromis mossambicus*
24.	Nilotica	Nile tilapia	*Oreochromis niloticus*

Fisheries Management: There is no fishery-based community association found in the study area. Fishing right on existing fish habitats is limited. Enforcement of fisheries regulation is also weak. No fish sanctuary is found in the study area.

8.8 Ecological Resources

Bio-ecological Zones: In the context of physiographic and biological diversity IUCN, The World Conservation Union, has divided Bangladesh into 25 Bio-ecological Zones.[131] The study area has fallen under bio-ecological zones of Teesta Floodplain (4a). Major physiographic units of this area are Karatoya-Bangali floodplain. Average rainfall of this zone ranged from 1270-2290 mm. Non-calcareous dark grey floodplain soils predominate in this zone.

This area is characterized by this region is very similar to the Tista Meander Floodplain in physiography and soil and comprises a mixture of Tista and Brahmaputra sediments. Most areas have smooth, broad, floodplain ridges and almost level basins. The soils are grey silt loams and silty clay loams on ridges and grey or dark grey clays in basins. The soil is moderately acidic throughout. Organic matter contents are generally low in the cultivated layer of ridge soils and

[130]BBS District StatisticsBogura, 2011and Field Visit
[131]Nishat et al., 2002

moderate in basins. General fertility is medium. The following figure shows the Bio-ecological zones of Bangladesh including the project area.

Figure 8.15: Bio-Ecological Zones of Bangladesh indicating the Project Site[132]

8.8.1 Common Flora and Fauna

Floral diversity of the project area: In general terms an ecological system can be defined as an assemblage of organisms (plant, animal and other living organisms - also referred to as a biotic community) living together with their environment (or biotope), functioning as a loose unit. That is, a dynamic and complex whole, interacting as an "ecological unit". Ecosystems are functional units of interacting biotic, biotic and cultural (anthropogenic) components. All natural ecosystems are open systems where energy and matter are transferred in and out through the complex interactions of energy, water, carbon, oxygen, nitrogen, phosphorus, sulphur and other cycles. The project site is located in rural area. There is no significant natural vegetation or forest cover within the project area. However, appropriate mitigation program should be undertaken to protect the existing ecosystem from gaseous emissions and water discharge from the proposed BEZ.

Terrestrial Flora: Terrestrial plants found during survey in and around the project area, on homesteads, roadside and agricultural lands have been listed. The project area provides the following major species of natural plants including herbs, shrubs, grasses and plants which are important both economically as well as for environmental sustainability of the area.

[132] Bio Ecological Zones of Bangladesh, IUCN

Table 8.19: List of Terrestrial Flora Around the Project Site[133]

	Local Name	English Name	Scientific Name
1.	Sal	Sal	*Shorearobusta*
2.	Bot	Banyan tree	*Ficusbenghalensis*
3.	Pakur	pippala tree	*Ficusinfectoria*
4.	Badam	Peanut	*Arachis hypogea*
5.	Sonalu	Golden shower	*Cassia fistula*
6.	Gab	Persimmon trees	*Diospyros precatorius*
7.	Kadam	Kadam	*Anthocephaluscadamba*
8.	Shimul	Cotton tree	*Bombax ceiba*
9.	Sissu	North Indian Rosewood	*Dalbergia sissoo*
10.	Gamar	Beechwood	*Gmelina arborea*
11.	Acacia	Acacia	*Acacia aralica*
12.	Bash	Bamboos	*Bambusabambos*
13.	Amm	Mango	*Mangiferaindica*
14.	Peara	Guava	*Psidium guajava*
15.	Jam	Black berry	*Syzygiumcumini*
16.	Ata	Custard apple	*Annona reticulata*
17.	Tetul	Tamarind	*Tamariandusindica*
18.	Tal	Palm	*Borassusflabellifer*
19.	Kathal	Jackfruit	*Artocarpusheterophyllus*
20.	Peype	Papaya	*Carica papaya*
21.	Anarosh	Pineapple	*Ananascomosus*
22.	Kola	Banana	*Musa sapientum*
23.	Narikel	Coconut	*Cocos nucifra*
24.	Lichu	Lichi	*Litchchinensisi*
25.	Dalim	Pomegranate	*Punicagranatum*
26.	Khejur	Dates	*Phoenix sylvastris*
27.	Dumur	Fig	*Ficuscarica*
28.	Jaiphal	Nutmeg	*Myristicafragrans*
29.	Akanda	crown flower	*Calotropis giganta*
30.	Dhatura	Dhatura	*Datura metel*
31.	Amlaki	Indian Gooseberry	*Phyllanthus emblica*
32.	Nilkalmi	Indian jalap	*Pharbitis nil*
33.	Somraj	Purple Fleabane	*Vernonia anthelmintica*
34.	Haritaki	Black or chebulic myrobalan	*Terminalia chebula*
35.	Ghash	Grass	*Imperataarundinacea, Chrysopogon acidulates*

Terrestrial Faun: The terrestrial fauna including mammals, birds, reptiles and amphibians around the project site are presented in the following table.

[133]BBS District Statistics Bogura, 2011and Field Visit

Table 8.20: List of Terrestrial Fauna around the Project Site[134]

	Local Name	English Name	Scientific Name
Mammals			
1.	Bagh	Tiger	*Panthera tigris*
2.	Mohish	Buffalo	*Bison bison*
3.	Bonnoshukor	Wild boars	*Sus scrofa*
4.	Bagdas	Large Indian civet	*Viverrazibetha*
5.	Ud	Ottar	*Lutralutra*
6.	Kat biral	Squirrel	*Callosciuruspygerythrus*
7.	Beji	Bengal mongoose	*Herpestesedwardsi*
8.	Idur	Rats	*Bandicotabengalensis*
9.	KhekShial	Bengal Fox	*Vulpes bengalensis*
10.	Banor	Rhesus Macaque	*Macaca mulatta*
11.	Kukur	Dog	*CannisFamiliaris*
12.	Chagol	Goat	*Capra Hircus*
13.	Bhera	Sheep	*Bovidae:Ovis*
14.	Goru	Cow	
15.	Biral	Cat	*Felis: Catus*
Birds			
1.	Gochila	Marsh harrier	*Circus aeruginesus*
2.	Cheel	Pariah kile	*Milvus migransgoviada*
3.	Mach ranga	king fisher	*Alcedoatthis*
4.	Haldepakhi	Black-hooded oriole	*Oriolusxanthornus*
5.	Finga	Kingcrow	*Dicrurnsadsimilis*
6.	Myna	chestnut-tailed starling	*Sturnus malabarica*
7.	Shyama	White-rumpedshama	*Copsychusmalabaricus*
8.	kokil	Cuckoo	*Cuculusmicroplerus*
9.	Flowerpecker	Flowerpecker	*Dicacumerythrochynchos*
10.	Ghughu	Dove	*Streptopeliasuratennis*
11.	Pencha	Owl	*Bubu zeylenensis*
12.	Payra	Pigeon	*Pavocristatus*
13.	Sharosh	Heron	*Ardealagrayii*
14.	Sharosh	King stork	*Alcodoathisbengalansis*
15.	Mach ranga	King fisher	*Ephippiarhynchus*
16.	kaththokra	Woodpecker	*Dinopiumbenghalense*
17.	Baj	Lanner falcon	*Falco biarmicous*
18.	Shakoon	Rumped Vulture	*Gyps bengalensis*
19.	Bulbuli	Brown eared/Red vented Bulbul	*Microscelisamaurotis/ Pycnonotuscafer*
20.	Kak	Crow	*Corvussplendens*
21.	Shalik	Indian mynah	*Acridotherestristis*
22.	Doyel	Magpie Robin	*Copsychussaularis*
23.	Paira	Pigeon	*Columba liviadomestica*
24.	Hash	Duck	*Anatidae: Anseriformes*
25.	Rajhans	Goose	*Anserspp*
26.	Balihans	Common Teal	*Anas crecca*
Reptiles and Amphibians			
1.	Kasim	Asain Leaf Turtle	*Cyclemys dentata*
2.	Guishap	Monitor lizard	*Varanus salvator*
3.	Bang	Frogs	*Rana limnocharis*

[134]BBS District Statistics Bogura, 2011 and Field Visit

	Local Name	English Name	Scientific Name
4.	MajhariKaitta	Median Roofed Turtle	*Pangshura tentoria*
5.	Bang	Toad	*Bufomelanostictus*
6.	DholaTiktiki	Indo-Pacific Gecko	*Hemidactylus garnotii*

8.8.2 Ecosystem Services and Function

The Millennium Ecosystem Assessment (MEA) defined ecosystem services are "the benefits people obtain from ecosystems." The MEA also delineated the four categories of ecosystem services—supporting, provisioning, regulating and cultural. The national economy and the people of Bangladesh are inseparably linked to the productivity and sustainability of Bangladesh's ecosystem, including vast and differentiated terrestrial ecosystem that are seasonally variable in their characteristics as well. The population of the project area usually get all types of ecosystem services as discussed below.

Supporting services: Ecosystem services that is necessary for the production of all other ecosystem services. These include services such as nutrient recycling, primary production and soil formation. These services make it possible for the ecosystems to provide services such as food supply, flood regulation, and water purification.

Products Obtained from Ecosystems

- Food (including sea food and game), crops, wild foods, and spices
- Raw materials (including lumber, skins, fuel wood, organic matter, fodder, and fertilizer)
- Genetic resources (including crop improvement genes, and health care)
- Water
- Biogenic minerals
- Medicinal resources (including pharmaceuticals, chemical models, and test and assay organisms)
- Energy (hydropower, biomass fuels)
- Ornamental resources (including fashion, handicraft, jewellery, pets, worship, decoration and souvenirs like furs, feathers, ivory, orchids, butterflies, aquarium fish, shells, etc.)

Regulating services: "Benefits obtained from the regulation of ecosystem processes"

- Carbon sequestration and climate regulation
- Waste decomposition and detoxification
- Purification of water and air
- Pest and disease control

Cultural services: "Nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences"

- Cultural (including use of nature as motif in books, film, painting, folklore, national symbols, architect, advertising, etc.)
- Spiritual and historical (including use of nature for religious or heritage value or natural)
- Recreational experiences (including ecotourism, outdoor sports, and recreation)
- Science and education (including use of natural systems for school excursions, and scientific discovery)
- Therapeutic (including ecotherapy, social forestry and animal assisted therapy)

8.9 Potential Environmental Impacts and Mitigation Measures

Item	Expected Impacts	Mitigation Measures and Environmental Management
Air Quality	– Impact of air pollution, dust/emission gases by construction work	– Sprinkle water around the Project site and roads – Avoidance of intensive operation of construction machineries
Water Quality	– Discharging muddy water from bare land – Wastewater from construction camps	– Installation of setting ponds or simple turbid water treatment – Installation of septic tank – Preparation of the discharge water treatment plan
Waste	– Construction waste by cut earthwork	– Reuse the residual soil generated in cutting work for filling work in the site – Preparation and implementation of the waste management program
Noise and Vibration	– Impacts of noise and vibration by construction machineries and vehicles	– Installation of sound-proofing sheet – Avoidance of construction at night time – Advanced notice for construction work time near the residential area – Avoidance of intensive operation of construction machineries – Speed limit for drivers
Hydrology	– Impact on hydrology due to water consumption used in the construction work	– Limited and short term usage of groundwater – Preparation of tentative retention pond – Suggest less water consumption industry
Earthquake	– Increasing of the damage of the earthquake in and around the Projects site	– Compliance with the National Standard Operational Procedure for building construction

9 Social Review

9.1 Socio-economic Condition

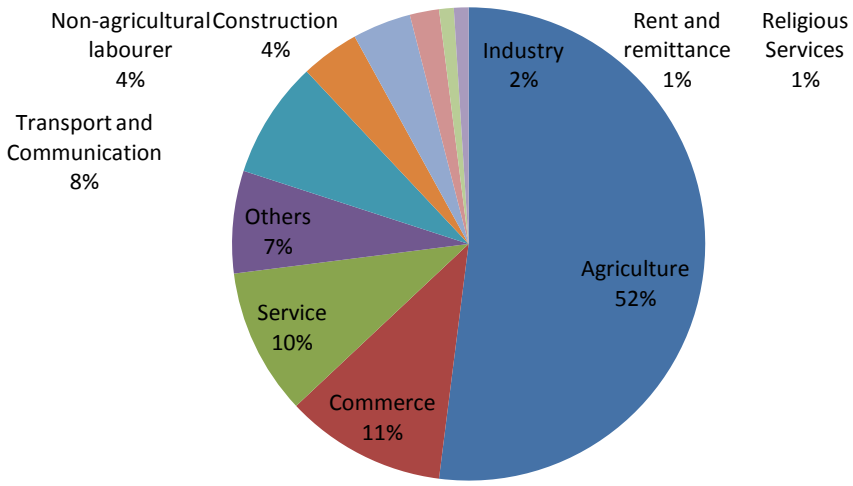
The total population of Shajahanpur Upazila is 2, 90,000 with a population density of 1,307 per square km. Among the total population, 1, 50,000 are male and 1, 40,000 are female; the sex ratio (male/female) is 106. There are 72685 HHs with average size of a HH 3.86. Based on religious identity, 2, 78,139 are Muslim, 11,557 are Hindu, 42 are Buddhist, 41 are Christian and 25 are of other religions. The following table shows the demographic status of Shajahanpur Upazila.

Table 9.1: Demographic Conditions of the Project Area[135]

Demographic indicators		Shajahanpur Upazila	
Total Population	Male	290,000	150,000
	Female		140,000
Population density (per sq. km.)			1,307
Number of Households			72,685
Average Household sizes			3.86
Sex ratio			106
Number of Population by religion identity.	Muslim		278,139
	Hindu		11,557
	Buddhist		42
	Christian		41
	Others		25
Number of tribal community			-

There are various kinds of livelihood are existed in the project area. However, most of the population of the project area is agriculture dependent. The order of occupations of Shajahanpur Upazila is Agriculture (55.48%) > Commerce (13.01%) > Services (10.98%)> others (7.09%)> Transport and communication (6.49%)> Non-agricultural labourer (2.52%)> Construction (2.50%)> Industry (1.37%)> Rent and remittance (0.39%)> Religious service (0.17%). The livelihood status of the population of the project area is given in the following figure.

Figure 9.1: Livelihood Patterns of Shajahanpur Upazila



[135]BBS District StatisticsBogura, 2011

IIFC

The following table shows total establishments in the urban and rural areas and persons engaged by sex and activity in Bogura district.

Table 9.2: Number of Establishment Persons Engaged by Activity[136]

Activity	Establishments			Persons Engaged		
	Total	Urban	Rural	Total	Male	Female
Mining and quarrying	-	-	-	-	-	-
Manufacturing	17,479	2,491	14,988	81,989	62,194	19,795
Electricity, gas and water supply	20	12	8	778	625	153
Construction	33	24	9	190	186	4
Wholesale and retail trade	47,663	15,729	31,934	97,285	91,668	5,617
Hotels and restaurants	2,268	1,008	8,640	7,983	7,983	657
Transport, storage and communication	1,087	644	443	3,676	3,608	68
Bank, insurance and financial institution	590	239	351	5,897	4,670	1,227
Real estate and renting	1,617	644	973	3,126	2,437	689
Public administration and defence	545	398	147	7,324	6,658	666
Education	4,503	551	3,952	25,235	19,933	5,302
Health and social work	1,412	429	983	6,045	4,395	1,650
Community, social and personal services	12,924	2,153	10,771	26,042	23,996	2,046
Total	90,141	24,322	65,819	26,6227	228,353	37,874

According to above table there are 90,141 establishments in the district in which 266,227 persons are engaged in different types of non-farm activities. Female participation in non-farm activities is very poor (14.23%) in the Bogura district.

9.2 Quality of Life Indicators

Education: The literacy rates in Shajahanpur Upazila have been observed 57.7%. The overall literacy rate for the District has been estimated for 49.4%. The literacy trends in these locations were observed to be normal when compared to the national literacy rate for Bangladesh estimated at 56.75% with respect to individual literacy trends amongst males and females, it can be observed that literacy amongst women is lower compared with their male counterparts. The difference registered were 45.9% and 52.9% in Bogura District.[137] The number and types of different educational institutions are given in the following table.

Table 9.3: Number and Types of Different Educational Institutions[138]

Name of the Educational Institutions	Number of Educational Institutions
Government primary school (class I-V)	84
Registered primary school (class I-V)	36
Private (non-registered) primary school (class I-V),	0
Kindergarten school (pre-schooling),	43
NGO school	29
Government secondary school	0
Non-government secondary school	30
School and college (operating jointly),	3

[136]BBS District Statistics Bogura, 2011 and Field Visit
[137]BBS District Statistics Bogura, 2011 and Field Visit
[138]Same as above

Name of the Educational Institutions	Number of Educational Institutions
Government college	0
Non-Government college	5
Madrasah	32
Kawmi madrasah	16
Ebtedayee madrasah	46
Technical and vocational institution	1
Medical college	0
Agricultural and veterinary college	1

Noted Educational institutions of the project area are- Cantonment Public School and College (1979), Cantonment Board High School and College (1986), Ranirhat Technical College (2000), Khotta Para Siddiqua Senior Fazil Madrasa (1905), Domonpur Amiya Fazil Madrasa (1908), Jora Nazmul Ulm Fazil Madrasa (1910), Behigram ADU Central Fazil Madrasa (1921), (BBS, 2011; Banglapedia, 2018).

Health: The health profile for the area indicates that the most prevalent diseases within the project area are Tuberculosis, Pneumonia and diarrhea etc. Besides, other seasonal diseases in the project area have been observed like cold, seasonal viral fever etc. The condition of health services related institutions of the project are given in the following able.

Table 9.4: Health Related Facilities in Project Area[139]

Health related facilities	Number of Health related facilities
Government health complex	31
Private hospital/clinic	4
Diagnostic center	3
Physician/Practitioner	38
Number of health center providing health and family planning services	11
Number of existing family planning personnel	2
Number of Community clinic	10

Different NGOs like PalliUnnayanPrakalpa, Grameen UnnayanPrakalpa etc. are conducting awareness raising programs on different health services as well as hygienic promotion activities through their sanitation programs. Department of Public Health Engineering (DPHE) is providing sanitary latrines, ring slab toilets through sanitation health program from their Upazila office. They are providing arsenic free water supply to the people of the area.

Water and Sanitation: The water and sanitation status of the project area has been given in the following table.

Table 9.5: Water and Sanitation Status of the Project Area[140]

Health and sanitation indicators		Shajahanpur Upazila
Sources of Drinking water	Tube well	94.73
	Tap	0.75
	Pond	0.14
	Others	4.38%

[139]Same as above
[140]Banglapedia, 2018

Health and sanitation indicators		Shajahanpur Upazila
Latrine types	Sanitary latrine	41.05%
	Non-sanitary latrine	38.59%
	No latrine	20.36%

Maximum households of the proposed project area use tube well water for their drinking purposes and other minor sources of drinking water are tap, pond and other sources. Non-sanitary latrines are predominant in the project area whereas significant number of households of the project area lack sanitary latrines.

Transportation and culture: Road transport and railway communication transport are available in the area. Rajshahi-Bogura Highway is only 0.2 km away from the project site. In Shajahanpur Upazila, there is 102.25 km metalled road, 3.78 km semi-metalled road, 791.97 km un-metalled road. There are no waterways. As a result, only communication by road with the project area is well established. [141]The culture of the area is manifested in various cultural forms, including music, dance and drama, art and craft, folklore and folktales, literature, philosophy and religion, festivals and celebrations etc.

9.3 Income and Poverty

The estimates of HCR (Head Count Rates) in 2016 using the lower poverty line for Rajshahi Division is 14.2% and upper lower poverty line is 28.9. Enrollment from poor households for Rajshahi division is (92.5%) and for non-poor households is 97.6%. Average amount received (tk) per household from Social Safety Nets Programme is 2615.4. Poverty rate of (using upper poverty lines) Rajshahi District is 20.1.[142]

9.4 Gender and Women

The male and female composition of the population of proposed project area is relatively equitable. The number of female population in Shajahanpur Upazila is 1, 40,000 and the sex ratio is 106. The overall literacy rate of women ofShajahanpur Upazila is 57.7% where male and female literacy rate are 51.93% and 45.10%, respectively. Women comprise 48.28% of the total population which more or less indicates a healthy sex ratio.[143] This indicates a lower disparity for the girl child. However, women in Shajahanpur Upazila may still be classified as vulnerable due to the fact that a large fraction of the same are not allowed to work or earn a living or pursue higher level education due to cultural and religious belief.

9.5 Common Property Resources

Throughout the world there are assets that are neither private nor state property, but common property. The term denotes a class of institutions that govern the ownership and rights-of-access to assets. Common property assets are to be distinguished from "public goods," in that, unlike the latter, use by someone of a unit of a common property asset typically reduces the amount available to others by one unit (in economic terminology, such an asset is rivalrous in use). The institution of common property creates and harbors reciprocal externalities. As some of the most interesting examples of common property assets are natural resources, this entry is restricted to them. Social Institutions, Khals, Playgrounds can be referred as common property resources. Hats, bazars and fairs are social institution or at least the mechanism of not only trade but also

[141]BBS District Statistics Bogura, 2011
[142]HIES, 2016
[143] BBS District Statistics Bogura, 2011

social interaction. The common property resources of the project are having been given in the following table.

Table 9.6: Common Property Resources of the Project Area[144]

Common property resources	Number of common property resources
Daily Bazar	26
Weekly Hat	23
Public library	0
Mosque	443
Eid-Gah	65
Temple	56
Church	0
Pagoda	0
Cyclone shelter	0
Flood camp shelter	0
Stadium/ Playground	0
Park/ Amusement Park	0
Bridge	70
Baily bridge	4
Culvert	329

9.6 Conflict of Interest and Law and Order Situation

12 police stations/camps have been established in Bogura to protect the local residents against any types of violence. One of them has been established to maintain the law and order of the commercial and residential area of Shajahanpur Upazila.

9.7 Historical, Cultural and Archaeological sites

The proposed project area does not have any key cultural heritage or resource of national and regional value. Some archaeological sites in Shajahanpur Upazila are KhadashRajbari (Gohail), three doomed Gohail Jami Mosque built by Pandit Shah, Buddhist Math (Bergari), Jami Mosque (Ullah Akanda Para). The cultural sites in the project area are mosques and graveyards which are located mostly in respective villages. The project footprint is devoid of any cultural sites or heritage sites. If evidence of any other ancient heritage or any archaeological symbol is found during execution of the project, actions will be taken in accordance with relevant GoB acts and rules

[144]BBS District Statistics Bogura, 2011 and Field Visit

9.8 Potential Social Impacts and Mitigation Measures

Potential Negative Impacts	Potential Positive Impacts	Mitigation Measures
• Agriculture land would be converted into industrial area affects socio-economic conditions of marginal & tenant farmers; • Long term use of ground water may affects irrigation for the cultivation of agriculture; • Conflict may arise during land acquisition process; • The unskilled local community may feel unhappy if preferential treatment is given to the people outside Shahjanpur Upazila for skilled jobs. • There will be an increase in the demand for temporary accommodation, housing and basic services including sanitation, health and emergency services in Shahjanpur Upazila areas. • The rate of poverty and illiteracy in the area may lead to the child labor deployment. • The absence of gender inclusive policies and procedures may lead the women to take up unskilled and low skilled jobs.	• The commissioning of BEZ will directly improve the local economy of the area which in turn will increase the purchasing power of the local population. • The employable population in Shahjanpur Upazila will have access to better employment opportunities during the construction and commissioning phases of BEZ. • Enhanced employability for the women in the area.	• Industry with less water consumption can be given priority for its sustainability and agriculture irrigation; • Need to develop a long term development plan for the area to improve the quality of basic amenities for the increasing population in the coming years. • Equal employment opportunities should be given to women, especially those who are now unemployed or are working in the service sector as daily wage workers. • Measures should be taken to prohibit child labor in the EZ as per the National Child Labor Elimination Policy 2010 of Ministry of Labor and Employment. • Land acquisition process should follow the guidelines of WB, GoB, etc.

9.9 Recommendations

a) Environmental Management and Monitoring Plan should be developed and followed strictly for both during construction and operation phases of the Project;

b) Zero Discharge Plan (ZDP) should be developed and maintain during operation phase of the project

c) National 3R Strategy for Waste Management (Reduce, Reuse, Recycle) should be followed for Liquid and Solid Waste Management;

d) IFC PS-3 (Resource Efficiency and Pollution Prevention) should be followed for Occupational Health and Safety (OHS) Management during construction and operation phases of the Project;

e) Roof top all infrastructures should be managed for the purpose of harvesting rain water, photovoltaic solar energy and gardening;

f) All infrastructures should be built based on the seismic design consideration to avoid potential hazard risk;

g) To avoid hazard due to any disaster, warning system, emergency evacuation system, construction of ground flood at an elevated level, provision of emergency equipment should be considered;

h) Proper training regarding EHS should be provided to Project Management Unit as well as work forces during construction and operation phases;

i) Development of a green belt surrounding the area should be considered with due importance;

j) A social census can be carried out on land owner before land acquisition so as to determine their actual loss, and prepare right compensation plan by BEZA;

k) Eligible local people should be considered on priority basis that will be helpful for minimizing the socio-economic disruption.

10 Financial and Economic Analysis

10.1 Financial Analysis

This section presents the assumptions and results of the financial analysis of the Economic zone. The purpose of the financial analysis is to determine the financial viability of the project. The financial analysis conducted is based upon BEZA/Government led model and PPP model for the zone.

The key objectives of preparing a financial model for financial analysis were:

- to demonstrate the financial viability of development of the Economic Zone based upon demand forecast, expected lease rates, cost estimates, planning parameters and other information;
- to illustrate the sensitivity of the financial and commercial viability to key parameters and to identify the areas which could be adjusted (lease rates or other parameters) to influence the profitability of the project;
- to determine the requirement of initial support and later on to implement project on a commercial footing.

The main approach was to determine the financial viability of the project on the basis of an assessment of demand forecast for industrial plots, revenue collection from commercial areas, capital cost estimate for the project, revenue projection and financing structure.

Financial analysis of the project has taken into consideration, such factors as:

- short and long-term financial obligations;
- projected revenue stream, projected costs (fixed and variable), depreciation schedule and asset construction schedule;
- demand forecast for leasable area of the Economic Zone;
- lease rate structure and the impact of amendments in that structure;
- financial structure of the project.

The financial model has covered the following:

a) determination of the revenue projection, projection income statements and cash flow statements over the life of the project;

b) calculate various financial outputs such as IRR, payback periods and debt-service coverage ratio for assessment of project viability;

c) sensitivity analysis on the major parameters including capital cost, O&M cost and lease rate. in order to explore its sustainability under different changing situations;

d) financial analysis on options for cost recovery of capital investments and recurrent costs under different demand forecast scenarios.

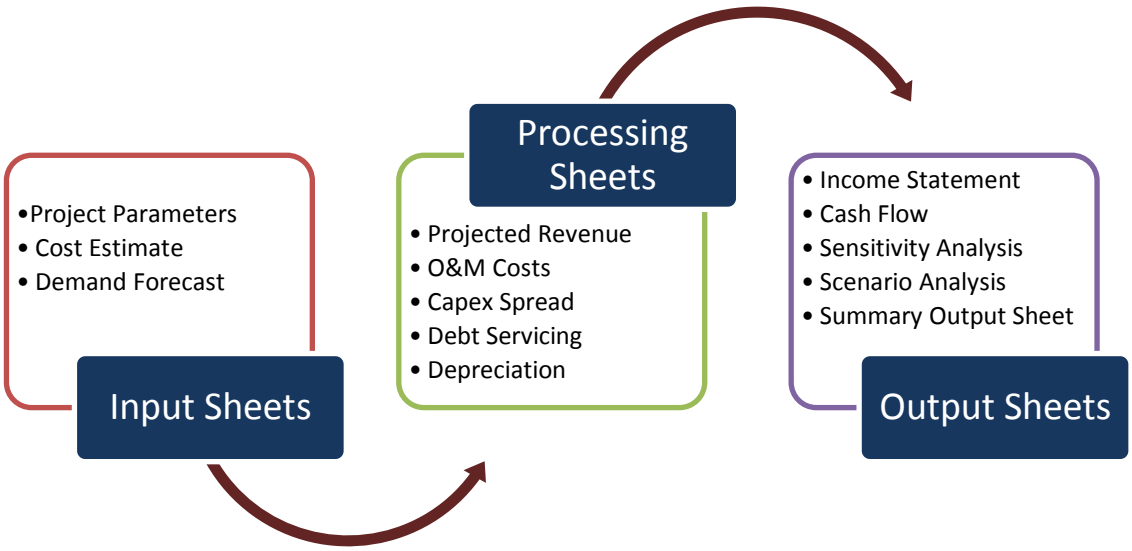
10.1.1 Structure of the Financial Model

The financial analysis for the project was conducted using a spread sheet based model:

1) a projection of each component of cost and expenses on the basis of a consistent set of background financial/economic assumptions; and

2) the revenue generated by a given structure of revenue sources. The results of combining cost and revenue projection are presented as output indicators as shown in the following figure.

Figure 10.1: Flow Chart of the Financial Model



The model contains interlinked sheets keeping in view of the available data and information. The sheets of the model are as follows:

Input Sheets	
	Project Parameters Cost Estimate Demand Forecast
Processing Sheets	
	Debt Servicing Projected Revenue Depreciation Projected O&M Costs
Result Sheets	
	Income Statement Cash Flow Statement Sensitivity Analysis Scenario Analysis Summary Output Sheet

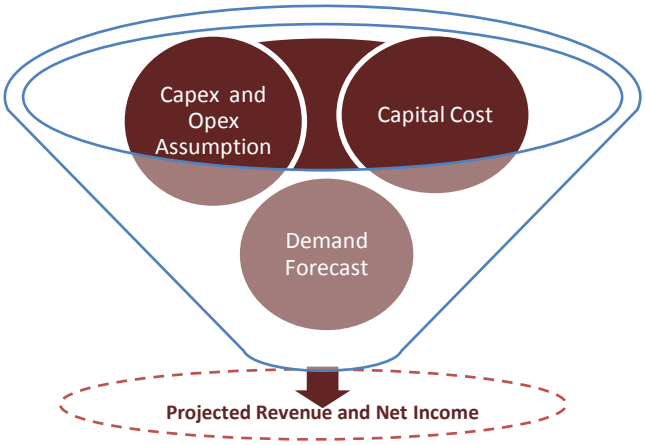
The input and input support sheets accommodate all the basic inputs of the project required for the financial model. These inputs have connection with other sheets (processing/intermediate calculation) where specific calculations are made. Then the outcomes of the individual sheets were connected to the result sheets to obtain the final results. Sensitivity analysis is also included in the model to test its sensitiveness on change of different important parameters.

The interlinked sheets as used in the financial model are briefly described as follows.

Input and Input Support Sheets:

The input sheets include (1) Capex Assumption sheet (2) capital cost summary sheet, and (3) demand forecast sheet.

Figure 10.2: Input Sheets in the Model



Capex and Opex Assumption Sheet: These two sheets contain all the major parameters of the project which will act as inputs to the model. The parameters include: (1) leasable commercial area, and (2) cost escalation factors, etc.

Capital Cost Summary Sheet: Capital cost summary includes land development, off-site infrastructure, on-site infrastructure, project management costs.

This worksheet provides a summary of the project costs for the development of the economic zone. This worksheet has an onward relationship with depreciation, Capex year and cash flow sheet.

Demand Forecast: The sheet provides different demand projections based on different space take up scenarios. The projected demand was used for determining the projected revenue and projected variable costs for the project. This sheet has an onward relationship with the revenue and O&M.

Processing Sheets: The processing sheets compute and process data as provided in the Capex assumption and capital cost sheets. The processing sheets are (1) sources of finance (2) revenue, (3) depreciation, (5) O&M Costs and (6) Capex year.

Sources of Finance: This worksheet sets out a consolidated summary of finance stating separately the yearly amount of equity in Bangladeshi Taka. The computation of yearly equity is derived from capital cost, and debt equity ratio. This sheet has link to the cash flow sheet.

Revenue: This worksheet calculates the projected revenue of the Economic Zone from sources such as:

a) Rent from Land Lease
b) Rent from Training Centre Space
c) Rent from Commercial Facilities Space
d) Rent from SFB

e) W&S service charge from tenants
f) Power service charge from tenants
g) CETP service charge from tenants

Revenue was calculated based on the demand forecast and the lease rates. The output of the revenue sheet is processed in the income statement sheet to calculate the projected net income of the operator.

Depreciation: Depreciation sheet calculates the depreciated value of the assets annually. It takes data from Capex assumption sheet and after computation, the depreciation expense from this sheet goes to the income statement.

O&M Costs: It receives data from the input sheet and input support sheets regarding operation cost, maintenance cost and fixed costs of the project. The output of the O&M costs sheet is used in the income statement sheet to calculate the projected net profit of the business.

Capex Year Sheet: The Capex year is used for incorporating capital cost phasing of the project year by year. Phasing of construction cost during construction is also projected in this sheet.

Financial Statements: Results of operating performance and financial position at periodic intervals are the essence of financial statements. The financial model provides projected financial statements such as, income statements and cash flow statements depicting profitability, liquidity and overall financial health of the entity. The result sheets include (1) Income Statement and (2) Cash Flow Analysis.

Income Statement: The financial model provides income statements for each year for 20 years. The revenue stream over the years is shown in the income statement. The statement also shows the operating expenses (fixed and variable), financing expenses and depreciation expenses as deductions from the revenues to obtain net income before tax. After deducting applicable tax, the net income for the equity holder is derived.

Cash Flow Analysis: Cash flow statement is an important financial output in the model, especially to work out the appropriate cash requirements of the project. The financial model incorporates the cash flow analysis for the project and determines the Project and Equity IRR.

Result (Financial Indicator) Sheets

Summary Output Sheet: The key requirement for financial viability is that the business is able to earn profit and keep up cash flow sufficient to finance all necessary future investments. This sheet gives the results of the model run in summarized form. The key results indicators are:

- Internal Rate of Return (IRR) on capital employed in the total project and on equity. This is the ultimate parameter to determine the viability of the project.
- Total Capital Payback Period
- Equity Payback Period

Figure 10.3: Key Financial Indicators

Sensitivity Analysis Sheet: Sensitivity analysis is used to test the robustness of the results to variation in key inputs and project parameters. Cash flow as well as financial indicators depend on the interplay of several factors including capital cost, O&M cost and revenue and charges it earns from different category of services. It was used to identify the values, if any, at which, preference for one option is switched to preference for another. Considering these variations of parameters, change of output /results was found through this analysis.

Scenario Analysis Sheet: The model incorporates different demand forecast scenarios. This sheet analyses the results of these scenarios in different combinations.

10.1.2 Bogura Economic Zone Businesses

The Economic Zone Act 2010 provides the legal coverage for attracting and leveraging private investment towards development of zones as zone developers and operators. As such, the financial model of the economic zone incorporates two types of investment choices, government/BEZA led model and PPP model. In both choices/ options of investment the financial model considers broadly two types of sub-businesses.

1) Core/Main Business (designated as M1, M2 and M3)
2) Component Businesses (designated as C1, C2, C3, C4 and C5)

The core business is leasing out land to different industries and rents collected from the floor space and other facilities of training center and commercial amenities.

The component businesses are premised on different sub-components of the project that have individual cost recoveries, such as power supply, gas supply etc. The capital, O&M costs and revenues for the component business have been matched exactly so that the resulting tariffs do not have any element of cross subsidization.

10.1.3 Land Lease

The EZ will lease out land to different industries and receive revenue. Assumptions and estimates have been made on the following major items for the economic zone with respect to land lease and operation and maintenance:

1) Land Lease Tariff to be charged from the industrial units. The lease tariff covers the conservancy tax for cleaning, security, street lighting etc.
2) Total leasable area
3) Total Capital Cost for construction of Boundary Wall, Admin Building, land filling etc.
4) O&M Expense
    - Maintenance
    - Salary and Allowances

It has been assumed that 95% of the leasable space will be taken up at full capacity. 5% of the leasable area is estimated to be transitional, *i.e.* in-between lease and unoccupied. The capital cost covers the cost for boundary wall, internal road, common zone facilities, etc.

10.1.4 Vocational Training Centre

One of the core businesses of the EZs is to provide training center facilities, lease out spaces of training center and receive revenue. Assumptions and estimates have been made on the following major items for the EZ with respect to operation and maintenance of training center:

5) Rental Tariff to be charged from the training center lessees
6) Total Floor Space of training center
7) Total Capital Cost for construction of the training center
8) O&M Expense for operating the training center
    - Maintenance
    - Salary and Allowance
    - Land Rent
    - Utilities

It has been assumed that 95% of the leasable space will be taken up at full capacity. 5% of the leasable area is estimated to be vacant for transition.

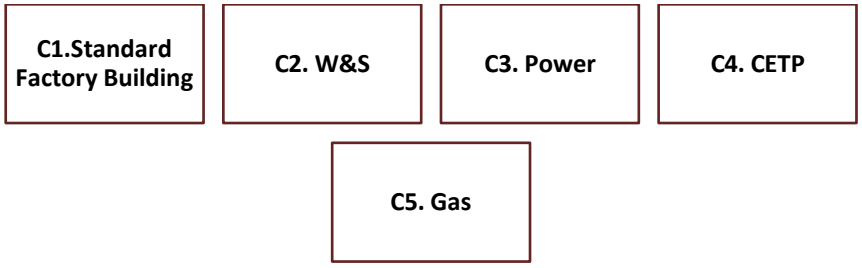
10.1.5 Commercial Facilities

One of the main services of an economic zone is to lease out commercial facilities/spaces and possessions to the different vendors, shop owners, banks etc. Major assumptions and estimates made with respect to commercial facilities are as follows:

1) Rent Tariff
2) Total Floor Space
3) Total Capital Cost for constructing the commercial facilities
4) O&M Expense for maintaining the Commercial Facilities
    - Maintenance
    - Salary and Allowance
    - Land Lease Rent
    - Utilities

It has been assumed that 95% of the leasable space will be taken up at full capacity. 5% of the leasable area is estimated to be transitional, *i.e.* in-between lease or unoccupied.

The Economic Zone will earn substantial revenue from different facilities and services (component businesses) offered in the forms of charges for the use of water supply, power, CETP and others. The Ishwardi and Uttara EPZ tariff rates have been applied in the component businesses for determining the overall tariff of the Economic Zone.



10.1.6 Standard Factory Building

Standard factory building is a significant part of the business of an economic zone. It helps the entrepreneurs to start businesses on a first track basis with readily available factory space. The financial model presents the assumptions and estimates made on the following items:

1) Rent Tariff for space in SFB
2) Total Floor Space in SFB
3) Total Capital Cost of constructing SFB
4) O&M Expense for operation and maintenance of SFB
    - Maintenance
    - Salary and Allowance
    - Land Lease Rent
    - Utilities

Rent for spaces of SFB is based on the rates of Standard Factory Building of Ishwardi and Uttara EPZ in the country. It has been assumed that 95% of the leasable space will be taken up at full capacity. 5% of the leasable area is estimated to be transitional.

10.1.7 Water and Sewerage System

Water and sewerage services may be treated as a component business to determine the tariff rate for water and sewerage services to be charged to the industries. The EZ will have deep tube wells, water treatment plant for providing these services. The EZ will also lay water and sewerage pipes and pumps, and also be responsible for operation and maintenance of the water and sewerage system. The EZ will charge tariff to different industries for these services. The tariff will be charged based on the amount of water supplied (Taka/m3) to the industries. Major assumptions are as follows:

1) W&S Charge (tariff to be charged from tenants)
2) Capacity of the system
3) Total Capital Cost for constructing the system
4) O&M Expense for running the system
    - Maintenance
    - Salary and Allowance
    - Land Lease Rent
    - Utilities

The tariff of water and sewerage system is based on the rates of Ishwardi and Uttara EPZ in the country. The above facilities will use ground water for water requirement of the zone.

10.1.8 Power

The Economic Zone is responsible for providing power connections to industrial enterprises to be located within the zone. Therefore, the EZ has to either build its own power generation plant, or enter into an agreement with a third party to construct a power plant and supply power to the zone inside tenants/industries. Tariff (Tk/kWh) will be charged to the industries for the electricity supplied.

Major assumptions and estimates have been made for power supply on the following items:

1) Power Tariff
2) Capacity of the Power Plant
3) Total Capital Cost for constructing the power plant
4) O & M Expense for running the power plant
    - Maintenance
    - Salary and Allowance
    - Land Lease Rent
    - Fuel and Utilities

The tariff of power is based on the rates of Ishwardi and Uttara EPZ in the country. The plants are not always operated at 100% load factor. The Plant Load Factor (PLF) has been considered as 70%.

10.1.9 CETP

Central Effluent Treatment may be treated as a component project to determine the tariff rate to be charged to the industries for providing effluent treatment services. The tariff will be charged based on the amount of effluent treatment (Taka/m3) to the industries. The financial model contains major assumptions and estimates that have been made with respect to CETP for the following items:

1) Charge (tariff) for effluent treatment
2) Capacity of the CETP
3) Total Capital Cost for constructing the CETP
4) Operation and Maintenance Expense of CETP
    - Maintenance
    - Salary and Allowance
    - Land Rent
    - Utilities

The tariff of CETP system is based on the rates of CETP at CEPZ.

10.2 Term/Business Period

The business period over which the EZ would receive a profitable return on his investment is very important. However, this would depend on the following factors:

- sources of capital and its repayment terms;
- economic life of major depreciable assets;
- revenue earnings;
- capability of the tenants/ buyers to pay the cost; and
- Phasing of the Zone's infrastructure.

The financial model is prepared considering a period of 20 years, although law permits for 50 years lease period. From financial point of view, longer project period will not carry any significant impact on the results of the financial model. Moreover 50 years, a very long investment recovery period will eventually discourage the investment.

10.3 Capital Cost

Capital costs have been estimated both at the base year (2018) and subsequently at the point when they will be incurred with escalation during time elapsed. It comprises cost of land development, land filling, external/ off-site infrastructure, which include connectivity infrastructure like road, gas or power. The social infrastructure ensures proper living conditions of the people inside the zone, which includes administrative buildings, a mosque, a vocational training center and commercial facilities. These are the part of capital cost but some of the social infrastructure like the mosque, etc. will not generate direct revenue. The capital cost also include the commercial facilities like shops, restaurants, banks, etc. are essential for day-to-day life of the tenants inside the Zone.

The table on the following page shows BEZA has to bear the whole investment cost in BEZA/government led model whereas the PPP operator has to bear only the on-site infrastructure cost. In PPP model BEZA has also obligation to bear cost other than onsite and offsite infrastructure cost. In case of PPP option offsite infrastructure will be borne by other relevant agencies. Though the land cost will be incurred by BEZA in PPP model, the PPP operator will have to pay some upfront fee and annual lease rent.

10.4 Cost Escalation and Contingency

It is assumed that all costs are escalated from the time of their estimation to the time the cost is actually incurred at the rates shown in the following table:

Table 10.1: Cost Escalation Rates

	Cost Item	Escalation Rate (per year)	Comments
1)	Land Filling Cost Escalation	5%	Percentage adapted as per industry norms
2)	Cost Escalation for Off-site infrastructure	15%	Average of Construction Material Price Indices and recent trend, Bangladesh Bureau of Statistics
3)	Cost Escalation for On-site infrastructure	15%	As above

Table 10.2: Capital Cost

	Rate			Cost	Cost Split			
	Tk per unit	Amount	Units	Tk m	BEZA Led Model		PPP Model	
					BEZA	Private Sector	BEZA	Private Sector
1. Land Development and Boundary Wall					**1,076**	**0**	**1,076**	**0**
1.1 Land Filling	408	2,539,208	cum	1,036	1,036	0	1,036	0
1.2 Boundary Wall	8,000	4,963	m	40	40	0	40	0
					2,265	**0**	**2,265**	**0**
2. Land Cost	9,000,000	252	Acre	2,265	2,265	0	2,265	0
3. Off-site Infrastructure					**64**	**0**	**64**	**0**
3.1 Access Road & Water Disposal Line	8,500	1,829	sqm	44	44	0	44	0
3.2 Optical Fiber Cable			LS	20	20	0	20	0
4. On-site Infrastructure					**4,935**	**0**	**0**	**4,935**
4.1 Common Facilities and Businesses								
4.1.1 Internal Roads	8,500	80,169	sqm	990	990	0	0	990
4.1.2 Other Common Zone Facilities				728	728	0	0	728
4.1.3 Social Facilities	25,000	26,912	sqm	673	673	0	0	673
4.1.4 Training Center	25,000	1,856	sqm	46	46	0	0	46
4.1.5 Commercial Facilities				934	934	0	0	934
4.2 Component Businesses								
4.2.1: C1. SFB	2,500	184,000	sqm	460	460	0	0	460
4.2.2: C2. Water Supply and Sewerage System				374	374	0	0	374
4.2.3: C3. Power Supply System				144	144	0	0	144
4.2.4: C5.Gas Supply System				61	61	0	0	61
4.2.5: C4. CETP	LS			525	525	0	0	525
5. Project Preparatory Costs of the Sponsors					**62**	**0**	**62**	**0**
5.1 Consultancy Fees for Feasibility Study	LS			6	6	0	6	0
5.2 Offsite Infrastructure Consultancy Fees	LS			0			0	
5.2 Legal Support	LS			6	6	0	6	0
5.3 Administrative & Marketing Promotions	LS			5	5	0	5	0
5.4 Vehicle	LS			45	45	0	45	0
Total (before cost escalation and IDC and Upfront fee)					**8,402**	**0**	**3,467**	**4,935**
6. Upfront Fee	10% of Land Price				0	0	0	227
Total (before cost escalation and IDC)					**8,402**	**0**	**3,467**	**5,161**
7. Cost Escalation					**1,566**			**1,518**
8. Interest During Construction Period					**786**			**525**
					10,754	**0**	**3,467**	**7,204**
Total Capital Cost						**10,754**		**10,671**

10.5 Demand Forecast

The model has been used to assess the viability of developing the economic zone using three different demand forecast scenarios. The three different scenarios analyzed are as follows:

Table 10.3: Time Required for Land Take-up

Years Needed for Full uptake	Light Engineering	Furniture	Food Processing/Auto Rice Mill	RMG	Pharmaceutical
Base case	6	6	7	7	8
Aggressive Case	4	4	5	5	6
Conservative Case	8	8	9	9	10

The above land take up rates have been taken in consideration of the following:

Investment Trends: The demand forecast considers new company formation trends and viability of existing business enterprises as a way to establish a baseline upon which the demand estimations are based.

Relocation Trends: The zone will be heavily marketed to attract companies wishing to relocate from city. As such, consultants explored these firms' stated willingness—and actual proclivity—to locate or relocate, external pressures to move, and analyzed the types of firms that would actually move.

Uptake Rates in Bangladesh: The demand forecast reviewed actual land uptake rates of other economic zones in Bangladesh in support of high demand for serviced industrial space.

For each scenario, the financial analysis indicates the internal rate of return (IRR) of the project and allows for sensitivity analysis on costs and other factors to see their effect on the IRR.

10.6 Identification of Revenues and Expenses

10.6.1 Revenues

The Economic Zone is expected to earn revenue from a number of sources. The financial model considered the following sources.

CRS activities were considered in the financial model, such as day care center, secondary school etc. Assumptions were made in the financial model that the revenue sources will be from land lease, training center, commercial facilities, SFB rent, water supply charge, power supply charge, CETP and gas supply.

10.6.2 Depreciation

Depreciation is a non-cash expense. Though it does not directly influence cash flow, it influences tax obligations from income of the business, by offering tax savings adding to depreciation. Depreciation like interest is a tax deductible item considered by the tax authorities.

Basis of Depreciation: The Income Tax Ordinance, 1984 allows deduction of depreciation of assets from the income of the particular year to determine the taxable income for that period. Section 29(1) (VII) and (IX) of the Income Tax Ordinance provides provisions for the following methods of depreciation:

- Normal Depreciation
- Accelerated Depreciation

The ordinance also provides prescribed rates of depreciation irrespective of actual life of the assets. Normal Depreciation method is used in the model. It is briefly described in the following section. The Income Tax Ordinance prescribes the depreciation schedule.

The "Normal Depreciation Method" is considered as base case for the financial model. The following table provides the prescribed rates for normal depreciation.

Table 10.4: Schedule for Normal Depreciation

	Types of Assets	Depreciable amount[145]
1)	Building (general)	10%
2)	Factory building	20%
3)	Furniture and fixture	10%
4)	Machinery and plant (general rate)	20%

Each year, depreciation has been charged by the above prescribed%age on the written down value *i.e.* the value of asset less accumulated depreciation in the previous years. In accounting concept, it is referred to as declining balance method. Depreciation each year will be reduced as the same%age as applied on a declining balance. This method of depreciation has been used in the financial model as the base case, as the depreciation is mainly calculated for determining taxable income and thereby tax to be paid.

According to S.R.O No. 227 and S.R.O No. 229 of Finance Act 2015, Developers of Economic Zone in Bangladesh will enjoy the following Income Tax Exemption:

Duration of Tax Exemption	Rate of Tax Exemption
Year 1-10	100%
Year 11	70%
Year 12	30%

As tax exemptions are already provided in the front-end of the years of operation, accelerated depreciation will not be beneficial as such, as that would not result any tax saving. Rather normal depreciation may result some tax saving for the developer at the back-end as this method will result some level of depreciation over the whole period of operation.

10.6.3 Operating Expenses

Each of the facilities developed and constructed by the Economic zone has operational costs, which include salary and allowances of employees, maintenance costs, and utilities costs. In addition, the cost of fuel used in the power plant is also an operational cost. Maintenance costs associated with training center and commercial facilities are based on the amount of revenue generated from each items. The O&M cost will be higher if the buildings are in full capacity and lower if not all leasable spaces are taken up.

145 As%age of written down value

Economic zone will also operate and maintain 20 MW power generation unit. Fuel costs associated with running the power plant, operation and maintenance costs and salary of staff of the power plant has been estimated and incorporated in the model.

O&M Cost of W&S, and CETP has also been considered. Maintenance of roads, sewerage system all have yearly operations and maintenance costs associated with them. Estimates on the amount of O&M cost has been made on the basis of investment. In addition to the internal infrastructure, there are also costs associated with the operations of the Zone such as security, etc. All such costs have been incorporated in the model.

For O&M expense calculation of both main and component business, the salary and allowance is based on the latest rate (pay scale 2015) declared by the pay commission of Bangladesh. The allowance including medical, festival and New Year bonuses, house rent, conveyance, education for children etc.

Table 10.5: O&M Cost Escalation Estimates

Salary and Allowances Escalation Rate	5%	per yr
Other O&M Expenses Escalation Rate	2.5%	per yr

10.7 Return from the Project

The internal rate of return (IRR) on a project is the annualized effective compounded return rate or discount rate that makes the net present value of all cash flows from the project equal to zero. Internal rates of return give an indication on the desirability of investments or projects. The higher a project's IRR, the more desirable it is to undertake the project. Amongst other factors, returns depend upon tariff rates. The following tariff rates have been assumed:

Table 10.6: Assumed Tariff Rates

		Unit	Base Tariff (2018)	Beginning Margin over Base Tariff	Beginning Tariff (Bogura EZ) 2021	Comparison		Unit
1.	Land Lease Charge	$/sqm/yr	1.25	10%	1.38	Ishwardi & Uttara EPZ Charge	1.25	$/sqm/yr
2.	Power	Tk/kWh	8.97	10%	9.87	“”	8.97	Tk/kWh
3.	Water and Sewerage	Tk/m3	24.74	10%	27.21	“”	24.74	Tk/m3
4.	C1. SFB	$/sqm/yr	1.60	10%	1.76	“”	1.60	$/sqm/yr
5.	CETP	Tariff (year-wise)	47.88	15%	55.06	DEPZ Charge	2.75	$/sqm/mon
6.	Rent of Training Center	Tk/sqm/yr	5,000	25%	6,250	“”	47.88	Tk/m3
7.	Rent of Commercial Facilities	Tk/sqm/yr	5,000	25%	6,250			
8.	Gas Supply	Tk/m3	7.76	10%	8.54	Titas Indust. Rate (1 Jun 17)	7.76	Tk/m3
9.	O&M Charge	of Utility Charge	15%		15%			

Table 10.7: Financial Return From the Project

Output	Government led Model	PPP Model
Equity IRR (after tax)	10.06%	15.15%
Project IRR (after tax)	10.03%	13.93%
DSCR		
Average	1.00	1.40
Maximum	2.29	3.28
Minimum	0.10	0.07
Equity Payback Period (year)	14	12
Project Payback Period (year)	11	10

The equity IRR of the project has been calculated from the projected cash flow to equity where as project IRR has been calculated the cash flow with respect to the project. However the project and equity return as well as DSCR and payback period are satisfactory.

Project IRR Computation using Discount Rate: Project IRR computation is shown in the following table.

Table 10.8: Project IRR Computation (using discount rate)

	Government Led Model		PPP Led Model	
Net Present Value (NPV) at				
	9.5%	509	13.0%	467
	10.5%	-405	14.0%	-30
	10.03%	0	13.93%	0

The above table shows the present value of net cash flow is zero at discount rate 10.03% in government led model and 13.93% in PPP model which represent the project IRR.

Net Present Value (NPV): NPV has been calculated using the cost of capital/hardle rate of 9%. The computation shows the NPV in Government led model and PPP model are Tk. million 876 PPP Tk. million 3,418 which are positive and indicates the project is viable in both cases.

10.8 Scenario Analysis

Scenario analysis of different options demonstrates is in the table below.

Table 10.9: Scenario Analysis

		Government led Model	PPP Model
Equity IRR	*Base Case*	10.1%	15.2%
	Aggressive Case	11.7%	17.9%
	Conservative Case	8.5%	12.6%
Project IRR	*Base Case*	10.0%	13.9%
	Aggressive Case	11.2%	15.7%
	Conservative Case	8.9%	12.2%
Average DSCR	*Base Case*	1.0	1.4
	Aggressive Case	1.2	1.6
	Conservative Case	0.9	1.2
Equity Payback Period, years	*Base Case*	14	12
	Aggressive Case	13	10
	Conservative Case	15	13

		Government led Model	PPP Model
Project Payback Period, years	*Base Case*	11	10
	Aggressive Case	10	9
	Conservative Case	12	11

Difference of results obtained from base case and aggressive case is substantial which indicates IRR depends on the early land take-up. Average DSCRs in all cases are more than 1 which is satisfactory. Equity and project payback period in government led model shows the project need more than half of the project tenure to recover the capital. PPP model is attractive in comparison with government led model.

10.9 Sensitivity Analysis

Various factors affect the equity IRR of the project. In order to understand the importance of each factor in determining the viability of the project, it is important to carry out a sensitivity analysis. The following factors have been analyzed for examining their impact on the internal rate of return:

- Capital Cost;
- O&M Cost;
- Lease rate

The above factors were varied by 10% in both directions and the effects on the equity IRR were observed.

Table 10.10: Sensitivity to Equity IRR

Government led Model

	-20%	-10%	0%	10%	20%
Capital Cost	13.3%	11.5%	10.1%	8.8%	7.6%
O&M Cost	10.4%	10.2%	10.1%	9.9%	9.8%
Lease Rate	7.1%	8.6%	10.1%	11.4%	12.6%

PPP Model

	-20%	-10%	0%	10%	20%
Capital Cost	18.8%	16.9%	15.2%	13.7%	12.3%
O&M Cost	15.5%	15.3%	15.2%	15.0%	14.8%
Lease Rate	11.5%	13.4%	15.2%	16.8%	18.4%

Based on reasonable assumptions after tax equity IRRs 10.1% and 15.2% have been derived for Government led Model and PPP Model respectively. The Equity IRR varies significantly with changing the key factors, capital cost and lease rate, whereas O&M cost variation has insignificant effect on equity IRR.

10.10 Economic Analysis

Infrastructure investment is considered as capital investment and it has a ripple effect throughout the economy that continues to provide favorable outcome for a long time. Although the infrastructure does not directly contribute to the production process but it is a prime requirement for the development and operation of any production facility. The primary challenge that the developing countries such as Bangladesh face in establishing and operating production based industries are the lack of different infrastructural support. The government in most cases does not have the capacity to develop the required infrastructure. To solve the issue the Government of Bangladesh has taken the initiative to involve the private sector in developing the infrastructure support through systematic investment in the economic zones. The government itself is also developing some economic zones, in areas that are important for the overall growth of the economy of the country. When an entity invests significant amount in the development of infrastructure facilities, the primary motive usually is to get financial return by using that infrastructure. The return in this case would be the direct return to the developers. But a large scale infrastructure development always has greater impact on the economy as a whole. The following chapter aims at to quantify the economic impact of Bogura Economic Zone on the economy as a whole.

10.10.1 Economic Impact & Cost Benefit Analysis

Rational of the project: Economic zones are basically infrastructure development projects that would provide support to other industrial projects. They would provide land, road access, utility services and other facilities to potential industries that would be setup inside the zone. They would be the provider of resources to the investors for uninterrupted operation of their business. Developing infrastructure is costly. Economic zones would receive economies of scale in terms of operation regarding the infrastructures developed, since there would be many industries inside a zone and all of them would be sharing the cost. Therefore for individual investors the cost of setting up a new industry would be lower compared to the industries setup outside a zone. The industries that are being setup in isolation would therefore make underinvestment in infrastructures, leading to lower operational efficiency and lower competitiveness. The economic zone would be an organized initiative to develop sophisticated technology based industrial operation. It would be important not only to strengthen infrastructure access but also to improve other capabilities (technical, managerial, operational) of the unit investors.

Methodology of Economic Analysis: In order to conduct economic analysis, it is first required to quantify the costs and benefits in to economic equivalent terms. It is required to identify and evaluate the inputs and outputs at their true economic cost. All the revenues and costs used for the economic analysis has been obtained from the financial modeling in the previous chapter. Some important considerations for the economic analysis are:

a) Economic analysis is considered at constant prices in local currency terms. Thus, in case of accounting for economic costs and benefits, all costs and benefits must be measured in 'real' terms. In such analysis, all the costs and benefits are considered at the commencement year i.e. 2018 and an escalation factor has been applied on the costs and the associated benefits. To undertake the economic analysis, financial costs were converted to their economic cost equivalents. Financial components include Capital

Costs (land acquisition, development and construction cost, etc.), and Operating Expenses.

b) Items such as taxes and duties, included in financial costs are excluded as these are market distortions.

c) Debt service costs are not included as costs in an economic analysis as the interest payments do not entail the use of a resource. The economic analysis for the proposed Economic zone is undertaken at three levels:

- **Level 1:** Estimation of ERR by considering the economic equivalents of direct costs and benefits of the project. Benefits in terms of employment generation are also estimated.
- **Level 2:** Estimation of cost of off-site infrastructure and its impact on the economy. While data on the cost of off-site infrastructure is available, data on commensurate economic benefits that will accrue due to the provision of off-site infrastructure is not readily available. Hence, a description of economic benefits stemming from the project has been provided.
- **Level 3:** The income and employment multiplier effect has been discussed in this level.

***Assumptions*:** The economic analysis has been conducted based on a time period of 20 Years. The model is based on the similar assumptions that was drawn on for the financial model and has been discussed in the financial model chapter. The assumptions that differ has been discussed here:

Capital Expenditure (CAPEX): The CAPEX incurred on various components has been provided in the financial model. This CAPEX is segregated into three components:

a) Material: 50% of the total CAPEX,
b) Equipment: 40% of the total CAPEX,
c) Labor: 10% of the total CAPEX

The effect of inflation has already been considered in the financial model in determining all the costs and revenues. So, it can fairly be assumed that the figures in the financial model are economic/ market cost and revenue.

Operation and Management (O&M) Expenditure (OPEX): The OPEX incurred on various components as provided in the financial model is also segregated into three components, in the following proportion:

a) Material: 10% of the total OPEX,
b) Equipment: 20% of the total OPEX,
c) Labor: 70% of the total OPEX.

Standard Exchange Rate (SERF)[146] of 1.03 and Shadow Wage Rate Factor (SWRF) [147]of 0.944 have been considered based on Bangladesh Planning Commission information and previous ADB

[146] Shadow Exchange Rate (SER): The economic price of foreign currency used in the economic valuation of goods and services. Shadow Exchange Rate Factor (SERF): The ratio of economic price of foreign currency to its market price. Alternatively, the ratio of the shadow to the official exchange rate. For economic analysis using the domestic price numeraire, the SERF is applied to all outputs and inputs, including labor and land that have been valued at border price equivalent values, with project effects measured at domestic market price values left unadjusted.

economic analysis reports for Bangladesh. These have been applied to tradable inputs and labor component to get domestic equivalents.

Equipment: It has been considered that around 75% of the equipment and machinery used for the project would be imported.

Treatment of Tax: Since tax, subsidies and incentives are distortionary in nature; their impact is required to be zeroed out by making necessary adjustments. On the 75% of the equipment that is imported, Shadow Exchange Rate Factor (SERF) has been applied that is the rate after adjusting for all distortions including trade restrictions, duty etc. Therefore, on this component after adjusting by SER, the import duty need not be reduced as it has already been taken into account while arriving at SER. On the domestic component (25%) of the equipment, VAT or other applicable rates are reduced to convert to economic cost. VAT rate has been considered as 15% as per prevailing rate in Bangladesh.

Calculation: The total economic cost has been arrived at by adding the following components of the project:

a) Material (CAPEX)
b) Equipment (CAPEX)
c) Labor (CAPEX)
d) Land Cost
e) Material (OPEX)
f) Labor (OPEX)
g) Equipment (OPEX)

Total economic benefit has been arrived at by adding the following components:

a) All lease revenues (industrial plot, commercial area, residential area)
b) All utilities revenue (Electricity, Water, GAS, CETP)
c) Service Charge

Economic IRR	12.86%		
Discount rate	10%	12%	14%
NPV of Net Benefits	2,921,017,390	733,334,974	(813,217,501)
Benefit Cost Ratio	1.18	1.05	0.93

The Economic IRR derived from above methodology is 12.86% with a Benefit to Cost ratio of 1.18 considering a discount rate of 10% during base case. The Economic IRR of 12.86% shows that the project is economically viable throughout its life. It is going to create a positive impact on the economy of the nation as a whole.

[147]Shadow Wage Rate Factor (SWRF): The ratio of the shadow wage rate of a unit of a certain type of labor, measured in the appropriate numeraire, and the project wage for the same category of labor. Alternatively, the ratio of the economic and the SWRF can be used to convert the financial cost of labor into its economic cost. It is assumed that 75% of the labor in the project would be skilled and the SWRF for them would be 1.00. The same would be 0.75 of unskilled labors and they would compose 25% of the labor force.

In addition, the economic analysis also assumes the loss of yield by the cultivation of triple season's agriculture crops in Bogura District. The total production of paddy in Bogura District for the year of 2016-2017 is presented in table below .

Table 10.11: Production of paddy Bogura District[148]

Type of Paddy	Year 2016-2017	
	Area (in Acres)	Production (in MT)
Aus[149]	46,649	47,137
Aman[150]	447,636	494,235
Boro[151]	458,984	719,981
Total	**953,269**	**1,261,353**

It is found that a total of 1,261,353 MT paddy has been produced during 2016 to 2017 in Bogura District within 953,269 acres of agriculture land. The proposed BEZ would be established on 251.43 acres of agriculture land with triple cropping pattern. So for 251.43 acres of land, a total of 333 MT yield would be lost according to assumption based on agriculture statistics of year 2016-2017. It is calculated that the loss is 0.02% of total yield in Bogura District. Expert thinks that this loss has no significant impact on the local economy of Bogura, as planned economic infrastructure development (i.e. BEZ) would play vital and sustainable roles to the livelihoods of affected farmers and tenants. Moreover, local crop productions would be backward support of raw materials for agro-based industries that has been proposed in upcoming BEZ.

[148] BBS (Bangladesh Bureau of Statistics), 2017. Yearbook of Agricultural Statistics. Ministry of Planning, Government of the People's Republic of Bangladesh.

[149] The paddy which are sown during the month March-April and harvested in July-August every year

[150] The paddy which is harvested in the month of November and December

[151] The paddy which is cultivated in the month of March to May

11 Conclusion

Bogura is called the gateway to north Bengal and a hub of small businesses. It is a business city where many small and mid-sized industries are sited. Trade association of Bogura is very much active to relocate or set up new industries in the EZ for creating employment opportunity for the youth and economic development of the area. In addition, the existing small engineering plants will get a boost once the EZ is built in Bogura.

The local trade association expects positive impact on the socio-economic development in the area as a result of the development of the EZ project. They also expect that the EZ would improve communication and transportation facilities in the locality and overall socio-economic conditions of the local communities. It was also perceived that the project would adequately contribute to the increase in employment and income opportunities of the people by various means, thereby alleviating poverty in this region. New livelihood opportunities will be available to the people during the construction and commissioning phases of the zone. Direct employment opportunities for the local people (especially construction workers and unskilled labours) are expected to increase.

The consultation reflected that the agro based industry, jute mill, foundry, pharmaceuticals, auto rice mill, cold storage, metal industries, rice bran oil mill, plastic factory, processing wood industries, poultry and fish feed mill, woven bag industries, particle board industries, paper mill, flour mill, light engineering, ceramic industry, tiles factory, meat processing Industries, garment industry have been established in last ten years in this area.

The trade association reflected that to prevent environmental pollution, some industry owners have set up their industry in the very low density area with ETP. To establish industries in BEZ the following points are important:

Strong: Availability of labor, manufacturing of quality products , low price of land , availability of raw materials, available transportation, business oriented people;

Weak points: Insufficient gas and water and need of a domestic airport;

Opportunity: Expansion of business, employment creation, use of domestic products;

Risks: Higher interest rate of bank loan, power and infrastructure facilities, inadequacy of skilled labor

It has been suggested that appriopriate steps be taken to make available the following facilities to attract investors in the identified areas.

- Connection of gas and power needs to be simplified;
- Development of transportation network (road, rail and air);
- Low price of land/plot;
- Land/space allocation needs to be simplified;
- Necessary support for getting long-term loan.

It is important to note that this report has covered the benchmarking of the EZ, industry assessment and demand forecast to comply with the ToR. Concept of master planning, social and environmental review has also been covered.

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