11 Challenges Urbanization and Settlements for the BDP 2100

Derived form the issues as described in the previous sections, there are two main challenges for urbanisation and settlement with regard to the Delta plan:

- Providing a holistic long term plan combining (amongst others) water management and sustainable spatial and urban development.
- Establishing a well functioning planning and implementation structure

11.1 Providing a holistic long term plan combining (amongst others) water management and sustainable spatial and urban development.

The long term holistic plans should not be considered blueprints, but are strategic plans that help to guide policies and investments towards a sustainable future. Strategies should be made for different scale levels that link and strengthen each other.

Of course in relation to those fiscal plans, aspects with regard to poverty, health, gender, infrastructure, water quality, drainage, local economy, environment and housing should be addressed with additional policiciy measures.

11.1.1 National scale

A strategic plan is needed for urban (and industrial) development in relation to a national flood risk protection and water management strategy, a land use strategy and infrastructure plan. This plan would include aspects such as (decentralised) urban and industrial growth centres, land use planning (including environmental and recreational reservations), main infrastructures axes, a national flood risk protection and water management strategy. On this scale also a strategy should be developed with regard to the regions invested in and strategic priorities and interdependencies of major interventions.

11.1.2 Regional scale:

Regional strategy with regard to linkage between urban and rural area's, and to the linking and development of urban and metropolitan regions, this is closely linked to and should include land use, strategic reservations for environment and recreation, infrastructure and mobility of regions. A special issue that could be addressed here within the Regional strategies related to the Delta plan is land use zoning in relation to river training and land reclamation.

11.1.3 Urban scale:

Strategic, inherent and integral plan regarding the urban growth principles of a certain city, providing guidelines and development directions for sustainable development. The plan should be integral and combine aspects of water management, urban drainage, flood risk management, infrastructure and mobility (including public transport, mobilisation strategy, road infrastructure plan and hierarchies), land use zoning (including sectoral and economic clusters, housing variability, mixed use zones, housing for the poor and densities) and a spatial quality framework. This quality framework can address issues with regard to special places such as waterfronts, linkage between spaces and identities, structure plan with regard to green ecological and recreational networks.

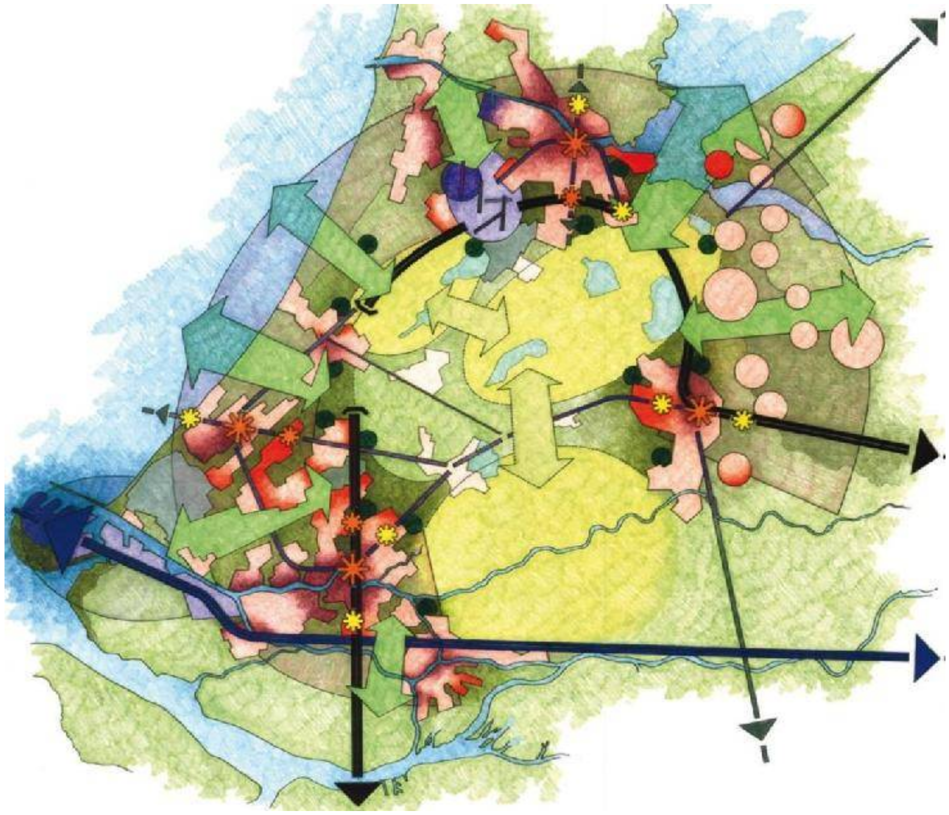


Figure 67 Example of an regional strategy of the so called Randstad region in the Netherlands.

Source: Steef Buijs

11.1.4 Neighbourhood scale:

Neighbourhood's should be developed bearing in mind some essential principles for sustainable neighbourhood design, in which aspects are addressed such as: identity, green, recreation, land use, mixed use, mobility housing variability, street and public space design, diversity, heritage, local economy, local water management and climate adaptation.

11.2 Establishing a well-functioning planning and implementation structure

In addition to the making of integral holistic plans, the implementation of such plans should be improved. In order to be able to make and implement the abovementioned plans, there should be a well functioning, coordinated and hyrarchical planning, urban governance and implementation structure. The planning structure should have a link to the national budget provision and include aspects such as decentralisation, participatory design and take the informal sector into consideration.

12 First Selection of Measures for a Well-Functioning Planning and Implementation Structure

In this chapter some first identified possible measures with regard to improving the planning and implementation structure for spatial planning are mentioned. Since this is a baseline study the list of measures is not yet complete and no concrete strategies have been defined yet, this will be done in a later stage of the project.

12.1 Bringing coordination and hierarchy in physical planning and policy

Since the current national and local planning institutions and multiplicity of service provides are crippled by unclear mandates, a lack of accountability, weak finances, and other factors, the need arises to rethink the structure and configuration of the planning and implementation apparatus. Several potential measures are identified to bring back hierarchy and coordination in national and local spatial planning.

- Create an integral national physical plan in which clear choices are made how to manage the urban to rural transition by assigning growth centres, corridors and key locations for national scale infrastructure and industry. Additionally, rural development has to be managed to limit rural settlements in encroaching on other land uses. Increasing density in Upazila towns and providing infrastructure, services and amenities can limit rural to urban migration and mitigate the continuous influx of people to the existing large cities.
- Translate into action of existing policies such as Disaster Management (DM), Water Acts, Urban Policy, Environmental policies to integrate Disaster Risk Reduction (DRR)/Climate Change (CC)/Environmental aspects – bring convergence and synergy amongst the policies, especially of Water, Health, Energy, Transport, Industry, Infrastructure sectors (Roy and Rahman 2013).
- Set-up a Rural Development Agency to oversee physical planning and implementation in rural Bangladesh.
- The installation of Metropolitan Development Agencies with a cleat mandate as the top-level agency to overlook and coordinate all physical development and strategic spatial planning in Bangladesh's metropolises and mega cities.
- Delegation or devolution of planning activities to the proper (lower) levels of government and hence;
- When local planning activities are transferred to the local urban government, the opportunity is there to vest the UDD with the responsibility for drawing up national-regional plans (not to be confused with the international regions) at critical locations.

12.2 Effective urban governance

- Coordination and Leadership; in an environment of weak capacities limiting the multiplicity of agencies is a better arrangement than trying to coordinate a large number of agencies with overlapping functions. In line with our other recommendations on decentralization and capacity building, an extensive programme of institutional restructuring (including the informal sector), re-allocation of resources and building of required competencies is needed to ultimately result in an more effective urban governance system.
- Transparency and accountability; building a renewed governance system can only be seen in cohesion with a serious effort to root out corruption and partisanship. As a first step to building a culture where "naming and shaming" is commonly accepted, the decision making process should be made visible and understandable to citizens.

12.3 Decentralisation & participatory planning

- Strengthening of planning agencies through capacity building and resource allocation (manpower and funds) at local urban government; building the planning departments with sufficient authority
- Invest in training good quality urban planners, and build the capacities of their already practicing colleagues.

- Participatory planning; community based organization should be able to participate in the local decision making process to create ownership and involvement.
- Recognition of the vital role of civil society participation in urban governance, as non-governmental and grass roots organizations demand greater involvement in local affairs
- Implementation of and compliance to the Urban Area Plans by recruiting more urban planners in concerned urban centres
- Create an enabling environment for local economic development in small and medium-size cities. The priority is to connect them to markets and create a level playing field in the provision of basic services across locations in order to improve livability and promote local entrepreneurship.

12.4 Aligning budgeting with the modern urban context

- Local urban government should be stimulated to be innovative in raising property taxes and other revenue
- Large development projects (inner-city rehabilitation, large infrastructure) should be planned with a long term financial planning and be funded accordingly.
- Spatial plans (specifically large scale plans) should be integrated with the national planning and budgeting system.

12.5 Accepting the informal sector in the formal urban governance system

- Self-governance by citizens that are not serviced by the regular public institutions should be legitimized and stimulated. A new form for "co-governance" is foreseen where the informal self-organized governance activities are promoted and carried out in partnership with the formal institutions, benefitting both parties (Rahman, 2013).

13 First Selection of Possible Measures and Notions for a Holistic long-term Strategy Combining Flood Risk and Sustainable Spatial Development

In this chapter some first identified possible measures and important notions with regard to developing a holistic strategy are described. Since this is a baseline study the list of measures is not yet complete and no concrete strategies have been defined yet, this will be done in a later stage of the project. Also the notions are (though selected on there applicability in the Bangladesh setting) still generic, later they can be applied to specific (urban) areas within Bangladesh.

13.1 Notions for holistic spatial and flood risk design

A holistic plan food flood risk protection, water and flood management and spatial design allows for measures and strategies on 4 different scale levels:

- national /regional scale (country / regional strategy)
- urban /settlement scale (urban centres or rural settlements)
- local scale of a place (neighbourhood / street)
- building scale

This chapter will for those different scale levels describe a variety of potential measures, concept and important notions or lessons from other projects relating to creating a holistic long term strategy for flood risk and water management and sustainable spatial development.

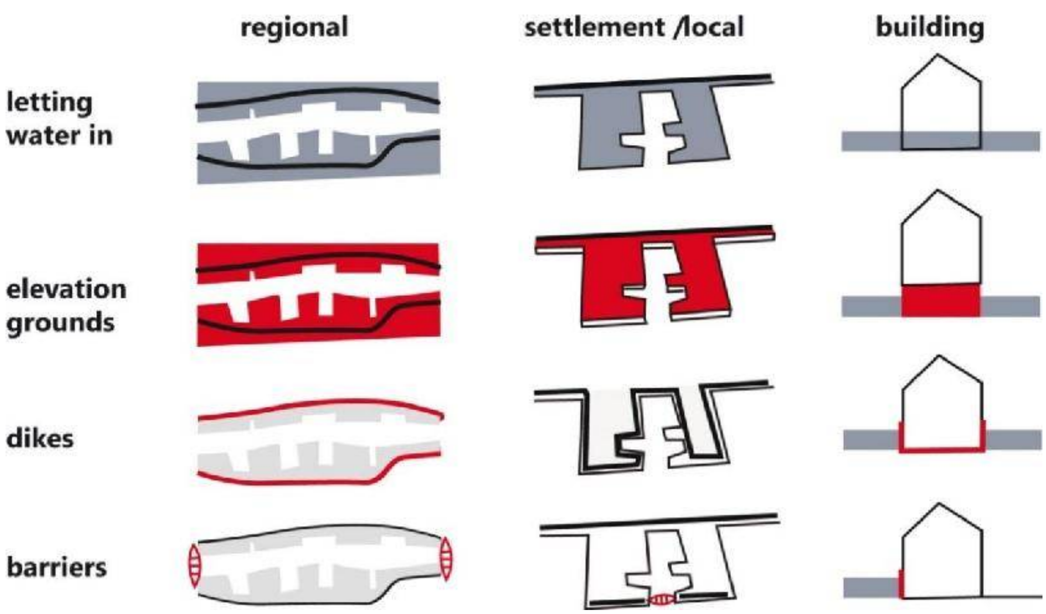


Figure 68 Representation of flood risk interventions on 4 scale levels

13.1.1 National scale strategy for flood risk protection and spatial development

On a national scale, a strategy that relates water management interventions to the location of growth centres and urban development is essential. Within this national strategy the choice for development locations on a national scale can be related to the way the country will be protected from floods or provided with water. Of course water management is not the only relevant factor: on this scale for instance the economic development of regions, the exciting or potential route network of the country and large developments also influence the opportunities for developing certain regions.

1. **Essential element: Connecting different scale levels**

Developing a national scale strategy does not mean that all the measure should be on the national or hydraulic system scale; measures from different scales should be used in addition to each other: different scale levels cannot be seen separately in both spatial planning as well as in water and flood risk management the relation between scales and interventions on different scales is essential.

Figure 75 as an example a diagram is shown that shows the relation with regard to 4 basic choices with regard to flood risk protection that can be made on different scales (different measures on different scales can complement each other;

- letting the water in (and dealing with floods on other scales or with insurance/evacuation)
- elevating grounds
- dikes or polders to protect land
- barriers te divert or block the water from the area

The scales and interventions are to some degree interchangeable; for instance letting the water into an inhabited area in order to optimise the flow capacity of the river will mean that on a lower scale level of the building you can provide flood protection by taking measures to flood proof buildings.

2. Important concept: ‘multi-layer flood risk protection’

Flood risk can be defined as the probability of a flood x the consequence of a flood. This means that flood risk protection measures can be taken both to reduce the probability (for instance by constructing barriers or dams) or by reducing the consequence of a flood, for instance by flood proofing buildings, constructing mounts to build on or by having a evacuation plan and shelters in place.

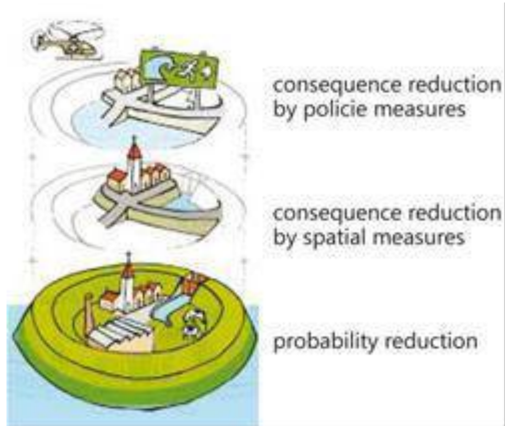


Figure 69 multi-layered flood risk protection, with below the prevention, in the middle spatial interventions to reduce the consequence of a flood, such as building on mounts and flood proof buildings, and on top consequence reduction by policies such as ensurences or evacuation and shelters

Source: National water plan, 2009

Here also different interventions in different layers can be combined. For instance highly populated existing area's might be best to protect by prevention reduction (since changing existing buildings might be costly) while with planning new development in some cases creating flood proof developments of buildings and open space might be the most resilient option.

3. The interdependency of flood risk interventions and spatial development

Often flood risk protection measures are necessary to protect urbanised or inhabited area's from flooding. However the flood risk protection measure itself can subsequently become a driver for development, this can lead to different future obligations

This can start a spiral of interdependency where the development behind a flood risk protection measure can heighten the economic value of the protected value hence the need for improved flood risk protection.

Taking probability reduction measures in area's that will remain challenging to defend against natural disasters on the long term can, due to the increase of occupation resulting from the first provided protection, become an ongoing costly protection obligation on the long term.

An example of this we see in the Netherlands were an extensive polder system has been developed. The safety standard of the polder dike-rings is enshrined in Dutch legislation. These norms were originally

established in the 1960's and based on factors such as economic output of an area, presence of either salt or fresh water and opportunities for timely evacuation of inhabitants. Some of the polders created in peatland area's are subsiding ever since they have been poldered, making the polder and the dikes themselves subside with up to 1 meter a century. The agriculture land due to subsidence in time became less productive and nowadays the ground is so wet that the only possible agricultural land use is cattle. However very big investments are necessary to be able to meet the Dutch safety standards. For one of the dike rings with mainly agricultural and rural settlements the investment is estimated at 1,8 billion.

4. Designing for different scenario's

The national strategy developed should be robust. This means that under multiple scenario's it will still function. The scenario is not something you choose but something that happens and you don't have control on.

As an example; the Hamburg Hafencity plan is a city-part elevated to be protected from floods very thoroughly designed on the expected water levels in normal and extreme conditions. Now it turns out that the extreme water height is increasing faster that expected. The Hamburg plan is however developed based on predicted and expected water levels, not on the extreme scenario that the water level might raise quicker. This means the Hamburg Hafencity project does not turn out to be robust to unexpected changes in water levels.

A second example is the Dutch flood risk protection system. It is a very expensive system with a lot of maintenance cost. It could be that this system is not tenable in a scenario with very low economic growth (which is one of the scenarios developed for the Dutch Delta Programme). The book 'A Guide to Integrated Urban Flood Risk Management' (GFDRR, 2014) categorises different flood risk protection strategies in relation to their robustness to uncertainties.

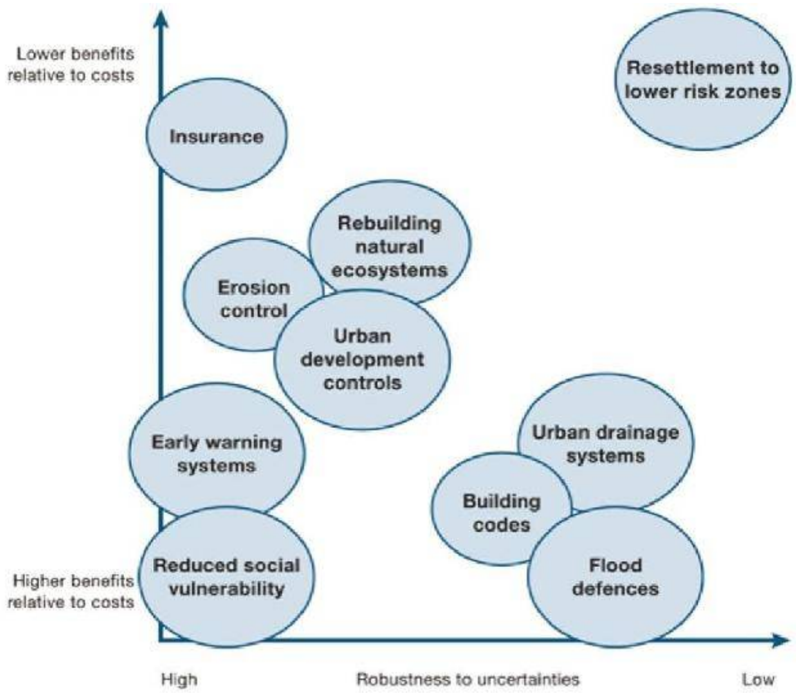


Figure 70 Flood risk protection strategies in relation to uncertainties (GFDRR 2014)

5. Designing for different return periods

Designing for flood risk does not mean that the protection needs to be the same for every flood occurrence and that no flooding is acceptable in every situation. It can be that a minor flood occurring every once in a while can actually benefit for instance agriculture, but also remain the awareness of living in a flood risk area. This awareness can be important for people to be aware of the risk and for instance built flood proof houses and high places for cattle or is an incentive for not occupying flood plains, so that in case of a major flood they are not surprised and struck unprepared.

It can also be that a protection strategy protects for the yearly floods, so that the street don't get blocked yearly and area's have no yearly hinder from floods. But that it is found acceptable that once for instance every 50 years you have to evacuate the whole area or there will be a hinder for transportation only in extreme events.

6. Protecting vital functions

It is important to be aware where your vital functions are positioned. Even if you have a system with very good prevention it would be good to pay special attention to vital functions within the protected area. Though the probability of a flood occurring in a area with probability reduction measures, this does not mean a flood can not occur and if it does there are some vital function that would be essential to be functioning to prevent hindering functions in the whole country. Such functions can for instance be electricity plants, oil transportation lines, communication centres, vital railway or road connections, hospitals or government crisis centres.

7. Taking the natural layer into account

For a while flood risk protection strategies have mainly been focussed on the idea that infrastructural interventions can fully control natural phenomena. In the recent decades there are more notions that the natural underground or logic of systems should be taken into consideration.

Ian Mc Harg started the thinking of urban and landscape design with regard of the natural layer. He made a conceptual ‘triple layer framework’ with three different layers identified:

- The substratum (the natural layer of the subsoil in which changes take centuries),
- The network (the layer of the infrastructural networks, changing over the course of 50-100 years)
- The occupation layer (the layer of the human occupation, changing over the course of 25-50 years)

He advocated to build with the logic of the natural layer and be aware of how those different layers influence each other. This knowledge could for instance be used in decisions to keep natural discharge channels open or to leave sufficient room for the river.

This way of thinking has been extended in the complexity theory that is lately regularly applied to urban areas and built environments. This theory states urban area’s are complex systems with various complex interrelations. Changing one aspect will influence the others. It takes advanced understanding of the underlying processes to be able to intervene in a responsible way.

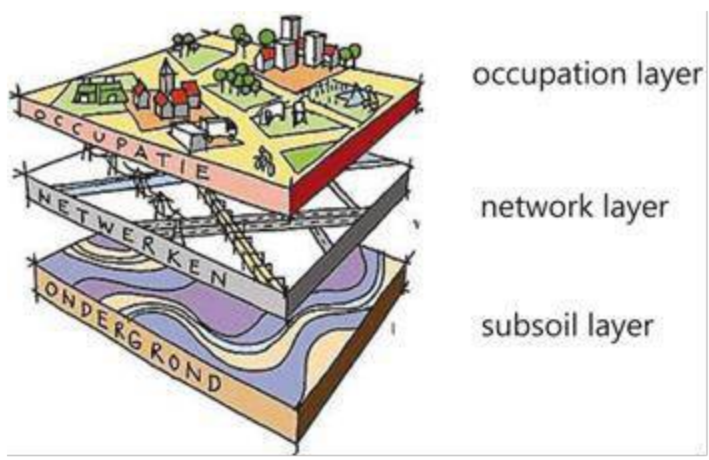


Figure 71 Triple layer model as represented by the Dutch Ministry of Infrastructure and Environment (Ministerie van VROM 2001) and based on the triple layer model by Ian MCHarg (1969)

8. Different flexibility of reservation area’s for future development

In long term planning often reservation zones are necessary in order to on the long term guarantee the availability of space for certain functions. Those functions can include space for widening roads or rail tracks, extending airports or harbours or for flood risk protection or water supply areas expected to be needed in the future. The reason those areas are reserved is that otherwise buying out building owners in the future will be to expensive and necessary projects become unfeasible.

Sometimes the reserved space is not used for a view decades, this space can then meanwhile be used by more flexible functions that can easily be removed or replaced when the ground is needed for development. Functions like that can be three nurseries, temporary living area’s or market spaces.

9. The importance of Urban design and visualization

In the book 'Designing Dhaka, a manifesto for a better city' by Kazi Khaleed Ashraf (2012) the need and importance of urban design, especially for the Bangladesh context, is stressed. The author describes in his prologue 'making a plan for a stubborn city' (which can almost be seen as a manifesto) that urban design can offer a way out of the paralysing complexity of Dhaka. He refers to an urban design as not an act of beautification, bus as a 'precise projection for deploying the right resources and orchestrating the most effective coalition for a better future'. He prefers to use urban design over urban planning since the latter is burdened with an association of bureaucratic and policy-laden slowness. He feels that design can offer alternative realisms. He claims it is important that design studies and proposals infiltrate the collective imagination, so they may become fodders for public pressure and activism and perhaps even policy making.

10. Change of values with growing prosperity

In general with growing prosperity we see different values and requirements for our living environment. This is both important with regard to integral water management strategies as with regard to developing urban plans in general. Some examples with regard to water management interventions are given to illustrate this:

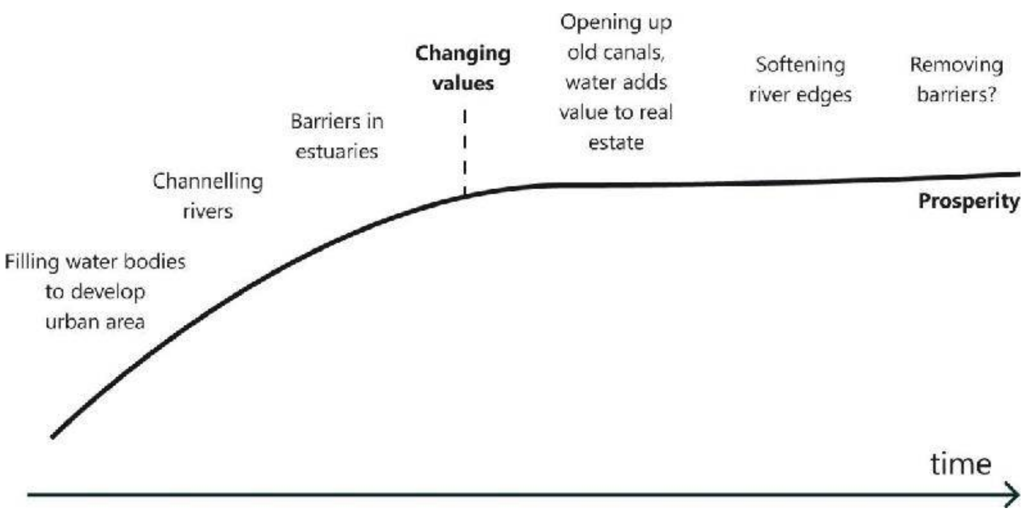


Figure 72 Schematic representation how the growth of prosperity can coincide with changing values, and with that different views with regard to (among other water management) interventions

11. Changed insights with regard to: Removing water from cities in the Netherlands

In the Netherlands on a urban scale we see that many canals and waterways have been removed from cities. They were not seen as valuable elements, since water was seen as a polluting and sometimes hazardous element in the urban fabric, dried up tom make place for roads, developments or parking. Now that the water improved in quality and is clean, we see that water is highly appreciated as a qualitative element in cities. Additionally the open water helps the storage capacity of rain and storm water and strengthens the ecology within the city. In many cities there are projects with regard to restoring previous canals or ponds.

12. Changed insights with regard to: Barriers versus ecology in the Netherlands

Also in the Netherlands we see new developments on the national scale where barriers constructed to protect the country from floods from the sea are being under discussion. The reason is the impact those barriers have on ecology. In time the knowledge with regard to ecology and the importance of ecology within society grew. One of the dams of the Delta works proposed after the big flood in the 1950's has closed of one of the brackish water estuaries of the Netherlands, transforming it in to a fresh water basin with a sudden transition to the salt sea water. This provided sufficient fresh water for agriculture and the agricultural lands alongside the estuaries provided from increased value and productivity of land. However as has been discovered the estuaries are an important stepping stone for migrating birds that require a brackish water ecology to find food. Also the closed river block the way for fish that migrate upstream all the way into Europe to procreate. Now there is a debate on whether the barriers should be opened or even removed. This would however impact the profit of the agriculture land since it will be harder to exploit the land with brackish water infiltrating into the groundwater.

The current complexity theory approach aims at exploring and revealing such complex interrelations on forehand in order to show the effect interventions have on other stakeholders and aspects of the Delta.

13.2 Flood proof buildings

13.2.1 Floating dwellings

The floating dwelling is positioned in the water and unaffected by fluctuations in the water level, other than variations of its height in relation to the land. Gangways, sewage pipes and cables should be flexible and both design and construction must allow for a minimum one metre of water beneath the property to guarantee an adequate flow of water and to ensure good water quality.

13.2.2 Amphibious house

The amphibious house is a dwelling type that sits on land but is capable of floating, designed for locations subject to water level fluctuations and generally built in flood-prone areas, such as the immediate vicinity of rivers and flood relief areas, i.e. land designated as a basin, or repository, for excess water to relieve flooding. Although the amphibious house resembles the floating dwelling, there are some essential differences between the two types. The distinctive caisson of the amphibious house is exposed when there is no water. The caisson can be made from concrete, organic materials such as bamboo or made of foam or plastic. A second difference is the distribution of forces in the base. When the property is sitting on land it lacks the even upward force of the water which it experiences when it floats, so the caisson of an amphibious house is more robust than the concrete barge of a floating dwelling. The biggest difference between floating and amphibious homes is their connection to the public infrastructure such as roads, sewers and mains electricity. Amphibious houses are often build where high water levels occur incidentally but are extreme when they do occur. The infrastructure is often not designed to cope with such exceptional circumstances, which means that a floating property can become isolated.

Flexible pipes are used to absorb major differences in water level. Mooring poles ensure that the property can move up and down yet remain fixed in place at high water. If only one pole is used the property remains in place but is capable of rotating; two poles used make rotation impossible. The height of the mooring poles is determined by the anticipated differences in water level, which can be as high as five metres. In areas where such huge fluctuations may occur, the poles tend to be a visually dominant feature; in recent designs they are concealed inside the property.

13.2.3 Pile dwellings

Pile dwellings are built in shallow water or on tidal flats, coastal areas, flood relief areas or lakes used for the collection of rainwater where any fluctuations in the water level can be predicted. Pile construction can exploit cheap building space in the water.

Pile dwellings have much in common with the land-based dwellings. Both types of housing rest on concrete or wooden poles, or piles, except that in the case of pole dwellings the poles protrude a good deal out of the ground or the water, keeping the lowest part of the building some distance above the ground or maximum water level. The pile construction of a water dwelling provides a secure and stable connection with the ground. The downside of this otherwise secure connection is the lack of flexibility; if rising water exceeds the level for which the dwelling was designed then the property will flood.

In coastal areas developers tend to factor in a generous safety margin for the height of the piles, so that even during violent storms and high surges no water will get inside. From a technical point of view pile dwellings can also be built in deeper water, beyond the immediate coastal area – think of the drilling platforms in the sea – though that would require a robust and heavy construction at high cost.

Seeing water flowing underneath the pile dwelling intensifies the experience of the water and makes that type of home popular in areas of natural beauty as it leaves the natural surroundings intact.

13.2.4 Mound dwelling

In flood plains dwellings have traditionally been built on artificial mounds, as refuges from high water. Whole farms or entire villages find safety just a few metres above any likely floodwater. A mound will keep a house or a farm dry and provide enough space for cattle and food storage. The mound dwelling is connected to the land and, like the pile dwelling, remains dry until a maximum water level has been reached. It intuitively feels safer and more secure than a floating dwelling, despite in fact being less safe because at extreme and unexpected high water it can flood, with no means of escape.

Traditional the mounts are (sometimes as clusters) scattered around the countryside and will be surrounded by water only in extreme cases, becoming islands. In modern interpretations a mounts can take the form of a multi-story, building or a water-proof platform. They commonly have a greater building density and feature evacuation routes to other, higher neighbourhoods or parts of town in the event of high water. As an example Hamburg Hafencity can be seen as a city part scale 'terp' and the Bangladesh apartment blocks with parking on the ground floor can also be seen as a flood proof house based on the mount principle of elevating the house on a solid base.

13.2.5 Dyke house

Sea and river dykes or banks, both naturally formed or built to protect the land from water have traditionally been popular places of settlement. Many old dykes or banks along rivers feature distinctive ribbon-shaped villages and are often the preferred route of through roads. Over time some have lost their original function when the river shifted or new dykes or polders were built, but they continued to be used as safe, higher ground. A dyke house can sit on top of the dyke itself but also on its incline. In the latter case, the property is usually stepped back down the sloping side of dyke so that at high water the dyke houses retain their connection to the infrastructure on the dyke. Lower parts of a house and garden on the outer side of the dyke will be at risk of flooding. Dyke houses can be built on either side of the dyke, the main difference being that the danger of flooding is considerably less on the landward side. With many dyke reinforcement projects necessary over time, the downside of having a house attached to a dyke is becoming apparent. In some locations dykes have to be moved, raised or widened to meet improved safety standards.

13.2.6 Waterside living

Waterside houses tend to be all about the experience and view of the water. They are usually built at a safe distance from the water, for instance on a high river bank or on a sloping bank beside a lake, and sometimes feature a garden as a transitional zone leading down to the water. Plantings can provide sufficient privacy for houses with a traditional garden on the waterfront.

The usual definition of a water dwelling is a dwelling with one or more sides in the water. The waterside house does not meet this definition and is much more like a regular land-based property in the vicinity of water. It does however have a number of qualities that justify its categorization as a water dwelling type.

A considerable number of waterside houses are located on floodplains where climate change scenarios predict an increasing risk of flooding. Some properties are fitted with flood-proofing that can turn them into genuine water dwellings, and in some cases the site layout has been adjusted to the water, creating urban patterns that are typical of water-based living.

Figure 73 Example of Dyke house

Figure 74 Example of mound dwelling

Figure 75 Waterside living: Example of the Bangladesh parliament

13.2.7 Example flood proof city development: Hamburg Hafencity

The harbour city of Hamburg lies on the Elbe River a hundred kilometres from the North Sea. In extreme conditions, combining a strong wind and high river levels, the water can rise by as much as seven metres. Water safety is consequently an important theme in developing in this area. The whole area is elevated and the streets and individual buildings are developed on a safe level. By making each separate block flood-proof, investments in water safety grew in line with the pace of development.

In HafenCity the new buildings on the quays have flood-proof plinth courses eight metres high. The spaces under the buildings are mostly used as parking areas, commercial properties or cafes and restaurants. HafenCity has so many built-in parking facilities that there is no need for separate above-ground parking areas. In case of high water, the flood-proof areas are closed off by floodgates.

The broad quays in the public areas have been kept open to form a waterfront pedestrian area. A number of multi-level flood-proof connections have been built between the old quays and the new, higher access roads, forming an urban park in which the layered construction enables people to get close to the water and to experience the differences in water level. An emphasis on the public character of the new city quays was essential to the development of HafenCity. It was decided to offer a varied programme to create a lively section of the city. Many direct connections to the existing inner city made the docklands easily accessible. The excellent network for cyclists and pedestrians is compact and well-interlinked, making the area attractive and accessible.

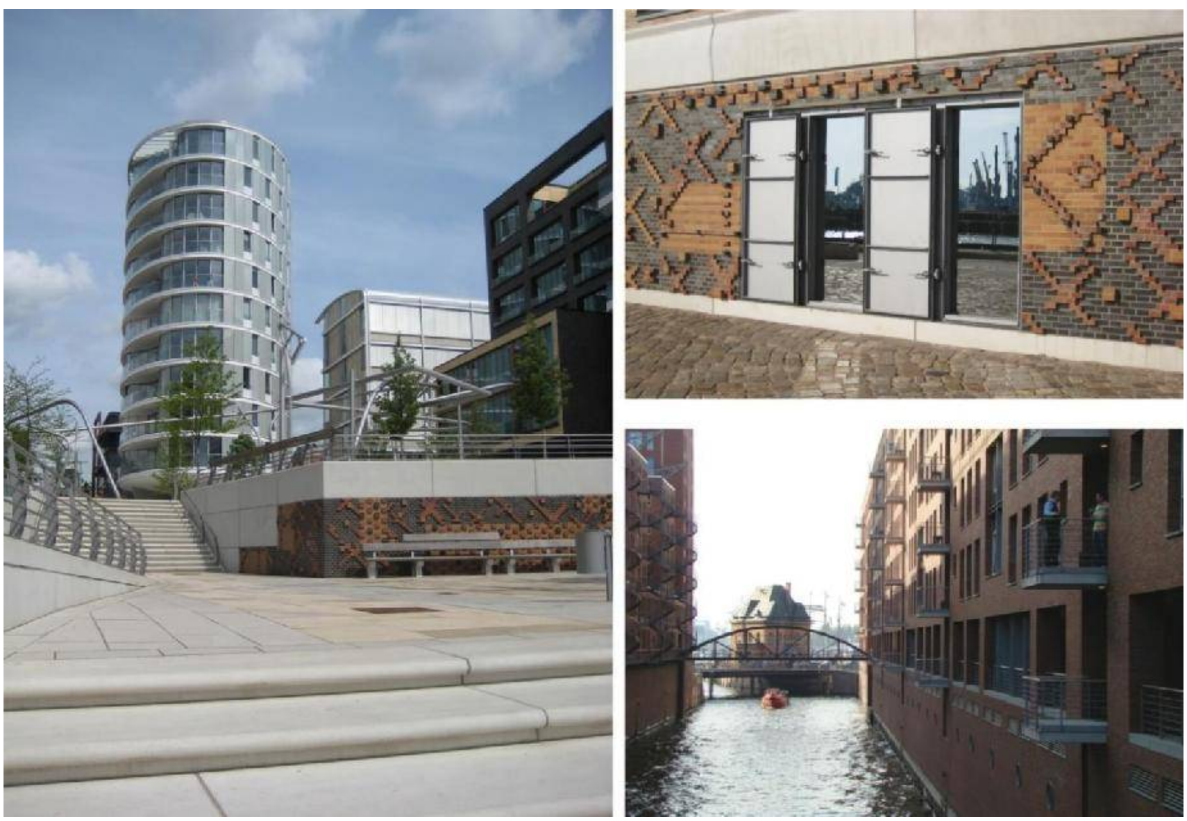


Figure 76 The harbour city of Hamburg

13.3 Spatial planning and (urban) water management

13.3.1 National and urban scale integral design

On the national and urban scale coordination between land use planning or zoning and water availability or the possibility for treatment is essential. Industrial zones could ease the collective water treatment. In all planning scales (national, regional, urban and neighbourhood scale) basic principles such as closed sewerage systems for black water, ground water availability without exploiting the ground water level and quality of surface water are essentials. Those aspects should be an integral part of planning practise. The amount of water necessary could be limited by water saving manufacturing processes, but also by small scale measures such as using dry resistant planting and climate appropriate landscaping. In some countries the main water supply needed is used for gardening.

13.3.2 Concept of 'capturing, storing and draining' surface water

For urban water management the conceptual principle of 'capturing, storing and draining' can be applied. The aim of this concept is to consequently capture as much rainwater as possible in the area where it falls, for instance by infiltration into the ground, by vegetation's or on roof gardens. The water can then either replenish the ground water level or evaporate later on. The water can also temporarily be stored in water retention ponds or (green) open spaces that can temporarily hold water. There are examples of stadiums, squares and quays that can temporarily store the water. In Dhaka there are already big retention ponds built within the city. Part of the rainwater will have to be drained immediately. Natural and constructed drainage canals can be used. The infiltration can be improved by providing enough open surfaces and using water filtering asphalt.

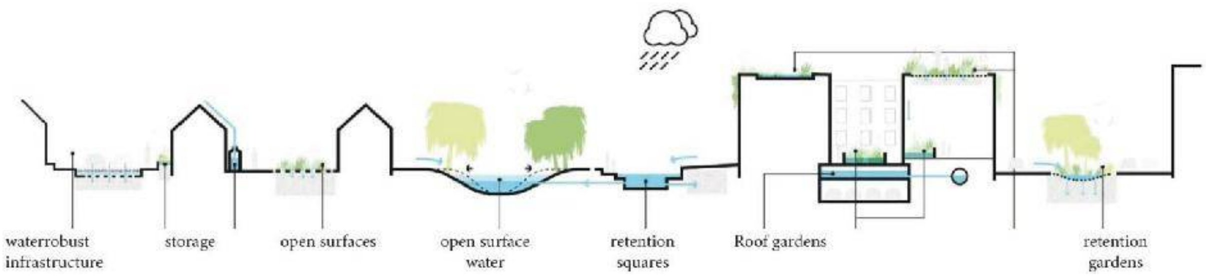


Figure 77 Rainwater storage and drainage in the municipality of Rotterdam 'Climate adaptation strategy'

We see that in many countries the drainage canals used to be concrete canals draining the water as fast as possible. Due to the ecological and aesthetic disadvantages of this type of canalized drainage canal we see many drainage canals being converted back to a more natural canal with green surfaces and natural slopes. This makes the canals appropriate to add to the identity of the city and to the recreative function and quality of the open space. If the water can reach the drainage canal without travelling over polluted surfaces the water quality can be quite good and the water can be. If the water becomes polluted the water should be filtered, this can often be done naturally with the use of filtering vegetation.

Figure 78 Restoring natural drainage canals (from the book 'city building' by Kriken 2010)

13.4 Integral strategy development of infrastructure and urban area's

Infrastructure development and urban development are very interconnected, infrastructure is an important base condition and also a driver for urbanisation. On a national scale urban development strategies should be drafted integrated with (investment) planning for infrastructure. Also on the urban scale the integral development of infrastructure and urban design is essential to ensure sustainable development, also here infrastructure can be used as a driver.

13.4.1 Guiding population and development by infrastructure

Infrastructure can be a driver for urbanisation since it can improve the connection to markets or amenities and development often originates around it. It can therefore be used as a tool for directing planning (on various scales).

The 'USA land use plan' includes an interesting scheme in which it is explained how infrastructure plans can be made in relation to expected population changes and economic development. According to the 'USA Land use plan' population can be guided by infrastructure (and other services and amenities) in three ways Keeping inhabitants in area's you don't want them to migrate from (for instance rural settlements) by providing jobs, services and infrastructure in centres that you would like to attract more people.

- Prevent sprawl by guiding people to new settlements centres where you provide basic services such as infrastructure, electricity and sewers so that they are drawn to develop in this area.
- Intensify existing settlements by heightening the density. This can only be done in a qualitative way if the amount of infrastructure and amenities are improved simultaneously to be able to serve the growing amount of inhabitants.

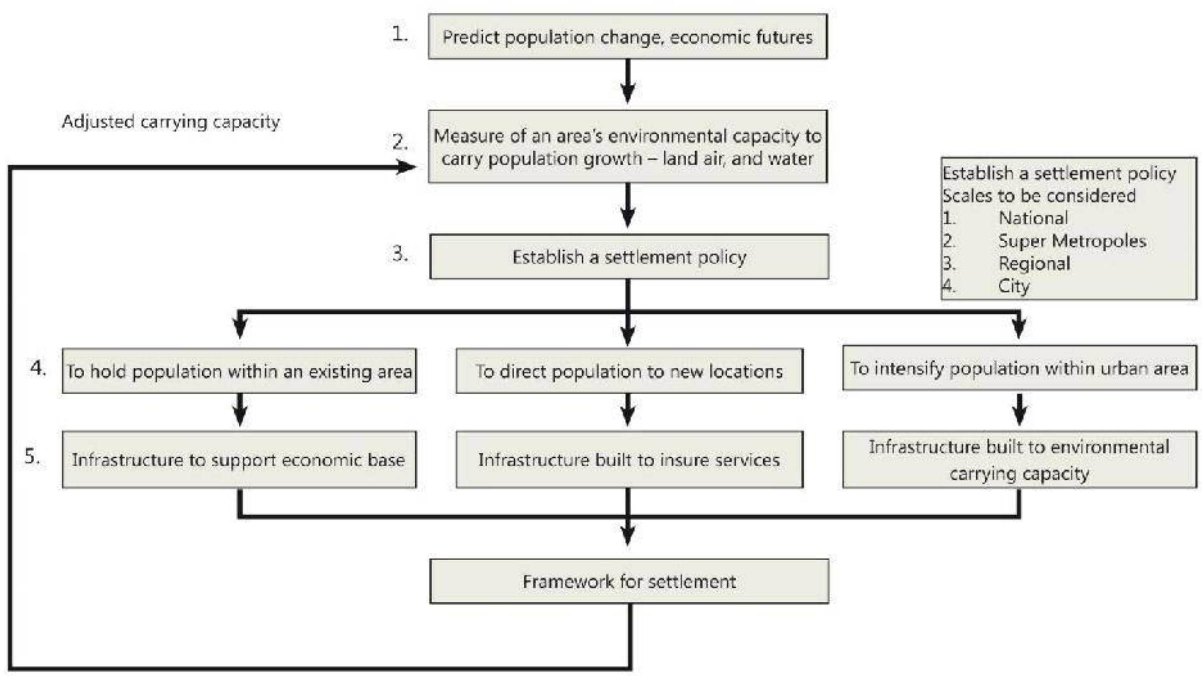
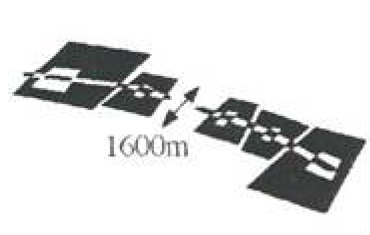


Figure 79 Planning procedure to establish and maintain a infrastructural framework for settlement

Source: Kriken 2010

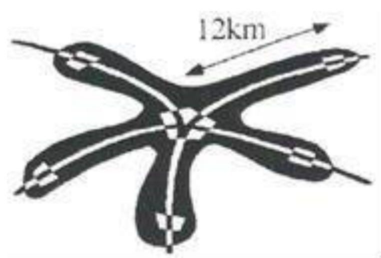
13.4.2 Infrastructure based approaches to urban from

At the city scale there are many structuring models and approaches for urban form strongly based on infrastructural road and public transport development. Knowledge of how infrastructure and urban forms can relate to each other can provide valuable insights for planning tools of urban structures in relation to infrastructure and centralities. In for instance making metropolitan plans the below shown models showing the relation between the city form and infrastructure planning can be an interesting starting point for strategy development. Images in this section are from: The TUDelft faculty of architecture and the build environment



1. **Linear city**

In the linear city model, the main urban centres are located at the head and tail of the structuring infrastructure line. The type of infrastructure determines the width of the urban centres connected to it (for example; 1600 meter for a subway line). Historically, this comprised the very first forms of mechanized transportation; the tramway, railway, and later the subway. In this model the largest cities are located at the head and tail of the connecting line. Smaller cities can be established at the points where perpendicular tangents (straight lines) intersect with the main infrastructure. This linear principle spawned long-branched cities along central traffic arteries. At some distance form the central infrastructure line, satellite towns spawned there where a radial infrastructure network intersected with the central line and its tangents. Negative aspects of this urban form are the lack of open space in the dense city centre. Additionally, the Linear city's structure stimulates urban sprawl.

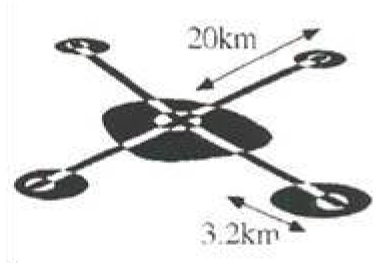


2. Finger city

This model relates to the linear model, as the dimensions of the "fingers" are traditionally determined by the type of rail infrastructure. For instance: a single subway line, the width of a "finger" can be 1,6 km, and the maximal length set by the maximal reach of the transportation system, in this case about 12 km. The main centre of the finger city is at the central node where the radial lines intersect. Secondary centres are located at about two thirds of the finger (away from the central node).

In the space between the urban fingers green or agricultural area's can still penetrate the urban fabric. From the central node there are always several connections to the green (potentially recreational) landscape. Also from the centres in the radials the green area's can always be reached within walking distance.

Nowadays the finger city model is also appreciated for the mitigating effect the green fingers have with regard to the urban heath island effect.



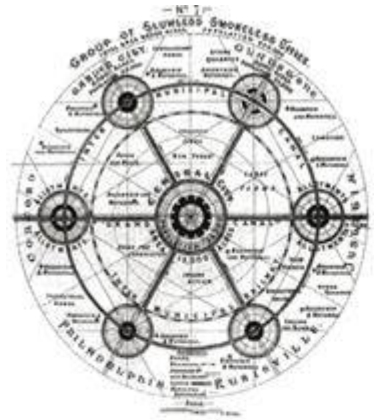
3. Satellite city

In the satellite city model the main urban centre is found at the central node where the radial lines intersect, alike the finger city. A satellite town is typically larger than a finger, and is set further away from the main centre. The connecting infrastructure is one of high quality and high capacity, which enlarges its reach. The dimensions of the satellite are determined by the number of stops in the system. This model very suitable for car transportation networks as well.

4. Merging city models

The models described above have the tendency to merge with one another. The open space in between the fingers in the Finger City model is under pressure of clogging up. Ultimately, this will saturate the city, and the distance between the inner city and open space will further increase, resulting in a large radial conglomeration.

For the Satellite City model, the optimal space for expansion is between the satellites and the main urban centre, since the infrastructure is already there. Filling the in-between space is more cost effective then adding new satellites.



5. Garden city

The Garden City model unifies the positive aspects of both living in countryside as living in the city. The small urban centre surrounding a large urban area, follow eight planning principles or values; planned dispersal, limiting town-size, amenities, the relationship between town and country, planning control, neighbourhoods, unified land ownership, and municipal and co-operative enterprise.

Theoretically, the Garden city comprises a central (existing) city of about 58000 inhabitants, circled by several (new) garden-city satellites of about 32000 inhabitants.

Railway lines connect the garden-city satellites with one another in a radial configuration. Tangential lines connect the satellites with the central city. The garden city is regarded as a great step towards increased liveability around industrializing cities with poor living qualities. Yet its typically low-density and sprawling nature makes that this urban form consumes vast areas of land. Additionally, the homogenous set-up of the satellite towns spawned various social problems throughout history.

The garden city is closely linked to decentralization and pursuing a general settlement pattern of small, healthy cities throughout the country.

13.5 Physical measures for Land scarcity

Some physical measures or strategies for dealing with land scarcity can be:

13.5.1 Multifunctional land use

This principle is based on using a single area for multiple uses simultaneous. For instance combining open water surfaces or flood plains with houses on stilts or floating houses so that the area has a double use; water storage/ flood plain and housing. Another example are green roofs that make it possible to overlap a building designation with ecology, urban agriculture, or water retention on the roof. This way you can increase the available surface and with that create more space for necessary functions. However not all functions can be successfully combined. For example in the Netherlands we see that many levees have been built on. Though this does create extra space, ti also creates issues with regard to the enforcement of the levees: it is hard to heighten them when there are fixed buildings on to of them. Nowadays they are therefor only allowing flexible buildings or functions to overlap with the levees.

13.5.2 Land reclamation

A often practised way of addressing land scarcity is the creation of extra land. Often for increasing the agriculture areal or for creating space for industries harbours or urban development. With planning new reclamations future development scenarios should be taken into consideration with regard to long term planning. For instance a changing economy (for instance more import of nutrients), population decline or sea level rise (and with that an increased flood risk) of the area, could influence the necessity, usability and value of the reclaimed land. Of course the land reclamation should be considered within the national holistic framework for spatial development.

13.5.3 High densities

By building in higher densities the pressure on the available land from an occupation perspective can decrease. It is essential though to while developing in high density to maintain the livability. For agriculture the 'density' can be improved by using high production agriculture techniques.

High urban density has advantages; it means you need less infrastructure (and lest costs for roads and sewage systems), less travelling time and keeps land open for agriculture and water storage or ecology. However uncontrolled high densities especially in low income countries often coincides with poor livability. High density is able to support high-end transit systems. Transit oriented development combined with walk able neighbourhoods offers a good accessibility. High density should be practised with regard to creating enough green, open spaces, views and sunlight on the streets. And there should be adequate amenities on walking distance. In general with growing prosperity the request will be for more square meters per person to live and for more amenities and the recreational social life and recreational functions linked to urban environments.

On the next pages the Density of Dhaka is compared to that of other cities, We see that Dhaka's density is outstanding within a relative small surface. We see references with a high density core (Shang Hai, New York), or multiple dense courses within one city (Mexico City, London). In Johannesburg we see a satellite model with separated multiple high density areas. Shang Hai has a very high density combined with a high investment in and quality of public space. Those reference cities can be studied to retain lessons in developing in high density.

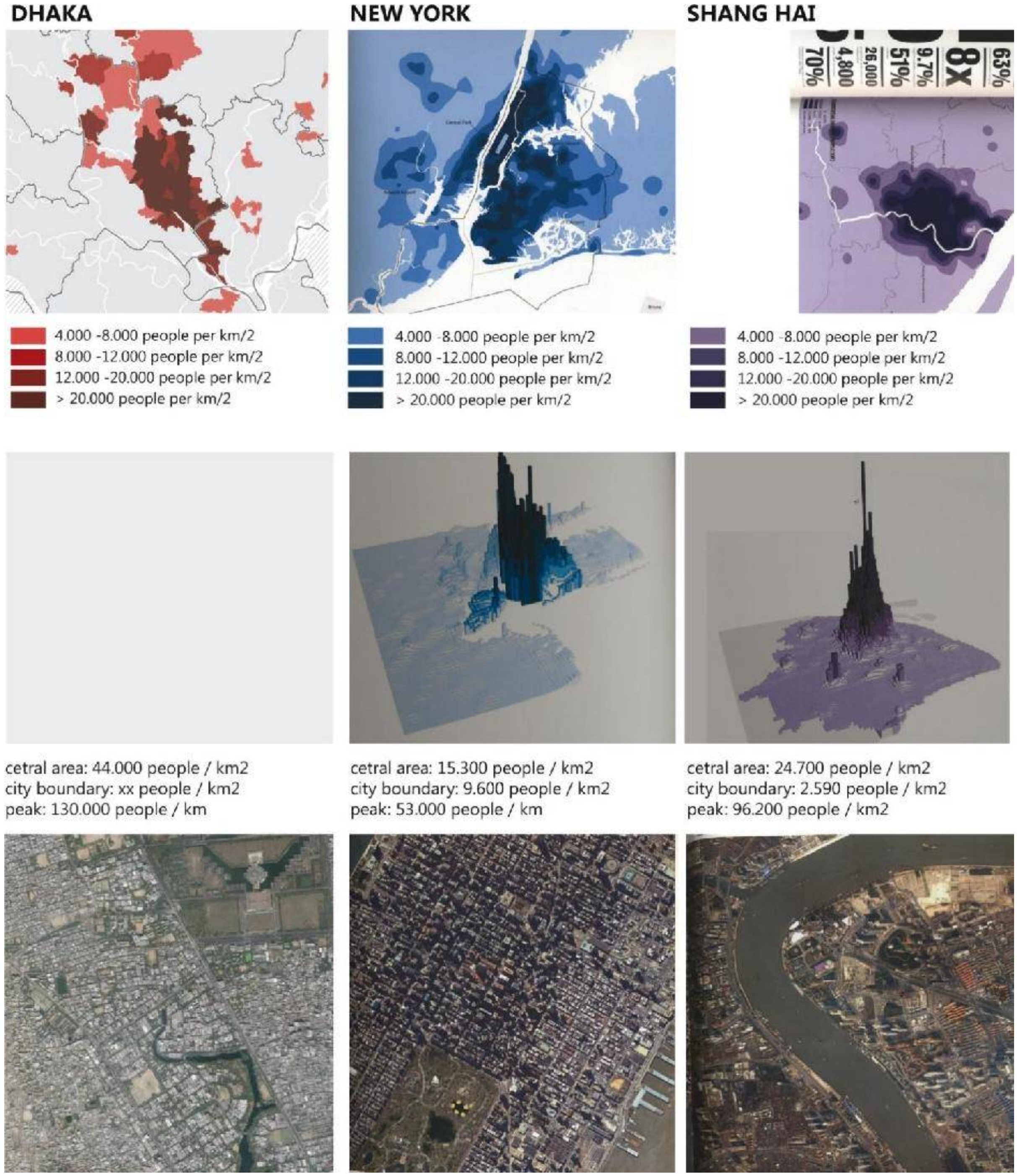
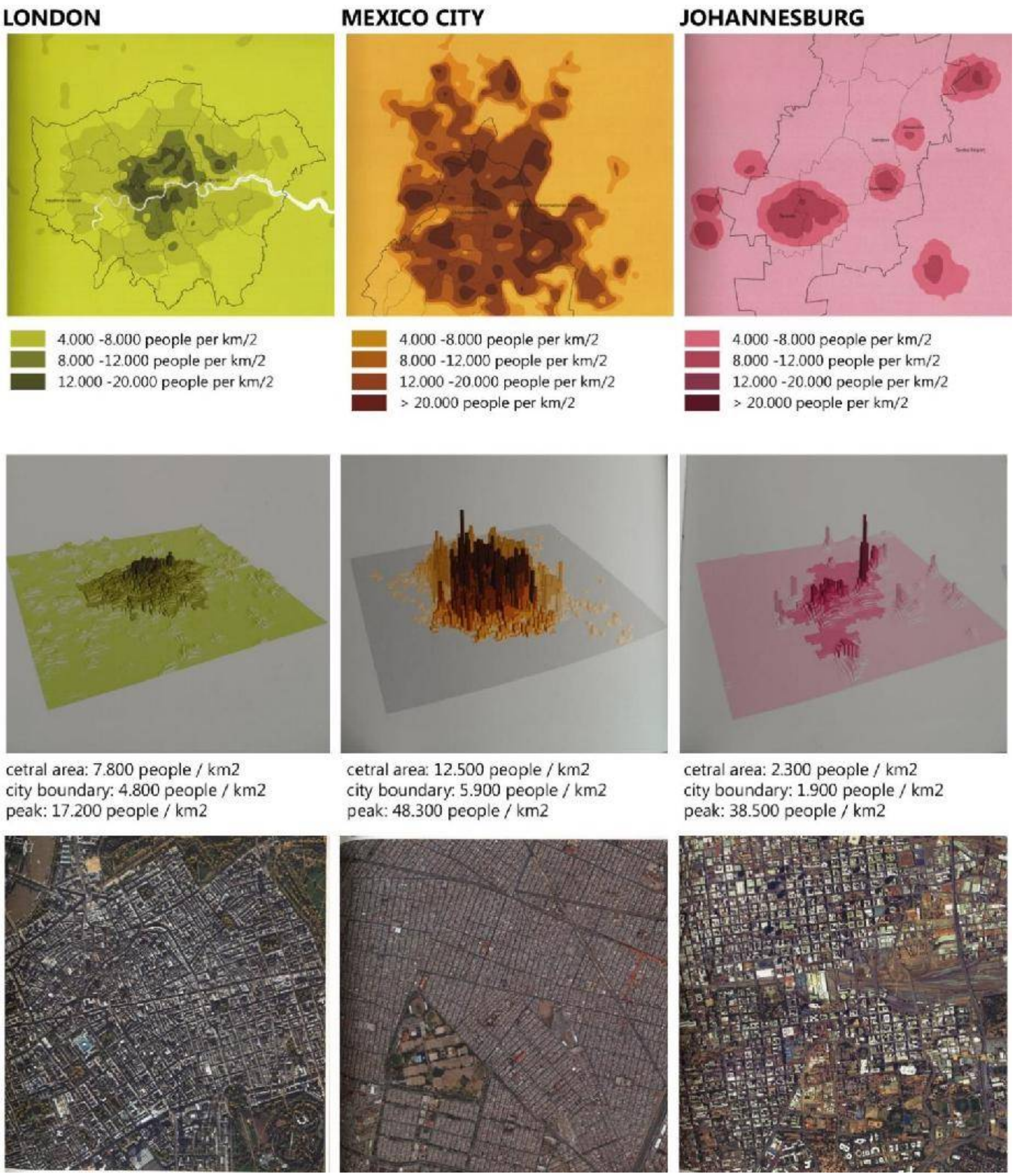


Figure 80 The densities of different cities compared. Dhaka by Defacto Urbanism, references From: The endless city



Reference: Dutch spatial planning in relation to the models

13.5.4 Dutch Third Directive ("nota") on Spatial Planning

The transition between mono-centric urban agglomerations to traversed polynuclear urban patterns is well illustrated when reviewing two of the Netherlands' most influential planning instruments, the third and "fourth extra" directives on spatial planning. Both directives shared a guiding principle; the planning of new social and economic programme was combined with extensive mobility infrastructure programming (both for public transportation and car).

In the Third Directive, urbanization policy focussed on the designation of Growth Cities and Growth Cores supported with appropriate mobility infrastructure. A general principle of "Concentrated Decentralization" was followed, to limit haphazard urban sprawl, but still allowing urban growth in several carefully designated (new and existing) urban centres throughout the country. Typically, Growth Cores functioned as satellite (New) Towns located in and around the Randstad, the conurbation in the west of the Netherlands comprising a.o. most major cities including Amsterdam. Specific railway systems were introduced to connect the Growth Cores firmly to their "mother cities". Growth cities usually included extensions of existing cities which were to be connected to existing infrastructure. Typically, these cities were further away from the Netherlands' largest urban conglomeration (the Randstad), which is in line with the "Concentrated Decentralization" strategy.

13.5.5 Dutch Fourth Directive (Extra) on Spatial Planning (VINEX)

In the Fourth Directive Extra a strict localization policy was adopted, the so-called "A-B-C profile policy". It directly links the settlement pattern of residential areas, business areas and amenities to mobility. A-locations are public transportation nodes, usually in the centre of large cities. Mobility is focussed on public transport and hence car accessibility is average. B-locations are easily accessible by car and public transport, bit do not serve as an major node. C-locations are accessible by car only. Based on these profiles, only A and B locations were stimulated as new locations of facilities and services. The earlier adopted policy of Growth Cities and Growth Cores was abolished, and a strategy for densification within the city limits was introduced. Spacious existing neighbourhoods built in the New-Town/CIAM era and former harbour areas were redeveloped. The primary focus of this policy was to limit the cities' spatial claim and to reduce commuting distances (and thus pursuing "compact city" characteristics). New residential areas (the infamous VINEX-districts) at the city's fringe were to be of relatively high density and were to be connected through high quality public transport systems. To sum up, these are the guiding principles of the Fourth Directive (Extra):

- Urban nodes as economic drivers
- Limiting the urban spatial claim
- Actively steering mobility
- ABC-profile localization policy
- New residential areas connected through high quality public transport

A negative effect of the ABC policy was that the designation of business areas, services and new residential areas was based on mobility factors only. It missed the other, more qualitative factors that influence a location's potential, such as the availability of urban services and amenities, of which its lack became illustrative for most of the new residential neighbourhoods. In reaction to the critiques, the focus of urbanization policy shifted in favour of further densification of inner city locations, a typical feature of the 'compact city'.

13.6 General principles for sustainable urban development

There are some general principles for sustainable urban development both at the national, urban as well as neighbourhood scale. They can support integrated water management and urban planning.

13.6.1 Potential future directions for urban form: the current urbanization challenge

Different growth models could be explored for use in a national urbanisation strategy in which the relation between different urban areas and settlements is addressed. If such a national strategy is developed it should coincide with governance measures that can support the realisation of such models.

1. **Compact city ("Smart Growth")**

The compact city promotes relatively high residential density with mixed land uses, combined with a strong focus on public transportation. The compact city is more energy efficient and less polluting since city dwellers live closer to work and urban amenities and services, which limits their needs for unsustainable modes of transportation by car. In a compact centre it is more feasible to provide good public transport and walkable house-work distances. Walk able neighbourhoods and a well-designed cycling-network are encouraged. Concentrating people and activities in urban centres gives advantages, yet given the choice and resources to exercise it, city dwellers may locate in the sprawling metropolitan periphery instead of the dense urban core.

The preservation of open space is a important factor in smart growth efforts. In rural areas it helps to restrain urban sprawl and guide development toward areas where development can be served by central water and sewer systems in compact settlements, limiting the strain on agricultural land use. Within cities and suburbs, the preservation of open land provides parkland and green ways that can be linked together in a system of green infrastructure. This kind of infrastructure is an important asset for future development as well when striving to create high quality living environments.

2. Smart growth concept in Bangladesh

Control the haphazard development in the outskirts of the city and ensure Sustainable development here. It is essential to plan cities beforehand rather then led them grow spontaneously. Smart growth is defined by the International City/County Management Association as ' development that serves the economy, community and the environment', provides a framework for communities to make informed decisions about how and where to grow. Based on the smart growth concept, which is usually associated with the mitigation of the effects of sprawl, directing growth towards existing communities and building compact neighbourhoods, 10 principles for smart growth are developed.

- Strengthen the direct development towards existing communities.
- Preserve open space, farmland and natural beauty and environmental areas.
- Mix land uses (residential with retails and business)
- Take advantage of the compact building design
- Foster distinctive attractive places with a strong sense of place
- Create walkable neighbourhoods
- Provide a variety of transportation choices
- Create a range of housing opportunities and choices
- Encourage community and stakeholder collaboration
- Make development decisions predictable, fair and cost effective

Applying these principles to Bangladesh would encompass:

- There cannot be an unlimited supply of houses in cities; the urbanisation needs to be controlled: decentralisation is an important to slow down the growth of Dhaka. The government should go for regional planning throughout the country to decentralize the administrative power to the divisional towns. Employment opportunities should be generated in intermediate cities.
- There should be a specific development plan for cities/ metropolis of Dhaka (holistic strategy for city form, for instance salinity model, transportation and land use.
- Steps should be taken up against land value increase by applying land management tools such as tax imposition, vacant land tax etc.
- The government should go for public private partnerships to make sure private developers provide housing to the low income people. In such ventures the government typically provides land and the private sector will be responsible for the rest. Since the high land prices are the main reason for high apartment prices this will lower the apartment price immediately and lower incomes will be able to provide houses on their own.
- People should adapt to living in apartments (even if they would prefer to live in a private home), solutions with high rise should be considered, and national and municipal policies for high rise should be considered.
- Sprawl development of Dhaka should be discouraged

- Development houses should be combined with development infrastructures (roads electricity, water, sewers, gas, telephone
- Special houses (with growing possibilities) should be developed for poor people / slums.
- Urban farming

3. Light Urbanism (“Metabolism”)

Strongly leaning on recent and upcoming advancements in sustainable technology and ecosystems management, ‘Light Urbanism’ tries to marginalize the need for central infrastructure and explores the opportunities for low density, autarchic communities. Energy and water consumption can be reduced by intelligent building design and decentral energy production. Eventually, even greater sustainability can be reached by maintaining a closed-cycle community metabolism, potentially combined with (urban) farming.

Both directions for urbanization can strongly supplement one another, and ultimately offer a variety of living environments and opportunities for the sustainable integration of the city and its hinterland. In compact urban systems dense nodes are combined with forms of Light Urbanism and a strong physical intertwining of green and blue (green, open space and water) networks. In this new, polycentric development pattern highly specialized urban centres emerge, connected in one integrated urban network (mobility, energy, waste etc.), dedicated to minimization of required inputs of energy, water and food, and waste output. The various types of living environments (ranging from low-density, mainly residential peripheral communities to high density, mixed-use urban centres) are directly linked to forms on energy-waste management to reach the smallest possible ecological footprint.

4. Compact Townships in Bangladesh

A Compact Township (CT) is an agglomeration of houses, hospitals, schools, markets, rural industries, roads and local governmental units that provide all basic services to a population of about 20,000. A CT should be largely self-governed and self-financed. The size is small enough for traffic within the CT to be conducted by non-motorized vehicles and for motorized traffic to be thus isolated from the CT itself. By locating along major roads a CT will be market connected yet environmentally friendly.

Bangladesh is a developing country which is incorporated with abundance of natural resources like land, water, as well as human resources. Here majority of people live in rural areas and their life is dependent on some valuable agricultural land which is their main earning source. But this land area is decreasing and population is increasing day by day. New pressure is being created on agricultural land area. Compact township approach has been taken as a practical topic aiming to incorporate all the rural settlement in one place where all the urban facilities and service like water supply, electricity, gas, education would be provided and previous homestead area would be treated as agricultural land. In addition, their employment generation place would be near to the homestead area.

Government of Bangladesh has already taken initiative to implement Compact Township concept in some rural areas of the country. The planning for Compact Township has completed, but not implemented yet. Executive Committee of National Economic Council (ECNEC) has approved a compact township project, ‘Palli Janapad’, for rural people based on cooperatives involving Tk 424.34 crore, aiming to protect arable lands and thus ensure food security and improve their living standards. The approval came from the 5th Executive Committee of the National Economic Council meeting.

A total of three uplift projects involving Tk 829.85 crore were approved. “Of the total project cost, Tk 520.03 crore will come from the national exchequer, while Tk 87.41 crore from the organization’s own fund and Tk 222.41 crore in project assistance. In the Palli Janapad project, four-storey buildings will be constructed in seven villages of seven divisions accommodating some 272 families in each village.

Of the total project cost, the government would initially provide 70 percent of the project cost while the rest of 30 percent will come from the beneficiaries. The flat owners would repay the loan to the government in 15 years at a flat rate of 5 percent. The project has been re-designed that includes expansion of the project area from three divisions to seven divisions, downsizing the buildings' size from six-storey to four-storey and some increased amenities. The project cost has gone up nearly five folds to Tk 424.34 crore from originally estimated Tk 86.54 crore.

The 'Palli Janapad' project is now expected to complete during a period from July, 2014 to June, 2017. The government will bear Tk. 362.98 crore of the project cost, while the beneficiaries will provide Tk 61.36 crore. Center for Irrigation and Water Management (CIWM) and Rural Development Academy (RDA) will jointly implement the project under the Rural Development and Cooperatives Division.

While the GoB can and should encourage the CT's through enabling laws, the real test will lie in having PPP's which forward the goal. Specific to areas, the CTs can be of several types (Rashid, 2013):

1) Transport oriented: Miyabazar
2) Production oriented: Garments relocation in general
3) Eco-tourism oriented: Shoron Khola
4) Poverty oriented: 4 cow model eg. Mymensingh
5) Leisure and history oriented: Kaliakor
6) Mining oriented: Phulbari
7) Rice, water and electricity oriented: Aman and Aus lands in general
8) Remittance oriented: Satura

A tentative plan is to have about 200-300 acres for each such CT, such as the Mirpur Staff College in Dhaka City and Bangladesh Academy for Rural Development (BARD) in Comilla district. Eventually some 7000 of these will become the basic rural landscape of Bangladesh, supplemented by a scattering of homesteads and some remaining number of the existent 68,000 villages. The general idea of gaining economies by agglomeration is an extremely simple one and has been the staple of several branches of Economics and Regional Planning. The concept put forth here is simple but important, necessary and applicable and provides a concrete shape to suit the current situation of Bangladesh

5. Example compact city: Chongmin island Masterplan

China has developed towards developing more sustainable and environmental cities. The Choming Masterplan is a 50 year plan. With a new connection of the island to the city of Shanghai unwanted sprawl of the island was expected, this is unwanted since the island has very productive agricultural grounds that are wished to be preserved. The main concept of the plan is to develop compact new communities while preserving and improving the agricultural farming as the core function.

The plan consists of different components among which: each caro would provide residence for 100.000 people, in total the amount of 800.000 people would live on 15% of the island. The cores would be pedestrian friendly (with good walkways and mixed functions) and have very good transit connections between each other. A large park was established and ecological valuable wetlands were protected.

An inland lake system was created for the fresh water supply within for this island positioned in brackish water. The farming villages were kept so that farmers could live close to their home. The agriculture land stayed the main function and the productivity of the land was enhanced further by growing high value crops. By establishing farmers markets in Shanghai the farmers would have a good market to directly sell their high and products.

Figure 81 Chongmin island Masterplan by Skidmore, Owings & Merrill LLP (SOM)

13.6.2 Guiding principles for sustainable cities and neighbourhoods

In this section more generic principles and guidelines for developing sustainable neighbourhood plans are described. Those principles can be applied while making sustainable integral designs for urban areas and neighbourhoods and include elements such as the density of cities, the mix of functions, strong local economic and open spaces, accessibility, identity and diversity.

1. Land use management

Use land use management as a tool to keep reservations for future development and keep enough open space for water storage and flood plain management. The water area's can, provided the water quality will come to an acceptable level serve as ecological and recreational area's within the city. Also it can cool down air and mitigate the urban heat effect.

2. Green cities with open spaces

Open and green spaces are essential for bringing quality livability, sustainability and resilience into high density urban area's. The open spaces can contribute to urban drainage, urban heat mitigation, urban ecology and can function as recreational space.

Green or blue corridors in urbanised area's, such as wide riverbeds can work as an ecological migration corridor along which species can migrate and through which they can increase their living area. Gradients are to be preferred over hard edges and steep slopes, since gradients provide differentiated conditions and with that can be appropriate for more different spaces.

Grown trees are very valuable; when cut down it can take years or decades before a new tree has grown to be the same size. For this reason of the both economic and qualitative value of grown trees in China we see many tree nurseries; In planning in China trees in some urban area's can not be demolished, if they need to be removed because of development the tree is removed carefully and transported to a nursery where it will be taken care of. When they develop the green spaces within the developments they bring back the adult trees.

3. Accessibility

Good accessibility is essential both on the national scale as within cities. Plans for city form and mobility often go hand in hand as can already be seen in the urban form section. In this section we will also look at the scale of the place

4. Clustering destinations

By clustering work destinations (for instance a campus, medical district, business district) the clusters can create enough support for public transport facilities for short daily commuting trips. For the feasibility of public transport systems it is important that the commuting can go both ways (if people in the morning travel from a living area to a working area and in the afternoon the other way round, the transportation system would be empty on half of the rides). For this some degree of mixed functions is essential. Mixed functions also can reduce the amount of public parking places needed; the same place can at night be used by inhabitants and during the day by commercial functions in close proximity;

5. Walkable cities concept

For walkable cities there are a view basic conditions. It is important that there are possibilities to work and use facilities on walking distance. Also small building blocks and street grids are essential to be able to reach your destination in an efficient route without going out of direction because the network is not fine enough. Also with a small street network pedestrians have to cross less lanes when crossing the road. Of course to be able to work, all streets should have safe travelling possibilities for different modes of transport, including safe sidewalks for pedestrians.

For a long time streets were designed to best fit car traffic and make traffic speed up; wide lanes and turning circles were designed. Those did however reduce walkability since fast traffic is less safe and wide curves at crossings increase the walking distance to cross the street. Worldwide we see that there nowadays with regard to sustainable cities is more focus on small streets; some streets are even narrowed and the leftover space is used for green and open water drainage or storage ponds.

Having green zones between the driving lanes can not only improve the traffic since it separates lanes, but also reduces the pedestrian crossing distance since it can be used as a stepping stone while crossing the street.

6. Street design

In designing streets there is often a hierarchy between different streets, from car corridors to local traffic streets to living neighbourhood streets and even pedestrian boulevards. The positioning of functions should correlate with the type of accessibility; for example along a school there should be the capacity for cars to wait and children to exit the school by foot safely.

Wider sidewalks can also provide space for functions such as street vendors, or as often seen in Europe; terraces and places to sit and be part of the urban public life.

Having multiple parallel roads to reach your destination by car can provide alternative routes in case of a blocked road in case of maintenance work or accidents. In order to always provide an optimal flow on the alternative route some routes could be turned into one direction streets. In order to be comfortable the streets can be shaded by trees.

Figure 82 Green in the middle of Gulshan avenue functions as stepping stone for crossing pedestrians

7. Corridors as barriers

Large corridors are connectors for who is on them but can be a corridor for pedestrians crossing. Therefor they should preferably be on the edge of neighbourhoods because otherwise the neighbourhood gets divided. The corridor can also be a barrier that cuts views and accessibility from public spaces or waterfronts.

8. Orientation

Within a city it is important to be able to orientate yourself. This can be achieved by knowledge of where main corridors are connecting to or though sight lines to open spaces or landmarks. Landmarks can for instance be distinctive buildings (distinct high-rise visible from far distance), squares with statues or distinguishable characteristics (such as seeing chimneys from brick factories).

9. Identity

Identity is an important quality for people to be connected with the place they live. With identity different aspects play a role such as the preservation of cultural heritage, recognisable landmarks or urban fabric, the recognisable view when approaching a city from the distance, natural features.

In general identity has to do with an identifiable uniqueness of the city or settlement. This is often threatened by developers that would like to create the same buildings, shops and restaurants in every location and that profit from flattened out development plots without natural changes from natural drainages or small elevations. The most important tools to preserve or create identity is preserving natural and urban or settlement characteristics (and the views to be able to perceive them) and developing buildings, streets and open spaces fitting and enforcing the identity of the city.

10 Diversity

Diversity is always an important high appreciated quality of cities, both on the city scale itself as on the scale of the street. Within the city it is essential if there is a diversity of different neighbourhoods with different identities. Those diversities can be in aspects such as densities, parcel sites, street profiles, views, building type and height, architectural differentiation and mixed functions or housing prices and economic wealth of inhabitants. Conserving old buildings and heritages is not only important for the identity of neighbourhoods but also for the diversity within streets.

11. Mixed use

Mixed uses is essential for creating walk able cities and the feasibility of public transport. In many European and American countries we see that separated use has long been the ideal, however this caused several problems among which: Separating living and work increases car dependency and the amount of traffic. At night area's with offices and stores are deserted giving problems with safety on the streets. People in poor living neighbourhoods are cut of from the accessibility of functions and services since they don't have a car at their disposal. Public transport is not feasible since one part of the day commuters go somewhere and ad the end they go the other way, but the public transport is with that empty half of the time which is not cost efficient. Additionally some functions/ shops miss their critical mass of customers when they are not surrounded by a living neighbourhood.

The mix of uses can be based on the everyday need of people to visit certain functions; shops for groceries, schools and workplaces should be close to the living environment. Specialised services one needs less often such as car sales or travel agencies can on a larger distance. The mixed use can contribute to a strong local economy.

With mixed use it is also important to have mixed affordability of houses so that people with different resources can live in the same neighbourhoods. This is important to prevent segregation and allow people who provide services to live close to their work. In Dhaka this is already hard since the land prices are high and can only be purchased in 100 square metre plots. It would be essential to also leave space for development for middle and low income housing and shops in high land value neighbourhoods. If necessary economic support can be applied to achieve this.

12. Open space

When it comes to recreational spaces there should be different degrees of recreational space available on different distances. Play grounds should be available on short walking distance. A city park on a moderate walking distance and it should be possible to reach a regional park within reasonable time by transit or car. The experience of green spaces improves when they are connected with green streets, so your walk towards the park is already part of the enjoyable experience.

In a open space such as a park or boulevard it is important that you can take different routes of different lengths. Riverfronts are important open spaces since they provide a wide view to the river and are part of a bigger open space. It is therefore that public access to the waterfronts is provided and maintained. Once the waterfront becomes private it can be hard and costly to regain public access. Also the view to the water should be preserved. Often however the view from the urban area to the water is blocked by flood risk protection structures such as dikes, creating a barrier between the city and the water. Also building or developments should be restricted from completely blocking the view to the open spaces or riverfronts.

In order to keep a feeling of open space and livability in streets it is important that when high rise is constructed the possibility for sun to still reach the street is essential. In the high rise city New York we see for instance strict building regulation with regard to allowing sun to reach the street.

13. Reference: Policies to preserve open space in the USA

13.6.3 Complete land ownership

If the goal is to actively manage open space for recreational, ecological or educational purposes, it is recommend to acquire the complete bundle of rights to land. This includes water rights, mineral rights, air rights, the right to sell or lease land, the right to pass land and the right to develop land. The complete bundle of rights is known as the "fee simple".

1. Land trust

A land trust is a private non-profit organization that may receive donations of land, interests in land (see below) and funds. Donors may use these gifts as charitable deductions for income tax purposes. Some land trusts actively acquire land rights to open space. A land trust may manage the open space it owns as a nature preserve with some public access for limited recreational and educational uses. A common practice for land trusts is to purchase open space and sell it to local and state governments for parkland. In the USA, there are over 1300 active land trusts.

2. Federate Land and water conservation fund

The land and water conservation fund is the primary federal program for preserving open space. It receives its royalties from federal offshore oil and gas leases. Since its establishment in 1965 it has added almost 28000 km2 (nearing the surface of the Dhaka division before its splitting; 31000 km2) to the national parks, national forests and Wildlife Refuge System. States can apply for funding by describing how the money will be spend to meet its outdoor recreation needs. The federal funds may be used to cover half the costs of purchasing or improving recreational land, and must be matched by funds from state and local governments and non-profit groups. Land acquired with these funds must remain forever in outdoor recreation use.

3. State programmes

Several states operate open-space preservation programmes, funded through real estate transfer taxes

4. Conservation easements

A conservation easement is an interest in real estate less than the complete bundle of land rights, the fee simple. It is a legally binding contract in which a landowner voluntarily restricts the rights to use and develop land. For example, a conservation easement may limit activities allowed on the land to open-space uses such as wildlife habitat and watershed protection. Most conservation easements are to last forever.

5. Reference: Netherlands building code: 10% open water required in Dutch planning developments

For new development in the Netherlands it is obliged to designate 10% of the developed area with open water. This is to ensure sufficient storage capacity for water in case of extreme rainfall.

The regulation triggered the creativity of developers that lost 10 % of their building ground, but are using the water surface in creative ways to optimise profit:

- as part of there landscape design, improving the quality of the public space (and the housing price)
- as a small ditch touching as many houses as possible, so that every house increases in value
- building houses on stilts, or floating houses to be able to use the water surface as building ground

14 References

ADB (2005) Supporting Urban Governance Reform TA project, Asian Development Bank

ADB (2010) Strengthening the Resilience of the Water Sector in Khulna to climate change, Final Report, MOLGRD&C, GoB

Ahmed, K. I., 2006. The rural Bangladesh courtyard BRAC University Journal, Vol. III, No. 1, 2006, pp. 9-15

Ashraf, K, K. 2012. Designing Dhaka, a manifesto for a better city Loka Press, Dhaka

Annual Development Programme-2014-15, Planning Commission, GoB

Alam, M. and Rabbani, M.D.G. (2007) "Vulnerabilities and responses to climate change for Dhaka", Environment and Urbanization, Vol. 19, No. 1, pages 81–97.

Aqua-Sheltech, (2002) Khulna Masterplan, Khulna Development Authority, 2002.

Bangladesh Bureau of Statistics (BBS) (1997) Bangladesh Population Census 1991, Urban Area Report, Ministry of Planning, Dhaka

Bandyopadhyay, S,. & Skoufias, E., 2013. Rainfall variability, occupational choice, and welfare in rural Bangladesh Review of Economics of the Household DOI 10.1007/s11150-013-9203-z

BBS (2009) Multiple Indicator Cluster Survey 2009, Vol. 1, Technical report, Bangladesh Bureau of Statistics and UNICEF

BBS, in collaboration World Bank (WB) and United Nations World Food Programme (WFP). 2009. Updating Poverty Maps of Bangladesh: Key Findings. Dhaka.

BBS (2014) Bangladesh Population and Housing Census 2011, National Report, Volume-3, 2014, Bangladesh Bureau of Statistics (BBS), Statistics and Informatics Division (SID), Ministry of Planning.

Biswas, S., and Chowdhury, M. A. A., 2012. Climate Change Induced Displacement and Migration in Bangladesh: The Need for Rights-Based Solutions Refugee Watch 39 & 40, 2012

Cairncross, S,. and Ouano, E. A. R., 1991. Surface Water Drainage for Low-income Communities, WHO/UNEP, World Health Organization, Geneva, Switzerland.

Centre for Urban Studies 2014. Size classification of urban centres of Banladesh [unpublished image] N. Islam

Centre for Urban Studies (CUS), NIPORT and MEASURE Evaluation 2006. Slums of Bangladesh, mapping and census 2005. Dhaka

Centre for Urban Studies (CUS), National Institute of Population Research and Training (NIPORT) and MEASURE Evaluation (2006) Slums of Urban Bangladesh, Mapping and Census 2005, Dhaka, Bangladesh and Chapel Hill, USA

Choe, K. and B. Roberts, 2011, Competitive cities in the 21st century: Cluster-based local economic development. Mandaluyong City, Philippines: Asian Development Bank

Chowdhury Fazle Bari 1980. The Problems of Rural Housing in Bangladesh and Possibilities for Improvement, MS Thesis, AIT Bangkok

CLGF, Commonwealth Local Government Forum, 2014. Country profile: Bangladesh Available: http://www.clgf.org.uk/userfiles/1/files/Bangladesh%20local%20government%20profile%202011- 12.pdf [accessed 05-12-2014]

Clemett A., Maksudul Amin, Sharfun Ara, Md. Mashiur R Akan, 2006, Background Information for Rajshahi City, Bangladesh

Fakrul Islam, M., and Bazlur Rashid, A. N. M., 2011. Riverbank erosion displaces in Bangladesh: need for institutional repsonse and policy intervention Bangladesh Journal of Bioethics, 2011;2 (2) p. 4-19

GFDRR 2014 Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century Available: http://www.gfdrr.org/sites/gfdrr/files/urban-floods/urbanfloods.html [02-05-2014]

Hasan, M.N., Hossain, M.S., Bari, M.A. and Islam, M.R., 2013. Agricultural land availability in Bangladesh. SRDI, Dhaka, Bangladesh

Hassan, Md. S. 2006 The impacts of floods on rural roads and proposed mitigation options University Press Limited, Dhaka

IDS (2007) Governance Screening for Urban Climate Change resilience-building and Adaptation strategies in Asia: Assessment of Chittagong City, Bangladesh, Institute of Development Studies, The University of Sussex, UK.

IOM (2009) Compendium of IOM's activities in migration, Climate Change and the environment, International Organization for Migration (IOM), Geneva, Switzerland.

Ishtiaque, A. and Ullah M. S., 2013. The influence of factors of migration on the migration status of rural- urban migrants in Dhaka, Bangladesh Human geographies 7.2 2013 p. 45-52

Islam, N. 2012. Urbanization and Urban Governance in Bangladesh Background paper for the 13th Annual Global Development Conference on "Urbanization: Delving Deeper into the Nexus", Budapest, 2012

Islam,S.A., Rahaman, M.M., Islam, M.S., and Razzaque,M.A (2010) Problems of Existing Sanitation System In Khulna City Of Bangladesh: A Case Study, Khulna 3rd international Seminar paper AIT-2010.

Jahan, S. 2012 Managing the Urban Transition in Bangladesh In: Amed, S. (eds.) 2012 Leading Issues in Bangladesh Development UPL, Dhaka

KIT (2012) Land governance and food security fact sheet Available http://www.landgovernance.org/assets/2014/09/Bangladesh-Factsheet-20121.pdf [02-05-2014]

Kriken, J.L., 2010. City Building Princeton Architectural Press

LGED, 2014. Urban management unit, about us Available: http://www.lged.gov.bd/UnitAbout.aspx?UnitID=10 [04-12-2014]

Mallick, P. K. 2012. The effect of Rural-Urban Migration and Poverty Reduction Lambert Academic Publishing Saarbrucken

Maniruzzaman 2006 mitigating the impact of floods on cities through land use planning University Press Limited, Dhaka

Marshall, R. and Rahman, S., 2013. Internal Migration in Bangladesh: Character, Drivers and Policy Issues UNDP Bangaldesh

McHarg, I.L. 1969. Design with Nature San Val, Incorporated

Mowla, Q. A. and Islam, M. S., 2013. Natural Drainage System and Water Logging in Dhaka: Measures to address the Problems Journal of Bangladesh Institute of Planners ISSN 2075-9363 Vol. 6, December 2013, pp. 23-33

Murtaza, Ghulam (2001) Environmental Problems in Khulna City, Bangladesh: a Spatio-Household Level Study, GBER Vol. 1 No. 2 2001 pp 32-37.

Muzzini, E. and Aparicio, G. 2013. Bangladesh: The Path to Middle-Income Status from an

Urban Perspective Washington, DC: World Bank. doi:10.1596/978-0-8213-9859-3. License: Creative Commons Attribution CC BY 3.0

Nillesen, A.L. 2011 Amphibious Housing in the Netherlands Nai Publishers, Rotterdam

Panday, P. K. 2011. Local Government System in Bangladesh: How Far is it Decentralised? Lex Localis – Journal of local self-government Vol. 9, No. 3, pp. 205 - 230, July 2011

Parkinson, J., 2003 Drainage and storm water management strategies for low-income urban communities Environment & Urbanization Vol 15 No 2

Population Explorer 2015. Web-based population estimation tool Available: http://www.populationexplorer.com [02-12-2014]

Rahman 2006 The impact of floods and national housing policy University Press Limited, Dhaka

Rahman, M., M., 2004. Regionalization of Urbanization and Spatial Development: Planning Regions in Bangladesh The Journal of Geo-Environment, vol. 4 p. 31-46

Rahman, M. N. (eds.), 2012. Bangladesh population and housing census 2011 National report vol. 4 – socio economic and demographic report Bangladesh Bureau of Statistics (BBS), Ministry of Planning Available: http://www.sid.gov.bd/wp-content/uploads/2014/01/Socio_Economic.pdf [02-12-2014]

Rahman, T., 2013. Urban governance and informal growth regulation in Dhaka AHDPH

Rajshahi Development Authority (RDA) (2004) Rajshahi Metropolitan Development Plan, 2004-2024, Volume-I Structure Plan and Master Plan, Prepared by RDA under the Ministry of Housing and Public Works, Government of the People's Republic of Bangladesh.

RMMRU 2007 Coping with Riverbank Erosion Induced Displacement online: http://www.migrationdrc.org/publications/briefing_papers/RMMRU/Policy_brief_ISSUE_1.pdf [accessed 04-01-2015]

Roy, T. S., and Rahman S., 2013. Planned Urban Decentralization for Sustainable Development of Bangladesh Conference paper Planned Decentralization: Aspired Development World Town Planning Day 2013 Available: http://www.bip.org.bd/SharingFiles/journal_book/20140128161015.pdf [20-11-2014]

Royal Tropical Institute 2012. Land governance and food security fact sheet

Rural Enterprise Development (RED) 2009, Agricultural Market Assessment Report, Barisal and Noakhali Region.

Salim Rashid , Compact Townships and Urban congestion, , University of Illinois at Urbana-Champaign

Seraj, T.M., and Mahid, Y. 2012. Smart Growth: A Planned Solution for the Urbanisation

Steiner, F.R. and Butler, K. 2007. Planning and urban design standards John Wiley & Sons Inc. New Jersey

Sixth Five Year Plan (SFYP) 2011-2015, Planning Commission, GoB

Streatfield P. K., and Karar Z. A., 2008. Population Challenges for Bangladesh in the Coming Decades Journal of Health, Population and Nutrition 2008 Sep;26(3):261-272

Sultana, S., 1993. Rural settlements in Bangladesh: spatial pattern and development Dhaka, Graphosman.

UNDESA PD (United Nations, Department of Economic and Social Affairs, Population Division) 2014. World Urbanization Prospects: The 2014 Revision Available: http://esa.un.org/Unpd/Wup/Country-Profiles/Default.aspx [10-12-2014]

UN Habitat 1976. National report on human settlements Bangladesh

USAID 2010. Property rights and resource governance Bangladesh Available http://landwise.landesa.org/record/1287 [accessed 04-01-2015]

UN (2014) World Urbanization Prospects: The 2014 Revision, Highlights, Department of Economic and Social Affairs, Population Division, United Nations

Word bank 2000, ASIAN CITY DEVELOPMENT STRATEGIES: FUKUOKA CONFERENCE 2000 City; Available from profileshttp://info.worldbank.org/etools/docs/library/166856/UCMP/UCMP/Documents/khulna.pdf

Zaman M. (2011) "Climate Change Impacts and Urban Migration: Confronting the Looming Crisis" Draft Paper Dhaka Seminar 2011

BASELINE STUDY: 14

Sustainable Transportation and Infrastructure

Part 1: **Roads & Highways**

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Executive Summary : Study 14 (Part 1: Roads & Highways)

Based on a 2007 World Bank report, the share of roads and highways in Bangladesh transport sector in the carriage of passenger and freight traffic is more than 88% in passenger-km and 80% also in ton-km, making it the most utilized form of transport in Bangladesh.[5] This is the most likely a result of historically higher levels of investment as well as better quality service. The road sector not only provides point-to-point transport but also has the ability to interact with all other modes of transport, such as inland waterways, railways, and airports. The main stakeholders include the Roads and Highways Department (RHD) and the Local Government Engineering Department (LGED). RHD has constructed the major road network in the country, including the national and the regional highways, and zila roads, whereas LGED has developed the other roads like upazila, union and the village roads.

As of 2015, the total length of the road network is 21,481.25 km, of which 18,202.06 km is paved, under the management of Roads and Highways Department at present. Of the total road network under the Department, 3544 km is National Highways (16%), 4278 km Regional Highways (20%) and remaining 13,659 km is Zila roads (64%). Besides, RHD has 7,741 bridges and 13,751 culverts under its jurisdiction. Moreover, RHD has been operating about 134 ferry boats in 55 ferry ghats on its road network throughout the country. It should be mentioned here that the length of road network under RHD did not increase during last few years. However, RHD maintains that the quality of different *important* road segments has been significantly improved through carrying out development/ improvement works of various standards as per requirement.

Some of the government policies/plans related to the roads and highways sector that are detailed in this study include the Bangladesh's Sixth Five Year Plan, National Land Transport Policy, the Road Master Plan, and the National Sustainable Development Strategy 2010-21 (NSDS). The Road Master Plan is the most comprehensive policy guideline in the Roads and Highways sector.

The transport sector in Bangladesh does not have any direct revenue generating programs. Transport related revenue generators; such as tolls and vehicle taxes are given to the government exchequer first - it is up to the government to decide how much of the revenue is allocated to which Ministry and division. According to a 2003 World Bank study, less than 40% of money collected from road users was actually spent on road maintenance.[6] Bangladesh also has one of the world's lowest level of tax revenues in comparison to GDP, for instance in FY 2013 total tax revenue was only 11.3% of GDP.[7] As a result of the lack of sufficient funds in the budget and the low levels of government revenue, it is difficult for the Roads and Highways sector to develop at the desired rate at which it should be able to cope with a growing population and economy.

This study also analyzes some of the main challenges of the roads and highways sector. This includes a lack of maintenance and insufficient funding, slow implementation, encroachments on major highways and land resettlement, traffic growth and road safety, climate change, lack of rural access and agriculture, and organizational issues. If the maintenance is not done on due time, many roads will require costly rebuilding. A large proportion of roads in Bangladesh are of poor, bad, or very bad condition (about 38%), only due to lack of maintenance. This high percentage of bad roads only point to a high amount of money that would be required to fix these roads; it would also delay the repair works as it would need an extra period of time.

[5] Bangladesh Budget 2014-2015, Ministry of Finance

[6] *Private Solutions for Infrastructure in Bangladesh*, World Bank, 2003

[7] Ministry of Finance

In addition, based on the SFYP, RHD's target for road construction was 4,672 km of new roads by FY15. However, during FY11-FY13 a total of 702 km of new roads, or only 15% of the target, have actually been completed.[8] This is an example of one of RHD's biggest challenge – slow implementation, which is generally caused by a variety of factors including political instability and fund related issues. Political instability in the form of frequent *hartals* and strikes, changes in regime, and the politicization of projects can cause significant delays in implementation. Many project delays are also caused by the inability to place down sufficient funding on time. Moreover, there are many instances of land encroachment in Bangladesh which poses a big problem for RHD, considering that the reclamation and resettlement of land is not a simple task. Many plots of land are owned privately, and therefore resettlement will be costly as well as time-consuming as lengthy negotiations are required prior to hand-over to the government. In addition, major *haats* and *bazaars* will also require the resettlement of small businesses owned by small traders. Also, certain areas are densely populated, which makes relocation even more difficult.

Climate change is another difficult challenge for the sector. According to a 2010 World Bank Study titled *Climate Proofing Infrastructure in Bangladesh,* "using the 1998 (Bangladesh) flood as a benchmark for evaluating additional protection measures, the authors calculate conservatively that necessary capital investments out to 2050 would total US $2.671 billion (at 2009 prices) to protect roads and railways, river embankments, surrounding agricultural lands, and drainage systems and erosion control measures for major towns."

- Lack of updated published data

  Many key published data statistics appear to be missing or outdated. This indicates that there has not been enough emphasis on accumulating data related to transport sector. This can pose a problem during strategically planning the maintenance requirements as well as planning of new infrastructure projects.
- Lack of specificity in Government policies

  The GoB has prepared many key policies in relation to the country's transport sector, however many of these policies only point out the challenges in the sector and then proceed by offering ambiguous and open-ended solutions to these challenges.
- Lack of Prioritization of Projects

  The Government does a very good job in understanding the challenges, maintenance requirements, as well as outline necessary future infrastructure projects within the roads and highways sector. However, prioritization of projects in the sector should be done and also an adequate reconciliation is needed between what is required for the sector and what is financially and technically feasible.
- Inability to Forecast Future Transport Network

  Due to many of the challenges and knowledge gaps mentioned earlier, it is very difficult to accurately forecast the situation of Bangladesh's future transport network. As many projects are delayed or cancelled, or in need of more fund, or not prioritized, etc, a divide is created between what the government plans are and what the government can actually implement.

Some of the main recommendations are briefly discussed below. Detail overview of the recommendations is referred to in Chapter 3.

- The Government should place more emphasis on consistently keeping data regularly updated, published, and available in one central location for all stakeholders to access.
- Government Policies should not only set broad agenda, but also set specific plans of action based on realistic timelines. These policies should also be reflected in the Five Year Plans.

[8] Mid-Term Implementation Review of Sixth Five Year Plan, Policy Research Institute

- Too many projects are included in each FY's Annual Development Plans (ADPs); many projects have long time horizons, which are not taken into account during the formulation the following year's ADP. Essentially, the Government needs to pay more attention to prioritizing key projects instead of taking on too many projects at one time.
- New road projects should ensure that they are using quality materials and procedures, and these projects should be durable. Bangladesh should move away from "build, neglect, rebuild" mindset, and instead focus on ensuring proper maintenance of existing infrastructure.
- Many private companies are hesitant of PPP due to changing future macroeconomic and political factors that could decrease their ability to collect sufficient revenue from potential projects. In order to abate this, the Government should focus on ways to incorporate adequate Government guarantees, tax concessions, and a level of cost-sharing that encourages the advancement of BOT (Built Operate Transfer) projects.
- There is an urgent necessity of additional protections against flood waters through building of flood protection barriers around urban cities. Therefore, it is of utmost importance that design standards for roads be accordingly adjusted, investments in flood-proofing infrastructure are made, and that adequate policies and planning measures are completed.
- It is important that Bangladesh, a country of many inland waterways, pay special attention to the development of two other wings of transport, namely its inland waterways and railways due to increasing demand of transport. Interfaces that allow efficient inter-modal transportation, such as the seamless switching between river and land-based transport will be important for future development.
- It is of utmost importance that key infrastructure and management related agencies collaborate frequently and extensively to ensure that together they are helping to plan and implement key inter-modal transportation goals as well as the proper management of existing cities.
- Definite policy must be created to encourage the growth of satellite cities to take pressure away from the already deteriorating capital.
- It is important for the Government to have an accurate idea of what the future road network will be like in a future given year. This is for two reasons:
    - The sectors that are affected by the road network, such as agriculture, can anticipate how these changes will affect their sector.
    - The future road networks should take into consideration socio-economic and climate issues such as population changes, transport demand changes, and the impacts of climate change. The ability to forecast adequately a future road network is also heavily dependent on previously mentioned recommendations being carried out effectively.

1 Introduction

1.1 Background

An adequate and efficient country-wide transport system is a pre-requisite for initiating and sustaining economic development. Investment in improving transport efficiency is the key to the expansion and integration of markets – sub-national, national and international. In addition, it contributes to the generation of economies of scale, increased competition, reduced costs, systematic urbanization, export-led faster growth and a larger share of international trade. An efficient transport system is an important element of trade logistics cost and as such is a major determinant of export competitiveness. Efficient transport is also critical in enhancing the physical mobility of citizens. Efficient transport reduces the commuting time of general public, thereby contributing to their welfare.

The transport system of Bangladesh consists of roads, railways, inland waterways, sea ports, maritime shipping and civil aviation, catering to both domestic and international traffic. Besides an efficient transport system, a reliable power system (production, transmission and distribution) is an integral component to initiating and sustaining economic development.

1.2 The Objectives

The broader objective of the thematic baseline is to understand the core drivers within the context of Sustainable transportation and communication infrastructure aspects. These drivers will have to be analysed on the basis of their relevance and impact levels, among others.

The objectives of the thematic baseline study within the context of Sustainable transportation and communication infrastructure analysis therefore include:

- To evaluate existing challenges, developments, opportunities and (government) plans by transport system
- To evaluate expected challenges/opportunities in view of the long term (socio economic and climate) changes
- To identify existing trends and future developments
- To support the common knowledge base
- To identify on-going projects, projects in pipeline and long term perspectives/ideas particularly focusing on water transport system

1.3 Methodology

The methods for this baseline study (and its subsequent subsectors) build on fact finding and interviews by the study team with relevant institutions/stakeholders and the use of existing reports, plans as well as on information available on websites of the relevant institutions. Among this, information has also been gathered on on-going investment projects as well as future planned investment projects.

1.4 Key Sectors of the Study

Roads and Highways: Roads and Highways are considered as the bloodline of the internal communication. Therefore, understanding the present road network is very important

Railways: Railway has connects 44 districts and almost all the important places of the country and has a great contribution in accelerating the economic activities

Inland Waterways: Bangladesh is crisscrossed by thousands of rivers. Inland waterways always play a vital role in communication, especially transporting agricultural goods from one place to another

Ports and Maritime Shipping: (sea) ports and maritime shipping are crucial for import and export of goods (raw materials, such as coal for power stations, intermediary good, and end-products

Power: Power is considered as one of the top most priority sectors of Bangladesh. At present, it is the most critical growth driver of Bangladesh economy. Analysis of power sector and the present and future prospects of the sector in Bangladesh are very important.

1.5 Relationship to Delta Plan 2100

Transportation sector is a key sector which plays an important role in the economic development and urban planning of the country – for the present and the long run. As such the relationship between this infrastructure sector and the BDP 2100 is very important. During the preparation of this report, many discussions were held with roads & highways, railways, inland waterways & ports as well as the power sector. Apart from inland waterways and ports, which directly relates to the Delta Plan in terms of navigation and accessibility for shipping, the power sector, in terms of availability of cooling water and its consequences, are not directly related to Delta Plan strategies, and the various interventions/measures to be taken for the short, medium and long term up to 2100. However, when the Delta Plan is operational, their policies and accompanying (new) investment projects have to conform to the Delta Plan strategies and interventions including in particular, the spatial planning. Therefore, a mechanism has to be implemented, which can sort this out. In the Netherlands the so-called "Water Check" is carried out. For Bangladesh a comparable mechanism of conditionality have to be designed which can deal with (new) plans and (new) investment projects in the transportation infrastructure sector.

1.6 Relationship with other Baseline Studies

Roads & Highway and Railway Sectors

The Roads & Highways and Railway sectors are not directly related to the other Baseline studies, however they are related indirectly. The state of roads, highways, and railways in Bangladesh represent the country's infrastructure as well as the majority of the transport network, which in turn affects the overall economic development of the country. Economic development in turn affects all sectors of the country. Therefore the planning for any other sector (i.e. fisheries, agriculture), must take into consideration the state of the infrastructure.

On the other hand, the road and railway network are also influenced by other factors, such as population, climate change, and sectors that can either increase or decrease the transport sector's demand, such as agriculture. Issues such as population change and the development of dependent industries dictate the overall demand for transport, and therefore affect the way the transport network evolves over time. Climate change continuously affects the roads, highways, and railways, as made evident by the damages caused by persistent flooding. Therefore, it is important that infrastructure is planned in line with the changing dynamics of all directly and indirectly related sectors and issues.

Inland Waterways and Ports

The National Water Management Plan (NWMP) describes the river systems as the *life-blood* of Bangladesh. All those areas which are depending on or utilizing the river are directly linked with each other and integrated under the water management plan. As such, NWMP was prepared *in a comprehensive and integrated manner for the interests of all water related sectors and taking full account of other sectoral policies of the Government*. Accordingly, River Management and River Morphology are directly related with inland waterways.

Navigation requires water, availability of which ensures better eco-system. This way, the inland waterway is related with environment at large. Emission of carbon dioxide from the transport output is one of the largest contributors to global warming and climate change. Sustainable development of transport network must consider the issue of comparative carbon emission of different modes. So, Pollution is related with inland waterways. Rivers are directly and strongly affected by climate change and impact of climate change is already evident in the waterways of Bangladesh.

Power sector is also related with inland waterways as almost all power plants were developed by the side of the rivers. Constructions of power plants require certain navigability for the carriage of over-dimensional (O.D) equipment which cannot be transported by rail or road. River is also required after construction for a thermal power plant for continuous transport of coal and to meet the need of cooling water.

The Integrated Multimodal Transport Policy 2013 envisages *integration within and between different types of transport* with the objective of establishing an efficient transport network that is able to provide a cost and time effective door to door service. As such roads and highways, and railways are related with inland waterways and so with maritime ports.

Power Sector

The power sector is directly related to some other baseline studies, for example: Transportation specially water and railway, Environment and Hydrology etc.

The only way to transport heavy equipment's and machineries of power plants is waterway means rivers. According to the power system master plan there will be a big power generation hub in the northern part of Bangladesh. The rivers need to keep navigable during the construction phase. Fuel of power plant like coal can be transported by waterways and railways. The success in set up coal as main source of fuel of power generation is greatly dependent on related infrastructure development for coal transportation.

The large scale power plants are always located at the bank of river because it is convenient for equipments and fuel transportation. Also a huge amount of river water is needed as the source of cooling water for thermal power plants. Important information like shifting of location of river, depth and availability of water in rivers, river erosion and location of flood prone areas based on baseline study on river system management are essential for identifying proper location of new large scale power plant.

According to second national communication of Bangladesh submitted to UNFCCC, The power generation subsector is the main source of green house gases (GHGs) emission in Bangladesh. The power sector is also directly related to environment and climate change baseline studies. Among all power plants, the coal based power plants are having highest grid emission factor. In the future, the GHGs emission of power sector will increase considerably as coal will be the main fuel of power generation.

1.7 Structure of the Report

After the introductory Chapter 1, an overview of infrastructure development in Bangladesh including a comparison of the country's main transport infrastructure systems with the neighbouring countries has been described in Chapter 2. Thereafter, each of the main transport infrastructure system has been dealt with in a separate chapter. Subsequently, the following sub-sectors are analyzed and discussed: i) roads and highways, ii) railways, iii) inland water transport & ports and maritime shipping, and ix) power. The Chapter 3 in each report includes the history, present status, key policies, future outlook, key challenges, knowledge gaps and recommendations in the sub-sector concerned. An executive summary for each of the sub-sectors is presented at the beginning of this report. The relevant tables, figures, maps are enclosed as per the Table of Content.

It is important to note that data used in this study were primarily taken from government institutions, such as the Ministry of Road Transport & Bridges, Roads and Highways Division, Ministry of Railway, Ministry of Port, Shipping & IWT, Bangladesh Bureau of Statistics, Ministry of Finance, etc. However, the information/ data may often appear outdated due to unavailability of updated information. The most recently government published information was used for the majority of this report.

The report was initially prepared as one report containing all the sub-sectors under the title "Baseline Study: Sustainable Transportation and Infrastructure." However, it was decided later that the report would be divided into four parts, each one containing the baseline study of the relevant sub-sector. As it stands now, the four volumes of the report have been titled as follows:

Sustainable Transportation and Infrastructure Volume 1: Roads & Highways

Sustainable Transportation and Infrastructure Volume 2: Railways

Sustainable Transportation and Infrastructure Volume 3: Inland Water Transport & Ports

Sustainable Transportation and Infrastructure Volume 4: Power

However, the Executive Summaries of all sub-sectors are included in all the volumes. In addition, the introductory chapter (Chapter 1) and Chapter 2, giving an overview of infrastructure development in Bangladesh, are also included in all the four volumes.

2 Overview of Infrastructure Development in Bangladesh

A well-organized and dependable transport and communication system is essential for the socio-economic development of a country. According to data released by the Bangladesh Bureau of Statistics (BBS), in FY 2013-2014, the growth rate in this sector and its contribution to GDP at constant price were approximately 6.47% and 11.54% respectively.[9]

Table 1 Sectoral Shares of GDP (%) at Constant Prices (Base Year 2005-2006)

Sector	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Transport, Storage, & Communication	10.89	11.05	11.23	11.49	11.50	11.54
a. Land Transport	7.19	7.28	7.31	7.32	7.31	7.31
b. Water Transport	0.95	0.92	0.89	0.86	0.84	0.81
c. Air Transport	0.12	0.13	0.14	0.14	0.13	0.12
d. Support Transport Services, Storage	0.58	0.60	0.63	0.69	0.67	0.66
e. Post & Telecommunication	2.06	2.12	2.26	2.48	2.56	2.63

Source: Bangladesh Bureau of Statistics

The transport sector's (including transport, storage, & communication) high percentage contribution to GDP at constant price, 11.50% in FY 2012-2013 and 11.54% in FY 2013-2014,[10] indicates that the transport sector is an important component of the socioeconomic development of Bangladesh. Land transport represents the majority of the transport's sector's high percentage contribution to GDP with 7.31% in FY 2013-2014 (**Table 1**). However,

9 Bangladesh Bureau of Statistics

10 Bangladesh Bureau of Statistics

according to **Table 2**, extracted from the *World Economic Forum's Global Competiveness Report 2013-2014*, Bangladesh has a score of 2.8 in terms of infrastructure, which includes measures in electricity, roads, railroads, and port. Considering other countries in the region, Bangladesh, along with Myanmar, ranks in the bottom two in terms of infrastructure. Pakistan, a country with a lower overall country ranking than Bangladesh, leads Bangladesh in infrastructure quality with score of 3.3. The only country with a lower infrastructure score than Bangladesh is Myanmar, with a score of 2.1. This indicates that Bangladesh is badly in need of strong many infrastructural improvements in order to boost its economy in the future

Table 2 Global Competiveness Report 2013-2014, Comparison of Infrastructure Quality 2013-2014

Country	Country Ranking	Overall Infrastructure Score	Electricity	Roads	Railroads	Port
Bangladesh	**110**	**2.8**	**2.2**	**2.8**	**2.4**	**3.5**
India	60	3.9	3.2	3.6	4.8	4.2
China	29	4.3	5.1	4.5	4.7	4.5
Cambodia	88	3.9	3.2	3.7	2.0	4.0
Nepal	117	2.9	1.6	2.7	1.1	2.7
Bhutan	109	4.9	5.9	4.3	n/a	2.2
Myanmar	139	2.1	2.9	2.4	1.8	2.6
Pakistan	133	3.3	2.0	4.0	2.5	4.5
Sri Lanka	65	4.8	5.0	4.7	3.6	4.2
Thailand	37	4.5	5.2	4.9	2.6	4.5

Source: World Economic Forum, the Global Competitiveness Report 2013-2014

Note: Country Rankings are in descending order with "1" considered as the best performer. Overall Infrastructure score is in ascending order with "1" considered as a lower score.

In **Table 3**, a comparison of Bangladesh's infrastructure score over a span of 8 years (2006-2014), shows some improvement over time. For instance, Bangladesh's infrastructure score increased from 2.03 in 2006-2007 to 2.8 in 2013-2014, a result of improvements in the electricity and port sector.

Table 3 Bangladesh's Infrastructure Score over time

Year	Overall Infrastructure Score	Electricity	Roads	Railroads	Port
2013-2014	2.8	2.2	2.8	2.4	3.5
2010-2011	2.7	1.6	3.0	2.5	3.4
2006-2007	2.03	1.6	3.1	2.3	2.4

Source: World Economic Forum, the Global Competitiveness Report

If the changes in infrastructure score over the past 4 years (2010-2014) are compared, there has only been a very small increase in the score, from 2.7 to 2.8, however this improvement is again due to improvements in electricity (1.6 to 2.2) and port (3.4 to 3.5) only. On the other hand, in the same span of 4 years, roads and railroads have decreased from 3.0 to 2.8 and 2.5 to 2.4 respectively. This is likely due to immense Government focus on increasing access to electricity as well as developing port facilities, although the Government should simultaneously focus on drastic improvements in the roads and railroads sector.

The Government of Bangladesh (GoB) has recognized that in order to achieve targeted GDP growth rates, it is important to further develop Bangladesh's infrastructure. Bangladesh's *Sixth Five Year Plan* (2011-2015), a

Government plan for economic development over five years, has addressed this issue by setting certain strategic goals for the Bangladesh transport sector, which include primarily the following:[11]

- Undertaking an optimal mix of "market integration approach" and "poles of development approach" through the development of five main corridors: Dhaka-Chittagong, Dhaka-Northwest, Dhaka-Khulna, Dhaka-Sylhet, and Khulna-Northwest
- Building an integrated transport network by constructing Padma Bridge at Mawa-Janjira point (integrating inland water transport with existing or new road transport systems)
- Improving connectivity with neighbouring countries through the development of inter-modal transport network
- Improving resource mobilization through the introduction of user charges/fees in the entire transport network
- Ensuring the deficit free operation of the Bangladesh Railway
- Improving transport safety standards to reduce incidence of accidents
- Increasing private partnership in the transport sector through the PPP framework

Integrated multi-modal transport

The Govt has also recognized that **integrated multi-modal transport** should be prioritized, as indicated by the *Integrated Multi-Modal Transport Policy*, which states that the sustainability of the transport sector will be heavily dependent on its ability to offer its stakeholders integrated and multi-modal transport, essentially meaning that the transport system must integrate:

1) Within and between **different types of transport**
2) With the environment
3) With land use planning
4) And with policies for education, health, economic growth, gender and social equity, and poverty reduction

Intermodal Connectivity

In the past two decades, the Govt has been placing heavy emphasis on the development of the road sector at the cost of less development in the railway and inland waterway transport sectors. Certain geographic conditions of Bangladesh, such as the country being relatively flat, have contributed to this growth of road transport. To add, road transport offers more mobility and connectivity than other transport modes, partially due to its continuous development. Short-term planning has also resulted in the emphasis of roads versus inland waterways and railways. However, it is important that Bangladesh, a country of many inland waterways, and an exponentially increasing demand of transport pay special attention to the development of both its inland waterway and railway sectors.

Transportation connectivity in Bangladesh could be well enhanced and meet future demands of transport growth if an effective and full-proof plan for intermodal connectivity was followed. Railway offers certain distinct advantages, such as lower cost for the transportation of passengers and freight, as well as being more environmentally friendly. Inland waterways also offers advantages as they can contribute to the effective transportation of freight and if these same waterways were efficiently connected to railway and road, their importance and contribution to effective transport could only grow.

The *Integrated Multi-Modal Transport Policy* 2008 addresses this issue. Although, there is still a lack of integrated transport policy and planning framework that could result in the prioritizing of investments. This makes it difficult for the transport sector to allocate resources between sub-sectors effectively. Most importantly, there have been a number of transportation studies in recent years that advocate for intermodal connectivity, however, no real effort has

[11] Mid Term Implementation Review of Sixth Year Plan, Policy Research Institute

been made for the actual functional integration of different modes of transport. Increased intermodal connectivity could have positive effects on all economic activities; especially the carriage of freight, on agriculture. Nearly half of the population is employed in the agriculture sector, however rural areas, which are generally used for agricultural land, are yet to see efficient transportation infrastructure. This is understood by the fact that not enough rural areas have roads and if they do have roads, the majority of these roads are narrow and dirt roads (unpaved).In addition, many rural areas are unable to withstand the loads of heavy farm equipment; all of these factors taken together make the logistical costs between different parts of Bangladesh some of the highest in the world. If more investments were made into reliable infrastructure, the agricultural sector would improve. Agricultural supplies could more efficiently reach farm lands, and agricultural products could also efficiently reach markets through carriage on a mix of different transport modes: roads, railways, and inland waterways.

Inter-modal connectivity is especially important in and around Dhaka. Currently, the existing modes of transport act independently with each other and are often in competition, however, they should also benefit from each other. Passengers suffer due to a lack of connection between modes and poor scheduling, an integrated scheduling and ticketing system should be initiated in Dhaka within all modes of transport. For instance, an individual travelling by river from his/her village, should be able to connect to a railway link that can bring him/her into the heart of the city, and from there take a bus to his/her final destination with convenience. For example, Dhaka Airport has few direct bus connections, but the railway station is not very near. There is no high-speed form of transport, such as a metro line, from the airport; this only increases the transfer time many fold.

3 Roads & Highways Subsector

3.1 Sector History

In Bangladesh, the road sector has been playing an increasingly significant role in transporting both passengers and freight. In 1975, the road sector's share of passenger and freight traffic was only 54% and 35% respectively out of a total of 17 billion passenger km and 2.6 billion ton-km (**Table 4**). However, as of a 2007 World Bank report (the most recently published data including modal share statistics), the share of road transport in the carriage of passenger and freight traffic has grown significantly and is more than 88% in passenger-km and 80% in ton-km in 2005, making it the most utilized form of transport in Bangladesh.[12] This is most likely due to historically higher levels of investment and better quality service; for example, the road sector not only provides point-to-point transport but also has the ability to interact with all other modes of transport, such as inland waterways, railways, and airports.

Table 4 Historical Transportation Sector Modal Shares

Year	**Passengers**			**Freight**		
Year	**Road**	**Rail**	**IWT**	**Road**	**Rail**	**IWT**
1975	54%	30%	16%	35%	28%	37%
1985	65%	20%	15%	48%	17%	35%
1989	68%	17%	15%	59%	11%	30%
1993	75%	12%	13%	61%	7%	32%
1998	73%	13%	14%	63%	7%	30%

Source: World Bank, Private Solutions for Infrastructure in Bangladesh (June 2003) and Bangladesh Integrated Transport Sector Study 1997, Planning Commission

[12] Bangladesh Budget 2014-2015, Ministry of Finance

Table 5 Modal Share of Passenger & Freight Traffic (2005)

Modes of Transport	Passenger (billions of km)	Passenger Modal Share	Ton-km (billion)	Freight Modal Share
Road	98.4	88%	15.7	80%
Rail	4.2	4%	0.8	4%
IWT	8.9	8%	3.0	16%
Total	111.5	100	19.6	100

Source: Revival of Inland Waterways: Strategies and Options, Report, World Bank 2007

Prior to Bangladesh's independence, no national or regional highways existed in territory that is now known as Bangladesh. The only roads available connected Dhaka to the rest of East Pakistan. During this time, the transport system was more heavily dependent on railway and inland waterways. This higher level of dependence on railway and inland waterways as a form of transport is illustrated in **Table 5**. In 1975, the inland waterway and railway sectors together accounted for 65% of modal share of freight, and 45% of the modal share of passengers. However, as of 2005, the combined share of both the inland waterway and railway sector has dropped as low as 20% of the modal share of freight, and 12% of the modal share of passengers. Meanwhile, the roads sector has increased from 65% of passenger modal share in 1985 to 88% in 2005; similarly the freight modal share has increased from 48% in 1985 to 80% in 2005.

Major developments of road networks started in the early 1980s, with growth in later years. Since Bangladesh's independence in 1971, the Roads and Highway Department (RHD) has developed all of the country's national highway roads, regional highway roads, and zila roads. The Local Government Engineering Department (LGED) has developed Bangladesh's upazila roads, union roads, and village roads. Between FY 1973-2002, the Government allocated approximately 18,000 crore taka (approximately $4.5 billion) for the development of road networks through Bangladesh's Annual Development Program (ADP). Over the past few years, the allocation to RHD, responsible for Bangladesh's most heavily utilized roads, has been relatively constant, at around 2,300 crore taka per year ($330 million).

3.2 Present Status

As of 2014, the total road length of 21,481.26 km with 3,544 km of National Highway (16%), 4,278 km of Regional Highway (20%) and 13,659 km of feeder road (64%) (Zila roads), all of which are under the jurisdiction of RHD. In addition, there are approximately 304,379.31 km of rural roads [13] which are under the jurisdiction of LGED. There are also 7,741 bridges and 13,751 culverts. RHD also operates 134 ferry boats and 55 ferry ghats on its road network throughout the country.

National highways and regional highways are the most utilized transportation mode for both the movement of passengers and freight. Currently, the Government has given priority to five important corridors for road network development: Dhaka-Chittagong, Dhaka-Northwest, Dhaka-Khulna, Dhaka-Sylhet, and Khulna-Northwest.[14]

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[13] LGED

[14] National Sustainable Development Strategy 2010-2021

Table 6 Bangladesh Road Classification

Type of Road	Definition
National Highway	includes highways that connect Dhaka with divisional headquarters, seaports, land ports, or the Asian Highway
Regional Highway	includes highways that connect district headquarters, main rivers, or land ports with each other (that are otherwise not connected to the national highway)
Zila Roads	connect district headquarters with upazila headquarters, or connect one upazila headquarter to another upazila headquarter by a single main connection with the national or regional highway
Upazila Road	roads connecting upazila headquarters with Growth Centres or one Growth Centre with another Growth Centre by a single main connection or connecting Growth Centre to higher road system, through shortest distance/route
Union Road	roads connecting union headquarters with upazila headquarters, Growth Centres or local markets or with each other
Village Road	Type A) Roads connecting villages with union headquarters, local markets, farms and *ghats* or with each other Type B) Roads within a Village

Source: Roads and Highway Department & LGED

Table 7 RHD Road Network by Type

Year	National Highway (km)	Regional Highway (km)	Feeder Road 'A' type (km)	Total (km)
2001	3,086	1,751	15,962	20,799
2002	3,086	1,751	15,962	20,799
2003	3,086	1,751	15,962	20,799
2004	3,723	4,832	13,823	22,378
2005	3,570	4,323	13,678	21,571
2006	3,570	4,323	13,678	21,571
2007	3,570	4,323	13,678	21,571
2008	3,482	4,128	13,255	20,865
2009	3,478	4,222	13,248	20,948
2010	3,478	4,222	13,248	20,948
2011	3,492	4,268	13,280	21,040
2012	3,544	4,278	13,640	21,462
2013	3,544	4,278	13,659	21,481

Source: Roads and Highways Department

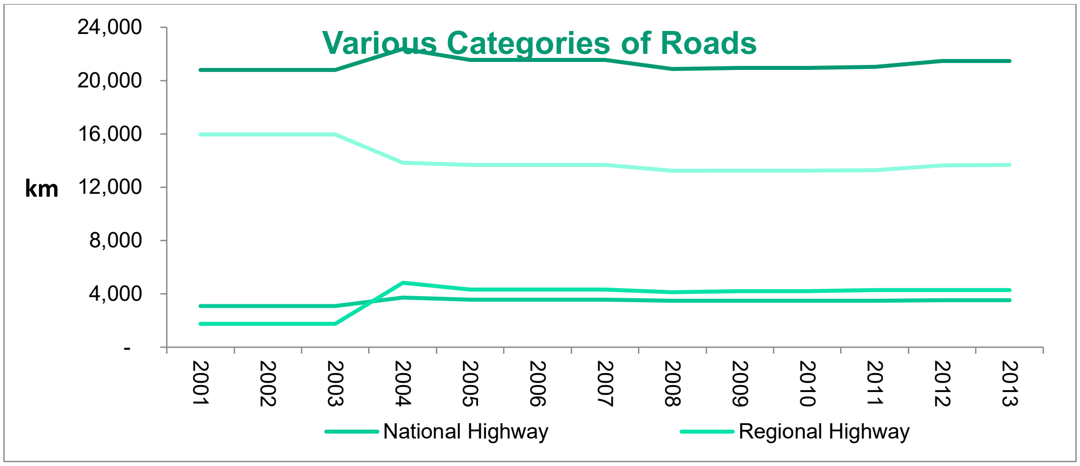

Figure 1 RHD Road Network Development over time

Source: Roads and Highways Department

It should be noted from **Figure 1** that there was a large increase in both the national and regional highways around 2004; however this increase was followed by a decrease in 2005. Since then (2005), the total km attributed to national and regional highways have stayed at a relatively stable level – indicating that no new major roadwork has since been initiated. For feeder roads, 2004 saw a large decrease (from 15,962 km to 13,823 km), after which the total road length has remained within 13,000 km. There is actually less road in 2013 (21,481 km) than in 2005 (21,571 km), a cause for concern as Bangladesh's dependency on the road sector has only been increasing. As Bangladesh's population and economy grows, its demand for transport services will also increase substantially. It is important that the road network should cope with this demand; without it, the socioeconomic development of the country will only retrogress.

Table 8 LGED Road Network by Type

Road Type	Earthen (km)	Pavement (km)	Total Length (km)
Upazila Road	6,585.81	29,797.33	37,334.86
Union Road	19,981.70	22,478.31	44,202.03
Village Road A	100,645.49	8,736.13	111,340.87
Village Road B	86,117.94	22,291.64	111,501.55
Total Roads	213,330.94	83,303.41	304,379.31

Source: LGED

Table 8 includes a list of roads under LGED's purview. This includes upazila roads, union roads, and village roads – together making up the total rural roads. This includes 304,379.31 km of road – however only a small percentage of these roads are actually paved, approximately 27%, whereas the rest are merely dirt roads.

Table 9 Paved vs. Unpaved Roads under RHD (km)

Type of Road	No of Roads	Paved Road	Unpaved Road	Not Surveyed Road
National Highway	71	3,476.55	12.26	49.20
Regional Highway	121	4,104.27	84.63	89.17
Zila Road	641	10,665.93	1,706.94	1,264.88
Total	833	18,246.75	1,803.73	1,403.26

Source: Maintenance and Rehabilitation Needs Report of 2012 – 2013 for RHD Paved Roads, RHD

A large portion of RHD roads, the most utilized roads, are also of low quality - as many roads are either in a deteriorating condition or unpaved. From **Table 9**, as of 2012, 1,803.73 km of road under RHD are still unpaved; this statistic may be even higher considering 1,403.26 km of road was not even surveyed. Considering that the roads under RHD are the most utilized and economically-important roads, it is vital that all these roads are in good condition.

Currently, various road network enhancements and bridges are either on-going or have been planned, and the initial work for the connectivity to the Asian Highway Network has begun, however most projects and their implementation have fallen behind schedule. This common thread of slow progress will make it difficult for Bangladesh to adapt to the increasing demand for adequate road transport by its growing population.

3.2.1 Recent Progress in Policy and Implementation

During the Sixth Five Year Plan period the improvement work of a number of National Highways to 4 (four) lanes has been initiated and implemented. Numerous important projects with regional and sub-regional significance have been taken up. Projects such as the Mass Rapid Transit are being implemented that will contribute to the easing of the congestion problem in Dhaka City. In addition, the Government welcomes private investment in mega road developments projects through PPPs to meet the increasing demand for road transport infrastructure.

The Budget allocated for road maintenance has been raised to a considerable amount (section 3.4) in order to narrow down the huge backlog created earlier and to keep the road conditions in reasonably acceptable condition. However it is observed that the network is damaged by vehicle overloading, monsoon weather, climate change impacts and natural calamities (see section 3.7). Attempts have been made to control overload by means on installing weigh-bridges at each important traffic origination point in various National Highways. The overload control stations are being operated according to the Vehicle Axle Load Control Station Operation Policy 2012.

The Government is deeply concerned about ensuring safety on its road network. RHD is implementing a separate project "Improvement of Roads at Black Spots on National Highways" for the treatment of 161 black spots. Meanwhile, "Road Maintenance Fund Board Law, 2013" has been approved by the Government in July 2013 to create a dedicated fund for proper preservation, maintenance and repair of roads under the RHD to ensure the necessary timely and uninterrupted financing.

3.2.2 Urban Transport

In recent years, the population of Dhaka has risen to approximately 16 million people. This is expected to reach up to 35 million people within the next 20 years. Unfortunately, the city has not been able to keep pace with this drastically growing population and quality of life has thus severely declined.

This rapid increase in population has contributed to Dhaka's current chaotic landscape in addition to extreme traffic congestion, deteriorating condition of existing infrastructure such as roads and bridges, air and noise pollution, haphazard parking, poor waste management and sewage. Many roads are inundated by the mix of motorized and non-motorized traffic, creating a general lack of control, traffic inefficiencies, as well as breaches of safety; for instance, the intermingling of different speeds between vehicles has resulted in many accidents. Many non-motorized vehicles, such as rickshaws, are also unlicensed. In the *Strategic Transport Plan* (STP 2004-2024) it was estimated that only 89,000 out of 600,000 rickshaws in Dhaka had official licenses, less than 15%, indicating that there is a strong breach in law and order on-going in the capital.

To add, numerous construction activities have caused congestion on single lane roads, as construction materials and vehicles have illegally taken up public road space. Many multi-storied buildings and multi-occupancy buildings have been gradually growing with little land-use planning, which will ultimately result in need for additional protections against flood waters through building of flood protection barriers around the city.

In 2005, the Government developed the *Strategic Transport Plan* (2004-2024) in order to create a guideline for transport planning. In addition, the *Dhaka Urban Transport Study* (2010-2050) was developed. However, the STP will likely need to be updated as it is dated by ten years, and many projects have already been implemented that may be in conflict with the projects initially proposed in the plan.[15]

New infrastructure is required to serve this ever-growing population; this includes enhancements in water supply, power, sewage, housing, and education, proper land use planning, in additional to large infrastructure projects. It should be noted that heavy in-migration to Dhaka due to centralization of economic activities in the capital has deterred the development of satellite cities; definite policy must be created to encourage the growth of satellite cities to relieve pressure from the already deteriorating capital. Large infrastructure projects that are central to the development of this growing city include a Mass Rapid Transit (MRT) system and Bus Rapid Transit (BRT) system that will serve long distances within short time periods for the general population. In addition, interfaces that allow efficient inter-modal transportation, such as seamless switching between river and land-based transport are important for future development.

A few projects that have been implemented, in order to improve the urban transport system in the traffic-ridden capital, include: flyovers on Airport Road (helping avoid two railway level crossings, and thus decreasing traffic as a result of bottlenecks, as well as connecting Mirpur, Bashundhara, and Purbachal to Airport Road. In addition, a large flyover connecting Gulistan and Jatrabari has been completed which will make it easier to enter and exit the city from Narayanganj. Other recently completed projects include the Banani flyover, the Begun Bari Hatir Jheel Project, Teesta Bridge, as well as the Nabinagar-DEPZ-Chandra road upgrading to four lanes. Currently the four-laning of the Dhaka-Chittagong Highway is on-going. Planned or on-going urban projects include the Dhaka Metro Project from Uttara to Mothijheel, the Dhaka Elevated Expressway, Dhaka-Ashulia Elevated Expressway, the Greater Dhaka Sustainable Urban Transport Project (BRT, Gazipur-Airport, and flyovers, and maintenance works on existing roads.

Urban transport's largest challenges include a lack of properly maintained roads, increasing traffic congestions, and a lack of law enforcement for parking and traffic laws. As urban transport plays a significant role in the economic development, its capacity must be increased to meet its total demand, this should be done through implementation of key harmonized projects as well as enforcement of important traffic and safety rules. A long-term solution to the issue of Dhaka's decreasing ability to service its large population will be the development of satellite cities around the capital that offer economic opportunities; this could be in the form of export-processing-zones (EPZ) that also offer basic services such as health, education, and leisure activities.

Mass Rapid Transit (MRT) Line-6 (Metro Rail)

The route of the MRT Line-6, financed by the Japan International Cooperation Agency (JICA), stretches from Uttara 3rd Phase to Bangladesh Bank via Pallabi-West side of Begum Rokeya Sharani-Khamarbari-Farmgate-Hotel Sonargaon-Shahbag-TSC-Doel Chattar-Topkhana Road. After completion of the project, 60,000 passengers in both directions will be able to commute per hour. The length of the metro rail will be 20.1 km. A Public Limited Company named DMTCL (Dhaka Mass Transit Company Limited) has been formed to construct, operate and maintain the Mass Rapid Transit (MRT).

Bus Rapid Transit (BRT) Line-3

The length of the proposed corridor of Bus Rapid Transit (BRT) Line-3 is about 22.0 km. The BRT route Line-3 is from Hazrat Shahjaial (R) International Airport to Jhilmil via Mohakhali-Mogbazar-Ramna-Gulistan-Nayabazar. It is expected that approximately 30,000 passengers in both directions will be able to commute per hour. Congestion will be reduced substantially and the traffic situation will be improved greatly.

[15] Strategy for Infrastructure Sector, Background Paper for the Seventh Five Year Plan, Policy Research Institute

E-ticketing clearing house is being established with the financial assistance of JICA to enable the passengers to travel in different mode of transport (BRTC/BRT/MRT/BR/Commuter Train/BIWTC/Private Bus Company etc) with the same e-ticket.

3.3 Main Stakeholders

Figure 2 provides an overview of the main stakeholders of the roads and highway sector. Of these stakeholders, the Roads and Highways Department (RHD), Bangladesh Bridge Authority (BBA), and Local Government Engineering Department (LGED) are involved with the development and maintenance of infrastructure projects. The remaining stakeholders are involved with the operations of the transport sector.

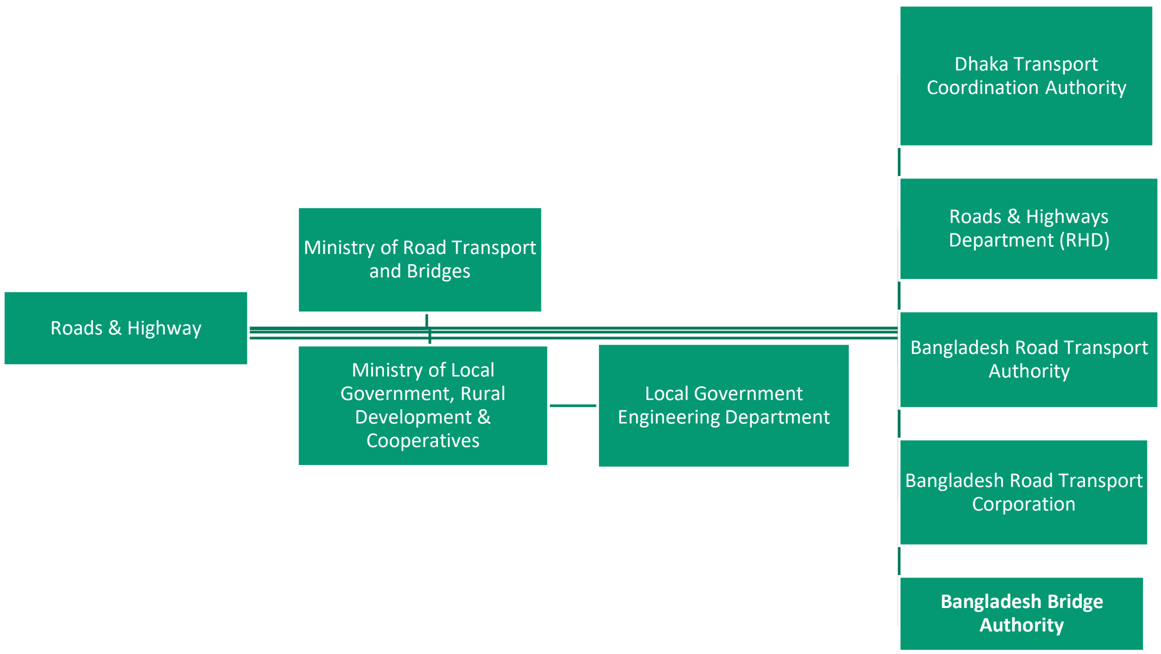

Figure 2 Main Stakeholders in Roads & Highways sector

3.3.1 Ministry of Road Transport & Bridges

In 2014, the Ministry of Communications was changed to the Ministry of Road Transport & Bridges. There are two divisions within the Ministry of Road Transport & Bridges: 1) Road Transport & Highways Division 2) Bridges Division.[16]

The Road Transport & Highways Division oversees:

1) Roads & Highways Department (RHD)
2) Bangladesh Road Transport Authority (BRTA)
3) Bangladesh Road Transport Corporation (BRTC)
4) Dhaka Transport Coordination Authority (DTCA)

The Bridges Divisions oversees:

1) Bangladesh Bridge Authority (BBA)

[16] Ministry of Road Transport & Bridges

3.3.2 Roads & Highways Department

Created in 1962, the Roads and Highways Department (RHD) is responsible for the construction and maintenance of the major road networks of Bangladesh; these include national highways, regional highways, and zila roads. Since the organization's establishment, the size of Bangladesh's major road network has grown from 2,500 km to approximately 22,000 km. RHD is headed by a Chief Engineer, and has a total staff of 9,369.[17]

The aim of Roads and Highways Department is to become a modern highway agency of international standard to meet the challenges of Government's Vision 2021 and the Five Year Plan targets. RHD is implementing a TA project "Institutional Strengthening of Roads and Highways Department" with ADB assistance. The three major components of the project to be addressed are (i) improvement of road maintenance systems (ii) axle load control and (iii) necessary changes in RHD organogram.

RHD is implementing an e-procurement system. RHD has already put in place an excellent Management Information Systems (MIS). The Central Management System (CMS) and the Highway Development Management System (HDMS) are internationally practiced systems that allow RHD to assess annual maintenance needs on the basis of regular monitoring of its performance and condition of its road assets. The Central Management System (CMS) is an advanced management information system being used at RHD headquarters and all field divisions at present. CMS ensures better transparency and accountability as well as discipline in financial matters. Other computer based modern tools of monitoring and supervision such as BMMS, RMMS, MIS, GIS and planning tools like HDM, PAF etc are being used in RHD.

To materialise the RHD vision, digitization of business procedures in RHD is essential. Modernization of business procedures will include implementation of modern maintenance practices, advanced land asset management, digitization of road data, e-filing system, expansion of e-Gp to all kinds of procurement activities, etc. Modern maintenance practices will be incorporated through implementation of pilot projects in annual maintenance programs over the next few years. The process of complete digitalization of other services in road sector is underway.

3.3.3 Bangladesh Road Transport Authority

Bangladesh Road Transport Authority (BRTA) was established in 1988, as a regulatory body to control and manage the road transport sector and enforce road safety.

Activities:

- Controlling and regulating road transport by executing motor vehicle acts, issuing route permits, and fixing rates and fares of buses and trucks
- Conducting regular activities such as: Issuing driving license, fitness certificates, registration certificates and driving instructor's licenses
- Registering schools for motoring
- Organizing and conducting workshop seminars for delivering information regarding safe driving and traffic regulations
- Research and development for developing ideas and methodologies for safe road transport and traffic system

[17] Bangladesh Roads and Highway Department

Services:

- Vehicle Registration
- Fitness & Tax Token Issuance
- Route Permit Issuance
- Number Plate Issuance
- Driving License Issuance

Since 1988, Bangladesh Road Transport Authority (BRTA) has been working for the purpose of overall supervision and management to maintain discipline in the road transport sector. BRTA is entrusted with registration, certificate and road worthiness, route permits of motor vehicles, licensing of motor drivers and other regulatory activities as specified in the Motor Vehicle Ordinance 1983, MV Tax Act 1932 and Motor Vehicle Rules 1984. BRTA has been providing training to professional drives to increase road safety awareness. Radio stations have been broadcasting regular programs on road accidents to build awareness among the drivers and road users. In 2013-14, 23,585 profession drivers' were given short-term training to enhance their professional capacity and road safety awareness. As part of its modernization and IT based control system, BRTA has issued 252,430 Smart Card Driving Licenses during 2013-14 and a total of 2,70,683 sets of Retro-reflective Number Plates affixed to the motor vehicles. Road accidents have been reduced significantly as a result of different initiatives. Introduction of CNG driven buses have been encouraged instead of diesel driven buses to reduce pollution. Revenue collection through online banking has made tax/fee payment easier and transparent. Seminars/conferences were conducted to enhance road safety and mass awareness.

The government has taken initiatives to digitize BRTA's activities. In this regard, a project named "Establishing Data Centre and Web-portal System for Digital BRTA" is being implemented with Korean International Cooperation Agency (KOICA) financing.

3.3.4 Bangladesh Road Transport Corporation

Bangladesh Road Transport Corporation (BRTC) was established as a government corporate transport body in 1961, with the objective of providing modern, comfortable, safe mass communication service. BRTC is mandated to deliver efficient, economic, comfortable and safe road transport services across the country. The objectives of BRTC are as follows:

a) To play strategic intervention role in road transport sector and to render emergency services during the time of natural calamity;

b) To play intervention role in controlling road transport fare and freight charges;

c) To train unemployed youth in motor vehicle driving and as automobile mechanics;

d) To help in creating opportunities for development of efficient and effective manpower for the road transport sector.

BRTC provides both passenger and cargo transport services. It contributes in people to people contact between Bangladesh and India through operating three international bus routes:

(i) Dhaka-Kolkata, (ii) Dhaka-Agartala and (iii) Dhaka-Shilong-Guwahati

Within Bangladesh, it operates inter-district bus service through its bus depots in Dhaka, Narayanganj, Gazipur, Manikganj, Narsingdi, Comilla, Noakhali, Chittagong, Sylhet, Bogra, Pabna, Rangpur, Barisal and Khulna and operates intra-city bus services in many major cities. BRTC also operates a fleet of trucks for the transportation of cargo; 20% of the government's food transportation is allotted for BRTC trucks.

3.3.5 Dhaka Transport Coordination Authority

The Dhaka Transport Coordination Authority (DTCA), originally the Dhaka Transport Coordination Board (DTCB), was established in 1998 to advise relevant agencies on an integrated and safe transportation system, coordinate traffic and transportation infrastructure development in line with the development strategy plan, and to formulate strategic planning for the transport sector within Dhaka. Its jurisdiction includes the districts of Dhaka, Narayanganj, Munshiganj, Mankganj, Gazipur and Narsingdi. To manage these areas, DTCA follows its own act, the *Dhaka Transport Coordination Authority Act, 2001.*

DTCA plays a key role in organizing effective meetings to ensure coordination among different agencies under the banner of the Transport Management Committee. DTCA also provides clearance for transport circulation plans for housing projects under jurisdiction of DTCA. Under the Act, they have the authority to advise other relevant agencies to remove illegal structures alongside roads. In addition, they can formulate policies for roads, footpaths and pedestrians.

Originally, Dhaka Transport Coordination Board (DTCB), it has now been transformed into an authority, Dhaka Transport Coordination Authority, in order to implement mass transport projects, such as the Metro Rail Transit and Bus Rapid Transit projects, through a coordinated traffic system. Prior to the establishment of DTCA it was difficult to integrate various traffic and transportation projects in and around Dhaka.

3.3.6 Bangladesh Bridge Authority (BBA)

The Bangladesh Bridge Authority is an autonomous organization under the Ministry of Road Transport & Bridge's Bridges Division. The Bridges Division was created in 2008, to deal with the planning, implementation, monitoring and evaluation of the construction of bridges (more than 1,500 meters in length), toll roads, flyovers, expressways, causeways, and link roads. It is also responsible for securing both external and internal funds for such projects. The Bridges Division is headed by a Secretary, who also acts as the Executive Director of the Bangladesh Bridge Authority.[18]

Table 10 shows the total number of bridges in 1991 compared to 2006, as well as the total length (m) of bridges, which has grown 200% in the span of 15 years (from 91,672 m to 184,598 m).

Table 10 Growth in Number of Bridges

Type of Road	1991 Number of Bridges	1991 Total Length (m)	2006 Number of Bridges	2006 Total Length (m)
National Highway	1,012	55,393	3,617	64,837
Regional Highway	302	9,896	3,535	43,828
Zilla Roads	1,843	26,383	7,560	75,933
Total	3,144	91,672	14,712	184,598

Source: Bangladesh Road Master Plan, 2009

From the above table it is apparent that the total number of bridges has dramatically increased between 1991 and 2006, approximately 470%, an indication of an improvement in infrastructure. However as Bangladesh is a country of many rivers, many more bridges are required to ensure adequate connectivity.

[18] Bangladesh Ministry of Communications

Table 11 Major Bridges in Bangladesh

Name of Bridge	Name of Roads	Length (m)
Jamuna Bridge	Dhaka-Bogra	4,800
Lalon Shah (Paksey) Bridge	Ishwardi-Kushtia Road	1,786
Meghna-Gumti (Daud Kandi) Bridge	Dhaka-Chittagong	1,408
Khan Jahan Ali (Rupsa Bridge)		1,360
Bangladesh UK Friendship (Bhairab) Bridge	Dhaka-Sylhet	1,194
2nd Buriganga Bridge		1,016
Meghna Bridge	Dhaka-Chittagong	930
Gabkhan Bridge	Barisal-Patuakhali	918
Hajrath Shah Amanath Brdige	Chittagong-Cox's Bazar	914
1st Bangladesh China Friendship Bridge (Postagola)		848
Dharala Bridge		657
Kaliganga Bridge	Dhaka-Aricha	647
Gorai Bridge	Faridpur-Jessore	630
Korotoa Bridge	Boda-Debiganj	572
Bagabari Bridge	Pabna-Sirajganj	570
Daleswari Bridge	Dhaka-Aricha	492
Shambuganj Bridge	Mymensingh-Haluaghat	464
Mohananda Bridge	Rajshahi-Nawabganj	448
Brahmaputra Bridge	Dhaka-Sylhet	443

Source: Roads and Highway Department

Bangladesh's Largest Bridges

The Bangabandhu Bridge, also known as the Jamuna Bridge, is the country's longest bridge and currently South Asia's 6th largest bridge. It was constructed in 1998 on the river Jamuna, to establish direct road and rail links between the north-west and eastern zone of the country. Jamuna River is one of the three major rivers of the country, and connects Bhuapur on the Jamuna River's east bank to Sirajganj on its west bank. The Bangabandhu Bridge is an important bridge as it strategically links the eastern and westerns parts of the country which allows for inter-regional trade and movement within the country. As the bridge includes both road and railway facilities, as well as electricity and gas pipelines that have been placed on the bridge, it provides vital transport to passengers, resources, and goods. The bridge will be incorporated in the proposed Asian Highway and the Trans-Asian Railway which, when fully developed, will provide international road and railway links from Southeast Asia through Central Asia to Northwest Europe.

Meghna Bridge, also known as the Japan Bangladesh Friendship Bridge 1, is a road bridge that is located along the Dhaka-Chittagong Highway. It is 30 km (19 miles) long and lies southeast of Dhaka, across the Meghna River. The bridge was financed with the help of the Government of Japan and was constructed by the Nippon Koei Company. The bridge was opened in 1991, and underwent extensive repair in 2005. A survey conducted in 2004, by the Japanese Embassy in Bangladesh, found that 42% of the trucks using Meghna Bridge transport goods between Dhaka and Chittagong.

The Meghna-Gumti Bridge was built in 1994; it is situated along the Dhaka-Chittagong Highway near Daudkandi. It is 1,410 metres long and crosses the Meghna-Gumti River. It was constructed by another Japanese company, Obayashi Corporation.

The Lalon Shah Bridge, also known as the Paksey Bridge, was completed in 2004. It is situated over the river Padma, between Ishwardi Upazila of Pabna on the east, and Bheramara Upazila of Kushtia on the west. The bridge is approximately 1,800 metres long (5,900 feet), and is the fourth longest bridge in Bangladesh. It provides road connections to the Mongla Port in the south from northern districts, such as Rajshahi and Rangpur.

3.3.7 Local Government Engineering Department

The Local Government Engineering Department (LGED), under the Ministry of Local Government, Rural Development & Cooperatives, is one of the largest public sector organizations in Bangladesh. Along with RHD and BBA, these Government agencies are responsible for the planning, construction, and maintenance of all roads and bridges in Bangladesh. In addition to the road network managed by both RHD and LGED, some urban road networks are operated under the jurisdiction of city corporations and development authorities within the Ministry of LGRD&C. LGED's responsibilities are primarily for the provision of transport infrastructure in rural areas, such as rural roads and minor feeder roads, to provide technical support to rural and urban local Government institutions, and to aid in small scale water resources development projects.

The following is a list of some of LGED's rural infrastructure development activities:

- Construction of upazila and union roads and bridge/culverts on those roads
- Development of Growth Centres (GC)
- Construction of union parishad (council) complexes and primary schools
- Construction of jetties and boat landing areas
- Constructions of cyclone shelters and *killas* (elevated areas for the shelter of livestock during floods)
- Development of technical specifications and manuals for the construction of rural infrastructure
- Development and updating of the rural road master plan, infrastructure database and digital maps
- Development of upazila and union plan books to facilitate local level planning and participation
- Provide technical support to zila and upazila parishads
- Tree plantation on the slope of roads and embankments

As LGED also provides technical and management support to urban local Government institutions (i.e. city corporations, city councils) to implement urban infrastructure development programs, the following is a list of such activities:

- Planning and implementation of integrated town Centres (bus terminals, markets etc.)
- Planning and implementation of municipal roads, bridge/culverts, drainage, water supply and sanitation projects
- Planning and implementation of solid waste management projects
- Planning and implementation of slum upgrading projects
- Development of land use plans, survey & digital mapping
- Development of database and software for the use of municipalities to improve planning & management capacity and resources mobilization & management
- Institutional development of municipalities through training and computerizations
- Preparation of district and upazila town master plans
- Development of technical specifications and manuals for construction of urban infrastructure

One recent urban project of LGED is the Khilgaon flyover in Dhaka. The objective of the Khilgaon flyover was to help decrease persistent traffic congestions in the capital city. The Executive Committee of National Economic Council (ECNEC), responsible for the approval of development activities reflective of long-term national policies and objectives, approved the project in 2000. It was subsequently opened for use in March 2005. However, one portion of the original design, the Saidabad loop, was not completed during the construction of the flyover, as a result, a large volume of traffic coming from Progoti Sarani, and the eastern part of Dhaka, such as Kadamtali, Basabo, and Goran, are unable to use the existing flyover. In order to solve these constraints, LGED is now constructing the Saidabad loop portion of the flyover, and the scheduled completion date is in 2015.[19]

Small Scale Water Resources Development Project

LGED's Small Scale Water Resources Development Project comprises areas in Greater Mymensingh, Sylhet and Faridpur (SSWRDP-JICA); the objective of the project is to reduce poverty through increased agricultural and fisheries production and rural employment opportunities in 15 districts of greater Mymensingh, Sylhet and Faridpur areas. The provided cost is 5,570 million Tk. (approximately $72 million) of which the GoB has provided 28% of the financing and JICA has provided a loan for the remaining balance. The project is developing an engineering infrastructure and a participatory organization for the beneficiaries, the Water Management Cooperatives Associations (WMCA), which will help encourage the sustainable operation and maintenance of the project's output. The engineering infrastructure includes water regulators, *khals* and embankments, WMCA offices, and buried pipe irrigation systems. There are currently 235-255 subprojects; each subproject covers up to an area of 1,000 hectares which together includes approximately 130,000 hectares of land.

3.4 Financing

3.4.1 Revenue Sources

Bangladesh has one of the world's lowest levels of tax revenues in comparison to GDP; in FY 2013 the total tax revenue was only 11.3% of GDP.[20] As a result of low levels of revenue, it is difficult for the Government to provide sufficient funding to all divisions. RHD, as well as other divisions within the Ministry of Road Transport & Bridges, have no direct revenue generating programs. Transport related revenue generators, such as tolls and vehicle taxes are given to the Government exchequer first – it is up to the Government to decide how much of that revenue is allocated to which Ministry and division. According to a 2003 World Bank study, less than 40% of revenue collected from road users is actually spent on road maintenance.[21]

However, a new initiative has been recently proposed, the *Road Fund*, which will be under the control of RHD. This fund will be gathered from new toll collections and will be used for specific purpose of the development and maintenance of road infrastructure. As this fund will consist of both existing tolls and newly introduced tolls, the amount of funding available will increase as well as RHD's access to funding will be more direct, thereby increasing RHD's ability to maintain and develop road infrastructure, and therefore it is important that this proposed *Road Fund* takes full effect soon.

Bangladesh currently has 5 toll bridges and 3 toll roads. Tolled bridges are generally bridges that are over 1,000 meters in length, such as the Bangabandhu Bridge.

Table 12 Targets & Collection of Tolls at Bangabandhu Bridge

Targets & Collection of Tolls at Bangabandhu Bridge (crore taka)			
Fiscal year	**Target**	**Collection**	**Revenue as % of Target**
2000-2001	78.09	81.15	103.91%
2001-2002	84.94	91.99	108.30%
2002-2003	95.03	107.02	122.62%
2003-2004	106.21	129.30	121.70%

[19] Bangladesh LGED

[20] Ministry of Finance

[21] Private Solutions for Infrastructure in Bangladesh, World Bank, 2003

Targets & Collection of Tolls at Bangabandhu Bridge (crore taka)			
Fiscal year	**Target**	**Collection**	**Revenue as % of Target**
2004-2005	117.60	150.43	127.92%
2005-2006	131.11	156.08	119.04%
2006-2007	146.19	171.50	117.30%
2007-2008	163.03	199.55	122.40%
2008-2009	181.53	212.44	117.00%
2009-2010	230.00	243.93	106.05%
2010-2011	260.00	267.66	102.95%
2011-2012	312.21	304.66	97.58%

Source: Ministry of Finance

In **Table 12**, it can be seen that the toll collection for the country's largest bridge, the Bangabandhu Bridge, has generally exceeded target toll collection year on year since 2000. For example, toll revenue as % of targeted revenue has historically been between (103-127%), with approximately 98% collected in 2011-2012. This shows that the Bangabandhu Bridge is not only an important and strategic bridge, but it is also a revenue generating bridge that is important for the economy. If the Government can effectively implement infrastructure projects similar to the Bangabandhu Bridge, these projects will likely have the ability to recover their costs as well as contribute to the Government exchequers.

Tolls in Bangladesh are based on the country's *National Toll Policy;* generally, RHD or Bangladesh Bridge Authority will propose a toll based on this policy, which will be subject to the approval of the Government before it is initiated. In October 2014, the Government approved a new toll policy, *National Toll Policy 2014*, to enforce tolls for vehicles that use RHD roads. As per the *National Toll Policy 2014*, vehicles will have to pay a minimum toll of Tk. 5 for rickshaws (6 cents) and maximum of Tk. 1,000 ($13) for large trucks. There will be Tk. 300 "base toll" for the national highway, Tk. 200 for the regional highway and Tk. 100 for the inter-district highway. Some highways will be designated as "important" and their base toll will be Tk. 400. Vehicles that use roads and bridges have been divided into 13 separate categories for toll collection (**Table 13**).

Table 13 Proposed Toll Rates

Type of Road	Base Toll (Tk.)	Trailers (% cost above base toll)	Heavy Trucks (% cost above base toll)	Buses (% cost above base toll)	Mini Buses (% cost above base toll)	Private Cars (% cost above base toll)
"Important" Highway	400	250%	200%	90%	70%	25%
National Highway	300	250%	200%	90%	70%	25%
Regional Highway	200	250%	200%	90%	70%	25%
Inter-district Highway	100	250%	200%	90%	70%	25%

Source: The Financial Express

According to the policy, trailers will be charged 250%of base toll, heavy trucks 200%, buses 90%, minibuses 70%, and private cars 25%.Of the 7,741 bridges under the RHD, those over 200 meters in length also come under the toll collection. The policy is also applicable to roads and bridges built under Public-Private Partnership (PPP).

Previously, toll collection for roads only included the following: port access road in Chittagong, Jagadishpur-Sherpur Road of the Dhaka-Sylhet highway and Chalan Beel Road on the Dhaka-Natore highway. Roads under the Local Government Engineering Department (LGED) remain out of the purview of the toll policy. The collected toll will be kept in the *Road Fund*, which will be spent on the development and maintenance of road infrastructure. This new toll policy, if implemented effectively, will be beneficial to the Bangladesh road sector as it will fund the improvement works of many deteriorated roads and assist in the implementation of new and necessary infrastructure projects.

3.4.2 Annual Development Program (2014-2015)

The GoB provides two types of annual budgets to relevant sectors of the Government, such as defense, power, transport, etc.; these are the non-development budget and the development budget. The non-development budget is used primarily for recurrent expenditures, such as salaries, allowances, supplies, operations, and maintenance. The development budget mostly includes expenditures on capital goods and new investments.

Within the development budget, are provisions for the Annual Development Program (ADP), which includes a list of projects that are divided by sector and have different yearly allocations prepared in line with the Government's investment plans, development policies, and programs. The Planning Commission prepares the list of ADP projects in line with the basic objectives and goals of Five Year Plans; this draft is then placed before the ECNEC for its approval. While preparing an ADP, sector and projects related to national economic development are prioritized. Funds are sourced both internally (domestic) and externally (donor). The ADP, however, does not include all development projects in a year, some projects are kept outside the ADP and are fulfilled with funds from the revenue budget, and the monitoring of the use of ADP funds is done by the Ministry of Finance.

Table 14 Bangladesh's Non-development & Development Budget: 2014-2015

(Tk. 2,506.06 billion budget, approximately $32.5 billion)

Sector	Allocation
Public Administration	15.3%
Education & Technology	13.1%
Interest	12.4%
Transport & Communication	9.8%
Agriculture	7.6%
Local Government& Rural Development	7.1%
Defence	6.6%
Social Security & Welfare	6.1%
Misc. Expenditure	5.3%
Public Order & Safety	5%
Energy & Power	4.6%
Health	4.4%
Industrial & Economic Services	1.1%
Housing	0.8%
Recreation, Culture, & Religious Affairs	0.8%

Source: Planning Commission

Table 14 includes a sector wise breakdown of the total 2014-2015 GoB budget (in %), it shows that the transport and communication sector has received 9.8% of the Government's $32.5 billion total budget. The transport and communications sector has received 4th largest allocation of Government funds, indicating that it is a priority sector. Although the percentage of allocation is high, the actual funds that the sector receives, approximately $3.25 billion, is not sufficient for the level of maintenance required by the sector in addition to the funds required for projects that are included in each year's ADP, for instance there are a staggering 126 projects in ADP 2013-2014 for RHD alone. Therefore, it is important that the Government find new sources of finance as well as set specific attainable goals within a certain timeline, as to not deplete resources on too many projects at once.

Table 15 Bangladesh's Development Budget: 2014-2015 (Tk 818.08 billion budget, $10.6 billion)

Sector	Allocation
Transport & Communication	23.8%
Local Government & Rural Development	18.5%
Education & Information Technology	15.4%
Energy & Power	14.1%
Agriculture	6.9%
Others	6.8%
Health	5.3%
Public Administration	4.7%
Social Security & Welfare	4.5%

Source: Planning Commission

Table 15 includes sector wise allocations of the GoB development budget (in %), the transport and communication sector has received the largest allocation of funds – roughly 24% ($2.5 billion). This also shows the Govt. has not only prioritized the sector but also has prioritized the development of new projects and investments within the sector. However, these funds are still significantly lower than the level of funds required for the implementation of the projects within the transport sector's ADP; therefore it is important that funds are used in an effective way.

Table 16 provides a detailed overview of each Ministry/division's total budget in FY 2014-2015. The bridge division has the highest allocation of funds, 38%, a result of the upcoming Padma Bridge fund requirements, a project that the Government has recently decided to fully self-finance.

Table 16 Transport & Communication 2014-2015 Budget

Ministry/Division	Budget 2014-2015 (Tk)	Budget 2014-2015 (USD)	% of Allocation within Transport & Communication
Road Division	68,580,000,000	$ 890,649,350.65	30%
Railway	63,590,000,000	$ 825,844,155.84	27%
Bridge Division	87,370,000,000	$ 1,134,675,324.68	38%
Other	11,820,000,000	$ 153,506,493.51	5%
Total	**231,360,000,000**	**$ 3,004,675,325.68**	**100%**

Source: Planning Commission

The road division has the second highest allocation of funds, 30%, and the railway sector has the third highest allocation of funds, receiving approximately 27% of funds.

Underutilization of ADP

Despite the fact that during the past two years, suggested budgets under the SFYP have generally matched the actual budgets allocated to transport sectors through the ADP, the main challenge seems to be the effective usage of such funds.

For instance, there has been a historical trend in Bangladesh to underutilize ADP budgets; at the end of fiscal years, funds allocated for development projects under different ministries are not fully spent and are thus returned to the Government exchequer. This is mostly due to the delay and poor implementation by implementing agencies; in FY

2012, the Bridge Division only used 61% of its total ADP allocation. ADP budgets are not being spent because projects are not always progressing due to inefficiencies, fund constraints, institutional issues, project backlog, and consequently the increase in funding requirements of these projects; for projects that are funded by development banks, these delayed implementation schedules result in higher payments in the form of interest. Without projects being completed, Bangladesh will only suffer from a lower country growth rate which only decreases the potential for other socioeconomic benefits, such as employment generation and GDP growth.

Table 17 ADP Allocation & Expenditure for Infrastructure (Tk. Billion)

Ministry/Division	FY 12 ADP Allocation	FY 12 ADP Expenditure	% Used	FY 13 ADP Allocation	FY 13 ADP Expenditure	% Used
Road & Railway Division	51.13	45.28	88%	66.56	64.69	97%
Bridge Division	6.88	4.18	61%	8.23		

Source: Mid Term Implementation Review of Sixth Year Plan, Policy Research Institute

We can see examples of this underutilization in **Table 17**. It is important for these Ministries/divisions to follow effective and efficient plans for the proper utilization of their budget allocations; this may include decreasing the number of projects within the transport sector.

3.4.3 Public Private Partnership (PPP)

In *Bangladesh's Vision 2021*, in which the country aims to become a middle-income economy by 2021, it was first identified that in order to achieve this, investments in infrastructure needed to increase up to 6% of GDP. As a result, the Government identified the public private partnership (PPP) as an important strategy.

A policy framework for PPP was first introduced in 1996 with the *Private Sector Power Generation Policy* (PSPGP), this saw the beginning of PPP projects in the power sector, such as the 450 MW Meghnaghat power project. This policy continued to grow with the *Private Sector Infrastructure Guidelines* introduced in 2004, and was ultimately followed by the most recent policy guideline, *The Policy and Strategy for Public-Private Partnership* (PPP), 2010. This policy is an updated framework that aims to boost the usage of PPP as well as to provide clearer procedural framework.

Each PPP contract, thus far limited in number and mostly attributed to the energy sector, represents a different allocation of risk between the public and private sector. These differences can be based on the size of investment by the private sector, the responsibilities taken in relation to construction, operation, maintenance, and service performance, the ownership of assets, and the length of the contract period. A balance of risk between the public and private sector is pivotal for these projects to be truly PPP in nature. The PPP contractual model is based on case-by-case basis depending on the project at hand. Generally, the public sector's prime responsibility includes specifying the project scope, service requirements, and standards, providing encumbrance free land, and providing viability gap funding for large infrastructure projects. On the other hand, the private sector is generally responsible for the detailed design, construction, financing, operation, and maintenance of such assets. The revenue payment risk can be taken by the private sector, public sector, or shared between the two.

The Sixth Five Year Plan (SFYP) also recognizes that a large portion of Government funds must be allocated to the transport sector; however, there is still a large resource gap. In order to combat this, it has advocated the development of public-private-partnership (PPP) arrangements to utilize funds from the private sector. For example, the SFYP has projected that annual PPP financing will expand from 0% in FY10 to 1% of GDP for every year starting from FY12. Essentially the goal in the SFYP was to have infrastructure investment represent 6% of GDP by FY15;

however it is expected to be approximately 2.8% of GDP by FY15.[22] The PPP implementation record since FY12 has shown limited success. Currently, the majority of infrastructure financing has come from the Government budget; in ADP FY 2014, infrastructure development funding has received the largest share of ADP funding (transport and power sector). However, this large budget allocation is still considerably lower than the funds required for the targets set in the SFYP.

For FY 2015-2016, the Government has decided to allocate only Tk. 2,000 crore, approximately $250 million, dropping from Tk. 3,000 crore ($380 million) in the previous fiscal year for PPP initiatives. This is an exceptionally small amount considering the Government's policy shift on PPP financing to encourage infrastructure development; this is due the lack of private sector interest in developing infrastructure, a direct result of poor enforcement of PPP laws. A large portion of the PPP budget goes to the Bangladesh Infrastructure Financing Fund (BIFF) for the financing of infrastructure projects. In FY 2014-2015, BIFF was established for the purpose of implementing PPP projects and was given a total budget of Tk 2,500 crore for the fiscal year. The PPP Office was given Tk 100 crore for conducting technical surveys, and the remaining amount, Tk 400 crore, was provisioned for viability gap funding. The ECNEC has recently approved 40 projects for implementation under the PPP program for FY 2015-2016, an alarming decision considering that little progress has been made in existing projects.

Based on **Table 18**, it must be noted that as of 2014, only one PPP project has had contract signing, indicating that this policy measure of the Government must be improved.

Table 18 Status of PPP Financed Projects

Sector	Name of Project	Estimated Cost ($ million)	Negotiation	Contract Signed
Road	Dhaka-Elevated Expessway	$1,088	•	•
Road	Dhaka-Ashulia Elevated Expressway	$1,471		
Road	Flyover from Santinagar to Mawa Road Bridge (New) over Buriganga River	$313		
Road	Upgrading of Dhaka Bypass to 4 lane (Joydevpur-Debogram-Bhulta-Madanpur)	$117		
Road	Hemayetpur-Singair-Manikganj PPP Road	$86		
Road	Jatrabari-Sultana Kamal Bridge-Tarabo PPP Road	$45		
Road	Dhaka-Chittagong Access Controlled Highway	$1,625		
Bridge	2nd Padma Multipurpose Bridge at Paturia-Goalundo	$1,640		
Rail Depot	Construction & Operation of Inland Container Terminal (ICT) at Khanpur	$32		
Rail Bridge	Fulchhari-Bahadurabad MG Railway Bridge	$1,435		
Rail Bridge	Dual gauge double line Bangabandhu Bridge	$1,025		

Source: PPP Office

According to the *Strategy for Infrastructure Sector, Background Paper for the Seventh Five Year Plan*, issues that have been limiting the growth of PPPs include:

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[22] Strategy for Infrastructure Sector, Background Paper for the Seventh Five Year Plan, Policy Research Institute

- A lack of understanding on international good practices in regards to land acquisition and the rehabilitation of project affected people;
- A culture of delayed implementation and frequent cost overruns which subsequently increases the country risk factor;
- Lack of data for future land use planning, such as long duration traffic flow and roadway capacity data;
- Absence of vital economic parameters including value of travel time (VOT), vehicle operating cost (VOC) which makes it difficult to perform reliable economic analyses and to establish an appropriate level for Viability Gap Funding (VGF);
- Lack of information on the Government's future development projects create uncertainty in forecasting future scenarios, especially future revenue streams;
- Lack of a standard concessionaire agreement for investors, standard sovereign guarantee/incentive clauses, legal framework, tolling structure;
- Litigation issues associated with land acquisition and the high cost of borrowing capital from the local market.

Essentially, the causes for the lack of growth in the PPP sector include institutional inefficiency, an inefficient bidding and contracting process, few incentives for private sector investment, the absence of important data that can influence financing decisions, and primarily a lack of experience in implementing PPP projects. To add, the involvement of the private sector in the road sector is limited to situations in which the private sector is able to absorb their costs and earn revenue, such as situations in which tolls can be collected, which is also heavily dependent on factors such as traffic flow in given areas as well as users' willingness to pay. This limits the number of infrastructure projects that the private sector finds financially viable, as not all forms of infrastructure, especially roads, can apply a toll or generate revenue. Also, it is difficult to gauge future traffic flow or users' willingness to pay accurately, when there is an absence of accurate, comprehensive, and updated data. Companies are also weary of investing money into uncertain situations with high revenue risk; they may find that users' willingness to pay for tolls for a proposed infrastructure project is high based on a small sample size survey. But in reality this may be much less than anticipated once the project is completed – these types of revenue risk generally deter private sector investors.

Another issue is the bankability of PPP projects; for the private sector to be successfully involved in the PPP process – there must be a clear access to affordable funds. Local financing is expensive and access to large amounts of capital is limited. In addition, finding international financing is a far lengthier process with international lenders also concerned about issues such as political risk. Many projects fall back by years due to the inability to lock down financing in time; for example, the Dhaka Elevated Expressway was unable to fully raise funds until the China Development Bank entered the agreement in 2014. It is important that initiatives are made to increase the attractiveness of PPP projects to lenders, making it less difficult to attract funds.

There is a *Guidelines for Viability Gap Financing (VGF) for Public-Private Partnership (PPP) Project* published by the PPP office. Within these guidelines it is specified that "the Government of Bangladesh" has decided to subsidize economically viable PPP projects that will not be financially viable if they are constrained to charge affordable user tariffs or utility payments. The Government will make such PPP projects financially viable by providing a budget line. This budget line is Viability Gap Funding". This VGF is only applicable to BOT projects, can only compromise up to 30% of the total estimated project cost, and the amount of VGF shall be equivalent to the lowest offer in the competitive tender for capital subsidy or annuity. Projects with higher economic rates of return will be prioritized. VGF management is under the Finance Division, Ministry of Finance through its PPP unit. Although such a provision to ease access to capital for private companies exists, there has been little experience within the Government in relation to VGF. This causes key concerns to private companies as there is uncertainty in regards to whether funding will be supplied as per the agreed-upon scheduling, as well as if VGF requests will be given decisions within an appropriate time period, as the Government often takes long periods of time to make decisions as a result of red tape, project delays, institutional inefficiencies, etc.

In order to further improve the PPP initiative, the Government must thoroughly analyze the constraints in its current PPP process and assess what remedial measures can be made. For example, many private companies are hesitant of the Build-Own-Transfer (BOT) policy due to changing future macroeconomic and political factors that could decrease their ability to collect sufficient revenue from potential projects. To abate this, the Government should focus on ways to incorporate adequate Government guarantees, tax concessions, and a level of cost-sharing that encourages the advancement of BOT projects.

One example of private sector participation that has shown success are *Operation and Maintenance (O&M) concession agreements*, in which the Government builds a road or bridge with own resources, and then enter into a multi-year concession agreement with a private party to maintain that road or bridge. For example, the Bangabandhu Bridge is maintained by the Jamuna Multipurpose Bridge Authority (JMBA), which operates and manages the bridge. JMBA enters into a contract of fees for the services it renders to the Government. The Government has vested unique powers to this authority, such as the ability to obtain funding and enter into contracts with funding entities (subject to Government approval), set toll regimes, determine which tolls are to be used for the operation and maintenance of the bridge, as well as employ traffic-control personnel and enforce their own traffic regulations. This unique set up and general independence given to JMBA to run their organization more like a corporation rather than a Government body and has thus enabled the Bangabandhu Bridge to be efficiently managed and maintained. The Government should use national case examples such as this, or from international case examples, to access if similar models could be used in future infrastructure projects.

PPP Case Study: Delhi-Gurgaon Expressway

The National Highways Authority of India (NHAI) was responsible for the implementation of the Golden Quadrilateral project, a highway project that would connect New Delhi, Mumbai, Chennai, and Kolkata. This includes the Delhi-Gurgaon Expressway project, connecting Gurgaon to Delhi. The project was given to a consortium of Jaypee Industries and DS Construction Ltd to design, finance, construct, operate and maintain the facility for a concession period of 20 years. As a BOT highway project, the concessionaire was allowed to collect tolls from users during the operation period to recover the investment. After the end of the concession period, the expressway is required to be transferred back to the Government.

This was the first BOT project in India in which the concessionaire offered to pay an upfront fee of 61.06 *crore* rupees to NHAI instead of receiving a capital grant from the Government; this is because of large traffic projections and an expectancy to make a good return from the expressway. The concession period included the construction period in order to encourage the concessionaire to complete the construction early. A special purpose vehicle (SPV) was formed, the Delhi Gurgaon Super Connectivity Ltd., with Jaypee Industries owning 51%, DS Construction 49%; throughout the project period. Jaypee Industries lowered their stake to 1.2%. Construction began in 2003, and operations commenced in 2008.

The SPV entered into a fixed time-fixed price Engineering, Procurement, and Construction (EPC) contract with DS Construction for the project. The Concessionaire was responsible for providing performance security on the date of the agreement to establish its obligation to the construction of the expressway; they were also entitled to collect tolls up to 130,000 passenger car units (PCU) with anything above being shared with NHAI. NHAI was responsible for land acquisition, providing right of way (ROW) from all encumbrances, providing environmental clearances and permits, and providing a loan facility at the State Bank of India Prime Lending Rate if revenue was to fall short of "subsistence revenue levels", this loan could also be given to meet shortfalls in debt service payments. 70% of project cost was financed by debt, which includes loans from state banks (primarily), and non-convertible debentures issued by the SPV.

This Expressway has more PCU carried per day than initially expected resulting in higher revenue levels. In addition, it contains 9 flyovers, 4 underpasses, 2 foot-over bridges, and 3 toll plazas. Smart tags are available for cashless automatic payments. The expressway is an 8/6 lane access controlled expressway that has reduced travel time from Delhi to Gurgaon from approximately 65 minutes to 20 minutes.[23]

3.5 Analysis of Policies and Strategies

This objective of this section is to provide an overview of the most recent key policies relating to the roads & highways sector, including the Sixth Five Year Plan, National Land Transport Policy, the Road Master Plan, the National Sustainable Development Strategy 2010-21 (NSDS), Strategic Transport Plan for Dhaka (STP), and the Dhaka Urban Transport Network Development Study (DHUTS). By understanding the policies in regards to the roads and highways sector, it will become more clear as to what the Government's plans are for this sector; more specifically what they view as the main challenges in the sector as well as how they plan to deal with those challenges. Each policy overview includes information regarding the policy's domain, status and time frame, location, objectives, and included measures.

Executive Committee of National Economic Council (ECNEC)

ECNEC is the country's highest authority for approving development activities reflective of long-term national policies and objectives, and therefore has a primary role in the Bangladesh's Transport and Communication sector.

Functions of the ECNEC:

1. To consider and approve project concept papers for all investment projects.
2. To consider and approve public sector projects having investment expenditure of above Tk 25 crore with prior recommendation of PEC meeting.
3. To review the progress of implementation of development projects.
4. To consider proposals for investment companies as private, joint ventures with foreign participation.
5. To monitor the economic situation and review over-all performance of the economy and related policy matters.
6. To consider the performance of statutory corporations and especially their financial performance.
7. To consider rates, fees and prices of public utility services or products of public enterprises
8. To consider and approve yearly target of foreign aid, expansion of trade, export of manpower as well as to review the progress of the yearly targets.[24]

Composition of the council is as follows (Table 19):

Table 19 ECNEC Composition

S.N.	Member	Designation
1	Prime Minister	Chairperson
2	Minister, Ministry of Finance	Alternate Chairperson
3	Minister, Ministry of Planning	Member
4	Minster, Ministry of Agriculture	Member
5	Minister, Ministry of Labour and Employment	Member

[23] Public Private Partnership Projects in India, Government of India, Ministry of Finance, Department of Economic Affairs

[24] Bangladesh Planning Commission

S.N.	Member	Designation
6	Minister, Ministry of Water Resources	Member
7	Minister, Ministry of Commerce	Member
8	Minister, Ministry of Communication.	Member
9	Minister, Ministry of Shipping	Member
10	Minister/State Minister of the relevant Ministry	Member

Source: Planning Commission

In the next few sections, the key policy documents related to the road sectors are described briefly in tabular form.

Key Policy Documents:

3.5.1 Sixth Five Year Plan of Bangladesh

1. Name	**2. Policy Domain**
Sixth Five Year Plan of Bangladesh	Country wide policies
3. Status & Timeframe	**4. Location**
FY 2011-2015	National
5. Objectives & Indicators related to Roads & Highways	
- Communication system between the better-off regions and lagging regions would be improved in order to increase economic activities in the lagging regions. One of the major communication projects, construction of Padma Bridge, is expected to open a new door of opportunities for the south-west region. - Better connectivity with growth Centres in neighbouring countries through regional cooperation efforts will be important. - Both inter-district and intra-district road communication system would be developed to increase economic mobility within the lagging regions. - Block allocation for local Government institutions for infrastructure development in lagging regions, particularly in lagging districts, would be enhanced. - Emphasis will be given to the completion of the upazila connecting roads in Barisal, Rajshahi and Khulna divisions.	
6. Included Measures – Projects – Programs (including status: proposed, in implementation, finalized)	
- To develop, maintain, and manage strategic road corridors, linking rural areas with National and District roads - Improve Dhaka-Chittagong highway to six lanes, and other National Highways and corridors to 4/6 lanes - Construct bridges, tunnels, overpasses, flyovers - Take measures to reduce road accidents	

3.5.2 National Land Transport Policy (2004)

1. Name	**2. Policy Domain**
National Land Transport Policy	All policy domains related to land transport
3. Status & Timeframe	**4. Location**
2004-2034	National
5. Objectives & Indicators related to Roads & Highways	

Roads Vision:

- To develop and properly maintain a Road Network which is able to fulfil the socio-economic needs of the country and is safe to use for all kinds of vehicles.

Objectives include:

- **To introduce long-term network planning**
  - Better use of existing infrastructure will be made by completing the missing links in the main road network, along with a continuation of the new bridge programs across the major rivers
  - Alternative means, other than use of the Land Acquisition Act, of procuring land for construction of new roads will be studied, to speed up the progress
- **To maintain the road network at a level which protects the value of the investment**
  - To protect investment in the road sector maintenance expenditure will be raised to a reasonable standard
  - Routine and periodic maintenance program will be drawn up by RHD, LGED, and city authorities. Where these provide value for money, Government will ensure adequate funding
  - The private sector will be encouraged to play a greater part in highway maintenance in the future, with the aim of improving efficiency
- **To secure a sustainable means of funding road maintenance**
  - The Government has started to research the most appropriate form of guaranteed funding for routine and periodic road maintenance of National, Regional, Feeder (District) and local roads in the country
  - Road users should pay towards road maintenance costs in proportion to the damage which they do to roads
- **To improve the management of traffic**
  - The Government will encourage the development of street management capabilities of concerned authorities to make best use of the road network, and to make traffic flow more efficient
  - The Government will consult with NGO's and local Government bodies to develop better traffic management, awareness and safety
  - Street management will address the problems at intersections and implement a major program of traffic priorities and traffic signal implementation and overhaul
  - Automatic traffic controls will replace manual systems
  - Parking policies will be formulated and implemented
  - Government will review the arrangements for metropolitan cities. It will require special traffic management plans to be drawn up for all metropolitan areas, based on studies
- **Management of road-side activities**
  - The Government will strengthen enforcement where *hats* and *bazaars* encroach onto National and Regional Roads and disrupt traffic flow
- **To develop an integrated planning approach in road construction**
  - In future, direct access onto main roads from *hats* and markets will not be allowed, and alternative access or service roads will be provided
- **To involve the private sector more in infrastructure, services and maintenance**
  - The Government will provide the appropriate legal framework so that private investors have a clear understanding of their roles and responsibilities, as well as rights and entitlements. Overall regulations regarding tariffs, investment criteria, and bidding

procedures will be published o Construction of bypass roads with private investment will be encouraged along with other components of a potential toll road network o **To well protect the environment from road construction program** o In future all new roads and major improvements, tolled or otherwise, will be subjected to an Environmental Impact Assessment (EIA) o Government will publish environmental standards for new roads, including social and re-settlement issues
6. Included Measures – Projects – Programs (including status: proposed, in implementation, finalized)
▪ Formulation of transport system for Dhaka city (Greater Dhaka) ▪ International links will be encouraged in the greater national interest. Bangladesh will play an active role in the field of international road communications

3.5.3 Road Master Plan

1. Name	**2. Policy Domain**
Road Master Plan	All policy domains related to roads, highways, and bridges
3. Status & Timeframe	**4. Location**
2009-2029	National
5. Objectives & Indicators related to Roads & Highways	
o Protecting the value of RHD's road and bridge assets o Improving the connectivity of the road network o Enhancing and developing the strategic road network to meet economic and traffic growth targets o Improving the zila road network to enhance connectivity to the country's growth targets o Improving road safety to reduce road accidents o Provide environmental and social protection o Outline the institution improvements required for RHD	
6. Included Measures – Projects – Programs (including status: proposed, in implementation, finalized)	

The following is a table which includes the capital programs and projects under the RHD *Road Master Plan* and their cost (approximately $5.1 billion):[25]

SN	Program	Cost in Taka	Cost in USD $
1	National Highway and Regional Highway Rehabilitation	54,070,000,000	696,957,978.86
2	Axle Load Control	3,200,000,000	41,247,744.26
3	Major National Highway By-Passes	2,910,000,000	37,509,667.44
4	Zila Road Recovery Program	31,880,000,000	410,930,652.23
5	Bridge Reconstruction Program	10,560,000,000	136,117,556.07
6	Narrow Bridge Replacement Program	4,440,000,000	57,231,245.17
7	PBS Replacement Program	7,550,000,000	97,318,896.62
8	Ferry Replacement Program	8,300,000,000	106,986,336.68
9	N1 Dhaka-Chittagong 4-Lane	18,670,000,000	240,654,807.94

[25] USD to BDT Conversion Rate: 77.58

10	N3 Tongi-Mymensingh	8,000,000,000	103,119,360.66
11	N102 Mynamati-Brahmanbaria	4,210,000,000	54,266,563.55
12	R260 Sylhet-Sunamganj	2,120,000,000	27,326,630.57
13	Dhaka Eastern By-Pass	5,000,000,000	64,449,600.41
14	Dhaka Western By-Pass	3,600,000,000	46,403,712.30
15	Dhaka Outer Orbital Route	15,000,000,000	193,348,801.24
16	R750/Z7503 Jessore to Lohagara	6,000,000,000	77,339,520.49
17	Deep Sea Port Sonadia - N1 Link	4,000,000,000	51,559,680.33
18	N1 4 Lane Chakaria to Chittagong (106 km)	10,600,000,000	136,633,152.87
19	N8 Dhaka-Mawa 4 Lane (60 km)	6,000,000,000	77,339,520.49
20	N4 Dhaka-Tangail 4 Lane (69 km)	6,900,000,000	88,940,448.57
21	N6 Beneshwar-Belpukur (16 km)	4,000,000,000	51,559,680.33
22	N5 Dhaka Baniajuri (78 km)	7,800,000,000	100,541,376.64
23	N2 Bhairab-Mouvlibazar (120 km)	12,000,000,000	154,679,040.99
24	N2 Dhaka-Bhairab (70 km)	7,000,000,000	90,229,440.58
25	N2 Habiganj-Sylhet (96 km)	9,600,000,000	123,743,232.79
26	N8 Jessore-Benapole 4 Lane	3,300,000,000	42,536,736.27
27	Chittagong Bypass	2,100,000,000	27,068,832.17
28	N1 - Hatazari Link Road	2,000,000,000	25,779,840.16
29	N1 2nd Meghna Bridge	7,500,000,000	96,674,400.62
30	N1 2nd Meghna Gumti Bridge	6,500,000,000	83,784,480.54
31	New Zila Roads	3,710,000,000	47,821,603.51
32	Paving Zila Roads	57,810,000,000	745,166,279.97
33	Commitments	29,210,000,000	376,514,565.61
34	Level Crossing Replacement	1,500,000,000	19,334,880.12
35	Land Port Connections	3,830,000,000	49,368,393.92
36	Asian Highway	5,360,000,000	69,089,971.64
37	Paving National and Regional Highways	19,180,000,000	247,228,667.18
	Total	**395,410,000,000**	**5,096,803,300**

The following is a table which includes the recurrent expenditure programs and projects under the RHD *Road Master Plan* and their cost (approximately $3.5 billion):

SN	Program	Cost in Taka	Cost in USD $
1	Recurrent Traffic Management	9,390,000,000	121,036,350
2	Road Routine Maintenance	13,920,000,000	179,427,688
3	Periodic Maintenance National Roads	114,210,000,000	1,472,157,773
4	Periodic Maintenance Regional Highways	40,500,000,000	522,041,763
5	Periodic Maintenance Zila Roads	76,200,000,000	982,211,910
6	Bridge Repair & Maintenance	7,350,000,000	94,740,913
7	Road Safety Measures	10,750,000,000	138,566,641
	Total	**272,320,000,000**	**3,510,183,037**

The total capital and recurrent costs for the Road Master Plan are approximately **$8.6 billion**.

*A **Road Sector Policy**,* which indicates the priorities for the *Road Master Plan**,*** is included below:

Problem Statement	Government Policy
Integrated planning should be improved	Development of the strategic road corridors will be planned in coordination with the development of the railway and inland waterway networks to ensure that the most appropriate mode is used for the movement of people and goods
Insufficient attention has been paid in the past to road maintenance. Road maintenance must be given a higher priority, and enough resources allocated. Road maintenance must be performed in a transparent and accountable way	· GoB to establish a 'Road Maintenance Initiative' to direct development partners to focus their assistance on a single program for road maintenance and rehabilitation · GoB to create a High Level Committee (headed by Minister) to oversee Road Maintenance Initiative, to ensure that targets are being met and adequate resources are provided · GoB will create Road Fund and autonomous Board to manage it · Board may create a Technical Advisory Committee on the Road Maintenance Initiative, comprising all stakeholders, including Government, transport industry, road users, industry and commerce, agricultural sector, and construction industry. Technical Advisory Committee to ensure that initiatives are taken to improve road maintenance quality and to meet the agreed standards
There are no agreed standards and targets for the condition of the road network. By setting targets the Government can expect road agencies to improve performance	Road network to be maintained to a set of agreed standards. GoB will set standards for the quality of the road network and ensure that resources are made available to road agencies for targets to be met
Routine maintenance is not done properly; it	All roads under RHD to be placed under routine maintenance

Problem Statement	Government Policy
must have a higher priority	contracts · Contractors will be asked to tender for 3 year contracts to provide all routine maintenance activities: vegetation control, culvert cleaning, slope protection, pothole filling and crack repairing, signage, lines etc. · Pilot schemes will be used to develop the most appropriate form of contract · RHD to set performance standards for these contracts
Overloaded trucks and buses cause excessive damage to roads and cost the country around Tk 300 crore per year in additional maintenance required. Axle loads need to be controlled	· GoB will confer powers on, and allocate resources to, road agencies to set and enforce limits on the weights of vehicles so as to protect the road network from damage caused by overloading · GoB to consult stakeholders on the issue of axle-load control in order to ensure understanding and compliance, before measures are introduced · RHD to install 18 weighbridges across the country (First Phase) · GoB to ban import of 2-axle trucks with an unladen weight of more than 5 tons from 1 January 2008, and encourage use of multi-axle trucks . Regulations to be enforced to ensure that vehicles are not physically modified from the registered specifications
Road building can damage the environment and cause social problems	· GoB to ensure that measures are introduced and adhered to that protect the physical and social environment from adverse effects of road construction · Government will finalize and approve RHD's draft 'Social Assessment Guidelines' and 'Land Acquisition and Resettlement Guidelines' These and the already approved 'Environmental Impact Assessment Guidelines' shall be followed for all road works · GoB shall develop a revised set of standard contract documents for maintenance and construction works that include environment and social protection clauses, and promotion of employment opportunities for local people
More than 20% of the Zila road network is in very poor condition due to a history of poor Maintenance	· The Zila road network will be rehabilitated over the next ten years to achieve a minimum accessibility level on all Zila roads · Minimum accessibility levels will be defined in the Road Master Plan
Road classification does not fully meet the hierarchy required to assist economic development	·The road hierarchy will be reviewed and roads re-classified where necessary to meet economic objectives · Within the hierarchy, road functions will be determined to ensure that traffic is managed to improve safety and efficiency of travel
Design standards and quality can be improved to enhance safety and get better value for money	· Design standards will be updated to meet international norms. · The quality of road infrastructure will be improved to higher standards
Road safety is a priority	· On National Highways strict safety measures will be enforced to

Problem Statement	Government Policy
and needs to be improved	protect vulnerable road users from fast moving traffic · Encroachment of roadside activities onto the main carriageway will be prevented, also to protect vulnerable road users in these locations · Local committees will be involved in implementing necessary measures · An integrated approach to road safety will be introduced with agencies and measures coordinated across areas of education, awareness, enforcement and physical improvements
Many level crossings are unsafe, and increased traffic will exacerbate this	· Grade separation will be introduced where train frequencies and traffic levels warrant Unprotected road/rail crossings will be placed in a program for safety enhancement through manned gates · RHD will co-ordinate with Bangladesh Railway on these issues
Bridges are an important asset for the road network. Their conditions must be improved and maintained	· Bridges in poor condition (category 'D' condition) will all be replaced or undergo major works to ensure safety and access over the next 10 years · All Portable Steel Bridges (PSBs) will be replaced by permanent structures over the next 20 years · Regular bridge maintenance will be introduced and enhanced · All narrow bridges (less than 7.3m) on National Roads will be replaced over the next 20 years by bridges having at least 7.3m carriageway · The Government will ask RHD to commission an independent study of the condition of all its bridges, by specialist consultants
Flooding undermines the investment in roads, and road building needs to take better account of flooding	·The Government will take necessary steps to protect its investment in the strategic road network from the adverse effects of flooding · All construction and rehabilitation works of National Highways will ensure that the road crest is at least 1 meter above the highest flood level of 50 years · For all other roads, the freeboard will be determined from time to time by the concerned agencies · All new road construction and rehabilitation works will be subjected to a full hydrological and morphological study
The proposed Padma Bridge is urgently needed to unlock the development potential of the south-west of the country	· Feasibility studies have been undertaken and the Government is fully committed to the construction of the proposed Padma Bridge
More use should be made of Bangladesh's geographical position to encourage trade	·The Government will seek to make bilateral transport agreements with neighbouring countries to avoid trans-shipment, and reduce

Problem Statement	Government Policy
	transport costs · In order to facilitate sub-regional movement, the Government will encourage SAARC to adopt a Sub Regional Transport Facilitation Agreement (STFA) . The Government will explore investment in additional and enhanced international infrastructure connections where there are clear economic benefits to Bangladesh . The Government will ratify the Asian Highway Network Agreement. The Government will Gazette the relevant part of the road network to be part of the Asian Highway. These roads will be upgraded to appropriate standards to accommodate the growth in traffic from international transit

3.5.4 National Sustainable Development Strategy 2010-21 (NSDS)

1. Name	2. Policy Domain
National Sustainable Development Strategy	All policy domains related to country development
3. Status & Timeframe	**4. Location**
2010-2021	National
5. Objectives & Indicators related to Roads & Highways	
○ In road sector more attention will now be given to **upgrading and maintenance of existing roads** than new road construction. The Government will take steps to remove the maintenance backlog and strengthen capabilities in all the fields of road maintenance in engineering, contracting and cost control. The Government will also take steps to remove all traffic hazard spots along the national highways to improve road safety. ○ Additional measures to improve the road safety include restricting mixed mode and non-formal traffic in major roads, constructing medians, and awareness program for drivers and passengers.	
6. Included Measures – Projects – Programs (including status: proposed, in implementation, finalized)	
▪ Asian Road network facilitating trade between Bangladesh and neighbouring countries. ▪ The Padma Bridge will serve southwest part of Bangladesh and improve the connection between Mongla Port and Dhaka.	

3.5.5 Strategic Transport Plan for Dhaka

1. Name	2. Policy Domain
Strategic Transport Plan for Dhaka	Dhaka
3. Status & Timeframe	**4. Location**
FY 2004 – FY 2024	Dhaka
5. Objectives & Indicators related to Roads & Highways	
▪ The provision of a safe and reliable public transport system including both bus and mass rapid transit services at prices which are affordable by all sections of the community ▪ Provision of highway and street infrastructure to serve the different functions required by different users ▪ Integration o different modes of transport by linking routes and services and by developing a	

common ticketing system

- Enhancing the transport systems so as to encourage economic growth in order to make the competitive position of Dhaka and Bangladesh stronger in the world market
- Acknowledging the needs of special sections of the community, especially the needs of children, the aged and infirm, and women
- Revision of laws and regulations so as to encourage the involvement of the private sector in the design, construction, and operations with Government control in the planning of land uses and transportation systems
- Revisions to the systems of licensing and testing for both drivers and vehicles to improve the quality of both, and to eliminate non-licensed vehicles and drivers
- The creation of a "Pedestrian First Priority" system to enhance the provisions for pedestrians and to increase the safety of vulnerable road users
- Creation of environmental pollution control standards with special emphasis on noise and emissions from vehicles
- A careful re-planning and re-construction of all city roads using up to date traffic management techniques so as to ensure that the maximum capacity from existing and future highways is realized consistent with a sound safety policy

6. Included Measures – Projects – Programs (including status: proposed, in implementation, finalized)

- The Dhaka Metropolitan Regional Authority (DAMERA): unified authority responsible for the overall control of land use and transportation planning – but only at a strategic level (no plan for this has yet materialized)

Sample of Policies: (15 out of 65 total Policies)

- Policy 1: To achieve integration between transportation and land use development, the Government intends to create a unified authority responsible for land use and transportation systems. DAMERA
- Policy 2: The formulation of the most efficient plan and the creation of a new authority will not be enough, what is most essential is the political will and determination of the Government supported by the people's commitment. The Government will create systems such that the climate will be amendable to encourage the public to participate in the policy drafting and comment on this Policy document
- Policy 3: The Government acknowledges mixed use areas and will endeavor to serve the needs of all people with the most appropriate transport means
- Policy 4: The Government will provide high quality transport systems to encourage and serve the preferred land use development
- Policy 5: The Government will empower DAMERA to develop new policies and guidelines based on recommendations
- Policy 6: The Government will implement a policy that removes inefficient competition between modes in order to encourage the selection of the most efficient mode or series of modes for each journey and integrate the modes
- Policy 7: The Government will make thorough investigation of the current mode routes and services and will provide funds to ensure that connections are made efficiently and safely
- Policy 8: An innovative but understandable mechanism will be developed for the integration of fares between modes and the provision of a common ticketing system to allow free movement between different modes
- Policy 9: The Government will encourage the private sector to develop a common ticketing system and to implement the interfaces between modes
- Policy 10: The Government will identify a reasonable fare structure in consultation with the

operators and with the agreement of the unitary authority DAMRA, the fare structure will take account of the length of trip and the type of service provided

- Policy 11: Where PPP are concerned, the Government will provide Concession Agreements with adequate provision for profit whilst at the same time ensuring an equitable fare structure for the passengers
- Policy 12: In order to create a sustainable system, the fare structures will be based on the fact that fares have to be revised periodically to adjust for justifiable cost increases, they must recover operating cost, and as far as possible, they should meet asset replacement cost
- Policy 13: The Government will via DAMERA, establish a new bus rapid transit operating organization
- Policy 14: The Government will investigate means whereby subsidies can be allocated to the poor and needy
- Policy 15: Where PPP is involved, the Concession Agreement will specify the conditions applying to the payments of subsidies such that the private operation is not required to subsidize those who benefit from other Government policies, such as preferential rates for children and pensioners

3.5.6 Dhaka Urban Transport Network Development Study (DHUTS)

1. Name	**2. Policy Domain**
Dhaka Urban Transport Network Development Study (DHUTS)	Dhaka
3. Status & Timeframe	**4. Location**
FY 2010 and onwards	Dhaka, specifically Dhaka Metropolitan Area, the area surrounded by the Turag, Balu and Buriganga Rivers

5. Objectives & Indicators related to Roads & Highways

- To formulate the Urban Transport Network Development Plan integrated with urban develop plan of the Dhaka Metropolitan Area for the period up to 2025
- To draw a general outline of the urban transport projects to be implemented on a priority basis
- To clarify the roles of the project implementation agency and the operation, maintenance, management agency, and to propose the development of their implementation capability
- To draw an outline of the feasibility study plan for construction of the urban transport system

Road Network Policy Recommendations:

1) The road network should play role as “prime mover of economic growth” and as arteries linking all parts of Dhaka should be a cohesive economic body to integrate Dhaka with the country and the region
2) The road network development in Dhaka shall be integrated with the land-use development plan of RAJUK
3) The Government will continue to give high priority to the rehabilitation and reconstruction of road network connecting to all parts Dhaka and with neighbouring divisions
4) The Government will continue to accord high priority to the maintenance of national highways, regional highways, and feeder roads
5) The Government will seek increasing private sector and road users to participate in road infrastructure development
6) The Government will speed up the adoption of law on roads as well as supporting legal and regulatory framework for efficient management of transport infrastructure

7) The Government will place emphasis on traffic safety for road users **Road Network Plan:** The principals of the road network development plan for DCC and DMA are: 1) To improve based on hierarchical functional road network 2) To improve the primary road network to link between CBD of Dhaka and urban cores, satellite communities, and division Centres 3) To improve the missing link within the urbanized area in order to prepare efficient road network 4) To develop the grid type road network for newly developed areas taking into consideration the geographic features of the East Fringe Area 5) To construct urban expressway to make backbone road network in the centre of Dhaka 6) To improve inner ring roads to serve traffic from Dhaka to regional Centres in RAJUK areas, but also in Bangladesh 7) To develop a concept of circumferential and radial road network 8) To improve inter-regional roads i.e. Dhaka, Chittagong Road, Dhaka-Khulna Road, etc.
6. Included Measures – Projects – Programs (including status: proposed, in implementation, finalized)
1) It is proposed that three development axes with mass transit corridors should be established: i) existing North-South Development Corridor, i.e. Tongi- Mirpur-City Centre- Narayanganj; ii) East-West Development Corridor, i.e. Purbachal – Uttara – Savar, and iii) Eastern Fringe Development Corridor ▪ Strategic urban development along with the mass transit corridors will include Bus Rapid Transit and Mass Rapid Transit ▪ Mass Rapid Transit (MRT) system should be a backbone of the transport system integrated with conventional public transport system, road network, and traffic management; development of MRT is essential ▪ Optimal Transport scenario in 2025 (minimum requirements scenario): Construction of MRT Line 6, Upgrading of existing Bangladesh Railway, Bus Rapid Transit (BRT) Line 1-3

3.6 Future Outlook

3.6.1 Traffic Growth & Transport Demand:

The population and economy of Bangladesh is expected to grow in coming years. According to the Bangladesh Bureau of Statistics', *Population & Housing Census 2011*, the average annual growth rate of the population was 1.34% in 2011; similar population growth can also be expected in the years to come. Recent GDP growth in Bangladesh has averaged at about 5.5% per year, indicating that economic activity in Bangladesh will only increase.

As a result of both population and economic growth, transport demand and vehicle growth rates will also simultaneously increase, for example, according to Bangladesh's *Road Master Plan*, the year by year growth of bus registrations has been approximately 4% (**Table 20**), resulting in higher levels of traffic and a growing dependency on the roads and highway sector for transport. In addition, according to *DHUTS*, the Greater Dhaka Area (GDA) which is under Rajuk's administration will see person trips increase from 35.9 million trips in 2009 to 65.5 million trips in 2025, an average annual growth rate of 3.8%. As a result of this growing dependency on transport, large investments will have to be made in the maintenance of existing road networks in addition to the implementation of new large scale projects. The sustainability of roads and highways network will depend on the country's ability to adequately respond to key future trends and scenarios, such as population and vehicle growth, as well as to work effectively in order to overcome key challenges in the sector.

Table 20 Average Annual Forecasted Vehicle Growth Rates:

Period	Truck	Bus	Car	Other	All Vehicles
Low					
2010-2015	5.95%	3.00%	8.30%	6.70%	5.25%
2015-2020	7.10%	3.00%	6.90%	5.25%	5.15%
2020-2025	1.40%	3.00%	5.50%	2.00%	2.45%
Medium					
2010-2015	6.85%	4.00%	9.15%	7.50%	5.82%
2015-2020	6.40%	4.00%	7.00%	5.30%	5.00%
2020-2025	2.80%	4.00%	5.70%	2.90%	3.18%
High					
2010-2015	8.00%	5.00%	10.60%	8.30%	7.25%
2015-2020	6.00%	5.00%	6.80%	5.20%	5.50%
2020-2025	5.22%	5.00%	5.45%	4.20%	4.90%

Source: Road Master Plan, 2009

More specifically, the following projects have been identified as necessary to cope with traffic growth during the *Road Master Plan* period (2009-2029), at a cost of Tk. 14,341 crore ($1.86 billion)

1. N1 Dhaka-Chittagong 4 Lane
2. N3 Dhaka-Mymensingh 4 Lane (to Mawna)
3. N102 Mynamati-Brahmanbaria
4. R260 Sylhet-Sunamganj
5. Dhaka Eastern Bypass
6. Dhaka Western Bypass
7. Dhaka Outer Orbital Road
8. Upgrading of R750/Z5703 Bhatiapara-Narial -Jessore
9. Deep Sea Port to N1
10. N1 Chakaria-Chittagong 4 lane
11. N8 Dhaka – Mawa 4 lane
12. N4 Dhaka – Tangail 4 lane
13. N6 Baneshwar – Belephur 4 lane
14. N5 Dhaka- Baniajuri 4 lane
15. N2 Bhairab – Moulvibazar 4 lane
16. N2 Dhaka – Bhariab 4 lane
17. N2 Habiganj – Sylhet 4 lane
18. N8 Jessore – Benapole 4 lane
19. Chittagong By-pass
20. N1 Hatazari Link Road
21. N1 2nd Meghna Bridge
22. N1 2nd Meghna Gumati Bridge
23. N8 Padma Bridge

3.6.2 Current & Future Government Plans:

According to a World Bank report, *Reducing Poverty by Closing South Asia's Infrastructure Gap,* **it will not be possible** for Bangladesh to achieve its goal of 7% percent GDP growth without upgrading the road network and other infrastructure. More specifically, Bangladesh will need approximately **$74 billion**, about 7.38% of Bangladesh's GDP per year, by 2020 to improve its infrastructure. This is the second highest infrastructure investment requirement of all countries in the region. According to the report, the region, which includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka, should improve their infrastructure through the use of both public and private sector funds as well as through the development of reforms. For example, the report suggests that Bangladesh should move away a "build, neglect, rebuild" mindset, and instead focus on ensuring proper maintenance of existing infrastructure. Key projects include the upgrading of the Dhaka-Chittagong Highway and the Dhaka-Mymensingh Highway, the Dhaka Metro Rail, and the Padma Bridge.

According to the Ministry of Finance's June 2014 Budget Speech, *Bangladesh: Beckoning a New Era of Prosperity*, on the 2014-2015 Budget, the following updates regarding Government infrastructure programs and projects were given:

Table 21 Implementation Progress of 2014-2015 Budget Commitments

2014-2015 Budget Commitments	**Implementation Progress**
Creation of Road Maintenance Fund	Road Maintenance Fund Board Act 2013, in the form of a bill has been sent to the Parliament Secretariat for placing before the Parliament
Implementation of Mass Rapid Transit (MRT) Line-6 Project	Dhaka Mass Transit Company Limited has been formed to implement the Mass Rapid Transit (MRT) line-6
Upgrading of Dhaka-Chittagong Highway into four lanes	Work of up gradation of Dhaka-Chittagong Highway into four lanes is in progress
Introduction of Bus Rapid Transit (BRT)	Construction work of 20 km of BRT lane project from Hazrat Shahjalal International Airport to Gazipur is in progress
Construction of Dhaka Elevated Expressway	Construction of the Dhaka Elevated Expressway is scheduled to commence in 2015
Construction of Padma Bridge	Decision has been taken to construct Padma Bridge through domestic financing. 8,100 crore Tk. (approximately $1.05 billion) has been allocated for this purpose
Construction of 2nd Padma and Bekutia Bridge	Construction of the 2nd Padma Bridge has begun and feasibility of construction of Bekutia Bridge is completed. DPP is being prepared
Construction of Tunnel in the Karnaphuli River, Chittagong Construction of Tunnel from Jahangirnagar Gate Dhaka to Rokeya Sharani	Feasibility study of construction of tunnel in Karnaphuli River as well as construction of Tunnel from Jahangirnagar Gate Dhaka to Rokeya Sharani is completed. Next steps have been started
Construction of Elevated Expressway from Hazrat Shahjalal International Airport to Chandra, Dhaka-Ashulia	Pre-feasibility study of the 38 km long Elevated Expressway has been completed. Subsequent works are being undertaken
Construction of 5 flyovers under the Chittagong Development Authority	Work is in progress
Construction of 20 km Uttara-Motijheel MRT Line-6	Consulting firm appointed
Establishment of Data Centre for Road Safety	Work is in progress
Construction of 2nd Bhairab and 2nd Titas Bridges	Related project has been approved by ECNEC and work is in progress
Up-gradation of national crucial highways into 4 lanes	Work is in progress

Source: Ministry of Finance's June 2014 Budget Speech, *Bangladesh: Beckoning a New Era of Prosperity*

The above list of projects includes prioritized infrastructure projects that are currently on the Government's primary implementation list. According to **Table 21**, projects that are currently on-going (construction phase), include Dhaka-Chittagong Highway, Dhaka-Mymensingh Highway, flyovers in Chittagong, and the Dhaka Elevated Expressway. Most other projects are still in the planning phase, i.e. pre-feasibility analysis, feasibility analysis, design phase, etc. It is important that these projects are completed in a timely and efficient manner to help the transport sector meet its increasing demand in the future as well as keep costs within their designated budgets.

In addition to the above projects, in October 2014, the Government announced the construction of the *Mirsarai-Cox's Bazar Marine Drive*. This road would be approximately 285 km in length and would connect Mirsarai, an important location of Chittagong, to Teknaf and then to Cox's Bazar. This project is in the preliminary planning stage. The purpose of this project would be to help develop the area, which will play host to many upcoming development projects such as large power plants, an LNG terminal, EPZs, etc.

More specifically in regards to roads and bridges that are being planned, the RHD's *Road Master Plan* includes the following roads and bridges to be constructed by 2024, a much longer period for investment.

4-lane roads:

1) Dhaka-Chittagong
2) Dhaka-Mymensingh (to Mawna)
3) Dhaka-Bhariab
4) Bhairab-Moulvibazar
5) Habiganj-Sylhet
6) Dhaka-Tangail
7) Dhaka-Baniajuri
8) Jessore-Benapole
9) Chakaria- Chittagong
10) Baneshwar-Belepur

Other important roads and bridges:

1) Mynamati-Brahmanbaria
2) Sylhet-Sunamganj
3) Bhatiapara-Narail-Jessore Road (upgrading)
4) Dhaka Eastern Bypass
5) Dhaka Western Bypass
6) Chittagong Bypass
7) Hatazari Link Road
8) 2nd Meghna Bridge
9) 2nd Meghna Gumati Bridge
10) Padma Bridge

The above list of roads and bridges have been identified as key projects to be built over the span of 20 years to further improve Bangladesh's ability to cope with increasing transport demand. The timely completion of such projects will be dependent on the Government's ability to address and overcome key challenges in the sector. Challenges in the sector are outlined in the next section (Section 1.7).

3.6.3 Access Controlled Highways:

An access controlled highway is a type of highway which has been designed for high-speed vehicular traffic, with all traffic flow and ingress/egress regulated. There needs to be an access controlled backbone network which links to important roads and highways. Currently, there is a mix of both motorized and non-motorized vehicles on high-speed highways, which results in frequent accidents and a slow-down of free traffic flow. This is not only unsafe but also results in an inefficient transport system.

High-speed mobility infrastructure must be created, many developed countries use access controlled highways or freeway systems in order to attain high-speed mobility of passengers and freight. Most highways in the country are operating at 25-35 km/h, while access-controlled highways have the potential to reach 80-110 km/h.[26]

One recommendation in the *Strategy for Infrastructure Sector, Background Paper for the Seventh Five Year Plan*, is to "gradually develop the existing interrupted highways to uninterrupted arterial roads by adopting two-tiered access controlled layout configuration for segregating mobility and accessibility functions of highways." The effectiveness of the above recommendation will also depend on the construction of interchange facilities, the widening of major highways and junctions, reducing conflicting usage of the highway, strict roadside land use development, the building of quality road using quality materials, and climate proofing such infrastructure.

The PPP Office is in the project preparation stage of a proposed project, the Dhaka - Chittagong Access Controlled Expressway. Currently road communication between the two largest cities, Dhaka and Chittagong, is served by a mere 231 km 2-lane national highway (N1). This highway is one of the most economically important highways in the country as it connects Dhaka to the port city, in addition to its inclusion in the Asian Highway. However, the traffic on this route is so severe that journeys are often doubled or tripled in time. There is also a complete lack of road safety as the route is used by mixed traffic such as pedestrians, bicycles, rickshaws, baby taxis, large busses, trucks, and automobiles.

The Dhaka-Chittagong Highway is currently undergoing widening, if this project were from the beginning working in tandem with installing an access controlled expressway the entire route could have been more effectively and efficiently planned and completed. It is important that all highway widening projects consider the issue of access control and how these initiatives can work jointly together. For economically significant and high volume national highways, access control is an important variable to sustainability. The Government should look into the applicability of other economically significant roads for conversion as well as ensure that these projects are completed on time.

3.6.4 Regional Connectivity:

The Government plans to improve Bangladesh's connectivity to neighbouring countries through the implementation of key initiatives, for example the Asian Highway, the Bangladesh-India-China-Myanmar (BICM) corridor, and the upcoming Cross Border Transport Infrastructure Project. Unfortunately, little progress has been made so far in any of these initiatives with many still in planning stages.

The Asian Highway

The Asian Highway project was initiated by the UN-ECAFE (United Nations Economic Commission for Asia and the Far East) in 1959, with the aim of creating regional cooperation amongst main land countries in Asia based on road transport linkages. UN-ECAFE is now the United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP). The Asian Highway falls under the Asian Land Transport Infrastructure Development (ALTID) project, which also includes the Trans-Asian Railway. The proposed Asian Highway network is 141,000 km long across 32 Asian countries with links to Europe. 1,761 km of Bangladesh's national highways are included within the Asian Highway network, specifically two routes, AH-1 and AH-2, cross Bangladesh. The initial work for the connectivity to the Asian Highway network has started however overall implementation has been slow. In addition, Bangladesh's

[26] Strategy for Infrastructure Sector, Background Paper for the Seventh Five Year Plan, Policy Research Institute

portion of the Asian Highway fails to meet the standards of quality required of it, according to the transport division of UN-ESCAP.

Specifically, two of the three local highways that are part of the Asian Highway network are mandated to meet international standards while the third should meet regional standards. However, not a single kilometre of Bangladesh's highways meet these standards. The network is divided into five classes – Primary, I, II, III and Below III – that are determined according to road design standards. Primary refers to access controlled highways which are used exclusively by automobiles. Access to the access controlled highways is at grade separated interchanges only and only motorized vehicles can use such a highway.

Only 72 km of the 1,761km Bangladeshi portion of the Asian Highway is a four-lane highway, which does not meet the standards for the Primary category, but is considered as the only stretch of Class I highway in Bangladesh, the remaining 89% of the highway, meets Class II standards.

- Highway AH-2 runs 805.59 km from Banglaband to Tamabil via Joydebpur, Dhaka, Kanchpur and Sylhet.
- For 291.34km, the highway overlaps with AH-1, whose 514.25 km route links Benapole to Myanmar via Kanchpur, Comilla, Chittagong, Cox's Bazar and Teknaf.
- Regional highway AH-41 has a length of 744.43 km, connecting Khulna to Chittagong port via Kanchpur and Daudkandi.

Bangladesh–China–India–Myanmar (BCIM) Corridor

The Bangladesh–China–India–Myanmar Forum for Regional Cooperation (BCIM) is a sub-regional organization of Asian nations aimed at greater integration of trade and investment between the four countries. Bangladesh–China–India–Myanmar Economic Corridor is an initiative directed for significant gains through sub-regional economic cooperation within the BCIM; the multi-modal corridor will be the first expressway between India and China and will pass through Myanmar and Bangladesh. Some of the benefits of the corridor include greater market access for goods, services, and energy, the elimination of non-tariff barriers, better trade facilitation, and investment in infrastructure development. The proposed corridor will cover 1.65 million km^2, encompassing an estimated 440 million people in China's Yunnan Province, Bangladesh, Myanmar and Bihar in Northern India through the combination of road, rail, water, and air linkages in the region.

As of December 2013, the four nations drew up a long discussed plan, emphasizing the need to quickly improve physical connectivity in the region, this marked the formal endorsement on the BCIM-EC by the four nations, whereby it was agreed that the corridor will run from Kunming to Kolkata, linking Mandalay in Myanmar as well as Dhaka and Chittagong in Bangladesh.

Cross Border Transport Infrastructure Project

Starting in August 2013, JICA conducted a study on transport infrastructure development for regional connectivity in four countries in South Asia (Bangladesh, Bhutan, India, and Nepal) and two countries in Southeast Asia (Myanmar and Thailand). This study's objective is to assess the current status of regional transport infrastructure in South and South East Asia and to identify potential JICA assistance programs for regional transport infrastructure development in the region. The study focuses on infrastructure components such as existing roads, railways, border facilities, and dry ports. It also takes into consideration international agreements between these regional countries. Most recently, *Minutes of Discussion* was signed with the Bangladesh Government in order to initiate this potential funding program that will promote regional connectivity, i.e. connecting Chittagong port to India's north-eastern states.

The completion of these projects will also help further develop Bangladesh's transport sector and help in stimulating trade between Bangladesh and its neighbouring countries, a prospect that will help improve Bangladesh's socioeconomic standing.

The Government of Bangladesh has accorded highest priority on regional connectivity. Development of road network taking into account the particular needs and problems of landlocked developing countries. An important provision of the Joint Communiqué, 10th January 20l0, signed between Honourable Prime Ministers of Bangladesh and India has opened up the opportunity of connectivity between Bangladesh, Bhutan, Nepal and India, particularly the eastern part of India. In continuation of this Communiqué, Motor Vehicles Agreement (MYA) for the Regulation of Passenger, Personal and Cargo Vehicular Traffic between BBIN countries (Bangladesh, Bhutan, India and Nepal) was signed on 15 June 201 5 at Thimphu, the Capital City of Bhutan.

Roads and Highways Department is carrying out number of study projects to improve road sections of regional and sub-regional significance under Transport Corridor Project (TCP) and Sub Regional Road Transport Project Preparatory Facility. At present, the Technical Assistance for Sub-regional Road Transport Project Preparatory Facility (SRTPPF) financed by Asian Development Bank and Government of Bangladesh has carried out feasibility study and detailed engineering designs for selected highways of approximately 1,786 km under RHD.

3.6.5 Key Connectivity Issues

The Government of Bangladesh has been making relentless efforts to improve the road connectivity through various regional cooperation forums such as UNESCAP, SAARC, SASEC, BIMSTEC and BCIM. Substantial progress has been achieved in this regard as of 2015. Bangladesh has acceded to the Asian Highway Network on 8 November 2009. The physical alignment of Asian Highway Route in Bangladesh is more or less completed so far as the road connectivity is concerned. The Government has taken initiatives to upgrade all National Highways including Asian Highway Routes in Bangladesh into 4 lane width by 2021. The 4 lanning of Dhaka-Chittagong Highway and construction of Dhaka- Chittagong Expressway have the highest priority in this regard. The Government has a strong commitment to construct the direct road link up to Kyauktaw for establishing regional connectivity with neighbouring Myanmar. The issue of "Missing Link with Myanmar" has got the highest priority in the regional integration plans. The issue was duly focused in the agreed BTILS Policy Framework and Strategies. BIMSTEC supports the urgent development of road connections in Myanmar, particularly of the connecting roads to neighbouring countries, so as to effectively link the road networks of Bangladesh, India, Myanmar and Thailand to create a future land bridge.

3.7 Challenges

The following section includes an analysis of the roads and highways sector’s main challenges. This includes a lack of maintenance and insufficient funding, slow implementation, encroachments on major highways & land resettlement, urbanization & traffic growth, road safety, intermodal connectivity, climate change, and institutional issues. It is vital that the Government formulate key policies and action plans which are fully implemented in order to help overcome these challenges.

3.7.1 Lack of Maintenance & Insufficient Funding

The road sector has suffered from a historic lack of maintenance, and unless this issue is addressed soon, many roads will require costly rebuilding. This lack of maintenance is primarily due to insufficient funding and poor planning; however total costs will only increase unless proper maintenance procedures are met.

Table 22 RHD Road Network Condition (2012)

Road	Good (%)	Fair (%)	Poor (%)	Bad (%)	Very Bad (%)
National	30.70	41.19	15.69	9.43	3
Regional	18.02	45.69	25.61	8.45	2.23
Zila Road	11.99	38.86	27.82	18.16	3.19
Total	**21.99**	**40.04**	**23.95**	**11.74**	**2.28**

Source: Roads and Highways Deptt. Maintenance and Rehabilitation Needs Report of 2012-2013 for RHD Paved Road

A large proportion of roads are of poor, bad, or very bad condition. For example, according to **Table 22**, which shows the condition of RHD roads, the most utilized roads, 37.97% of roads are in poor or worse condition, indicating that the maintenance of roads has not been properly ensured. This is an incredibly large percentage of important roads that are in deplorable condition, indicating that the Govt will have to spend a large percentage of its funds and time to fix these roads. This takes away funding and time from new projects that are also important for the transport network, thus suggesting that Bangladesh must shift towards a policy of not only building new infrastructure projects, but also properly maintain infrastructure over time.

Table 23 Definitions of Road Operating Categories

Category	Definition
Good	Road sections having an acceptable degree of road geometry and other features and where the riding quality is reasonable. All types of road marking, sign/signals, advance distance signboard, etc. are available but not entirely adequate. Sight distance in case of curves is appropriate and cross drainage is okay. Congestions are infrequent.
Fair	Road geometry and road furniture are of reasonable condition. Riding quality is reasonably good. Occasional traffic congestions are encountered in certain stretches of the road, particularly during weekly market days. Level of operation, in totality, cannot be said to be good enough.
Poor	Riding quality is not good. The paved surface is partly deteriorated e.g. ruts, cracks, potholes, undulations, and roughness of the surface are noticeable. Hard shoulder is damaged or missing and earthen shoulder is also undulated and poorly maintained. Traffic congestions are frequent.
Very Bad	Such case may arise in the National Highways when the road geometry, surface, and other features are greatly damaged which may be due to natural calamity or disaster like flood or cyclone, etc. This category shall indicate that traffic cannot operate on such roads without great difficulty and the level of operation is therefore, graded as very bad.

Source: Road Master Plan, 2009

Table 24 Road Network Maintenance Needs

Year	Funds Required
2012-2013	70, 913.82 million Tk. ($909 million)
2013-2014	20,099.14 million Tk. ($258 million)
2014-2015	13,322.68 million Tk. ($171 million)
2015-2016	11,470.38 million Tk. ($147 million)
2016-2017	10,358.24 million Tk. ($133 million)
Total	**$1.612 billion**

Source: Roads and Highways Division, Maintenance and Rehabilitation Needs Report of 2012-2013 for RHD Paved Road

According to **Table 24**, which includes a forecast of the funding required to rehabilitate existing roads, a total of $1.612 billion is required by the road sector between FY 2012-2017, more detailed information as to where and for what funds will be required are available in **Table 21**.

The funds required for maintenance for 2014-2015, $171 million, is almost 20% of the $890 million total budget for the road sector that year. Due to large scale deterioration of road networks, only about 62.03% of RHD roads are in good or fair condition.[27] Causes for road deterioration include weather related factors such as water damage and flooding, during both initial construction and repair work of roads, weather conditions, such as the monsoon season, cause delays in the implementation of road work.

Overloaded vehicles on highways, roads, and bridges have caused large damages to roads, estimated at billions of taka every year. In order to mitigate these damages, the Government has adopted the "*Vehicle Axle Load Control Station Operation Policy 2012.*" BRTA has a guideline that specifies that large load carrying vehicles should use excess axle to their loads, however most commercial vehicle drivers violate this. The installation of weighing stations is an importance part of ensuring that vehicles adopt these new guidelines; but only a few out of six overload control stations are functioning. To make this policy to take effect, more fully-functioning weight stations are required and penalties must be enhanced and enforced.

Many roads also require significant repair and rehabilitation work as a result of low quality resources used during the time of initial construction. Most roads are built on earth-filled embankments that lack proper compaction, during the monsoon season these earth filled embankments are loosened causing damage to the road surface on top. Instead, roads should be made from less water sensitive and rigid materials. Historically, budget constraints have caused most repairs and maintenance work to be done on a temporary basis, using material such as bricks, brickbats, sand, and as a result many potholes and cracks develop on roads during adverse weather conditions or as a result of deterioration over time. Many projects are also given to construction companies based on political connections or nepotism rather than given to companies with adequate technical capabilities. Another issue is a lack of proper roadside land-use planning, for example, when driving through the capital there are few sewerage systems and drainage systems that are visible. Within hours of heavy rainfall the entire city becomes flooded and transport halts. It is extremely important that roadside land-use is properly planned to install proper drainage facilities as well as to ensure that hawkers or semi-permanent establishments do not hamper the flow of traffic.

In the RHD's *Maintenance and Rehabilitation Needs Report of 2012-2013 for RHD Paved Road*, the capital costs required for a 5 year period for all roads are included. Only 5 years were taken into consideration for capital works (which includes periodic maintenance, partial reconstruction, full reconstruction, and routine maintenance) due to the fact that estimating future needs beyond a 5 year period cannot be done accurately. The 2012-2017 breakdown of capital costs required is based on the type of road (national, regional, zilla) in comparison to district zones, which is available in the report, though only for the years 2012-2013.

Table 25 Total Capital Work Demands (Million Taka) (2012-2017)

Road Class	**2012-2013**	**2013-2014**	**2014-2015**	**2015-2016**	**2016-2017**	**Total**
National						
Periodic Maintenance	9073.52	2301.84	1418.12	609.79	404.94	13808.20
Partial Reconstruction	6275.30	234.27	1.61	32.92	0	6544.10
Full Reconstruction	11847.49	0	0	0	0	11847.49
Routine Maintenance	305.12	721.61	729.83	763.39	801.75	3321.70
Regional						
Periodic	5870.20	1709.11	1010.64	777.19	481.25	9848.38

[27] National Sustainable Development Strategy 2010-2021

Road Class	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	Total
Maintenance						
Partial Reconstruction	3955.68	567.50	4.64	1.09	205.25	4734.15
Full Reconstruction	7883.59	116.83	0	0	0	8000.42
Routine Maintenance	422.62	996.76	1006.67	1080.82	1160.84	4667.72
Zilla Road						
Periodic Maintenance	7773.04	856.50	1592.19	1241.26	517.68	11980.67
Partial Reconstruction	11787.57	9055.95	3789.51	2862.75	2221.17	29716.94
Full Reconstruction	3998.59	75.15	36.22	90.02	232.53	4432.51
Routine Maintenance	1721.09	3463.62	3733.26	4011.15	4332.83	17261.95
Total	**70,913**	**20,099**	**13,322**	**11,470**	**10,358**	

Source: Roads and Highways Deptt. Maintenance and Rehabilitation Needs Report of 2012-2013 for RHD Paved Road

Based on the RHD *Maintenance and Rehabilitation Needs Report of 2012-2013 for RHD Paved Road*, it is evident that investment needs tend to decrease over time if the first year investment requirements are met fully; therefore it is important to decrease maintenance backlogs in order to keep costs in control.

RHD has been provided with Tk. 14 billion (approximately $179 million) from the FY 2015 budget for repair, maintenance and rehabilitation work of the roads and highways, compared to Tk. 13.38 billion ($172.8 million) in FY 2014. Based on the RHD *Maintenance and Rehabilitation Needs Report of 2012-2013 for RHD Paved Road*, capital costs required for FY 2015-2016 were forecasted at $147 million, indicating that the budget provided should theoretically meet the costs forecasted. However, the report's forecasting did not take into consideration that certain maintenance needs may have been unmet from previous years, therefore the capital costs required for FY 2015-2015 could be well above the $147 million projected.

Another important point to note is that infrastructure investment increased from less than 1% of the gross domestic product (GDP) in FY 2009 to about 2% in FY 2013, which is still considerably lower than the 7-10%, indicated to be required annually by the World Bank, for the next 10 years. This is evident that most budgets have been used by the road sector for the repair and maintenance of roads rather than implementation of new infrastructure projects. It is important that the RHD focuses on the proper maintenance of roads and make efforts to increase access to finance.

3.7.2 Slow Implementation

Based on the SFYP, RHD's target for road construction was 4,672 km of new roads by FY15. However, between FY11-FY13 a total of 702 km of new roads, or 15% of the target, have actually been completed.[28] This is an example of one of the RHD's biggest issue – slow implementation. In addition, RHD had a target of widening/strengthening 8,433 km of road by FY15; however as of FY13 only 22% of the target has been completed.[29]

Slow implementation is caused by a variety of factors including political instability and fund related issues; political instability in the form of frequent *hartals* and strikes, political regime changes, and the politicization of projects can

[28] Mid-Term Implementation Review of Sixth Five Year Plan, Policy Research Institute

[29] Mid-Term Implementation Review of Sixth Five Year Plan, Policy Research Institute

cause significant delays in implementation. Many project delays are also caused by an inability to lock down sufficient funding on time. Moreover, a general lack of forward planning, problems with procurement, a lack of quality resources, and difficulties with land acquisition add to this persistent problem. An overall backlog of projects make it difficult for implementation agencies to fully focus on particular projects, causing a spread of funds, time, and resources over multiple projects which results in few projects being completed on time. These delays cause major bottlenecks in the flow of passengers and freight throughout Bangladesh, as infrastructure is not being able to keep up with the demands of the public, it becomes more and more difficult for implementing agencies to deal with continuously growing levels of demand.

This implementation capacity constraint calls for the Government to change their strategy of towards one that prioritizes the timely completion of strategic projects instead of taking on too many projects at a time. It has been observed that the Government's Annual Development Program (ADP) has over a period of ten years (1997-2007) annually added new projects without ensuring that projects from the previous year's ADP allocation were completed, as a result, the total number of projects has risen by nearly 350% over a 10 year period.[30] As a result, it is difficult to prioritize projects in the ADP in an efficient manner, especially considering the scarce availability of resources.

The following table (**Table 26**) includes a summary of some of the SFYP targets that were set for the roads and highways sector, with an update of their completion as of FY 2013.

Table 26 Transport Sector Objectives, Performance Indicators and Targets for the SFYP

Objectives/Performance Indicators	FY 10 (baseline)	FY 13 (estimate)	FY 15 (target)
Achieve a transport sector growth rate of 7.5% per annum	6.62%	6.7%	7.5% (average FY 11-15)
Develop and manage strategic road corridors	RHD: National Highway: 3,478 km Regional Highway: 4,222 km Total: 20,948 km Total (including rural roads): 289,334 km	RHD: National Highway: 3,570 km Regional Highway: 4,323 km Total: 21,462 km Total (including rural roads): 290,026 km	Total under RHD: 26,134 km
Construction of Padma Multipurpose Bridge	0	10%	30%
Leverage private investments through PPPs for Expressway (Bangladesh Bridge Authority)	0	1 contract signed	40%
Percent of road network in good/fair condition	66%	N/A	95%
Construction of new roads	349 km	702 km (2011-2013)	4,672 km
Improvement/rehabilitation of roads	849 km	1,868 km (2011-2013)	8,433 km
Construction of bridges	7,251 meters	14,427 meters	10,362 meters
Construction of tunnel	0	0	20%
GDP Share of Transport (% of GDP)	0.55%	0.78%	1.3%

Source: Mid-Term Implementation Review of Sixth Five Year Plan, Policy Research Institute

[30] Road Master Plan, 2009

In every component, except for the construction of bridges, the Government is nowhere near to completing their FY 2015 targets. However, the construction of bridges target for FY 2015 was 10,362 meters of bridge, and as of FY 2013, 14,427 meters of bridges have been built; in this case the Government has not only achieved its target but progressed beyond the target. The Government must work similarly to complete other targets in a timely manner.

One specific project example of slow implementation is the Dhaka Chittagong 4-lane project, considered to be a high-priority project. Countless delays have escalated project costs by Tk. 28.72 crore according to the Road Transport and Highway Division. Work on the Dhaka-Chittagong 4-lane began in 2006 and was initially expected to be completed by 2013, eight years have passed and there is no clear understanding of when the project will be completed. Issues such as cancellation of tenders and changes of project directors have consistently plagued the project. According to an IMED report published in 2012, only 18.38% of the project has been implemented.[31]

Another project example of slow implementation is the Padma Bridge project, a major infrastructure project with the potential to have a large economic impact, initially set as a realistic goal under the SFYP. As of 2015, no construction work has begun whereas the project had initially been set for completion within the SFYP time period. Procurement related problems and the withdrawal of the initial donor funding have substantially delayed the project. This delay has caused hindrances to the Government's budgeting within the transport sector and also affected the set growth targets for the sector.

The Government should forego unrealistic targets and decrease the number of projects taken onto realistically attainable levels based on its past experiences. This would help ensure that prioritized projects are given an adequate amount of financing, attention, and time in order to be completed effectively.

3.7.3 Encroachments on Major Highways & Land Resettlement

According to the *Road Master Plan*, encroachments pose a large operational problem for major highways. These encroachments have been classified in 4 categories, and are included in **Table 27**.

Many of these encroachments pose large difficulties for RHD, considering that the reclamation and resettlement of land is not a simple task. Many plots of land are owned privately, and therefore resettlement will be costly as well as time-consuming as lengthy negotiations are required prior to hand-over to the Government. In addition, major *haats* and *bazaars* will also require the resettlement of small businesses, which will hamper the businesses of these small traders. Certain areas are also densely populated, which makes relocation even more difficult.

In an ADB study for the *South Asia Sub-regional Economic Cooperation Road Connectivity Project*, it was found that there will be significant impact with approximately 18.9 hectares of land acquired with commercial tenants experiencing the majority of impact. In addition, 2,394 households comprising 9,885 persons will be affected.[32] In order to decrease the externalities of situations such as these, the Government should map out a clear and formalized process to adequately move and compensate these affected individuals and businesses.

[31] Implementation Monitoring and Evaluation Division (IMED), Ministry of Planning

[32] ADB

Table 27 Types of Encroachments

Category	Encroachments	Types of Solution
A	Major *haats* and *bazaars* are located along the highway; sufficient vacant land is not available on the roadside within the RHD's right-of-way for widening and straightening of the carriageway, or for creating service lines for buses, trucks, and non-motorized transports, as well as for providing bus bays/stops, and for temporary parking of vehicles	Provide separate bypass roads with special design criteria, together with service lanes and well planned intersections
B	Sizeable encroachment exists on the highways, but land within the right-of-way can be restored through eviction of encroachments to provide service lanes for buses, trucks, and non-motorized transports, or if enough land is not available within the right-of-way, additional land required can be procured with less hassle, through easy resettlement with original owners	Provide service lanes for buses, trucks, and non-motorized, and also bays for loading/unloading together with foot over bridges and iron fencing barriers on both sides of the road, prohibiting all entry into the main carriageways around bazaar area
C	Railway crosses national highways at market places, and there is densely built-up area and homestead just outside the right-of-way (at times private land) and spread over wide area on both sides of the road in such a way that land for future road expansion becomes expensive	Provide over-bridges for thorough traffic, and separate lanes for non-motorized transports, and bus stops at the ground level, with requisite road furniture and delineators
D	There are certain intersections on the national highways, which are unable to cope with present level of traffic. These should therefore be designed properly	Need to improve designs of intersections, roundabouts, and islands at critical road crossing, and whenever possible use traffic signals, or other traffic management techniques

Source: Road Master Plan, 2009

Another type of encroachment is a result of lack of strategic and cross-institutional planning within the Government, for example LGED's adjacent developments along highways have in certain cases encroached on highway development by RHD, and this encroachment causes losses to the economic efficiency of the highway and could be easily avoided if proper roadside land-use planning was adapted. In the long-run, Bangladesh should establish two-tier highway systems with access control; such a system could offer accessibility to local roads as well as high-speed mobility.

3.7.4 Urbanization & Traffic Growth

The limitations or lack of infrastructure are most apparent in the urban cities, more specifically in the capital, Dhaka. With high levels of rural to urban migration and lack of economic development in cities outside the capital, the pressure on this urban Centre is increasing alarmingly. According to a study conducted by the RHD, traffic congestion in Dhaka causes a loss of up to Tk. 19,555 crore a year (approximately $2.5 billion).[33] This estimate is one quarter of the country's development budget in FY 2014-2015. The study estimates total losses by considering travel time cost, cost of excess fuel burnt, revenue loss by passenger transport operators, environmental damage, and the cost of traffic accidents. In addition, it finds that about 3.2 million business hours are lost every day, approximately one hour per working individual. It identified that one major cause of these losses is a gap between the supply of transport infrastructure and its demand. Other causes are the inadequate capacity of intersections, mixed traffic on the same

[33] Roads and Highways Department

road space, operational disorder, absence of scientific traffic control, disorder in bus operations, inadequate parking space, and lack of emphasis on the growth of satellite cities around Dhaka.

According to a 2005 World Bank study, titled *Road User Charge Study*, 59% of traffic on roads under the RHD is on national highways, and 38% of traffic runs on just 5% of the network (approximately 955 km of road) , which are the main roads that are connected to the capital, Dhaka – resulting in high traffic and congestion levels.

Table 28 Forecasted annual av. % growth in vehicle-km, National & Regional Highway Network

Year	**Low Growth Scenario (in %)**	**Medium Growth Scenario (in %)**	**High Growth Scenario (in %)**
2005-2010	6.71	7.52	8.13
2010-2015	6.01	6.40	6.98
2015-2020	6.18	5.84	5.71
2020-2025	3.28	3.86	4.98
2005-2025	5.54	5.90	6.44

Source: Road Master Plan, 2009

Based on **Table 28**, the medium growth forecast until 2025 for growth in vehicle-km, is just under 6% per year. According to the *Road Master Plan*, this is the recommended use for an aggregate growth rate for all traffic in the future. This forecast is based on data collected from the Bangladesh Road Transport Authority (BRTA) on historical vehicle and trip data. One of the greatest challenges for the road network in the next 20 years will be to accommodate this large growth in traffic in order to ensure economic growth.

To add, currently bus stops, bus terminals, waiting areas for rickshaws and baby taxis are either badly located which adds to traffic congestion and disorder, or simply lacking in number. Bus terminals are also in poor condition, making it a form of transport that is inconvenient and unpleasant to use. Pedestrian facilities, such as footpaths, over-bridges, zebra crossings, bus stops and terminals are either lacking in quality and number or non-existent, making it extremely difficult for the average citizen relying on public transport to live their daily lives. For citizens that rely on personal transport, such as the automobile, a complete absence of large-scale parking facilities, no clear rules and regulations for parking, and little road space have caused not only inconvenience to these citizens but leads to complete disruption of traffic flow as automobiles are parked in unauthorized spaces.

In addition, there are conflicting usages of carriageways that cause major road disruptions, traffic, and accidents. A mix of motorized and non-motorized vehicles on existing roadways have created a chaotic and inefficient road system, many vehicles and drivers have no legal licenses to drive on the road, due to lack of enforced legislation and corruption. There is also lack of strategic management within privatized transport companies; there are so many small owners of vehicular fleets offering public transport rather than large coordinated companies which adds to the overall deteriorating state of public transport today.

Many infrastructural developments, such as the public transport facilities (i.e. BRT, MRT) elevated expressways, flyovers, and the improvement of deteriorated roads will be required to meet the rising demand for road transport by the country's growing economy. According to DHUTS, "given only currently on-going projects in the road network and public transport and given nothing more than on-going improvements….the average travel speed on road will be as low as 4.2 km/h in 2025 compared to the current travel speed of 15.1 km/h (2010)…This means that the major roads will be fully congested all day, that is the volume/capacity (V/C) rate will reach 1.09 which means a saturated condition, compared to 0.51 at present.".

The absence of a unitary metropolitan authority is a big issue. In Dhaka, city governance is established by the Dhaka North and South City Corporations; currently these organizations are not given much real authority in the establishment of key metropolitan issues such as infrastructural development, traffic enforcement, public transport, and public facilities. Many of the key decisions in these areas are under the control of other Govt agencies, although the management of these activities could only be effectively done by an autonomous urban development authority, as seen in most mega cities around the world. Some of the key areas that such autonomous authorities focus on are public transport infrastructure, such as bus lanes, bus terminals, pedestrian footpaths, proper zebra crossings, land use zoning laws, parking regulations, time of day traffic flow regulations, traffic signals, etc. The Government should consider the idea of establishing *a unitary metropolitan authority* for the effective management of large cities.

A more long-term solution to the challenge of increased urbanization and traffic growth in the capital is the development of satellite cities and communities outside Dhaka. This has been initiated in areas such as Tongi, Gaizpur, Savar, and Narayanganj; a new town, Purbachal, is currently being developed by RAJUK; however this overall decentralization of population must be further developed. Tongi, Gaizpur, Savar, and Narayanganj are industrialized cities, with many factories; however there is lack of basic services, quality hospitals and educational institutions, as well as convenient housing, public spaces, such as parks, and leisure activities in these areas. Connectivity to the capital is also heavily dependent on roads, which are often so gridlocked with traffic that it takes hours to arrive into the capital. In order to decrease the ever-expanding burden on Dhaka, existing satellite cities must offer services that attract residents, as well as be easily connected through faster transit routes to other parts of the country. In addition, new satellite cities should be developed that offer enough incentives for citizens to decide to set up a residence outside the capital.

In the *Dhaka Urban Transport Network Development Study (*2010), four key issues for the development of a multi-core urban region were included:

1) Strategic urban development of satellite communities
2) Effective transport network to connect existing urban cores to surrounding growth poles
3) Economic integration between dominant urban Centre and surrounding urban, peri-urban, rural settlements
4) Good governance to manage the urban region in an effective and efficient manner

3.7.5 Road Safety

BRTA is responsible for road safety promotion and road safety prevention activities. They prepare a *National Road Traffic Accident Report* on the basis of reported data on road traffic accidents from the Bangladesh Police. The information below (**Table 29**) only includes information that has been reported to the Police, there are many unreported accidents that are not accounted for.

Table 29 Statistics of Road Accidents and Casualties

Year	**Road Accidents in Bangladesh**			
	Total Number of accidents	**Deaths**	**Injuries**	**Total casualties**
1994	**3,013**	1,597	2,736	**4,333**
1995	**3,346**	1,653	2,864	**4,517**
1996	**3,730**	2,041	3,301	**5,342**
1997	**5,448**	3,162	5,076	**8,238**
1998	**4,769**	3,085	3,997	**7,082**
1999	**4,916**	3,314	3,453	**6,767**
2000	**4,357**	3,430	1,911	**5,341**

Year	**Road Accidents in Bangladesh**			
	Total Number of accidents	**Deaths**	**Injuries**	**Total casualties**
2001	**4,091**	3,109	3,172	**6,281**
2002	**4,918**	3,398	3,770	**7,168**
2003	**4,749**	3,289	3,818	**7,107**
2004	**3,917**	2,968	2,752	**5,720**
2005	**3,955**	3,187	2,755	**5,942**
2006	**3,794**	3,193	2,409	**5,602**
2007	**4,869**	3,749	3,273	**7,022**
2008	**4,427**	3,765	3,284	**7,049**
2009	**3,381**	2,958	2,686	**5,644**
2010	**2,827**	2,646	1,803	**4,449**
2011	**2,667**	2,546	1,641	**4,187**
2012	**2,636**	2,538	2,134	**4,672**
2013	**2,029**	1,957	1,396	**3,353**
2014	**2,027**	**2,067**	**1,535**	**3,602**

Source: Police Headquarters (FIR) Report.

It is clear from the above table that Bangladesh has been suffering from deteriorating road safety with a growing number of road accident-related deaths. Some of the causes of this problem include: rapid growth in population, unplanned urbanization, careless driving, unfit vehicles, lack of relevant legislation or strict enforcement of existing traffic rules and regulations, and a lack of adequate investment in road safety activities.[34] The deficiency of quality road (potholes, fault lines, etc.), and the fact that many roads are too narrow considering the traffic they carry, constant road-congestions of people, animals, non-motorized vehicles, and motorized vehicles, vehicles carrying weight well beyond the capacity of roads, have all contributed to this deteriorating state of safety.

BRTA is currently responsible for conducting vehicle fitness tests and issuing certificates to vehicles that are fit to use roads. However, BRTA does not have the capacity to test all vehicles. In 2010, it was reported that just 41 inspectors are tasked with examining the fitness of 1,300,000 vehicles across the country.[35] Many inspectors simply perform a visual inspection of vehicles as they do not have the adequate time or resources to do proper inspections. According to *section-47 of Bangladesh Motor Vehicle Rules*, 1984, BRTA inspectors are authorized to check a total of 83 systems. For instance, emission, transmission, brakes, lights, wheel alignment, steering, mirrors and chassis condition are considered very important. Inspectors are also supposed to take a 35 km ride in the vehicle to test its performance; however none of this is actually done. These same inspectors are also responsible for issuing driving licenses, their lack of capacity means that more and more drivers are driving with no licenses or fake licenses; this overall lack of fit licensed vehicles and drivers further contributes to the decline of road safety in the country.

[34] Road Master Plan, 2009

[35] The Daily Star

According to a 2011 report of the Accident Research Institute (ARI) at the Bangladesh University of Engineering and Technology (BUET), in the last 15 years, a shocking total of 49,847 road crashes occurred in the country, killing 42,526 people and injuring around 39,000, the actual number is presumed to be much higher as many accidents remain unreported. Of the accidents, 54% occurred due to speeding and 38% for reckless driving.

In response to prevailing highway related accidents, a Highway Police was created in 2005; their primary responsibilities include maintaining law and order on highways and investing road accidents. There are currently 28 highway police stations followed by 44 outposts. However, only 11,806 km of highway across the country are being operated by the Highway Police. To add, the Highway Police are severely restricted of resources, especially human resource, making it difficult for them to perform their job well.

The main responsive measure that the Government has thus far initiated in order to deal with this safety issue is the widening and rehabilitation works of key economic roads, such as the Dhaka-Chittagong highway, which will help provide a safer quality of road. However, these measures alone, which are primarily attributable to national highways only, are not enough to help combat the long list of variables that have contributed to a lack of road safety throughout the country; effective activities would include introducing national highways that are access controlled as well as creating a system of accountability for road safety on all types of highways and roads.

The most pivotal agent of change will be when the general people enforce their own sense of moral responsibility and personal accountability towards following the law. Currently few drivers pay any respect or heed to systems of traffic management safety already in place; emphasis should be placed on programs or campaigns that enforce a sense of moral responsibility and personal accountability, be it through awareness campaigns or more disciplinary actions by traffic police. For instance, when driving through the army controlled areas, such as cantonments, vehicles follow a given set of rules much more strictly, out of fear of being stopped by Army personnel. This same fear and respect for the law is not followed elsewhere, as there is no effective traffic police system. In total, it is important that the Govt improve the quality of its roads, enforce strict rules and regulations, and enhance the capacity of relevant organizations.

3.7.6 Intermodal Connectivity

In the past two decades, Bangladesh has been placing heavy emphasis on the development of their road sector at the cost of less development in the railway and inland waterway transport sector. Certain geographic conditions, such as the country being relatively flat, have contributed to this growth of road transport. To add, road transport offers more mobility and connectivity than other transport modes, partially due to its continuous development. Short-term planning has also resulted in the emphasis of road versus inland waterways and railways. However, it is important that being a country of many inland waterways, and an exponentially increasing demand of transport, the Govt should pay special attention to the development of both its inland waterway and railway sectors.

Transportation connectivity could well be enhanced and it could meet future demands of transport growth, if an effective and full-proof plan for intermodal connectivity was followed. Railway offers certain distinct advantages, such as lower cost for the transportation of passengers and freight, as well as being environmental-friendlier. Inland waterway also offers advantages as it can contribute to the effective transportation of freight and if these same waterways were efficiently connected to railway and road, their importance and contribution to effective transport could only grow. *Integrated Multi-Modal Transport Policy* 2008, addresses this issue. Although, there is still a lack of integrated transport policy and planning framework that could result in the prioritizing of investments. This makes it difficult for the transport sector to allocate resources between sub-sectors effectively. Most importantly, there have been a number of transportation studies in recent years that advocate for intermodal connectivity. However, no real effort has been made for the actual functional integration of different modes of transport.

Increased intermodal connectivity could have positive effects on all economic activities; especially the carriage of freight, for instance agriculture. Nearly half of Bangladeshis are employed in the agriculture sector; however rural areas, which are generally used for agricultural land, are yet to see efficient transportation infrastructure. This is understood by the fact that not enough rural areas have roads and if they do have roads, the majority of these roads are narrow and dirt roads (unpaved). In addition, many rural areas are unable to withstand the loads of heavy farm equipment. All these factors taken together make the logistical costs between different parts of the country some of the highest in the world. If more investments were made into reliable infrastructure, the agricultural sector would improve. Agricultural supplies could more efficiently reach farmlands, and agricultural products could also easily reach markets through carriage on a mix of different transport modes: roads, railways, and inland waterways.

Inter-modal connectivity is especially important within and around Dhaka. Currently, the existing modes of transport act independently and are often in competition; however, they should also benefit from each other. Passengers suffer due to a lack of connection between modes and poor scheduling; an integrated scheduling and ticketing system should be initiated in Dhaka within all modes of transport. For instance, an individual travelling by river from his/her village, should be able to connect to a railway that can bring him/her into the heart of the city, and from there take a bus to his/her final destination with convenience. Even Dhaka International Airport has few direct bus connections, and the railway is far off. There is no high-speed form of transport, such as a metro line, from the airport; which dramatically increases the transfer time.

3.7.7 Climate Change

Bangladesh is one of the most flood prone countries in the world and has experienced 21+ above-normal floods, of which 4 were exceptional and 2 were catastrophic in the past 60 years.[36] The 2007 flood caused damage to 31,533 km of roads and affected 14 million people, with damage amounting to $1.1 billion. According to a 2010 World Bank Study, *Climate Proofing Infrastructure in Bangladesh,* "using the 1998 flood as a benchmark for evaluating additional protection measures, the authors calculate conservatively that necessary capital investments out to 2050 would total US $2.671 billion (at 2009 prices) to protect roads and railways, river embankments, surrounding agricultural lands, and drainage systems and erosion control measures for major towns. With gradual climate change, however, required investments would be phased. Beyond these capital intensive investment, improved policies, planning and institutions are essential to ensure that such investments are used correctly and yield the expected benefits."

One key challenge of the roads and highways sector will be formulating strategies as well as raising funds to effectively deal with the consequences of climate change and resulting monsoon flooding. According to the Intergovernmental Panel of Climate Change (IPCC), a warming trend in the larger Ganges Brahmaputra Meghna basins in South Asia, where Bangladesh is located, will result in an increase between 1-3 degrees Celsius by 2050, which will cause higher precipitation in the basins causing increased monsoon rainfall and subsequent flooding. This will cause damage to infrastructure and as a result it will be of utmost importance that investments are made to maintain key infrastructure as well as to design future infrastructure projects in such a way as to minimize flood related damage, which includes increasing the elevation of roads and village platforms.

The study was able to forecast necessary capital investments in infrastructure by first understanding the current spatial distribution of infrastructure, and then adding to it projected expected changes by 2050 (due to an absence of concrete long term planning for new roads, the total length of roads in the country was estimated to be increased by 25% over the existing stock up until 2050). The additional inundation risk zones due to climate change were then overlaid on an infrastructure map using GIS software to determine the assets exposed to additional inundation risk.

Table 30 shows the inundation areas by 2050. It should be noted that 50% of the country will constitute flood affected areas by 2050, indicating that a large percentage of the population will be at risk along with a large percentage of infrastructure (roads, railways, bridges, embankments, drainage systems, etc.).

[36] Climate Proofing Infrastructure in Bangladesh, the World Bank, 2010

Table 30 Inundation Area Estimates by 2050

	Baseline Scenario		Climate Change Scenario		Change due to Climate	
	Km2	**% of Total Area**	**Km2**	**% of Total Area**	**Km2**	**% of Total Area**
Flood Free	69,439	52%	64,550	49%	-4,889	-3%
F0 (0.1-0.3m)	2,950	2%	2,251	2%	-699	
F1 (03-0.9m)	14,123	11%	11,975	9%	2,148	-2%
F2 (0.9-1.8m)	19,118	14%	20,723	15%	1,605	1%
F3 (1.8-3.6m)	22,115	16%	26,153	19%	4,038	3%
F4 (>3.6m)	5,777	4%	7,870	6%	2,093	2%
Total Flooded Area	60,750	45%	66,362	50%	5,588	5%

Source: Climate Proofing Infrastructure in Bangladesh, World Bank, 2010

In **Table 31** given below, a breakdown of the percentage of roads by type that fall under a certain level of inundation depth in 2050 is shown. From the table it can be seen that 87% of all roads will be under an inundation depth of 0-0.5 meters, with 13% of roads under an inundation depth of up to 2 meters. All national and regional roads have been designed to be built above the highest flood level with a return period of 50 years, with feeder roads designed to be above normal flood levels. However, these standards are still not enough to prevent large losses in road infrastructure during recent major floods; road damage accounts for 15% of the total damage of about 0.7% of GDP during the 1998 flood.[37] Therefore, the forecasted increase in inundated areas as well as increase in inundation depths will only cause further risk of damage.

Table 31 Length of Road (km) at additional Inundation Risk from Climate Change in 2050

Additional Inundation Depth (m)	Feeder Road Type A	Feeder Road Type B	National	Regional	Rural	Total	Share of Total
0-0.5	6,175	4,203	998	587	11,065	23,027	87%
0.5-1	734	515	194	86	1,315	2,844	11%
1.0-1.5	72	68	11	6	189	346	1%
1.5-2.0	24	19	1	3	89	137	1%
2.0-2.5	7	4	0	1	17	30	-
2.5-3.0	8	2	1	0	8	19	-
All exposed	7,020	4,810	1,205	683	12,683	26,402	100%
Share of all exposed (%)	27%	18%	5%	3%	48%	100%	

Source: Climate Proofing Infrastructure in Bangladesh, World Bank, 2010

In order to deal with these increased risks of flooding, adaptation costs were estimated for roads. These adaptation measures include raising roads to avoid further inundation. **Table 32** provides a breakdown of the funds required for the road sector. Specifically, the estimated cost for elevating the entire road network to offset additional risk due to climate change is $2.12 billion, with national and regional roads accounting for 12% of costs and rural and feeder roads accounting for 88% of costs.

[37] Climate Proofing Infrastructure in Bangladesh, World Bank, 2010

Table 32 Adaptation Cost for Roads, by Road Type (millions $)

Additional Inundation Depth (m)	Feeder Road Type A	Feeder Road Type B	National	Regional	Rural	Total	Share of Total
0-0.5	730.986						92%
0.5-1	47.114	309.243	144.186	98.329	675.600	1,958.343	6%
1.0-1.5	6.286	20.843	11.086	8.271	47.843	135.157	1%
1.5-2.0	1.043	2.971	2.200	0.500	8.486	20.443	0%
2.0-2.5	1.086		0.071	0.157	1.257	2.529	0%
2.5-3.0	1.243	0.543	0.071	0.129	1.529	3.357	0%
All exposed	787.757	333.800	157.714	107.486	735.500	**2,122.257**	100%
Share of all exposed (%)	37%	16%	7%	5%	35%	100%	

Source: Climate Proofing Infrastructure in Bangladesh, World Bank, 2010

3.7.8 Cross-Drainage Facility for Roads

In addition to elevating the road levels, actions should also be taken for inadequate drainage facilities for flood water, for which, culverts and regulators are used for drainage at present. However, with increased instances of flooding, there will be an increased volume of flood water – which will require a substantial increase in the number of drainage facilities. The existing culverts may also require to be raised to deal with new inundation levels. It has been estimated that approximately 775 new drainage structures will be required at a total cost of $166.07 million, as well as 315 culverts will have to be raised at a cost of $4.50 million.[38]

Unpaved roads will also suffer the most, as intense precipitation and flooding will wash away unpaved roads, which are most common in rural areas. Scientific evidence has indicated that climate change will definitely intensify inundation problems in Bangladesh, it is therefore of the utmost importance that design standards for roads be accordingly adjusted, investments in flood-proofing infrastructure be made, and that adequate policies and planning measures are made. Climate proofing of the infrastructure will be a difficult and expensive challenge that will require effective long-term planning, and it is imperative that this planning start as soon as possible.

3.7.9 Institutional Issues

The institutional issue is a big challenge for the road sector. In general, there is an inadequacy of qualified professional staff across the relevant agencies. This is the general result of lack of quality educational institutions in the country that help develop enough qualified personnel to meet the demand of such individuals. There are only a handful of well-recognized higher educational institutions, making it more difficult for the Government to recruit skilled professional staff. One of the most persistent complaints of the management of such agencies is the dearth of staff of superior quality and efficiency, which is difficult to find.

RHD consists largely of an aging workforce, especially amongst Class 1 senior officers, and soon there will be an insufficient number to fulfil all management responsibilities. 56% of Class 1 officers are 51 years and older and will retire in the next 7 years. In addition, the organization's Executive Engineers have disbursement capabilities, meaning that they can be procurer, paymaster, and engineer within the same project – which causes auditing functions to be minimal.[39] There are also deficiencies in the staffing and skills mix; the majority of the professional staff in RHD and

[38] Climate Proofing Infrastructure in Bangladesh, the World Bank, 2010

[39] Road Master Plan, 2009

LGED are from Civil engineering discipline including structural design, highway engineering, soil mechanics, etc. However a mix of skill sets from other disciplines, such as project management, resource management, and financial management are also necessary for effective management. In order to combat these issues, it is important that the Government implement reforms within the organizational structure of Government bodies as well as enforce these bodies to construct and implement concrete and effective strategies/plans.

Institutional issues also include the issue of a long approval process; many projects are consistently delayed as there is a major backlog of projects and activities. Bureaucratic red tape and the heavily reliability on approvals from senior management consistently delay projects. During the Dhaka Elevated Expressway negotiation phase, the Government made changes in initial project plans which resulted in a major setback in the project timeline. The delay gave rise to the requirement of a new contract, which Bangladesh Bridge Authority was unable to provide within a short period of time. Many projects suffer from procurement related issues or a delay in the release of funds which also set back project timelines and result in higher capital costs.

Another issue is lack of coordination between implementing agencies. Some LGED plans may be at odds with BIWTA or RHD plans. LGED's practice of developing road following a sinusoidal alignment result in the inland waterway sector being unable to effectively create accessibility or headroom clearance for a large sized water transport, resulting in an inability for the inland waterway sector to successfully contribute to rural development.[40] Within Dhaka, traffic management and city development is often compromised as a result of a lack of coordination between relevant agencies and even an overlapping of functions amongst them. This breakdown of communication between agencies results in substantial losses to the capacity of operational service. According, to the *Strategic Transport Plan (2005)*, this can cause up to 50% of the capacity of the arterial system of roads to be wasted due to poor operating conditions. In addition, land use planners and transportation planners have no coordination, even though there is a plan adopted by the Government, *Dhaka Metropolitan Development Plan (RAJUK, 1998)*. There is an overall lack of guidance and adherence to such an idea. Planning is not done correctly and cohesively, such as few Traffic Impact Assessments are actually made for new developments. This overall lack of integration between land use planning and transportation planning, the former being RAJUK's responsibility, while the transportation planning function divided between BRTA, DTCB, DCC, and the Police, results in uncontrollable and unplanned development, poor compliance and a poor mix of land use and an overall inefficient transportation system.

It is of utmost importance that the agencies related to key infrastructure and management collaborate frequently and extensively to ensure that together they are helping to plan and implement key inter-modal transportation goals as well as the proper management of existing cities. Each relevant Ministry/agency should have planning teams with the responsibility of coordinating with other Ministries/agencies for inter-modal transportation planning, to be supervised by a central organization, such as the Planning Commission. Within established urban cities, it is important that all concerned agencies work synergistically together to achieve common goals. In the *Strategic Transport Plan (2005)*, a central planning committee in Dhaka, namely Dhaka Metropolitan Regional Authority (DAMERA), was recommended for land use and transportation planning, but it has not been materialised. Currently, DTCA is responsible for the coordination and planning of transport sector strategies and plans with other Government and private bodies; however the organization's ability to bring about meaningful change has thus far been limited.

3.7.10 Existing Plans of Action

Table 33 gives a brief overview of the action plans as how the Government has been combating the key challenges listed in this section so far.

[40] Strategy for Infrastructure Sector, Background Paper for the Seventh Five Year Plan, Policy Research Institute

Table 33 Measures taken thus far by the Roads and Highways sector

Challenge	Response	Analysis
Lack of Maintenance & Insufficient Funding	• Road Master Plan • Many planned/on-going projects • Proposed Road Fund (user fees) • Increasing budget allocation • Development Partner support (JICA, ADB) • Bilateral Transport Agreements (India) • Potential funding from SAARC Development Fund (Infrastructure Wing) • Utilizing funding via PPP projects	• Road Master Plan lacks specificity and key deadline based planning • Too many planned/on-going projects to adequately deal with • Road Fund has not yet fully taken affect • Increased budget allocations are still not at required levels • Development Partner support is still very limited • PPP guidelines, guarantees, and access to financing needs to be increased in capacity
Slow Implementation	• Prioritization of certain road corridors • Road Master Plan	• Too many projects are still a problem • Red tape and institutional capacity is difficult to solve
Land Resettlement	• Land Acquisition & Resettlement (LAR) Framework • Resettlement Action Plans	• Lack of strategic land-use planning • Framework is not enough to ensure appropriate resettlement
Traffic Growth/ Road Safety	• Planned service lanes (bazaars) • Planned intersections, loading bays, foot bridges, iron fence barriers, delineators, traffic signals • 4-laning of highways • Controlled Expressway (Dhaka-Chittagong) • BRTA drive against unfit vehicles (fitness certificates) • Construction of flyovers, elevated expressways, (such as flyovers on Airport Road, Jatrabari flyover (BOT), Major Hanif flyover (BOT), Banani flyover, Hatirjheel,) • Highway Patrol Police (2005) • BUET Accident Research Institute • BRTA Road Safety Cell	• Many solutions are still in the planning phase • Slow implementation • BRTA lacks capacity to deal with the number of vehicles on the road • Few public transport projects have finalized financing
Climate Change	• Govt has highlighted severe monsoon floods as a significant hazard and ensuring adequate flood protection infrastructure as a "pillar" of the Climate Change Strategy and Action Plan (GoB, 2009) • Govt has already invested over $10 million	• Climate change is not in the control of only Bangladesh • Govt's plans for climate change are still very minimal and lacking in scope considering the magnitude of climate change

Challenge	Response	Analysis
	(constant 2007 prices) in flood management embankments and emergency shelters	effects
Institutional Issues	• Renaming of Ministry of Communications – Ministry of Road Transport & Bridges • Many discussion/consultation forums (National Land Transport Policy) • Transport Sector Coordination Wing (TSCW) – Planning Commission	• Lack of overall coordination within all agencies, besides broad agenda to "solve" such issues, few practical and effective measures have been taken

3.7.11 General Challenges

- Due to the monsoon climate, natural calamities and vehicle overloading, serious damage to the road network occurs. Hence, more attention is being given to the management of road maintenance.
- Slow implementation of a Road Fund to ensure timely and adequate investment for road maintenance.
- Slow implementation of Troll Policy 2014 for generating revenue for ensuring maintenance provision of roads and highways.
- The operation of the highway network addressing congestion caused by traffic mix, encroachment and poor traffic management.
- Reduction of road deterioration due to vehicle overloading is difficult.
- Road safety is critical, as such initiatives have been taken to address in road design, traffic enforcement and public awareness, however much more needs to be done.
- High traffic growth over the next 20 years considering regional traffic leading for implementation of 4-lanning of National Highways and construction of a second bridge over large rivers.
- Government realises that significant commitment from its own end while ensuring quick return is vital in attracting the massive private sector investments; this is needed for successful implementation of PPP based road projects.
- Addressing the problems related to land acquisition, utility shifting, encroachment, consultant appointment, matching fund etc. for successful implementation of mega projects under road sector.

3.8 Knowledge Gaps

Some of the knowledge gaps of the roads and highways sector, defined as knowledge gaps that negatively affect the strategic operations and growth of the sector, include the following:

- **Lack of updated published data:**

  While researching for this baseline study, it became apparent that many key published data statistics, such as the freight modal share between the transport sub-sectors, the status of RHD and LGED roads, maintenance requirements, traffic forecast, trip times, etc. tended to either be dated or missing. This indicates that there has not been enough emphasis on accumulating data related to transport sectors – this can pose a problem when strategically planning the maintenance requirements as well as planning new infrastructure projects. For example, a lack of updated traffic data makes it difficult for the private sector to access whether or not it would be financially feasible to build flyovers in Dhaka city, under schemes such as BOT, and collecting the data themselves is a costly initiative that could deter private sector investment. Therefore, it is important for the Government's long term planning in the transport sector to regularly update data regarding the transport sector.

- **Lack of specificity in Government policies:**

  The GoB has prepared many key policies in relation to the country's transport sector, however many of these policies only point out the challenges in the sector and then proceed by offering ambiguous and open-ended solutions to these challenges. For instance, in the Government's *National Land Transport Policy* and *Integrated Multi-Modal Transport Policy,* many challenges are followed by a statement saying that the Government will address those challenges; however no specific action plan is included. The only policy that goes further is the *Road Master Plan*, but even within this plan there are only recommendations made with no specific set timeline and course of action set in stone.

- **Lack of Prioritization of Projects**

  The GoB does a very good job in understanding the challenges, maintenance requirements, as well as outlining necessary future infrastructure projects within the roads and highways sector – however, there needs to be an adequate reconciliation between what is required in the sector and what is financially and technically feasible. The 2013-2014 ADP for RHD alone includes an immense list of 126 projects, which amount to fund requirements well beyond the actual yearly allocation of the ADP. Each year, more and more projects are added on to the ADP program, with no real planning as to how many of the projects can realistically be completed given current funding. Instead of adding on so many projects each year, the Government should focus more on prioritizing certain projects to ensure that these projects are completed within scheduled time frame.

- **Inability to Forecast Future Transport Network**

  Due to many of the challenges and knowledge gaps mentioned earlier, it is almost impossible to accurately forecast Bangladesh's future transport network. As many projects are delayed, cancelled, in need of more financing, or not prioritized, etc, a divide is created between what the Government plans and what the Government can actually implement. As a result of this inability to accurately forecast the dynamics (number/type of structures, road length, road height, road condition, etc) of the future transport network, it is also difficult to understand what this future network could possibly mean both economically and environmentally. For instance, it is difficult to predict how the agricultural sector or the fisheries sector will be affected in 2020 based on Government infrastructure plans, as there is no real idea as to what the transport infrastructure will actually look like that far into the future. This makes policy planning for all sectors difficult; it is also difficult to effectively build climate change policies, or agricultural policies, or fishery policies, etc, without understanding what the transport scenario will actually be in the future. Therefore, it is important that the Govt start setting realistic goals and prioritizes projects in such a manner that they are completed in time; this will then have positive spill over effects in all sectors.

3.9 Recommendations

3.9.1 General Recommendations

❖ The Government should place more emphasis on consistently keeping data regularly updated, published, and available in one central location for all stakeholders to access. This data should have a set time for update requirement; say, all data should be updated by the December 15th of each Fiscal Year, with one central committee within each relevant department (including RHD, LGED, BBA, etc.), responsible for accumulating and publishing that data. Data should include information from project status, projects in pipeline, road network condition, freight modal shares, etc. The Planning Commission should be responsible for setting what information should be included in each yearly update, and this information should be accessible to all thorough online databases. Other parameters that could be included are: corridor/link wise annual average daily traffic (AADT), average travel time/speed, roadway condition, capacity, total travel demand/vehicle usage, accident data, land use data, demographic data.

- Government Policies should not only set broad agenda, but should set specific plans of action based on realistic timelines. These policies should also be reflected in the Five Year Plans. A large and important policy such as the Road Master Plan should be formulated and elaborated to include time-specific goals, which should be mostly mirrored in each subsequent Five Year Plan. Relevant stakeholder agencies, such as RHD and LGED, should base their yearly agenda on these Policies. A good example of a plan with more specificity is the *Dhaka Urban Transport Network Development Study*.
- Each agency related to transportation and urban planning should accumulate data and information on the best practices and case studies from similar countries, such as other countries in South Asia. For example, Bangladesh should learn from India's experience with Bus Rapid Transit – and take note of both good and bad decisions. This information should be consistently updated and shared with the management in order to make strategic decisions for future projects.
- Too many projects are included in each FY's ADP plan. Many projects have long time horizons, which are not taken into consideration when formulating the next year's ADP. FY 2016 ADP should accurately consider the funds required by the previous years' ADP projects for completion, instead of assigning new projects which will only increase backlog and lower productivity. Essentially, the Government needs to pay more attention to prioritizing key projects instead of taking on too many projects at a time.
- New road projects should ensure that they are using quality materials and procedures, so that the roads are durable. The projects should include drainage facilities, concrete pavements instead of traditional bituminous pavement, and strict axle load control policies, such as the introduction of weighing stations.[41] Emphasis should also be placed on the proper maintenance of key economic roads. It is important that the Road Fund takes full effect as soon as possible. The Govt and the relevant agencies should move away a "build, neglect, rebuild" mindset, and instead focus on ensuring proper maintenance of existing infrastructure.
- Many private companies are hesitant of PPP due to changing future macroeconomic and political factors that could decrease their ability to collect sufficient revenue from potential projects. In order to abate this, the Government should focus on ways to incorporate adequate Government guarantees, tax concessions, and a level of cost-sharing that encourages the advancement of BOT projects.
- There is an extreme necessity of additional protections against flood waters through the building of flood protection barriers around urban cities. Scientific evidence has indicated that climate change will definitely intensify inundation problems throughout the country, so it is of the utmost importance that design standards for roads be accordingly adjusted, investments in flood-proofing infrastructure be made, and that adequate policies and planning measures are completed. Climate proofing infrastructure will be a difficult and expensive challenge that will require effective long-term planning; it is imperative that this planning starts as soon as possible.
- Roadside land-use should be adequately planned to install proper drainage facilities as well as to ensure that hawkers or semi-permanent establishments do not hamper the flow of traffic.
- The Government should consider the idea of establishing a unitary metropolitan authority for the effective management of large cities.
- The general public should enforce their sense of moral responsibility and personal accountability towards following the law – this would be the most pivotal factor for change. Currently few drivers pay any respect

[41] Strategy for Infrastructure Sector, Background Paper for the Seventh Five Year Plan, Policy Research Institute

or heed to systems of traffic management safety already in place. This should be streamlined; either through awareness campaigns among general public, or through disciplinary actions by traffic police.

- ❖ Due to increasing demand of transport, it is important that in a country with many rivers, special attention should be paid to the development of the inland waterways along with the railway sectors. Interfaces that allow efficient inter-modal transportation, such as the seamless switching between river and land-based transport will be important for future development.
- ❖ It is important that the Government implement reforms within the organizational structure of Government bodies as well as enable these Government bodies to construct and implement concrete and effective strategies/plans.
- ❖ It is important that key agencies related to infrastructure and management collaborate frequently and extensively to ensure that together they are helping plan and implement key inter-modal transportation goals as well as the proper management of existing cities. For instance, each relevant Ministry/agency should have planning teams with the responsibility of coordinating with other Ministries/agencies for inter-modal transportation planning, to be supervised by a central organization, such as the Planning Commission. Within established urban cities, it is important that all concerned agencies work synergistically together to achieve common goals.
- ❖ Dhaka's STP will need to be updated as it is dated by ten years, and many projects have already been implemented that may be in conflict with the projects initially proposed in the plan. As urban transport plays a significant role in the economic development, its capacity must be increased to meet its total demand. This should be done through the implementation of key harmonized projects as well as the enforcement of important traffic and safety rules.
- ❖ Definite policy must be created to encourage the growth of satellite cities to take pressure away from the already deteriorating capital. A long-term solution to the issue of Dhaka's decreasing ability to service its large population will be the development of satellite cities around the capital that offer economic opportunities; this could be in the form of export-processing-zones (EPZ), that offer basic services such as health, education, and leisure activities.
- ❖ There needs to be an access controlled backbone network which links to important roads and highways. In the long-run, Bangladesh should establish two-tier highway systems with access control; such a system could offer accessibility to local roads as well as high-speed mobility.
- ❖ It is important for the Government to have an accurate idea of what the future road network will be like in a future given year. This is for two reasons:
  - o The sectors that are affected by the road network, such as agriculture, can anticipate how these changes will affect their sector;
  - o Future road networks should include the socio-economic and climate issues, such as population changes, transport demand changes, and the impacts of climate change. The ability to adequately forecast a future road network is also heavily dependent on previously mentioned recommendations being carried out effectively.

3.9.2 Priority Development Strategies and Policies for 7th FYP 2015-2020

- Ensuring better traffic management making provision of separate lane for slow moving transports while upgrading the national highways to 4 lanes.
- For better traffic management at congested intersections and rail crossings provision for overpass/flyovers in National Highways.
- Constructing link road with National Highways to activate the Sea, River and land ports to efficiently integrate the transport modes.

- Upgrading the Dhaka-Sylhet Highway to 4 lanes by phases as a part of Trans-Asian Highway and to construct missing link on the Highway network.
- Preparing the design of National and Regional Highways taking into consideration of axle load and frequency of traffic at present.
- Ensuring timely budget for the quick implementation of mega projects under RHO.
- To ease the traffic congestion, construction of Eastern Bypass Embankment and that of Dhaka Circular Road is essential along with their linkage with waterways.
- Implementing umbrella projects avoiding several small projects for Zila road development.
- Upgrading and widening of national corridors to extend the trade and economic connectivity with Nepal, Bhutan, India and Myanmar.
- Upgrading and widening of existing roads are preferred instead of constructing new roads and bypass roads to protect the valuable agricultural lands.
- Linking of private EPZ/SEZ for improving trade and commerce
- To provide an uninterrupted, safe and comfortable road network facility, all existing river gaps should be eliminated by constructing new bridges as early as possible.

4 References

Dasgupta, S., Huq, M., & Khan, Z. (2010). Climate Proofing Infrastructure in Bangladesh. *The World Bank,* 34-34. Retrieved October 1, 2014, from http://www.preventionweb.net/english/professional/publications/v.php?id=16426

TRANSPORT AND COMMUNICATION. (2008, January 1). Retrieved July 15, 2014, from http://www.mof.gov.bd/en/budget/er/2008/c11.pdf

Schwab, K. (2014). The Global Competitiveness Report 2013–2014. *World Economic Forum*. Retrieved July 18, 2014, from http://www.weforum.org/reports/global-competitiveness-report-2013-2014

Bangladesh Development Forum Meeting 2010. (2010, January 1). Retrieved August 12, 2014, from http://www.lcgbangladesh.org/bdf-2010/BG_ Paper/BDF2010_Session V.pdf

Integrated Multi-Modal Transport Policy Final Draft. (2008, January 1). Retrieved August 10, 2014, from http://fpd-bd.com/wp-content/uploads/2013/04/IMTP-Nov-2008-08.pdf

National Land Transport Policy. (2004). Retrieved July 20, 2014, from http://lib.pmo.gov.bd/legalms/pdf/National-Land-Transport-Policy-Bengali-english.pdf

National Toll Policy 2014, RHD.

Bangladesh Vision 2021, CDP

The Private Sector Power Generation Policy (PSPGP), October 1996, revised November 2004, Ministry of Energy and Mineral Resources, GoB.

The Policy and Strategy for Public Private Partnership (PPP), 2010, GoB; see also: www.pppo.gov.bd

Guidelines for Viability Gap (VGF) for Public Private Partnership (PPP) Project, GoB, see also: www.pppo.gov.bd

Reducing Poevery by Closing South Asia's Infrastructure Gap, World Bank , dec 2013

National Sustainable Development Strategy (NSDS). (2013). Retrieved August 15, 2014, from http://www.plancomm.gov.bd/wp-content/uploads/2013/09/National-Sustainable-Development-Strategy.pdf

PERSPECTIVE PLAN OF BANGLADESH 2010-2021. (2012). Retrieved August 3, 2014, from http://www.plancomm.gov.bd/wp-content/uploads/2013/09/Perspective-Plan-of-Bangladesh.pdf

Budget Speech 2014-2015. (2014). Retrieved August 18, 2014, from http://www.mof.gov.bd/en/index.php?option=com_content&view=article&id=274&Itemid=1

Mid-Term Implementation Review of the Sixth Five Year Plan of Bangladesh. (2014). *Policy Research Institute of Bangladesh*.

SIXTH FIVE YEAR PLAN FY2011-FY2015. (2011). *Planning Commission*.Strategic Tranport Plan (2004-2024) (STP), (2005), Ministry of Comnunications, Dhaka Transport Co-ordination Board.

Dhaka Urban Transport Network Development Study (DHUTS), (2010), Katahira and Engineers International, Oriental Consultants Co Ltd and Mitsubishi Research Institute.

About LGED. (n.d.). Retrieved from http://www.lged.gov.bd/#

RHD Overview. (n.d.). Retrieved from http://www.rhd.gov.bd/

Demands for Grants and Appropriations - Roads Division. (2013). *Ministry of Finance*. Retrieved from http://www.mof.gov.bd/en/budget/13_14/cdg/en/50_roads_en.pdf

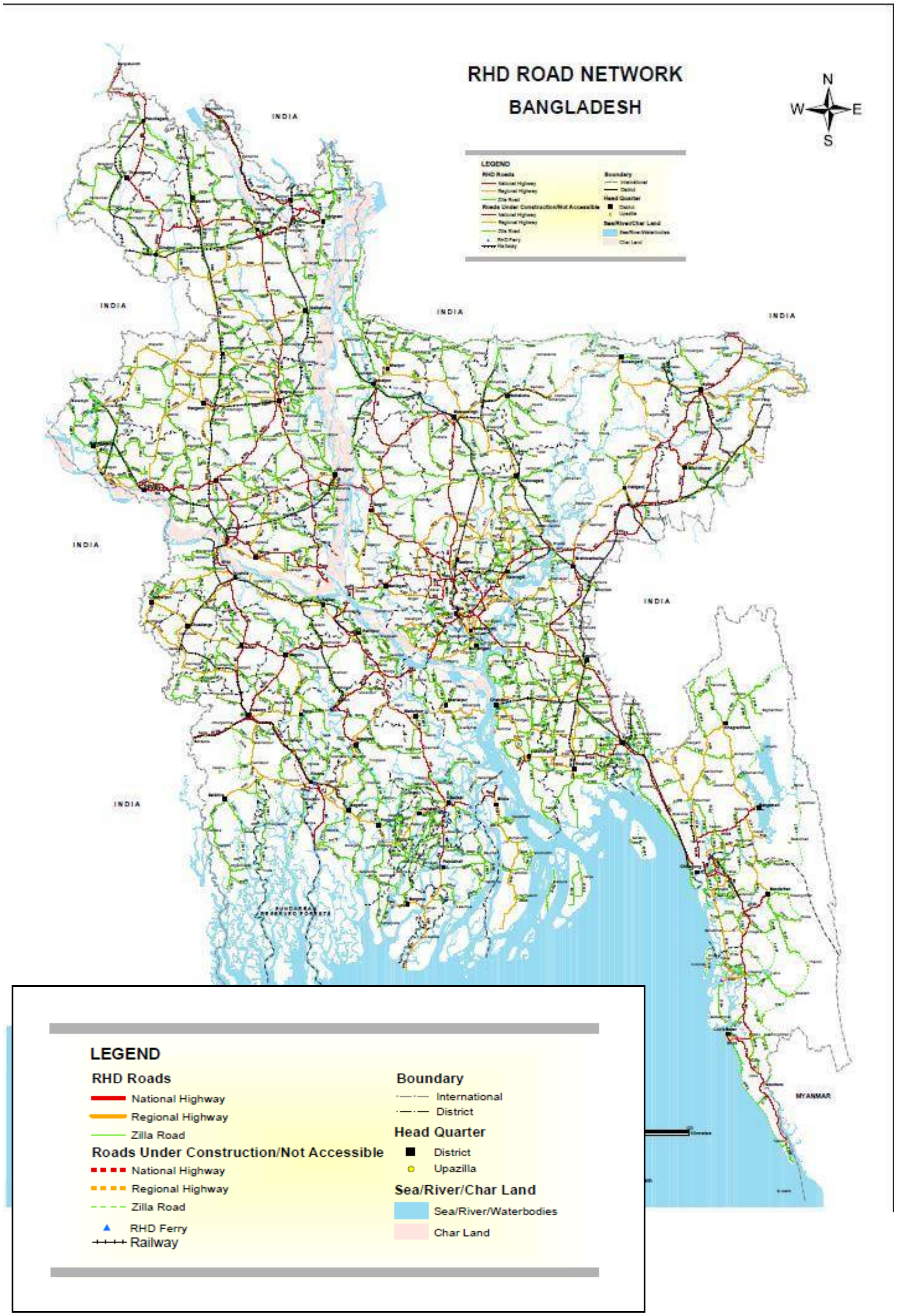
Maintenance and Rehabilitation Needs Report of 2012 – 2013 for RHD Paved Roads. (2012).*RHD*. Retrieved from http://www.rhd.gov.bd/RHDNews/Docs/Needs_Report_12-13.pdf

Road Master Plan. (2009). *RTHD*. Retrieved from http://www.rthd.gov.bd/assets/docs/road_master_plan.pdf

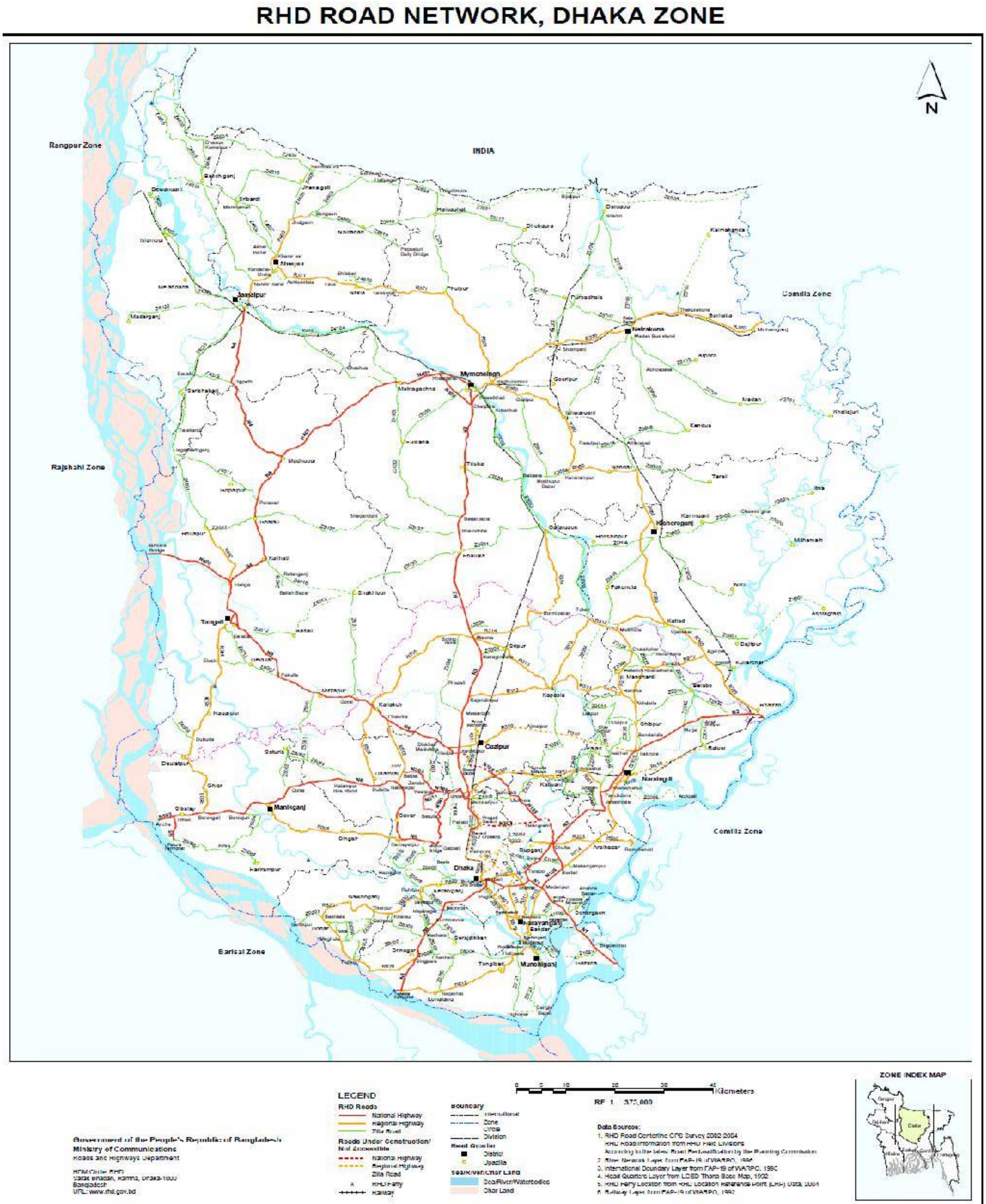
Transport and Communication. (2014). In *National Accounts Statistics 2013-2014.* Bangladesh Bureau of Statistics.

5 Annexes

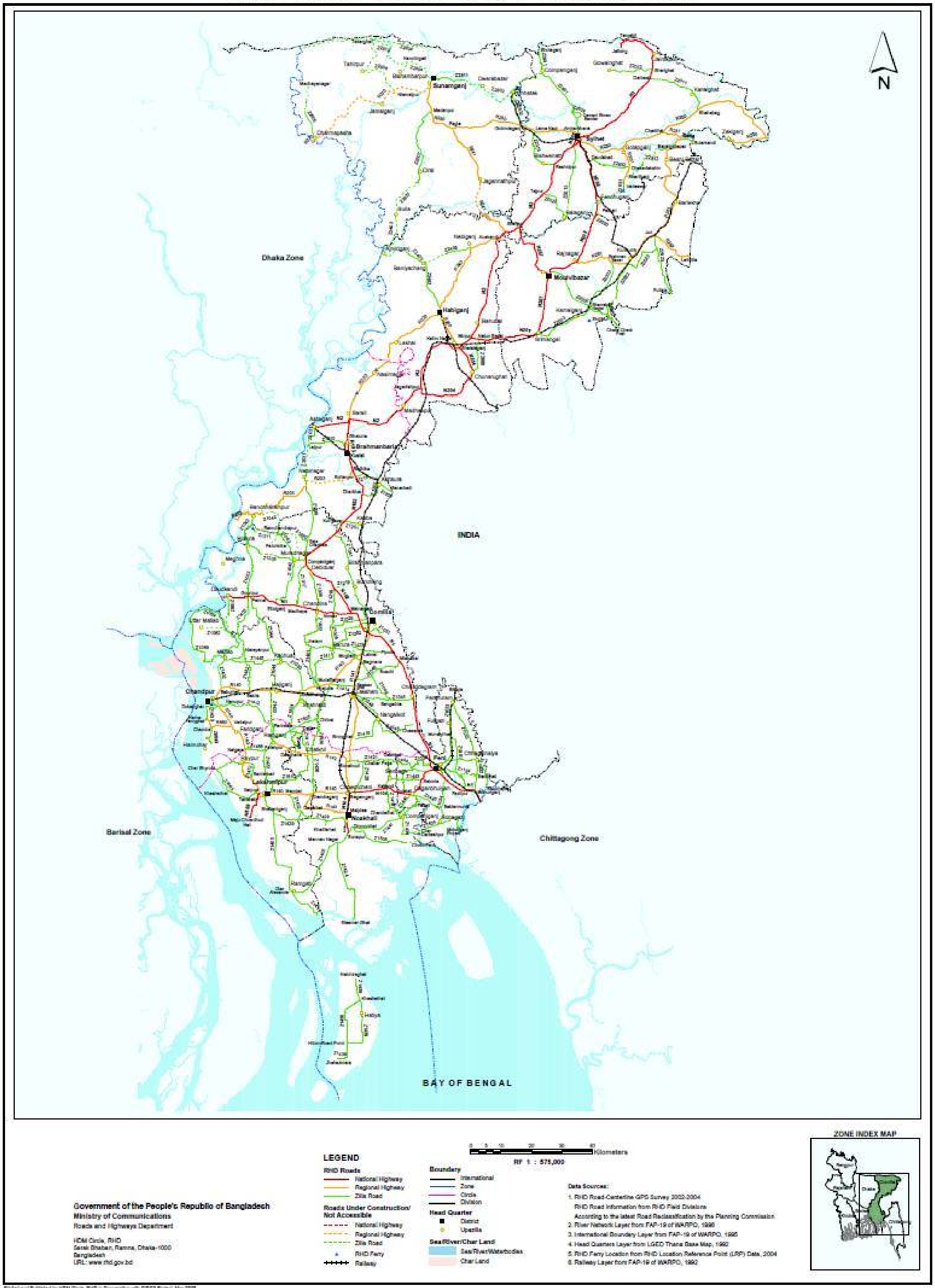
Roads and Highway Network Map: Bangladesh

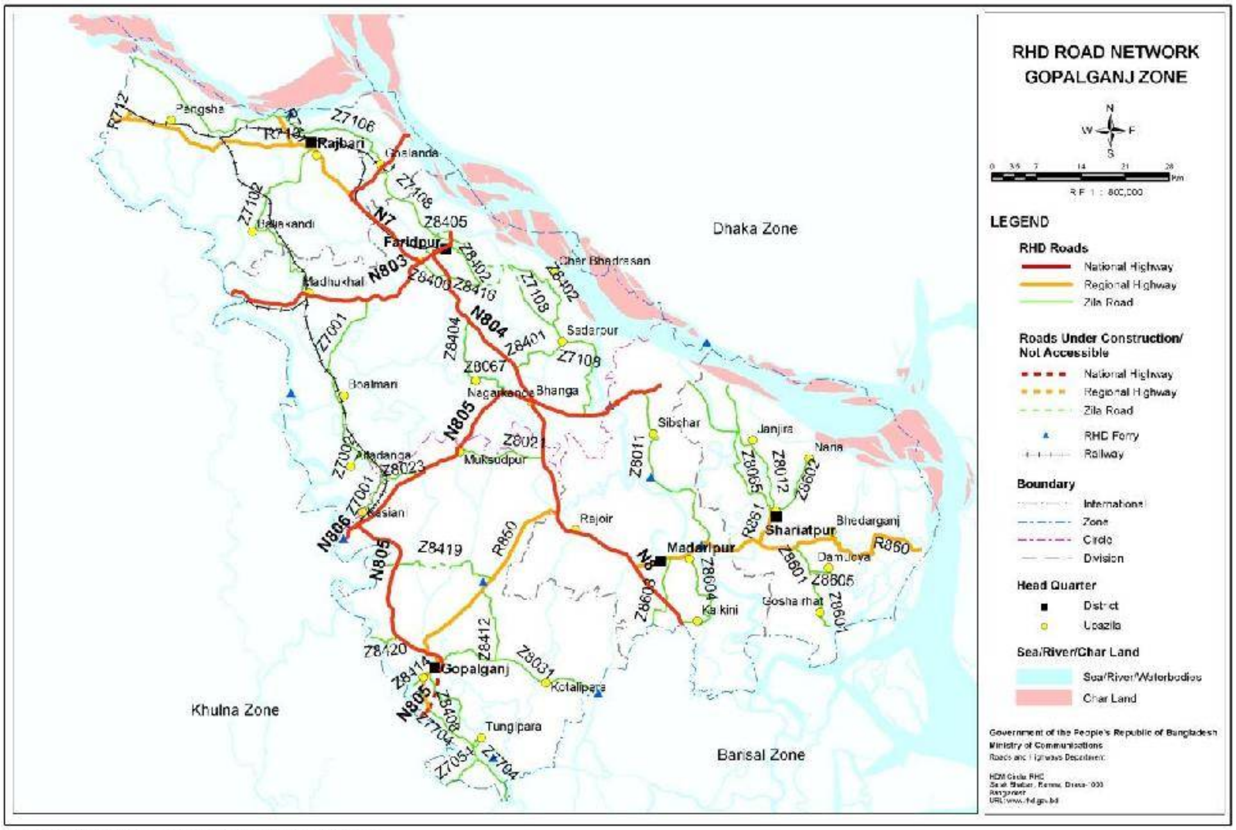


Roads & Highway Network Map: Zonal



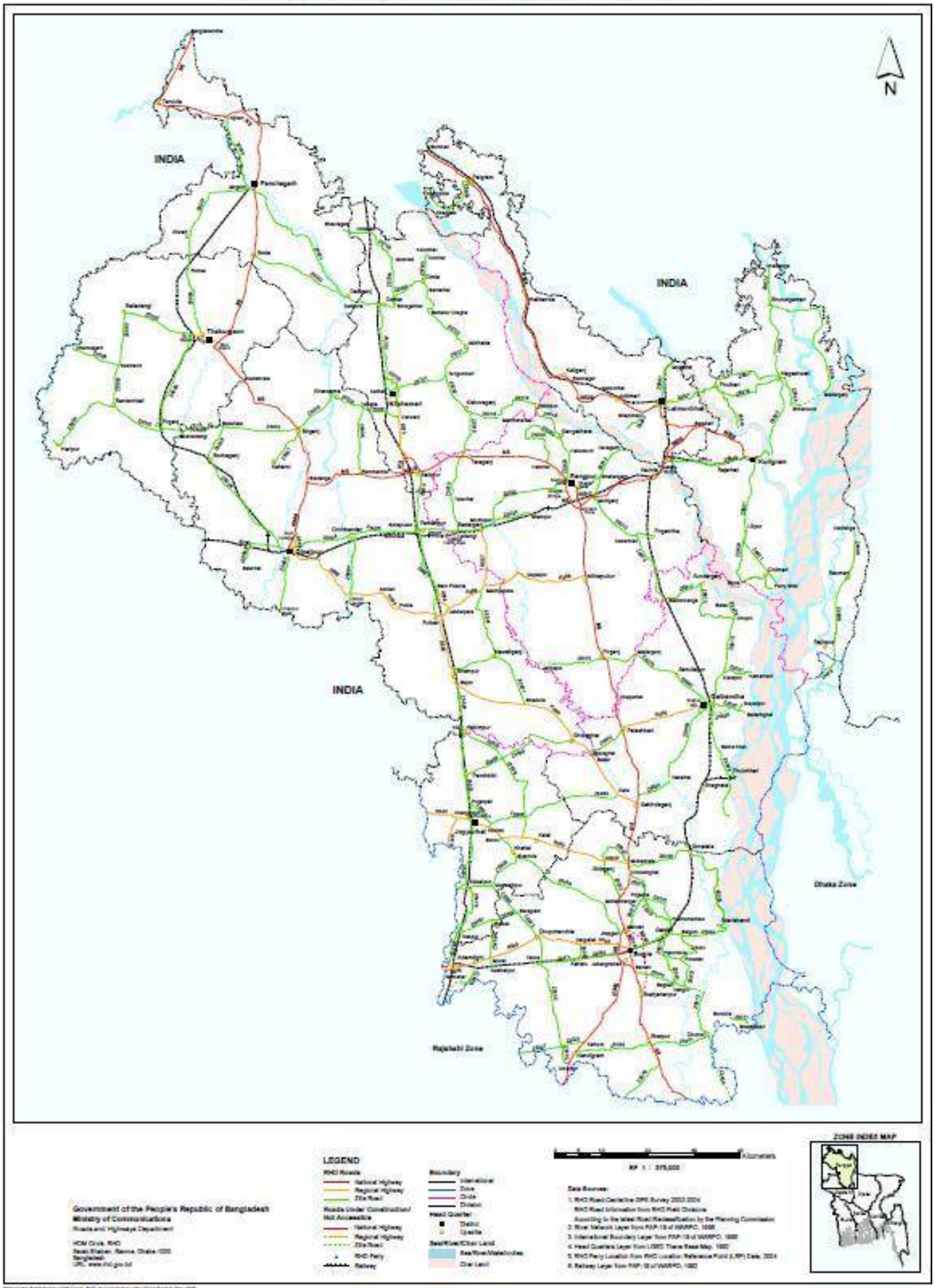
RHD ROAD NETWORK, COMILLA ZONE





Printed and Published by HDM Circle, RHD in Cooperation with ... Project, May 2005

RHD ROAD NETWORK, RANGPUR ZONE



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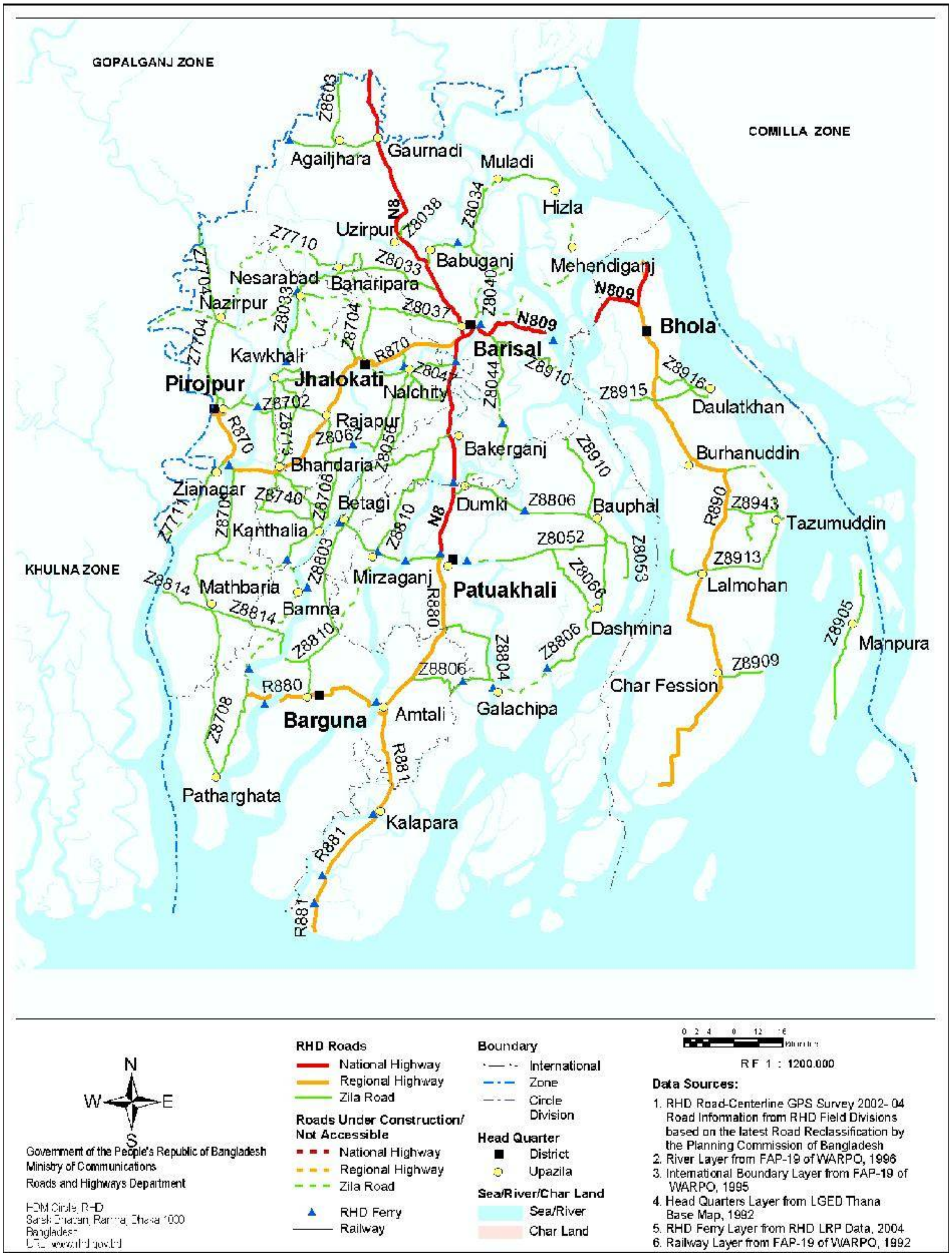

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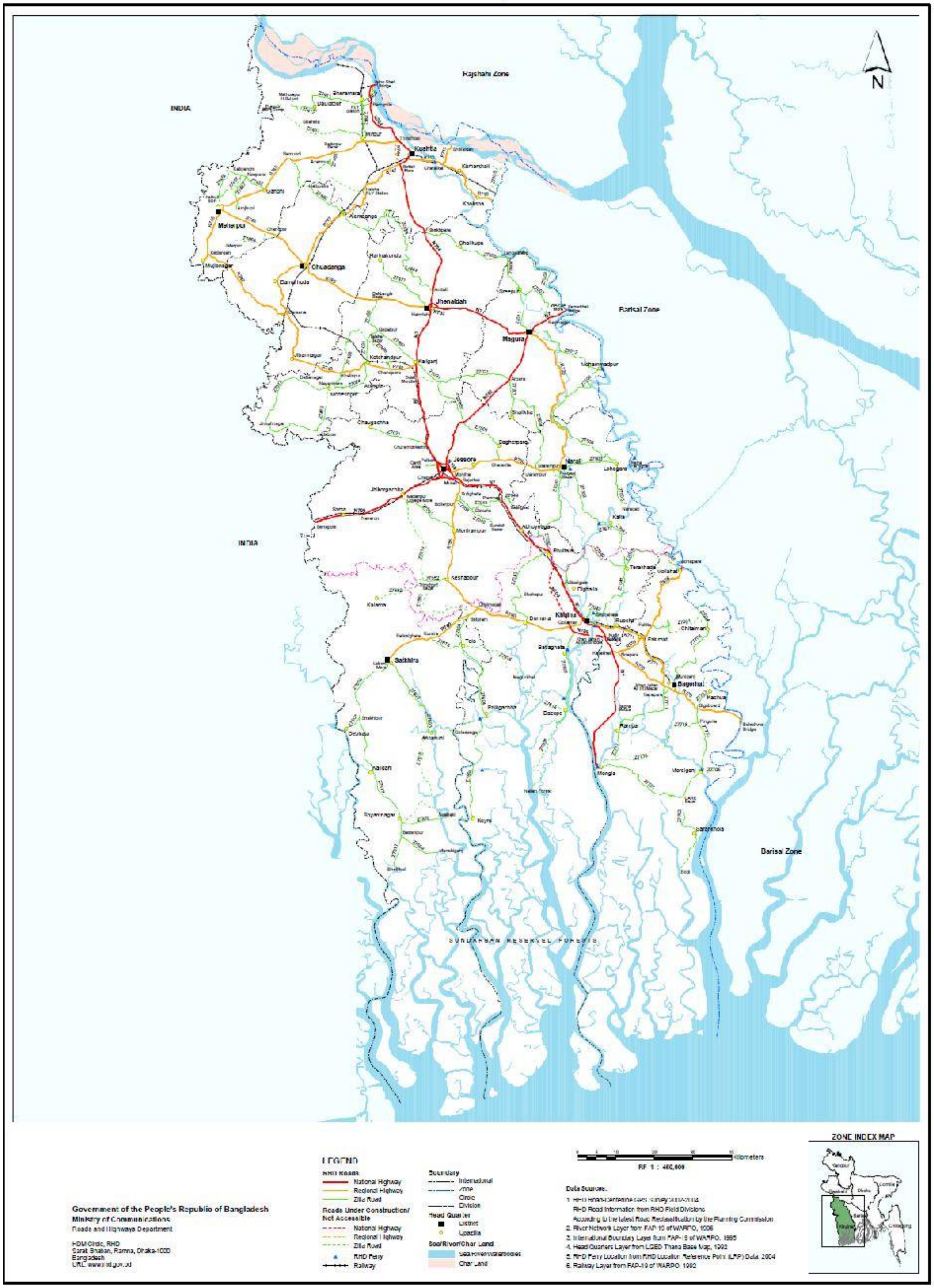

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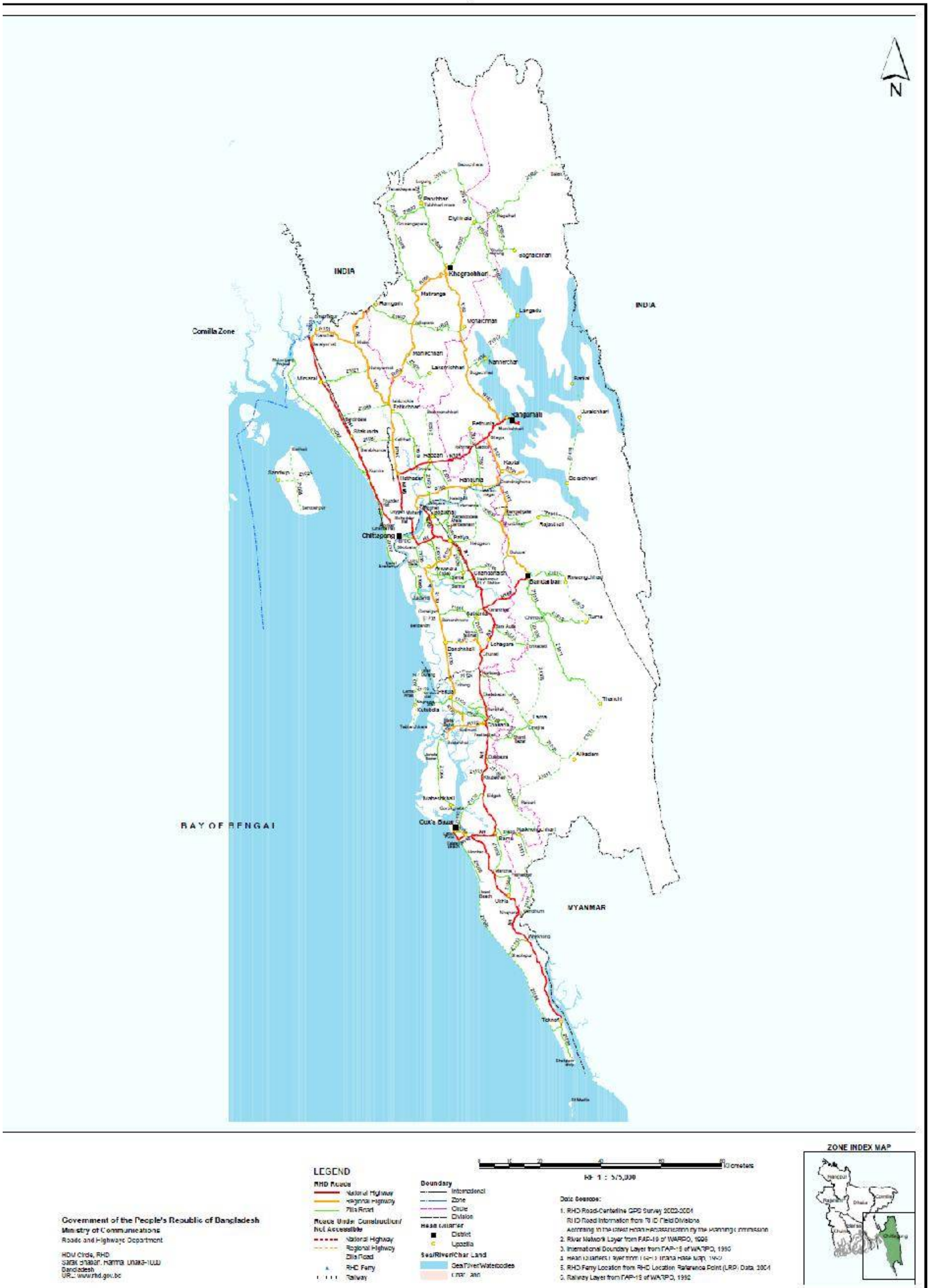

BASELINE STUDY: 14

Sustainable Transportation and Infrastructure
Part 2: **Railway**

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Executive Summary : Study 14 (Part 2 : Railway)

In Bangladesh, rail communication is considered to be the most environmental-friendly, safe, and affordable form of transport. However, based on a 2007 World Bank Report, it was found that the railway only represents 4% of passengers modal share and 4% of freight modal share – a strikingly low percentage considering the many benefits of the railway sector. This is due to railway's poor infrastructure, insufficient funding, deteriorated physical assets, and low efficiency of services compared to other available transport types. Bangladesh Railway (BR), the state-owned rail transport agency of the country, currently includes approximately 2,877 km of railway network (connecting 44 districts), 440 stations, 286 locomotives, 1,503 coaches and 10,226 wagons. There are 261 passenger trains of which 68 are intercity, 66 are mail and express, 127 local, and 55 goods and container trains. BR is under the control of the Ministry of Railways. The most frequently used rail route is from Dhaka and Chittagong and vice versa. Key features of the current railway are the coexistence of several gauges: broad, meter and dual gauges.

Some of the government policies/plans related to the railway sector in Bangladesh, include Sixth Five Year Plan, Perspective Plan of Bangladesh 2010-2021: Making Vision 2021 a Reality, the Railway Master Plan, Integrated Multi-Modal Transport Policy, National Land Transport Policy, and the National Sustainable Development Strategy.

BR, both a public utility service and a commercial enterprise, is heavily subsidized by the Government and has historically been incurring large operating deficits that have only been increasing year by year. Although BR is legally allowed to act commercially and is able to set its own freight tariffs, and add and cancel trains and services as they find suitable, they do not generally exercise this power primarily for fear of public and political backlash. For example, FY 2012's operational deficit is approximately ($128.05 million) and FY 2013's operation deficit is approximately $108.5 million (Tk. 841 crore); an incredibly large deficit and therefore burden for the Government to subsidize.

This study also analyzes some of the railway sector's main challenges. This includes a lack of connectivity, geographical constraint, historic lack of investment, slow implementation, institutional issues, and negative perception. A major constraint in BR is its lack of rail connectivity between rail networks, usually due to difference in rail gauges and the incompatibilities in rolling stock. The railway network is mainly built on two different gauges, broad gauge and meter gauge, which involve transhipments of traffic at certain points where there is a break of gauge points. Moreover, as Bangladesh is a riverine country and hundreds of river flow throughout the country, many far-flung locations cannot be connected rail-wise, as it would need to build costly bridges across the rivers. This makes it even more difficult for BR to adequately serve the needs of the country.

Moreover, since the liberation of the country in 1971, the government has not adequately focused on the construction of new rail-routes; the existing railway routes did not have the required proper maintenance. There has been minimal investment in the railway, which has left this particular transport sector in desperate need of adequate funding.

Climate change is also a huge threat. A World Bank study titled *Climate Proofing Infrastructure in* Bangladesh stated that, "using the 1998 (Bangladesh) flood as a benchmark for evaluating additional protection measures, the authors calculate conservatively that necessary capital investments out to 2050 would total US $2.671 billion (at 2009 prices) to protect roads and railways, river embankments, surrounding agricultural lands, and drainage systems and erosion control measures for major towns."

- Lack of updated published data Many key published data statistics appear to be missing or outdated. This indicates that there has not been enough emphasis on accumulating data related to transport sector. This can pose a problem during strategically planning the maintenance requirements as well as planning of new infrastructure projects.
- Lack of specificity in Government policies

The GoB has prepared many key policies in relation to the country's transport sector, however many of these policies only point out the challenges in the sector and then proceed by offering ambiguous and open-ended solutions to these challenges.

- Lack of Prioritization of Projects

  The Government does a very good job in understanding the challenges, maintenance requirements, as well as outline necessary future infrastructure projects within the roads and highways sector. However, prioritization of projects in the sector should be done and also an adequate reconciliation is needed between what is required for the sector and what is financially and technically feasible.

Some of the main recommendations are briefly discussed below. Detail overview of the recommendations is referred to in **Chapter 3**.

- If BR is developed through increased funding, enhanced planning and policy-building, and adequate human resources, this transportation sector has the potential to provide many benefits. To achieve these, intense modernization is required which will only be possible if BR works more like an autonomous corporation rather than a subsidized government entity. The train fares may increase as a result of this corporatization; however the enhanced quality of services and convenience will still allow it to remain competitive with other sectors. This will require an overhaul of management processes, which may include discontinuing operations of unprofitable routes and laying-off non-performing employees, internal restructuring, and a change in the organization's cultural mindset.
- Tariff reform is paramount. Tariffs for all passenger and freight routes must be reanalyzed and re-priced considering current price levels. When compared to other transport like roads (buses), the railway tariff remained a much cheaper mode.
- BR should focus on inter-city passengers to increase its market share in the transport sector as well as help encourage the proper development of its already deteriorating capital city, Dhaka.
- Introduction of effective commuter rail lines for urban areas, essentially for commuters who live in towns around Dhaka city. These services must be planned in accordance with other existing or planned major projects – such as the MRT and BRT.
- Railway plans should emphasize the development of freight and container transportation. A high-speed and modernized freight and container corridor for transporting goods from Dhaka to Chittagong port must be developed.
- The Bangladesh Railway should enter the regional traffic market as soon as possible. If Bangladesh were to offer railway connections via Bangladesh to neighbouring countries, for example via the Trans Asian Railway (of which Bangladesh is already a signatory) or allow the transportation of freight between India and its north-eastern states, the potential for revenue would increase dramatically which could help in improving BR's overall financial health as well as operational service quality. Therefore, BR should act fast in building infrastructure for regional connectivity.
- The Government and relevant stakeholders, such as City Corporations, should assist BR in controlling the increasing density of level crossings in order to ensure the safety of pedestrians as well as allow the BR to run their operations smoothly.
- Relevant organizations should work with BR in order to plan and implement full grade separations from roadways in order to help improve the traffic management system. As full grade separations can be very costly, thorough analysis should be done to understand which areas are the most beneficial (economically and socially) for full grade separation.
- The Government should put more emphasis on consistently keeping data regularly updated, published, and available in one central location for all stakeholders to access. This data should have a set time update requirement, for instance, all data should be updated by December 15th of each Fiscal Year, with one central committee within the BR responsible for accumulating and publishing that data. Data should include

information from project status, projects in pipeline, railway track/locomotive/engine condition, freight modal shares, etc.

- Government Policies should not only set broad agenda, but should set specific plans of action based on realistic timelines. These policies should also be reflected in the Five Year Plans.
- Too many projects are included in each FY's ADP plan; many projects have long time horizons, which are not taken into consideration when formulating the next year's ADP. Government needs to prioritize the key projects instead of taking on too many projects at a time.
- As mentioned under the Roads & Highways, enhancing inter-modal connectivity should not only be a set broad agenda, but also be taken into consideration with all project plans, for example, the double-tracking of railway lines should take into consideration how the roadway capacity will be affected; also, train stations should be set in areas that allow an easy switch of transportation to roadways or waterways. All transport stakeholders should work in unison when setting their own transport agenda such that all modes do not unnecessarily compete with one another, but rather work together for the socioeconomic benefit of the people. Historically, the unguided nature of development activities has been a direct result of an absence of synergistic efforts between stakeholders.

1 Introduction

1.1 Background

An adequate and efficient country-wide transport system is a pre-requisite for initiating and sustaining economic development. Investment in improving transport efficiency is the key to the expansion and integration of markets – sub-national, national and international. In addition, it contributes to the generation of economies of scale, increased competition, reduced costs, systematic urbanization, export-led faster growth and a larger share of international trade. An efficient transport system is an important element of trade logistics cost and as such is a major determinant of export competitiveness. Efficient transport is also critical in enhancing the physical mobility of citizens. Efficient transport reduces the commuting time of general public, thereby contributing to their welfare.

The transport system of Bangladesh consists of roads, railways, inland waterways, sea ports, maritime shipping and civil aviation, catering to both domestic and international traffic. Besides an efficient transport system, a reliable power system (production, transmission and distribution) is an integral component to initiating and sustaining economic development.

1.2 The Objectives

The broader objective of the thematic baseline is to understand the core drivers within the context of Sustainable transportation and communication infrastructure aspects. These drivers will have to be analysed on the basis of their relevance and impact levels, among others.

The objectives of the thematic baseline study within the context of Sustainable transportation and communication infrastructure analysis therefore include:

- To evaluate existing challenges, developments, opportunities and (government) plans by transport system
- To evaluate expected challenges/opportunities in view of the long term (socio economic and climate) changes
- To identify existing trends and future developments
- To support the common knowledge base
- To identify on-going projects, projects in pipeline and long term perspectives/ideas particularly focusing on water transport system

1.3 Methodology

The methods for this baseline study (and its subsequent subsectors) build on fact finding and interviews by the study team with relevant institutions/stakeholders and the use of existing reports, plans as well as on information available on websites of the relevant institutions. Among this, information has also been gathered on on-going investment projects as well as future planned investment projects.

1.4 Key Sectors of the Study

Roads and Highways: Roads and Highways are considered as the bloodline of the internal communication. Therefore, understanding the present road network is very important

Railways: Railway has connects 44 districts and almost all the important places of the country and has a great contribution in accelerating the economic activities

Inland Waterways: Bangladesh is crisscrossed by thousands of rivers. Inland waterways always play a vital role in communication, especially transporting agricultural goods from one place to another

Ports and Maritime Shipping: (sea) ports and maritime shipping are crucial for import and export of goods (raw materials, such as coal for power stations, intermediary good, and end-products

Power: Power is considered as one of the top most priority sectors of Bangladesh. At present, it is the most critical growth driver of Bangladesh economy. Analysis of power sector and the present and future prospects of the sector in Bangladesh are very important.

1.5 Relationship to Delta Plan 2100 (BDP 2100)

Transportation sector is a key sector which plays an important role in the economic development and urban planning of the country – for the present and the long run. As such the relationship between this infrastructure sector and the BDP 2100 is very important. During the preparation of this report, many discussions were held with roads & highways, railways, inland waterways & ports as well as the power sector. Apart from inland waterways and ports, which directly relates to the Delta Plan in terms of navigation and accessibility for shipping, the power sector, in terms of availability of cooling water and its consequences, are not directly related to Delta Plan strategies, and the various interventions/measures to be taken for the short, medium and long term up to 2100. However, when the Delta Plan is operational, their policies and accompanying (new) investment projects have to conform to the Delta Plan strategies and interventions including in particular, the spatial planning. Therefore, a mechanism has to be implemented, which can sort this out. In the Netherlands the so-called "Water Check" is carried out. For Bangladesh a comparable mechanism of conditionality have to be designed which can deal with (new) plans and (new) investment projects in the transportation infrastructure sector.

1.6 Relationship with other Baseline Studies

Roads & Highway and Railway Sectors

The Roads & Highways and Railway sectors are not directly related to the other Baseline studies, however they are related indirectly. The state of roads, highways, and railways in Bangladesh represent the country's infrastructure as well as the majority of the transport network, which in turn affects the overall economic development of the country. Economic development in turn affects all sectors of the country. Therefore the planning for any other sector (i.e. fisheries, agriculture), must take into consideration the state of the infrastructure.

On the other hand, the road and railway network are also influenced by other factors, such as population, climate change, and sectors that can either increase or decrease the transport sector's demand, such as agriculture. Issues such as population change and the development of dependent industries dictate the overall demand for transport, and therefore affect the way the transport network evolves over time. Climate change continuously affects the roads, highways, and railways, as made evident by the damages caused by persistent flooding. Therefore, it is important that infrastructure is planned in line with the changing dynamics of all directly and indirectly related sectors and issues.

Inland Waterways and Ports

The National Water Management Plan (NWMP) describes the river systems as the *life-blood* of Bangladesh. All those areas which are depending on or utilizing the river are directly linked with each other and integrated under the water management plan. As such, NWMP was prepared *in a comprehensive and integrated manner for the interests of all water related sectors and taking full account of other sectoral policies of the Government*. Accordingly, River Management and River Morphology are directly related with inland waterways.

Navigation requires water, availability of which ensures better eco-system. This way, the inland waterway is related with environment at large. Emission of carbon dioxide from the transport output is one of the largest contributors to global warming and climate change. Sustainable development of transport network must consider the issue of comparative carbon emission of different modes. So, Pollution is related with inland waterways. Rivers are directly and strongly affected by climate change and impact of climate change is already evident in the waterways of Bangladesh.

Power sector is also related with inland waterways as almost all power plants were developed by the side of the rivers. Constructions of power plants require certain navigability for the carriage of over-dimensional (O.D) equipment which cannot be transported by rail or road. River is also required after construction for a thermal power plant for continuous transport of coal and to meet the need of cooling water.

The Integrated Multimodal Transport Policy 2013 envisages *integration within and between different types of transport* with the objective of establishing an efficient transport network that is able to provide a cost and time effective door to door service. As such roads and highways, and railways are related with inland waterways and so with maritime ports.

Power Sector

The power sector is directly related to some other baseline studies, for example: Transportation specially water and railway, Environment and Hydrology etc.

The only way to transport heavy equipment's and machineries of power plants is waterway means rivers. According to the power system master plan there will be a big power generation hub in the northern part of Bangladesh. The waterways need to keep navigable during the construction phase. Fuel of power plant like coal can be transported by waterways and railways. The success in set up coal as main source of fuel of power generation is greatly dependent on related infrastructure development for coal transportation.

The large scale power plants are always located at the bank of river because it is convenient for equipment's and fuel transportation. Also a huge amount of river water is needed as the source of cooling water for thermal power plants. Important information like shifting of location of river, depth and availability of water in rivers, river erosion and location of flood prone areas based on baseline study on river system management are essential for identifying proper location of new large scale power plant.

According to second national communication of Bangladesh submitted to UNFCCC, The power generation subsector is the main source of greenhouse gases (GHGs) emission in Bangladesh. The power sector is also directly related to environment and climate change baseline studies. Among all power plants, the coal based power plants are having highest grid emission factor. In the future, the GHGs emission of power sector will increase considerably as coal will be the main fuel of power generation.

1.7 Structure of the Report

After the introductory Chapter 1, an overview of infrastructure development in Bangladesh including a comparison of the country's main transport infrastructure systems with the neighboring countries has been described in Chapter 2. Thereafter, each of the main transport infrastructure system has been dealt with in a separate chapter. Subsequently, the following sub-sectors are analyzed and discussed: i) roads and highways, ii) railways, iii) inland water transport & ports and maritime shipping, and ix) power. Each chapter (Chapter 3 to Chapter 6) includes the history, present status, key policies, future outlook, key challenges, knowledge gaps and recommendations in the sub sector concerned. An executive summary for each of the sub-sectors is presented at the beginning of this report. The relevant tables, figures, maps are enclosed as per the Table of Content.

It is important to note that data used in this study were primarily taken from government institutions, such as the Ministry of Road Transport & Bridges, Roads and Highways Division, Ministry of Railway, Ministry of Port, Shipping & IWT, Bangladesh Bureau of Statistics, Ministry of Finance, etc. However, the information/ data may often appear outdated due to unavailability of updated information. The most recently government published information was used for the majority of this report.

The report was initially prepared as one report containing all the sub-sectors under the title "Baseline Study: Sustainable Transportation and Infrastructure." However, it was decided later that the report would be divided into four parts, each one containing the baseline study of the relevant sub-sector. As it stands now, the four volumes of the report have been titled as follows:

Sustainable Transportation and Infrastructure Volume 1: Roads & Highways

Sustainable Transportation and Infrastructure Volume 2: Railways

Sustainable Transportation and Infrastructure Volume 3: Inland Water Transport & Ports

Sustainable Transportation and Infrastructure Volume 4: Power

However, the Executive Summaries of all sub-sectors are included in all the volumes. In addition, the introductory chapter (Chapter 1) and Chapter 2, giving an overview of infrastructure development in Bangladesh, are also included in all the four volumes.

2 Overview of Infrastructure Development in Bangladesh

A well-organized and dependable transport and communication system is essential for the socio-economic development of a country. According to data released by the Bangladesh Bureau of Statistics (BBS), in FY 2013-2014, the growth rate in this sector and its contribution to GDP at constant price were approximately 6.47% and 11.54% respectively[5] (**Table 1**).

Table 1 Sectoral Shares of GDP (%) at Constant Prices (Base Year 2005-2006)

Sector	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Transport, Storage, & Communication	10.89	11.05	11.23	11.49	11.50	11.54
a. Land Transport	7.19	7.28	7.31	7.32	7.31	7.31
b. Water Transport	0.95	0.92	0.89	0.86	0.84	0.81
c. Air Transport	0.12	0.13	0.14	0.14	0.13	0.12
d. Support Transport Services, Storage	0.58	0.60	0.63	0.69	0.67	0.66
e. Post & Telecommunication	2.06	2.12	2.26	2.48	2.56	2.63

Source: Bangladesh Bureau of Statistics

The transport sector's (including transport, storage, & communication) high percentage contribution to GDP at constant price, 11.50% in FY 2012-2013 and 11.54% in FY 2013-2014,[6] indicates that the transport sector is an important component of the socioeconomic development of Bangladesh. Land transport represents the majority of the transport's sector's high percentage contribution to GDP with 7.31% in FY 2013-2014.

[5] Bangladesh Bureau of Statistics

[6] Bangladesh Bureau of Statistics

Table 2 Global Competiveness Report 2013-2014, Comparison of Infrastructure Quality 2013-2014

Country	Country Ranking	Overall Infrastructure Score	Electricity	Roads	Railroads	Port
Bangladesh	**110**	**2.8**	**2.2**	**2.8**	**2.4**	**3.5**
India	60	3.9	3.2	3.6	4.8	4.2
China	29	4.3	5.1	4.5	4.7	4.5
Cambodia	88	3.9	3.2	3.7	2.0	4.0
Nepal	117	2.9	1.6	2.7	1.1	2.7
Bhutan	109	4.9	5.9	4.3	n/a	2.2
Myanmar	139	2.1	2.9	2.4	1.8	2.6
Pakistan	133	3.3	2.0	4.0	2.5	4.5
Sri Lanka	65	4.8	5.0	4.7	3.6	4.2
Thailand	37	4.5	5.2	4.9	2.6	4.5

Source: World Economic Forum, the Global Competitiveness Report 2013-2014

Note: Country Rankings are in descending order with "1" considered as the best performer. Overall Infrastructure score is in ascending order with "1" considered as a lower score. However, according to **Table 2**, extracted from the *World Economic Forum's Global Competiveness Report 2013-2014*, Bangladesh has a score of 2.8 in terms of infrastructure, which includes measures in electricity, roads, railroads, and port. Considering other countries in the region, Bangladesh, along with Myanmar, ranks in the bottom two in terms of infrastructure. Pakistan, a country with a lower overall country ranking than Bangladesh, leads Bangladesh in infrastructure quality with score of 3.3. The only country with a lower infrastructure score than Bangladesh is Myanmar, with a score of 2.1. This indicates that Bangladesh is badly in need of strong many infrastructural improvements in order to boost its economy in the future.

Table 3 Bangladesh's Infrastructure Score over time

Year	Overall Infrastructure Score	Electricity	Roads	Railroads	Port
2013-2014	2.8	2.2	2.8	2.4	3.5
2010-2011	2.7	1.6	3.0	2.5	3.4
2006-2007	2.03	1.6	3.1	2.3	2.4

Source: World Economic Forum, the Global Competitiveness Report

In **Table 3**, a comparison of Bangladesh's infrastructure score over a span of 8 years (2006-2014), shows some improvement over time. For instance, Bangladesh's infrastructure score increased from 2.03 in 2006-2007 to 2.8 in 2013-2014, a result of improvements in the electricity and port sector.

If the changes in infrastructure score over the past 4 years (2010-2014) are compared, there has only been a very small increase in the score, from 2.7 to 2.8, however this improvement is again due to improvements in electricity (1.6 to 2.2) and port (3.4 to 3.5) only. On the other hand, in the same span of 4 years, roads and railroads have decreased from 3.0 to 2.8 and 2.5 to 2.4 respectively. This is likely due to immense Government focus on increasing access to electricity as well as developing port facilities, although the Government should simultaneously focus on drastic improvements in the roads and railroads sector.

The Government of Bangladesh (GoB) has recognized that in order to achieve targeted GDP growth rates, it is important to further develop Bangladesh's infrastructure. Bangladesh's *Sixth Five Year Plan* (2011-2015), a

Government plan for economic development over five years, has addressed this issue by setting certain strategic goals for the Bangladesh transport sector, which include primarily the following:[7]

- Undertaking an optimal mix of "market integration approach" and "poles of development approach" through the development of five main corridors: Dhaka-Chittagong, Dhaka-Northwest, Dhaka-Khulna, Dhaka-Sylhet, and Khulna-Northwest
- Building an integrated transport network by constructing Padma Bridge at Mawa-Janjira point (integrating inland water transport with existing or new road transport systems)
- Improving connectivity with neighbouring countries through the development of inter-modal transport network
- Improving resource mobilization through the introduction of user charges/fees in the entire transport network
- Ensuring the deficit free operation of the Bangladesh Railway
- Improving transport safety standards to reduce incidence of accidents
- Increasing private partnership in the transport sector through the PPP framework

Integrated multi-modal transport

The Govt has also recognized that integrated multi-modal transport should be prioritized, as indicated by the *Integrated Multi-Modal Transport Policy*, which states that the sustainability of the transport sector will be heavily dependent on its ability to offer its stakeholders integrated and multi-modal transport, essentially meaning that the transport system must integrate:

1) Within and between different types of transport
2) With the environment
3) With land use planning
4) And with policies for education, health, economic growth, gender and social equity, and poverty reduction

Intermodal Connectivity

In the past two decades, the Govt. has been placing heavy emphasis on the development of the road sector at the cost of less development in the railway and inland waterway transport sectors. Certain geographic conditions of Bangladesh, such as the country being relatively flat, have contributed to this growth of road transport. To add, road transport offers more mobility and connectivity than other transport modes, partially due to its continuous development. Short-term planning has also resulted in the emphasis of roads versus inland waterways and railways. However, it is important that Bangladesh, a country of many inland waterways, and an exponentially increasing demand of transport pay special attention to the development of both its inland waterway and railway sectors. Transportation connectivity in Bangladesh could be well enhanced and meet future demands of transport growth if an effective and full-proof plan for intermodal connectivity was followed. Railway offers certain distinct advantages, such as lower cost for the transportation of passengers and freight, as well as being more environmentally friendly. Inland waterways also offers advantages as they can contribute to the effective transportation of freight and if these same waterways were efficiently connected to railway and road, their importance and contribution to effective transport could only grow.

The *Integrated Multi-Modal Transport Policy* 2008 addresses this issue. Although, there is still a lack of integrated transport policy and planning framework that could result in the prioritizing of investments. This makes it difficult for the transport sector to allocate resources between sub-sectors effectively. Most importantly, there have been a

[7] Mid Term Implementation Review of Sixth Year Plan, Policy Research Institute

number of transportation studies in recent years that advocate for intermodal connectivity, however, no real effort has been made for the actual functional integration of different modes of transport.

Increased intermodal connectivity could have positive effects on all economic activities; especially the carriage of freight, on agriculture. Nearly half of the population is employed in the agriculture sector, however rural areas, which are generally used for agricultural land, are yet to see efficient transportation infrastructure. This is understood by the fact that not enough rural areas have roads and if they do have roads, the majority of these roads are narrow and dirt roads (unpaved).In addition, many rural areas are unable to withstand the loads of heavy farm equipment; all of these factors taken together make the logistical costs between different parts of Bangladesh some of the highest in the world. If more investments were made into reliable infrastructure, the agricultural sector would improve. Agricultural supplies could more efficiently reach farm lands, and agricultural products could also efficiently reach markets through carriage on a mix of different transport modes: roads, railways, and inland waterways.

Inter-modal connectivity is especially important in and around Dhaka. Currently, the existing modes of transport act independently with each other and are often in competition, however, they should also benefit from each other. Passengers suffer due to a lack of connection between modes and poor scheduling, an integrated scheduling and ticketing system should be initiated in Dhaka within all modes of transport. For instance, an individual travelling by river from his/her village, should be able to connect to a railway link that can bring him/her into the heart of the city, and from there take a bus to his/her final destination with convenience. For example, Dhaka Airport has few direct bus connections, but the railway station is not very near. There is no high-speed form of transport, such as a metro line, from the airport; this only increases the transfer time many fold.

3 Railway Subsector

In Bangladesh, rail communication has traditionally been the primary mode of mass transport for both commercial and cargo use dating back to British rule. Rail communication is considered to be an environmentally friendly, safe, and affordable form of transport. According to Bangladesh's *National Sustainable Development Strategy 2010-2021,* "the railways consumption of fuel is only 10% of other modes of transport." In addition, the number of accidents in the railway sector is considerably lower than in other sectors, with road transport being the most accident prone; moreover, railway fare is relatively low in comparison to other forms of transport.

The railway sector in Bangladesh also has strong potential in playing a key role in sub-regional transport between Bangladesh, India, Bhutan, and Nepal. If the Bangladesh Railway (BR) were more strategically linked with the railways of neighbouring countries, revenue earnings could increase dramatically, as well as foreign exchange earnings, since domestic demand for the transport of heavy traffic, such as minerals or heavy equipment, is low in comparison to the demand of neighbouring countries. Interregional freight traffic between Bangladesh and India is an especially promising transport mechanism as it would allow India better access to its north-eastern states.

Despite all of these benefits, in a 2007 World Bank report, the most recently published report that includes information on transport modal share; it was found that as of 2005, the Bangladesh Railway only represents 4% of passenger modal share and 4% of freight modal share, a strikingly low percentage considering the many benefits of the railway sector (**Table 4**). This is primarily a result of heavy competition from the road sector – a result of its continuous development and subsequent high demand from both passengers and freight. Additionally, the BR's poor infrastructure, deteriorated physical assets, and low efficiency and quality of service make it almost impossible for the BR to adequately compete and gain market share in the transport sector.

Table 4 Modal Share of Passenger & Freight Traffic (2005)

Modes of Transport	Passenger (billions of km)	Passenger Modal Share	Ton-km (billion)	Freight Modal Share
Road	98.4	88%	15.7	80%
Rail	4.2	4%	0.8	4%
IWT	8.9	8%	3.0	16%
Total	111.5	100	19.6	100

Source: Revival of Inland Waterways: Strategies and Options, Report, World Bank 2007

The railway sector's share in the total allocation of the transport sector had declined to 13% in the Fifth Five Year Plan, in comparison to 23.9% in the First Five Year Plan, indicating that investment has decreased over time in this high potential sector.[8] However, in the ADP Budget of 2014-2015, the railway sector was allocated 27% of the total budget for all transport divisions, the road sector having received 30% and the bridge sector 38% - indicating that the Government has made a recent shift in policy to also prioritize the railway sector. This is an important initiative as the railway sector is in such a deplorable state that without proper initiative in the sector, it may become obsolete.

3.1 Sector History and Trend Analysis

The history of the railway dates back to November 1862, when a broad gauge single line was constructed and opened between Darsana and Jagoti, near Kushtia. A meter gauge network in the east was constructed to connect Chittagong Port with Assam, and to the west a Kolkata bound broad gauge route was built running down from the north. The current Bangladesh Railway is made up of shortened portions of the former East Bengal Railway and Bengal Assam Railway, of the then British-Indian rail system, which after the 1971 Bangladesh Liberation War became a part of Bangladesh's territory. After the Liberation War, BR had 2,858 km of rail line, 270 stations, 486 locomotives, 1,643 coaches and 16,823 wagons.[9] As these railways were not specifically designed for Bangladesh's current territory, consequently a vast number of weaknesses can be found in the railway network (**Table 5**).

Table 5 Bangladesh Railway: 1971 compared to Present

Type	1971	2014	% Change
Railway Network (km)	2,858 km	2,877 km [10]	0.6%
Stations	270	444	63%
Locomotives	486	286	-41%
Coaches	1,643	1,503	-9%
Wagons	16,823	10,226	-39%

Source: Bangladesh Railway

The above table demonstrates a comparison of various components of the Bangladesh Railway between 1971 and 2014. It should be noted that in all categories, besides railway network (+0.6%) and stations (+63%), unit numbers have decreased. The number of locomotives in 2014 is a mere 59% of the number of locomotives in 1971, indicating that rather than growing as Bangladesh's population and economy has grown over the years, the railway has mostly

[8] National Sustainable Development Strategy 2010-2021

[9] Bangladesh Budget 2014-2015, Ministry of Finance

[10] Ministry of Finance

shrunk in capacity (-41%); although, there has been a nominal increase in Bangladesh's total railway network, as illustrated in the figure below (**Figure 1**).

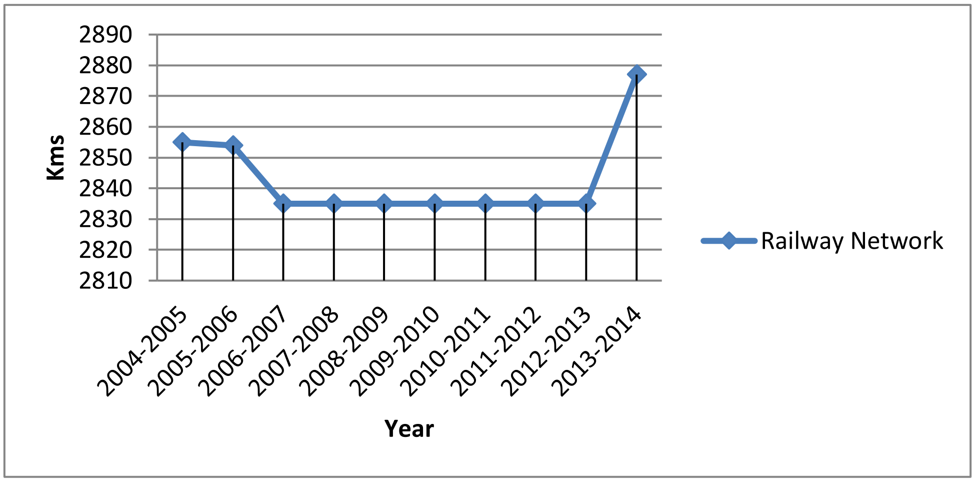

Figure 1 Bangladesh Railway Network (2004-2014)

Source: Bangladesh Bureau of Statistics

Within the figure, which represents Bangladesh's railway network from 2004 to 2013, it can be seen that the railway network decreased in size between 2004-2006, after which it stayed at a stable level up until 2013, in which 42 km were added to the network, this is likely a result of a very recent focus on the railway sector by the Government.

Table 6 Historical Transportation Sector Modal Shares

Year	Passengers			Freight		
Year	**Road**	**Rail**	**IWT**	**Road**	**Rail**	**IWT**
1985	65%	20%	15%	48%	17%	35%
1989	68%	17%	15%	59%	11%	30%
1993	75%	12%	13%	61%	7%	32%
1998	73%	13%	14%	63%	7%	30%

Source: World Bank, Private Solutions for Infrastructure in Bangladesh

Table 6 above indicates that the railway's modal share of passenger and freight traffic was 20% and 17% respectively in 1985, these values further decreased to 17% and 11% respectively in 1989, 12% and 7% in 1993, and 15% and 7% by 1998. As of 2005, passenger and freight traffic have decreased to a worrying 4% and 4% respectively, thus illustrating a significantly declining trend of usage in the railway sector. As there are no figures available for 2015, ten years after 2005, it is unclear as to the exact current state of the railway's modal share.

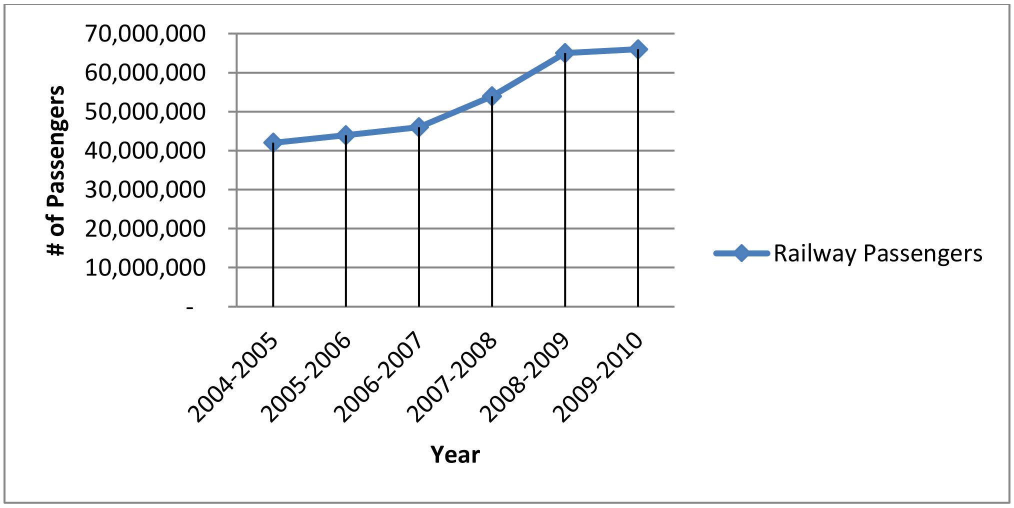

Figure 2 Bangladesh Railway Passengers Carried

Source: Bangladesh Bureau of Statistics

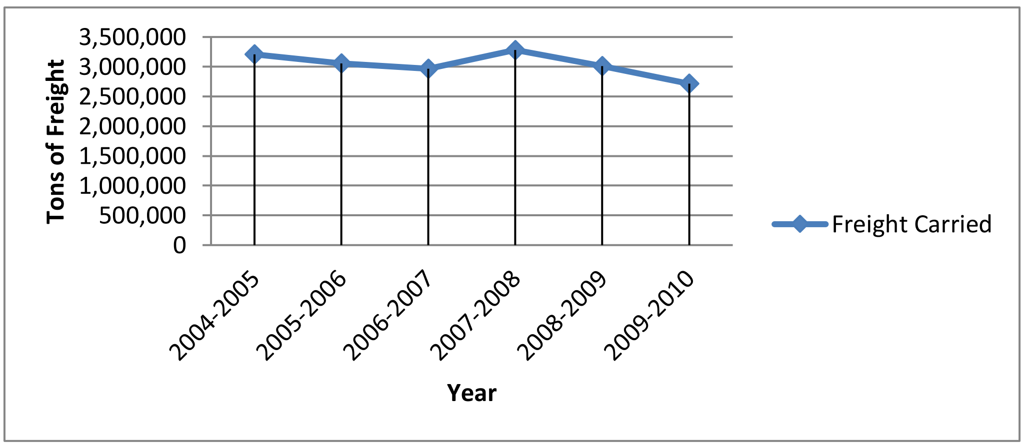

Figure 3 Bangladesh Railway Freight Carried (tons)

Source: Bangladesh Bureau of Statistics

From the above two figures (**Figure 2** and **Figure 3**), it can be seen that the number of passengers carried by BR has steadily increased, from 40 million passengers in 2005 to 60 million passengers in 2010. In 2013, passenger km was recorded at 8,253,000,000, indicating that passenger usage has not decreased over the years, but it increased instead. One of the underlying causes for railway usage as a form of passenger transport are increasing rates of rural to urban migration, for example, rural to urban migration is the most prevalent form of migration in Bangladesh, with an estimated 300,000 to 400,000 new migrants arriving to the capital annually.[11] The major pull factor of this rural to urban migration is the economic opportunities that urban cities, primarily Dhaka, offer to these migrants. For example, manufacturing industries and labour intensive industries, such as Bangladesh's Ready Made Garments (RMG) sector, provide vast employment opportunities to rural migrants. The railway reaches its peak demand during periods of public and religious holidays in which migrants travel from urban cities to their village in order to celebrate

[11] Dhaka: Improving Living Conditions for the Urban Poor. Bangladesh Development Series

Paper No. 17, 2007. World Bank

the festivals with the near and dear ones. On the other hand, tons of freight carried has mostly decreased over the years, from **Figure 3** it is clear that in 2005 freight tons carried were 3.25 million tons, in 2010 that value is approximately 2.75 million tons, and according to more recent data, as of 2013, that value is 2.0 million tons. There is a clear decreasing trend over the past ten years, and this is likely the result of BR's poor capacity and inefficiency in freight transport services.

3.2 Present Status

The Bangladesh Railway (BR), the state-owned rail transport agency, currently includes 2,877 km of route track (3,975 km of total track), connecting 44 districts out of total of 64 districts, 444 stations, 1,503 coaches, 10,226 wagons, and employs approximately 26,000 individuals.[12] There are 329 passenger trains and 49 goods and container trains.[13] BR serves two functions, firstly as a public utility service and secondly as a commercial enterprise. As a public utility service, the railway is expected to provide transport facilities to a large number of passengers as well as the transport of essential commodities for mass consumption at low and affordable fares. As a commercial enterprise, the railway is expected to generate enough revenue to meet its costs; however this has not been achieved by BR. Currently, the railway is predominantly used for passenger transport. The most frequently used route on the railway is from Chittagong and Dhaka. Key features of the current railway are the coexistence of several gauges: meter gauge, broad gauge, and dual gauge. The type and numbers of trains currently in operation is presented below (**Table 7**) and the length of each category of gauges is given in **Table 8**.

Table 7 Bangladesh Railway Trains

Type of Train	**Number**
Passenger Train:	
Inter-city	82
Mail, Express, Commuter	78
Local	137
DEMU Commuter	32
Total	**329**
Goods & Container Trains	**49**

Source: Bangladesh Railway

Table 8 Type of Rail & Definitions

Type of Rail	**Definition**	**Length of Railways**
Meter Gauge	Meter gauge is the system of narrow gauge railways and tramways with a track gauge of 3 ft. 3 in (1 m)	1,830 km of meter gauge tracks (mostly in the central and eastern regions)
Broad Gauge	a railway gauge which is wider than the standard gauge of 4 ft. 8 1/2 in (1.435 m)	660 km of broad gauge tracks (mostly in the western region)
Dual Gauge	a line of track that provides for trains of two separate gauges	365 km of dual gauge tracks

Source: Bangladesh Railway

12 Bangladesh Railway

13 Bangladesh Railway

The railway network is separated by the Jamuna River into a western and eastern zone of operations with only one bridge, the Jamuna Bridge, connecting the two zones. BR operates international, inter-city, and suburban rail systems within its network.

3.3 Bangladesh Railway

After Bangladesh's independence, the railway was first supervised by a Railway Board which was subsequently closed down in 1982. The BR was then under the jurisdiction of the Railway Division of the Ministry of Communications with the Secretary of the Division working as the Director General of BR. It is currently under the control of the Ministry of Railways, which was established in December 2011. The Ministry of Railways formulates policies and strategies for the railway sector that are in line with the ultimate objective of maintaining an affordable and environmentally-friendly railway network that contribute to socio-economic development.

The Railway Ministry's responsibilities are:

- Policy formulation: monitoring and evaluation of policies relating to railways and rail transport
- Development: expansion and maintenance of Bangladesh Railway and railway related systems
- Coordination of national and international railway systems
- Survey and monitoring of railway transportation
- Formulation and implementation of security poles relation to railway transportation
- Establishing international railway systems and playing a signatory role on behalf of the Bangladesh Government
- Determination and revision of fares and toll rates of railway transportation
- Maintaining profitability
- Ensuring fast and safe transportation of people and goods

BR's administration is headed by a Director General, with two General Managers below him/her. One General Manager is responsible for tracks belonging to the east zone, and the other to the west zone (separated by the Jamuna River). Each zone is further divided into a number of divisions under the control of Divisional Railway Managers that are associated with different departmental heads and subordinates. BR cadre is composed of two BCS cadres: BCS-Railway Engineering and BCS-Transport & Commercial. BCS-Railway Engineering has 5 sub-cadres: Civil, Mechanical, Electrical, Signal & Telecom and Stores. There is also a BCS-Audits and Accounts cadre, responsible for maintaining BR's accounts.

Bangladesh Railway Services:

Passenger Service:

Intercity train services, includes 82 intercity trains running. As of 2008, approximately, 38.5% of total passengers of the railway were carried by intercity trains, which contribute approximately 73.3% of the total earnings of passenger traffic.[14]

Maitree Express:

The Maitree Express is an international train, commenced in 2008, and links Dhaka and Kolkata, India; the travel time is approximately 13 hours.

[14] Passenger & Freight Traffic, Bangladesh Railway

Accommodation Classes:

Bangladesh Railway has three classes of travel: Air Conditioned Class, First Class and Second Class. Most trains have First Class and Second Class only. Second Class is divided into Shovon Chair, Shovon, and Shulov sub-classes. In some trains a separate mail compartment is present. For intercity and long-distance trains, a restaurant car and a power car are included in the center.

Fare Pricing:

Bangladesh Railway fares are cheaper than bus fares. As of 2013, the average revenue per passenger was 79.10 Tk.[15] Ticketing services are available at all railway stations across Bangladesh, and most railway stations are computerized and connected to a central network.

Freight and Cargo Service:

As a national carrier, the railway is obliged to carry essential commodities like food grains, fertilizer, jute, cement, coal, iron and steel, stones and boulders, petroleum products, salt, sugar etc. to remote corners of the country at discounted rates. In addition, the railway transports containers from Chittagong to Dhaka. A total of 180 bogie container flats were procured from China and India in order to help transport containers. An Inland Container Depot has been opened in Dhaka with customs and port facilities for the clearance of container traffic. A dedicated (exclusive) container train was introduced in 1991.

In FY 2009-10, Chittagong Port handled 1.21 million twenty-foot equivalent container units, 75% of which were bound for Dhaka. The number is increasing at about 13% per annum, the number of container transported by the railway between Chittagong Port and Dhaka Inland Container Depot has been steadily growing; however, the railway is only transporting approximately 10% of the containers bound for Dhaka from Chittagong.[16] As a result of line capacity limitations, the Dhaka-Chittagong railway corridor is currently unable to increase its market share in the freight segment (**Table 9**).

Table 9 Freight Carried by Bangladesh Railway

Commodity	2008-2009 Tons	2008-2009 (%)	2009-2010 Tons	2009-2010 (%)
Rice	164	5.45%	142	5.23%
Wheat	349	11.59%	299	11.02%
Other Grains	1.58	5.25%	138	5.08%
Vegetable Oil	314	10.43%	274	10%
Jute (Raw)	7	0.23%	6	0.22%
Cotton	0.30	-	0.33	1.5%
Container	613	20.37%	548	19.90%
Cement	0.14	-	30	1.11%
Marble & Stone	117	3.89%	110	4.05%
Oil Fuel	549	18.27%	521	19.20%
Petrol	53	1.76%	48	1.77%
Kerosene	242	8.04%	232	8.56%
Fertilizer	228	7.57%	220	8.11%

Source: Ministry of Railway

As seen in the above table, in FY 2009-2010, 50% of the freight carried by BR were containers, oil fuel, or wheat, most likely freight assigned by the Government. BR is obliged to carry essential commodities, such as food grains, jute,

[15] Bangladesh Railway

[16] Asian Development Bank

coal, iron, fertilizer, salt, sugar to remote corners of the country at low-cost rates to the Government, making it unable to compete in the transport sector due to its low revenue collection; this obviously result in financial losses. BR's revenue from freight transport has faced increasing competition from other forms of transport, primarily road transport, as these transport sectors tend to provide direct point-to-point transport as well as more frequent and reliable services. Fare and the freight charges of Bangladesh Railway and BRTC during the last decade are given in **Table 10** and **Table 11**.

Table 10 Fare in Taka per passenger per km

Transport Corporation	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009
BR	0.39	0.38	0.38	0.3808	0.3819	0.3850	0.38
BRTC	0.72	0.72	0.72	0.78	0.87	1.05	1.05

Source: Bangladesh Bureau of Statistics

Table 11 Freight in Taka per ton per km

Transport Corporation	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009
BR	1.46	1.45	1.49	1.49	1.55	1.56	1.58
BRTC	1.50	1.50	1.50	2.47	2.58	3.04	3.64

Source: Bangladesh Bureau of Statistics

From the above tables, it can be seen that from FY 2002 to FY 2009, BR has decreased its fare in taka per passenger per km from 0.39 to 0.38; on the other hand, BRTC has actually increased its fare from 0.72 to 1.05. Similarly, BR has only increased its fare in taka per freight ton per km from 1.46 (2002) to 1.58 in (2009); whereas BRTC increased their fare from 1.50 (2002) to 3.64 (2009) – a much larger increase. From this it can be understood that BR has not been able to raise its fare in the same way that the road sector has, most likely a cause of the pressure to serve as a public utility service. This inability to charge sufficient fares have caused substantial financial losses that make the railway sector unable to invest in the improvement of its operations; which has made it almost impossible for the railway sector to compete with the road sector.

3.4 Financing

Table 12 Bangladesh Railway Net Operating Income

Bangladesh Railway Traffic & Revenue (in millions km, crore taka)					
Fiscal year	**Passenger traffic km**	**Freight traffic km**	**Revenue earnings**	**Revenue expense**	**Deficit**
2000-2001	4209.00	907.88	366.39	523.87	-157.48
2001-2002	3972.00	951.82	388.40	535.48	-147.08
2002-2003	4,024.20	951.99	420.10	586.71	-166.61
2003-2004	4,341.50	895.50	394.17	639.41	-245.24
2004-2005	4,164.13	816.80	445.62	695.09	-249.47
2005-2006	4,387.45	820.49	444.27	814.73	-370.46
2006-2007	4,586.04	775.58	452.76	933.11	-480.35
2007-2008	5,609.24	869.59	561.64	1,088.55	-526.91
2008-2009	6,800.73	800.15	625.35	1,172.74	-547.39
2009-2010	7,304.95	710.06	566.30	1,257.20	-690.90
2010-2011	8,051.92	684.63	629.55	1,491.82	-862.27
2011-2012	8,787.23	582.11	582.11	1,576.74	-994.63

Source: Ministry of Railway

In 2013, BR's revenue per passenger was approximately 79.1 taka, and revenue per ton of freight transported was approximately 544 taka, these rates are incredibly low considering the rates of other transport modes.[17] BR, both a public utility service and a commercial enterprise, is heavily subsidized by the Government and has historically been incurring large operating deficits that have only been increasing year by year. Although BR is legally allowed to act commercially and is able to set its own freight tariffs, and add and cancel trains and services as they find fit; they do not generally exercise this power primarily in fear of public and political backlash. The above table (**Table 12**) shows the BR's operational deficit from 2000-2012, FY 2012's operational deficit is approximately ($128.05 million) and FY 2013's operational deficit is approximately Tk. 841 crore ($108.5 million); an incredibly large deficit for the Government to subsidize.

The primary cause of these large deficits is that fares are priced below cost in order to ensure affordability for the public, in addition to causes such as inadequate financial and operational maintenance which have deterred business, as evident in freight and cargo operations. As BR is chiefly a public utility service, its main priority has been to ensure transport services for large volumes of commodities and a large number of passengers, thus in order to maintain the social and economic interest of the country. BR has prioritized its role as a public utility service rather than a commercial enterprise, resulting in the continuation of non-profitable branch lines and train services.

This widening gap between operating costs and revenues have led to a sick cycle in which the Government has historically decreased the level of funding available to the railway, which in turn has led to the deterioration of track infrastructure as well as locomotives and wagons, which in turn has reduced the quality of the service and further decreased traffic volumes. This has led to declining revenues, which has further diminished the ability of the Bangladesh Railway to fund railway improvements. Unless proper re-orientation and development is initiated this sick cycle will only continue.

Some potential areas for increasing BR revenue include:

1) Transport of freight
2) Transport of containers
3) Enhancing inter-city services
4) Enhancing commuter services
5) Optimizing the usage of fixed-assets

Freight/Container Transport

Freight and container transport is currently most dependent on roads; however, if the BR decreased their hauling time, improved the quality of its services, and improved its infrastructure, many products such as petroleum products, stone, sand, food grain and fertilizers could be transported more frequently via railway. The benefits of such a shift in market share would include more competitive transport tariffs, higher quality services, as well as decreased truck traffic on Bangladesh's already deteriorating roads. Additionally, container transport is a promising investment as the railway represents only 10% of the container transport market, whereas container transport demand from the Chittagong port is only increasing every year. According to the Bangladesh Railway, the railway can in the future represent up to 25% of the market and remove up to 500 container trucks per day from roads. Some initiatives that are currently taking place that will augment this opportunity include the new Inland Container Depot (ICD) at Dhirasram, the Tongi-Bhairab dual track line, and the Lakhsam-Chinkiastan dual track line.

[17] Bangladesh Railway

Inter-city/Commuter Services

Creating a massive public transport service in Dhaka for commuters would decrease the traffic congestions surrounding Dhaka as well as within Dhaka, and substantially improve the quality of life for many individuals. Travel times would be drastically cut and positive economic spill-over effects would take place. Presently, the BR has capacity constraints and a lack of quality commuter services. If commuter services were paid close attention with an increase in track and network capacity, the BR could effectively capture this high potential market segment of commuters. Moreover, inter-city services, such as those that will be offered by Dhaka's future MRT project, could end long trip times and decrease emphasis on road transport. Inter-city train services would attract high-volume customers on a daily basis with a higher willingness and ability to pay for increased fares in comparison to rural customers; this could significantly increase BR's revenue earnings while simultaneously decreasing road traffic congestion. Essentially, the BR needs to review the present railway's contribution to urban travel demand and develop the railway in such a way that it not only focuses on long-distance travel services but also provides urban travel services.

Fixed Assets: Land

Another area of high potential for revenue includes the leasing out of fixed assets, such as land. At present, the BR earns 30% of its revenues from non-railway related businesses. This is despite the fact that many portions of land are illegally occupied by influential people or organizations; for instance, in 2005, 12,000 acres of BR land was illegally occupied out of 23,900 total acres of land.[18] Many plots of land are even contested between Government agencies, like in 2013 – Bangladesh Railway was struggling to reclaim over 4,465 acres of its land grabbed by different government and autonomous bodies and people. According to BR, non-governmental institutions and influential people were illegally occupying over 3,543 acres of land while the Government and autonomous bodies were occupying 922 acres. These Government bodies include a wide variety of agencies, educational institutions, and local administration. Local administration officers that are illegally occupying railway land have even leased out such land to third parties for personal revenue generation. This illegal occupation is a by-product of corruption that must be stamped out. Without centralized Government action against such illegal occupiers, BR will not be able to further develop.

BR has recently planned to develop unused land in station areas of major cities such as Dhaka, Comilla and Chittagong, with the involvement of the private sector under a PPP basis, for the building of shopping malls, hotels, etc. Strategies such as these should be further developed and implemented. If BR managed such fixed assets in efficient and transparent ways as well as marketed these opportunities in organized and resourceful systems, their revenues could substantially increase.

3.4.1 Ministry of Railway Budget

The table below (

Table 13) shows the total budget for the railway sector from 2011-2015, with projected budgets till FY 2018. Based on this table, it is apparent that the total budget available to the sector has increased year by year; however, according to the *Railway Master Plan*, approximately $30 billion will need to be spent over the next 20 years on development activities[19], approximately $1.5 billion per year. The total budget, including both development and non-development activities, in FY 2014-2015 is only $822 million with FY 2013's operating deficit at $108.5 million; indicating that the development funding required by the sector far outweighs its budget and revenue potential. This is an indication of a history of underinvestment in the sector, as well as large fund requirements in the future.

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[18] Re-orientation of Bangladesh Railway: A Market Integration Study, Saidur Rahman, 2005

[19] Ministry of Finance

Table 13 Ministry of Railway Budget, in Thousands Taka

	Revised Budget 2011-2012	Revised Budget 2012-2013	Budget 2013-2014	Budget 2014-2015	Projected 2015-2016	Projected 2016-2017	Projected 2017-2018
Non-Development	16,248,459	16,810,000	18,027,800	18,740,000	22,301,727	25,321,724	27,331,726
Development	22,656,600	30,216,900	38,780,600	44,850,000	44,684,673	49,033,376	55,202,474
Total	38,905,059	47,026,900	56,808,400	63,590,000	66,986,400	74,355,100	82,534,200
YoY Change		17%	17%	11%	5%	10%	10%

Source: Ministry of Finance

3.4.2 DEMU Passenger Trains

In 2013, BR introduced Diesel-Electric Multiple Unit (DEMU) passenger trains in an effort to raise passenger volumes and lower transit times; the Railway Ministry had procured 20 sets of DEMU trains in 2011, at a cost of 460 crore ($59.4 million) in order to offer passenger routes from Dhaka to suburbs such as Narayanganj and Joydebpur. However these costly trains have not proved to be effective in Bangladesh. For example, these trains carry 25% of the number of passengers that second class trains can carry, and due to many operational problems are usually used during off-peak hours. In addition, DEMU trains take the same amount of time as traditional trains to reach the same destination; however the traditional train suffers less operational issues – making traditional trains more convenient and effective. Moreover, the DEMU trains suffer from many design problems such as narrow windows that do not allow adequate air into the cabins. This causes heat to rise in cabins which make it difficult for passengers to travel in these non-air-conditioned trains. This is an example of a lack of effective planning on the part of BR, although the BR was able to identify the lucrative market of commuter passengers, they must also be able to provide quality services such that customers will continue using such a service. It is important that BR perform adequate due diligence on such initiatives to ensure that investments are being made in productive ways. In fact, according to a 2015 newspaper report[20], the BR is planning to purchase additional DEMU passenger trains for services that will run from Dhaka to the proposed Kaliakoir Hi-Tech Park, indicating that the BR lacks an effective operational culture in which public opinion is valued and proper due diligence is required in order to make sound investment decisions.

3.4.3 Private Sector Involvement

Private sector involvement in the railway began in 1997 with computerized seat reservation and ticketing systems at designated stations. The on-board services of ten inter-city trains were outsourced to the private sector, and as of 2006, 79 trains, including mail-trains, express-trains, and local-trains, were privatized. Privatization activities have proved profitable in the past, for example, in 1998, a private operator took control of the ticketing and luggage booking services of the Padmagarh Express, which runs between Santahar and Lalmonirhat, resulting in a 368% increase in revenues.[21] To add, the installation, operation and maintenance of fiber optic cables along major railway lines, in order to improve communication and signalling systems of the railway, was also done under a PPP basis. More specifically, the leasing out of the surplus capacity of BR's fiber optic telephone system to a private company, Grameen Phone (GP), allowed for BR to earn extra revenue through an annual rental lease. GP also assumed all costs

[20] Dhaka Tribune

[21] Forging Sub-regional Links in Transportation and Logistics in South Asia, Uma Subramanian, John Arnold

associated with the maintenance of the railway telecommunication system and costs associated with upgrading the system, a win-win situation for both the public and private sector.

Private sector involvement should be encouraged in the railway sector, especially in the fields of operation and maintenance, as this could help to decrease costs and maximize efficiency. However, privatization does not necessarily mean that revenues are always adequately guaranteed. For example, currently, the Chandpur railway is losing revenue after its train on Chandpur-Chittagong route – the Sagorika Express, was privatized. Adequate financial and operational analysis should first be done to understand if the privatization of certain services will in fact be financially sustainable for all parties involved.

In Bangladesh's *National Land Transport Policy* (2004) the following railway activities were outlined as the most optimal for private sector involvement:

1) Ticketing, ticket allocation and seat reservations
2) Operations of all types of passenger services
3) Supply of rolling stock, freight operations
4) Rolling stock maintenance
5) Track maintenance

Currently, the Public Private Partnership Office (PPPO) is in the planning stages of a few railway development projects on a PPP basis. For example, the BR operates a number of hospitals throughout the country; many of these facilities are in poor conditions and are in drastic need of modernization and expansion. In order to expand and modernize these facilities, the BR is actively seeking partnership with the private sector on a PPP basis. In 2015, the PPPO selected a private company, PricewaterhouseCoopers Pvt. Ltd., India, to provide transaction advisory services for the establishment of a 50-bed Medical College at the Central Railway Building in Chittagong, as well as for the modernization of an existing Railway Hospital with 250 beds.

Table 14 Railway Projects under PPP Consideration (2015)

Projects	**Status**
Construction of a Railway Bridge parallel to the existing Bangabandhu Bridge with provision of Dual Gauge Double Track over the river Jamuna	Project Development Stage – Feasibility Study
Construction of Railway bridge over river Jamuna near Fulchhari Bahadurabad Ghat including approach Rail links	Project Development Stage – Feasibility Study
Construction of a New Inland Container Depot (ICD) near Dhirasram Railway Station	Project Development Stage – Advisor Appointed

Source: PPPO, Bangladesh

The above table includes three additional planned PPP projects, currently; the *Construction of a New Inland Container Depot near Dhirasram Railway Station* is the most developed with an advisor having been appointed. Further opportunities for private sector involvement will largely depend on reforms in pricing arrangements; private firms must be able to make their investment back through pricing their services to end-users or the BR at sustainable prices, this will likely require increases in fares.

The private sector has been involved in the operations of the railway rather than through ownership of rolling stock of ancillary facilities.[22] The BR and PPPO should continue to actively look into ways to encourage the private sector's involvement in BR's operations, maintenance, and development activities.

[22] Bangladesh Railway

In the past, development partners have encouraged the Government to fully corporatize the railway in order to make it financially solvent and efficient. This would require numerous organizational, structural, and operational reforms, as well as an emphasis on skill development. For instance, the private sector could be used for the development and management of the sector, whereas the Government would function more as regulator/facilitator. However, this also poses some challenges as BR is primarily a public utility service, and is thus expected to transport essential commodities and passengers at rates affordable to the public and the Government. The railway has also served as a transport facility for the Government in emergency situations, such as floods – these services would be less accessible if BR was fully corporatized. In addition, BR has also provided many individuals with employment, as well as medical and education benefits to their families, etc. – making it an important institution to those employed by it. A balance between maintaining public interest and privatizing certain services within the railway is the best method for ensuring long term sustainability.

3.5 Policy Analysis

This objective of this section is to provide an overview of the most recent key policies relating to the railway sector in Bangladesh, including Bangladesh's *Sixth Five Year Plan, Perspective Plan of Bangladesh 2010-2021: Making Vision 2021 a Reality, the Railway Master Plan, Integrated Multi-Modal Transport Policy, National Land Transport Policy, and the National Sustainable Development Strategy*. By understanding Bangladesh's policies in regards to the railway sector, it will become clear as to what the Government's understanding of the railway sector in Bangladesh is; more specifically what they view as the main challenges in the sector as well as how they plan to deal with those challenges. Each policy overview includes information regarding the policy's domain, status and time frame, location, objectives, and included measures.

The most specific policy measures regarding the railway have been detailed in the Railway Ministry's, *Railway Master Plan*. The 20-year objective outlined in this plan is for the Bangladesh Railway to become a reliable mode of mass transportation that can meet its total demand. A target of implementing 235 projects in 4 phases amounting to Tk 233,944 crore (approximately $30 billion) has been fixed under the *Railway Master Plan*. According to the *Integrated Multi-Modal Transport Policy (2008)*, key policy performance targets for the railway are for intercity railway passengers to grow by 30% over the next 5 years, and for the share of container traffic to double over the next 8 years.

Key Policy Documents include:

3.5.1 Sixth Five Year Plan of Bangladesh

1. Name	**2. Policy Domain**
Sixth Five Year Plan of Bangladesh	Country wide policies
3. Status & Timeframe	**4. Location**
FY 2011-2015	National

5. Objectives & Indicators related to Transportation & Infrastructure

- Communication system between the better-off regions and lagging regions would be improved in order to increase economic activities in the lagging regions. One of the major communication projects, construction of Padma Bridge, is expected to open a new door of opportunities for the south-west region.
- Better connectivity with growth centres in neighbouring countries through regional cooperation efforts will be important.
- Appropriate measures would be adopted for intensive utilization of Mongla port. The implementation of transit access to the neighbouring countries (India, Bhutan and Nepal) will be of immense benefit to the revitalization of the Mongla Port.
- Creation of export oriented industrial zone near the Mongla port will be considered with special emphasis to direct foreign investment.
- Supply of electricity would be increased in the lagging regions on a priority basis.
- Construction of gas transmission line to the lagging regions would be expedited.
- Both inter district and intra district road communication system would be developed to increase economic mobility within the lagging regions.
- Intensity of bank branches would be increased in the lagging divisions to increase financial services for general people as well as investors of the regions.
- Communication system in three hill districts would be developed to create economic opportunities for these areas.
- The long-term dredging programs of inland waterways would be expedited.
- Block allocation for local Government institutions for infrastructure development in lagging regions, particularly in lagging districts, would be enhanced.
- Emphasis will be given to the completion of the upazila connecting roads in Barisal, Rajshahi and Khulna divisions.

6. Included Measures – Projects – Programs

- Priority is to modernize Bangladesh railway through proper investments in rolling stocks, modern traffic and safety equipment and the conversion of narrow gauge to broad gauge system to harmonize with neighbouring countries and allow the regional rail connectivity
- Establishing 67 proper rail connectivity to provide access to Bhutan, India and Nepal to the Chittagong and Mongla ports will be a major investment priority
- To continue upgrading the rural roads to provide better farm-to- market access roads
- Improve railways and waterways as energy efficient multi-modal transport system to reduce carbon emission

3.5.2 Perspective Plan of Bangladesh 2010-2021: Making Vision 2021 a Reality

1. Name	2. Policy Domain
Perspective Plan of Bangladesh 2010-2021: Making Vision 2021 a Reality	Sector wide policy
3. Status & Timeframe	**4. Location**
FY 2010-2021	National
5. Objectives & Indicators related to the Bangladesh Railway	
○ Special emphasis, therefore, will be placed on…establishment of effective railway linkages between the east and west zones of the country, integration of road, rail and inland water transport, and participation in global and regional transport connectivity initiatives that help develop the land route links between South Asia and East Asia through Bangladesh ○ Rehabilitate, upgrade/improve and replace old-aged infrastructure and rolling stocks to reduce journey time, improve the service quality and to build the image of railway as a safe and reliable means of transport ○ Augmentation of line capacity along selected corridors, acquiring modern locomotives, coaches and wagons ○ Organizational reforms introducing a modern financial management system, improved maintenance and operational system and human resource development ○ Increase market share in freight transport, container transport, passenger transport, between Dhaka-Chittagong port ○ Improve Commuter Train Services to provide better urban transport facilities to the daily passengers around Dhaka, Chittagong, Rangpur, Dinajpur, Parbatipur, Nilphamari, Sylhet etc	
6. Included Measures – Projects – Programs	
▪ Connect the Capital City with Cox's Bazar, Mongla Port, Tungipara, Barisal, Chittagong Hill Tracts and other areas where rail network does not exist	

3.5.3 Railway Master Plan

1. Name	2. Policy Domain
Railway Master Plan	Bangladesh Railway
3. Status & Timeframe	**4. Location**
FY 2014-2024	National
5. Objectives & Indicators related to the Bangladesh Railway	
○ A Railway Master Plan has been formulated to be implemented in the next 20 years with an objective of making railway an effective mode of mass transportation and to meet the peoples' demand. A target of implementing 235 projects in 4 phases (five years each) amounting Taka 2,33,944.00 crore (approximately $ 30 billion) has been fixed under this Master Plan	
6. Included Measures – Projects – Programs	

• **Short-term:**
  ○ Implement 44 ongoing projects by 2015, the projects include construction of new tracks, improvement of the signalling system and procurement of locomotives and coaches
  ○ 50 additional projects have been outlined for the next 2 years (2015-2017)
  ○ Bangladesh Railway's linking with Trans-Asian highway
• **Mid-term:**
  ○ 2015-21: 49 projects to be implemented
• **Long-term:**
  ○ The construction of elevated circular rail lines around Dhaka, lines from Tungipara to Fakirhat
  ○ 2021-2030: 57 projects to be implemented
  ○ Building rail lines from Khulna to Barisal, Barisal to Kuakata, and Navaran to Satkhira, Chittagong to Khagrachari and Bandarban.
  ○ Linking Cox's Bazar with the proposed deep-sea port at Sonadia
  ○ National and international connections such as a Trans-Asian Rail Network and SAARC Network

3.5.4 Integrated Multi-Modal Transport Policy

1. Name	**2. Policy Domain**
Integrated Multi-Modal Transport Policy	All transport related to policy, special emphasis on railway and inland waterway transport
3. Status & Timeframe	**4. Location**
FY	National
5. Objectives & Indicators related to the Bangladesh Railway	
• Improved inter-city service quality, timetabling and capacity • Increasing container movement efficiency and capacity • Establishing more inland container depots • Taking a lead in providing multi-modal door-to-door services in close co-operation with operators of other modes • Developing multimodal corridors between major economic centres which give priority to freight and a high-speed network for passengers. The immediate priority will be the Dhaka Chittagong Economic Corridor • Establishing technical harmonization and interoperability between various logistics and systems, including regional traffic, particularly for rail-based container movement • Reorganizing the organization into lines-of-business with a focus on operations in the multimodal environment • Ensuring better integration and interchange • Establishing regional links, including those of Trans-Asian Railway, to facilitate trade in goods and services • Corporatizing BR in order to bring in efficiency and modern business practices • Encouraging BR to divest itself of non-operational land holdings • Improving value for money for passengers from the Government subsidy; and bringing forward investment plans and projects to meet these objectives	

3.5.5 National Land Transport Policy

1. Name	2. Policy Domain
National Land Transport Policy	All policy domains related to land transport
3. Status & Timeframe	**4. Location**
2004-2034	National

5. Objectives & Indicators related to the Bangladesh Railway

- To encourage greater private sector participation in the provision of services
  - The private sector will be encouraged to take a part in: ticketing, ticket allocation and seat reservations, operations of all types of passenger services, supply of rolling stock, freight operations, rolling stock maintenance, track maintenance
- To enhance the operational capacity of railways
  - Where rural branch services are unable to meet their expenses, alternative modes of operation, subsidy payments, and closure of loss incurring services/lines will be considered. In cases of social need and economic benefit the Government will consider subsidy payments (Public Service Obligation) to BR to maintain operations.
- To obtain a greater share of the freight market
  - Government will remove regulations on BR regarding freight traffic, so that tariffs can be negotiated to maximize market share. When Government departments wish to use the railway to carry goods at below market tariffs, they will need to make up the difference between costs of carrying and revenues.
- More efficient management of the railway's assets
  - For mass public transport services for Dhaka, the possibility of implementing new rail commuter services between Tongi and Narayanganj, via Dhaka (and other such mass public services) will be assessed by a detailed study. Further mass transit proposals for Dhaka can be considered once the financial position of BR is more robust.
- Improved financial efficiency
  - The Government will not generally regulate passenger and freight fares. In cases where the Railway is not allowed to increase fares, Government will pay subsidies to make up the losses to BR
- More effective provision of services for social needs
- Fostering international rail links
- To reduce involvement in non-rail activities
  - The Government will explore with BR the most efficient uses of the Railway's land assets (for example in joint ventures with the private sector) and invest the income to provide efficiency improvements.
- Improvement of railway safety
  - The Government will initiate a program of flyover construction at the busiest level crossings, with priority on economic merit. New National Roads will in future be grade-separated from railways
- Improvement of institutional capability of Bangladesh Railway

6. Included Measures – Projects – Programs

- Rail commuter services on Joydebpur-Narayanganj line will be introduced
- Mass transit plans will be developed and studies on sub-ways and elevated systems of transport, in conjunction with institutional strengthening in the transport sector and assistance from development partners, will be undertaken

3.5.6 National Sustainable Development Strategy

1. Name	2. Policy Domain
National Sustainable Development Strategy	All policy domains related to country development
3. Status & Timeframe	**4. Location**
2010-2021	National
5. Objectives & Indicators related to the Bangladesh Railway	
• Railway linkages will be established between the east and the south west zones of the country through construction of the first Padma Bridge. Expansion of line capacity by double tracking of major rail corridors, rehabilitation /upgrade and replacement of old aged railway track, bridges, signalling and other assets, acquisition of modern rolling stocks to provide speedy, environmental friendly and cost effective transport facilities to the national, regional and international traffic will be made.	
6. Included Measures – Projects – Programs	
○ Connect the capital city with Cox's Bazar, Mongla Port, Tungipara, Barisal, Chittagong Hill Tracts and other areas where rail network does not exist. Improve commuter train services to provide better urban transport facilities to the daily passengers around Dhaka, Chittagong, Khulna, Rajshahi, Sylhet and Rangpur.	

3.6 Future Outlook

As railway transport is a more affordable, less accident prone, and more environmentally friendly form of transport, an efficient rail connectivity system would create an enabling environment for both businesses and citizens. Nevertheless, BR has been unable to realize its true potential as a result of poor services. Many of BR's locomotives, wagons, and railway tracks are in a deteriorated state due to age and a lack of maintenance which has led to poor performance of the railway. Trains are often over-crowded and follow consistently delayed schedules. One of the major issues is a lack of both locomotives as well as route capacity. The railway suffers from excess traffic in comparison to the capacity of its routes, as passenger trains are given priority to freight trains – many freight trains incur frequent delays and cancellations. The current poor performance of BR is the result of a history of poor operating performance which has been primarily caused by inefficiencies in both physical and human capital as well as insufficient resources and a lack of key institutional reform. Understanding this, recently many plans have been made to help enhance the efficiencies of BR; including plans to renovate existing railway establishments, purchase new locomotives, and introduce new rail services. It is important that BR is modernized to include new technologies such as high-speed trains, standardized railway tracks, and updated signaling systems.

According to the Economic Relations Division's (ERD) *Transport & Communications Report 2010,* BR has identified 127 projects to implement within the next 5 years at a total cost of $6.2 billion. Within these projects, 26 have been identified as priority projects to be implemented with the assistance of development partners.

Some planned and on-going initiatives /of BR include the following:

- 454.6 km expansion of railway network, through five projects: Dohazari-Cox's Bazar- Gundum (128 km), Kalukhali-Bhatiapara-Gopalganj-Tungipara (135.5 km), Pachuria-Faridpur- Bhanga (60.1 km), Ishurdi-Pabna-Dhalar char (78 km) and Khulna-Mongla (53 km). The progress of which are detailed in
- Some projects have been initiated with an Indian line of credit, primarily the procurement of new equipment

- Dhaka-Mongla line development, Chittagong-Cox's Bazar line development, Dhaka-Sylhet line development
- Khulna-Mongla rail line and 2nd Bhairab and 2nd Titas Bridge
- Rail line rehabilitation: construction of a new ICD at Dhirasram, modernization of Saidpur workshop, modernization of stations, procurement of 2 relief cranes, establishment of load monitoring device in Bangabandhu bridge
- To meet the expectation of the stakeholders necessary steps have been taken for doubling Dhaka-Chittagong railway corridor and introduction of rail communication over the Padma Bridge.
- Bangladesh signed the "Inter Governmental Agreement on the Trans-Asian Railway (TAR) Network".
- Steps have been taken to establish Trans-Asian Railway Network and Regional/sub-regional connectivity in Bangladesh.
- To meet the traffic demand new Express connections have been introduced.

According to the Ministry of Finance's June 2014 Budget Speech, *Bangladesh: Beckoning a New Era of Prosperity*, on the 2014-2015 Budget, the following updates regarding railway programs and projects were given (**Table 15**).

Table 15 Railway Network Expansion Progress

Planned Railway Network Expansion	Implementation Period	Progress as of 2014
Dohazari-Cox's Bazar- Gundum	2010-2016	0.56%
Kalukhali-Bhatiapara-Gopalganj-Tungipara	2010-2015	51%
Pachuria-Faridpur- Bhanga	2010-2015	80%
Ishurdi-Pabna-Dhalar char	2010-2016	37.92%
Khulna-Mongla	2010-2014	16% (as of 2015)

Source: Ministry of Railway

As of May 2015, the Laksham-Chinki double railway line, a portion of the Dhaka-Chittagong railway route spanning approximately 61 km, has been completed. Construction initially began in October, 2011. As a result of this project, passenger and cargo trains will be able to reach both destinations in a shorter amount of time. Previously, cargo trains were required to wait for hours at the station in order to facilitate the movement of passenger trains, with this new double-lining container congestion will decrease. The new track will speed up movement between Dhaka and Chittagong by approximately two hours, since trains will no longer have to wait for other trains coming from the opposite direction to pass through.

The table below (**Table 16**) includes projects that are currently on the Government's priority list, and therefore will be more likely implemented than other projects. For the future, the Government has drawn up an ambitious plan to develop the railway sector for which it has to invest more than Tk. 120,000 crore ($15 billion) in the next 17 years. [23]Currently, BR is implementing 44 projects, many of which are maintenance and procurement related projects.

[23] Railway Master Plan

Table 16 Implementation Progress of Key Railway Projects

2014-2014 Budget Commitments	Implementation Progress
Implementation of Railway Sector Improvement Project	The ongoing project was scheduled to be completed by 2014
Up gradation of Railways into two lines	The work is in progress through 3 projects
Inclusion of Bangladesh in Trans-Asian Railway	More than 50% works of 3 projects undertaken from the inclusion of Bangladesh with the Trans-Asian Railways are completed
Transforming the Bangladesh Railway into a corporate body	Work in progress under the Railway Sector Improvement Project
Upgrading Dhaka-Chittagong railway corridor to double lines	Different programs have been undertaken under 5 different projects
Construction of one railway bridge each parallel to 2nd Bhairab Bridge and 3rd Titas Bridge	Construction work has been started

Source: Ministry of Finance's June 2014 Budget Speech, Bangladesh: Beckoning a New Era of Prosperity

3.7 Challenges

The following section includes an analysis of the railway sector's main challenges. This includes orientation problems & lack of connectivity, historic lack of investment, slow implementation, institutional issues, and negative perception. It is vital that the Government formulate key policies and action plans which are fully implemented in order to overcome these challenges.

3.7.1 Orientation Problems & Lack of Connectivity

The railway network of Bangladesh, which was inherited from a pre-independent India, is unsuitable for present traffic flow requirements; these orientation problems have affected the overall functionality of the railway. Little investment has been made to re-orient the railway network towards the capital city, shorten distances between major cities and districts, improve district coverage, or connect the railway to other important inter-modal facilities, such as ports and highways. One major constraint in BR is its lack of connectivity between rail networks, usually a result of a difference in rail gauge and the incompatibilities in rolling stock. The railway system consists of different gauges: meter gauge, broad gauge, and multi-gauge, which require trans-shipments of traffic at certain points where there is a break of gauge points. Specifically, most of Bangladesh's inherited railway networks from the pre-Liberation War railway are meter gauge and broad gauge. The east-west railway system over the Bangabandhu Multipurpose Bridge is inter-connected using a dual-gauge track, but the east part of the network consists of meter gauge. These variations in track types will require reorientation in order to enhance connectivity and overall efficiency in the Bangladesh rail network. For example, India is not able to link with its north-eastern states through Bangladesh, as a result of a difference in rail track. India has a three gauge system while Bangladesh primarily has broad gauge and meter gauge. To add, Bangladesh is also a riverine country, with approximately 405 rivers flowing through the country.[24] Therefore,

[24] Joint Rivers Commission, Bangladesh

many areas of the country are difficult to reach as they require building of costly bridges. This makes it even more difficult for BR to adequately serve the needs of the country.

Out of a total of 64 districts in Bangladesh, only 44 districts are connected via railway. Some of the existing route lines are also inefficient and time-consuming, for example, Bangladesh's two largest and economically significant cities, Dhaka and Chittagong, are connected through such a route line. The Dhaka-Chittagong corridor is considered the life-line of the country as it connects its capital city to the port city, this route is currently dominated by road transport because of a less effective railway link between the two cities. More specifically, the current rail link between Dhaka and Chittagong is not straight; it is characterized by a large rounding loop between Dhaka and Laksam (Comilla) drastically increasing the time it takes to transport passengers and freight between the two locations. A proposed rail line on this portion, in order to establish a faster link between Dhaka and Chittagong, has been on the table for decades. A chord line, a railway route that runs across the outer spaces of an urban area, was proposed in the 1970s for faster transportation. The Dhaka-Chittagong rail journey would decrease by almost 100 km, or three hours, if the chord line was to be built, currently, the Dhaka-Chittagong route is 320.79 km as trains have to reach Tongi before passing through Comilla in order to reach Chittagong from Dhaka. The proposed chord line would reduce the route to 227.01 km. The estimated cost of the construction had been fixed at about Tk 11,622 crore, and has been floated as a PPP project, but little interest has been shown by the private sector. This is an example of how the BR's rail track orientation problems cause issues with the efficiency of operations and connectivity. In order for the railway to adequately compete with a sector such as road, connectivity must be greatly enhanced.

3.7.2 Historical Lack of Investment

Since Bangladesh's liberation, the Government has not adequately focused on the construction of new rail-routes and existing railway routes have not had proper maintenance. There has been minimal investment in the railway, which has left this transport sector in desperate need of adequate funding. As the railway sector has been historically neglected by the Government, with an emphasis being placed on the road sector instead, BR has not been able to develop or compete with the continuous development of the road which now offers more direct connectivity and higher speeds of mobility. The following includes a list of some of BR's largest issues, which are results of a historical lack of investment:

- Track maintenance is especially important to avoid derailments and provide quality riding for traffic, however, in Bangladesh; track maintenance is undertaken manually and infrequently with mechanical maintenance only done with aged equipment for the Dhaka-Chittagong line. As a result, there are often speed restrictions placed on trains as to limit chances of major accidents on poorly maintained track. A 2007 track condition study carried out by BR indicated that out of 2,885 km of rail route, 1,009 km of track needed urgent rehabilitation.
- As of 2007, only 8% of Bangladesh's route track has double track or part of the route has double track, this lack of double tracking has a largely negative impact on capacity[25]
- Some railway bridges were built over 100 years ago, such as the Hardinge Bridge, Titas Bridge, and the Lakhya Bridge, the permitted speed on such bridges is very low, approximately 30-50 km/hour, and most of these bridges are in dire need of urgent repair.

[25] Bangladesh Railway

- Railway signals are used to enhance order and safety, and the railway sector is especially dependent on signalling systems as stopping a train must be done up to 2-3 km ahead of the stopping point. Efficient signalling systems not only maintain safety but they also offer increased efficiency such as higher speeds and improved control. In Bangladesh most of the signals and systems are dated and most modern equipment is used for major routes only, such as the Dhaka-Chittagong route. 47% of BR's network has speed restrictions of less than 50 km/h, this is a result of a lack of track maintenance and dated signalling systems.
- In 2010, almost 78% of the locomotives and 28% of passenger coaches were beyond their economic life and in need of immediate replacement.[26] The serviceable lives of the majority of locomotives have already expired and most carriages and bogies are backdated. It is difficult and often very expensive to find replacement parts for such old locomotives, further making it more difficult to guarantee reliable operations. The quality of rolling stock has an effect on the quality of operations, and the repairable number of rolling stock is only increasing every year.
- A lack of adherence to scheduling, low speed of services, infrequency of services, and a lack of clean train facilities – are all characteristics of the current BR, all of which are a direct result of a historical lack of investment.
- Rail transport is considered the safest form of transport in Bangladesh; however, the number of train accidents is increasing year by year at approximately 16% as a result of poor infrastructure and track maintenance, although the number of fatal accidents is less than other forms of transport. Types of railway accidents include collisions, derailments, fires in the train, and trains running into obstructions. Causes include unguarded level crossings, frequent mechanical and human failures, poor rail tracks, and outdated signalling systems; most often accidents are a result of derailments, directly linked to poor track conditions. At many level crossings, the railway has not been able to provide adequate approach warning signals and road signals. Bangladesh's entire rail network has approximately 1,403 level crossings and only 250 level crossing gates are operated by gatemen at all times. Many pedestrians are also killed by approaching trains, an issue which the BR has little control over. As per rules, activities are considered illegal within 50 yards of railway tracks, unfortunately, few people obey such rules. As most accidents are primarily a result of poor track and signalling systems which ultimately stem from a lack of investment, it is important that more funds are spent to sufficiently address these issues.
- More specifically, the railway suffers from short loop lengths and marshalling yard lines/terminals which restrict the ability for locomotives to carry full train loads. Freight train speeds are further limited due to poor mechanical signalling and track structures. Railway freight transportation is one of the slowest in the world, as it can take up to 18 days to bring a container from Chittagong port to Dhaka as a result of a shortage of

[26] National Sustainable Development Strategy 2010-2021

freight trains, as well as very low travelling speeds, a mere 15-20 mph.[27] Most lines and crossing loops, besides the main line, are in bad condition and lead to persistent derailments and delays. Most of BR's rolling stock, the wheeled vehicles used on railways (locomotives, rail road cars, coaches, and wagons), are beyond their economic life, which means that trains move at a slow speed.

Table 17 Annual Transport Investment

Year	Transportation Sector Investment as a % of ADP	Roadway	Railway	Inland Waterway
1974-1975	11.56%	32.4%	7.3%	40.30%
1979-1980	13.79%	42%	30.6%	27.4%
1984-1985	11.59%	35.9%	36.3%	27.8%
1989-1990	12.01%	49.6%	29.9%	20.5%
1994-1995	16.91%	78.3%	14.7%	7%
1990-2000	18.81%	88%	9%	3%
2004-2005	19%	88.6%	8%	3.4%
2009-2010	19.20%	88.9%	7.8%	3.3%

Source: Ministry of Finance

From **Table 17** above it is clear that the percentage of ADP allocated to the railway sector has consistently declined over the years, from 36.3% in FY 1984-1985 to 3.3% in FY 2009-2010. This historical lack of investment is also a result of historical operational deficits; this in turn becomes a sick cycle, as operational deficits occur as a result of heavily subsidized passenger fares, which lead to insufficient revenues for adequate investment.

3.7.3 Slow Implementation

What has been most often cited as a challenge for BR is slow implementation. For instance, according to Bangladesh's SFYP, "Railway reforms are well identified, implementation has been a problem. This issue will be carefully reviewed to identify what has held back the progress. Based on this review, proper measures will be taken to speed up reform implementation." To add, the SFYP's FY 2015 railway objective was for a total of 3,252 km of usable route track in Bangladesh to be in effect, unfortunately there is currently only 2,877 km of route track, with uncertainty as to how much of this track is even in usable condition, a clear example of slow implementation. This poor track record for implementation is a result of a lack of adequate physical and human capital, a lack of funding, as well as institutional issues. Weather related issues, such as the monsoon season and heavy rainfall also frequently result in cost over-runs and delays in project implementation.

According to the Economic Relations Division's (ERD) *Transport & Communications Report 2010*, "…programs have already been undertaken with development partner assistance…..to replace Bangladesh Railway's old aged rolling

[27] Strategy for Infrastructure Sector, Background Paper for the Seventh Five Year Plan, Dr. Khurshid Alam, Policy Research Institute of Bangladesh

stocks, to rehabilitate existing tracks and establish important missing links and reopening of closed tracks, double tracking of missing portion of Dhaka-Chittagong main corridor, and the modernizing of signalling systems and railway workshops etc.” For example, the ADB funded project, *Bangladesh Railway Sector Investment Program,* is a currently on-going large scale initiative divided into four tranches, to rehabilitate existing rail lines, remodel/rehabilitate existing railway stations, upgrade signalling, and increase the procurement of locomotives and carriages/wagon. In 2006, this $430 million multi-tranche financing facility was initiated in order to rehabilitate the Bangladesh Railway.

Another initiative includes the ECNEC approved (2012) construction of 3rd and 4th dual gauge rail tracks in the Dhaka-Tongi section (49 km) and the doubling of the dual gauge double track in Tongi-Joydebpur section (13 km, including signalling works) at a cost of Tk. 8.49 billion (approximately $110 million) – both of which would reduce congestion in Dhaka. These tracks will also enhance commuter train services between Dhaka and adjacent cities such as Tangail, Narayanganj, Mymensingh, Joydebpur, and Brahmanbaria.

Table 18 List of Projects under the Indian LOC to Bangladesh

1	Procurement of 165 Broad Gauge oil tank wagons and 6 nos Broad Gauge Brake vans for Bangladesh Railway
2	Procurement of 10 Broad Gauge diesel locomotives for Bangladesh Railway
3	Procurement of 81 Meter Gauge tank wagons and 3 Meter Gauge Brake vans for carrying aviation fuel for Bangladesh Railway.
4	Construction of 2nd Bhairab and 2nd Titas railway bridges with approach rail lines, including feasibility study
5	Procurement of 16 Broad Gauge diesel locomotives for Bangladesh Railway
6	Construction of Khulna-Mongla Port Rail Line, including feasibility study
7	Procurement of 50 Meter Gauge flat wagon and 5 Meter Gauge Brake vans with Air Brake for carrying containers for Bangladesh Railway
8	Procurement of 170 Meter Gauge flat wagon and 11 Meter Gauge Brake Van with air brake system for carrying containers for Bangladesh Railway
9	Construction of 3rd and 4th dual gauge rail track between Dhaka-Tongi and doubling of dual gauge tracks between Tongi-Joydevpur
10	Procurement of 120 Broad Gauge passenger Coaches for Bangladesh Railway.
11	Replacement and modernization of signalling system of three stations between Ashuganj and Akhaura section of Bangladesh Railway
12	Rehabilitation of the Kulaura-Shahbajpur section of Bangladesh Railway

Source: High Commission of India, Bangladesh

The initial implementation period was 2012-2015, however little progress has been made as of 2014. These railway development projects, in addition to various other railway procurement related projects are being partially financed under an $800 million credit line at 1% interest from India. The Government has already approved many projects under the Indian Line of Credit (LOC) most of which are projects to improve Bangladesh's railway communications (**Table 18**).

However, implementation has been very slow as a result of delays in decision making as well as lengthy land acquisition processes. For instance, only 16%[28] of the construction of the Khulna-Mongla Port railway link, a priority project of the railway, was completed. Initially set to be completed by December, 2014, the project has now been extended by an additional five years. The estimated cost of Khulna-Mongla rail project, to be financed by the Indian government, has more than doubled in last five years. Compared to its initial cost in 2010, the project as of 2015 has increased by from its initial Tk. 17.21 billion to approximately Tk. 38.02 billion. The construction of the 2nd Bhairab and 2nd Titas Bridges with approach lines, initially set to be completed by 2016, has only seen 7% progress. Unless Bangladesh focuses on the completion of projects such as these, the Bangladesh Railway's promising potential will never be materialised.

3.7.4 Climate Change

Bangladesh is one of the most flood prone countries in the world and has experienced 21+ above-normal floods, of which 4 were exceptional and 2 were catastrophic in the past 60 years.[29] For instance, Bangladesh's 2007 flood caused damage to 31,533 km of roads and affected 14 million people, with damage amounting to $1.1 billion. According to a 2010 World Bank Study, *Climate Proofing Infrastructure in Bangladesh,* "using the 1998 (Bangladesh) flood as a benchmark for evaluating additional protection measures, the authors calculate conservatively that necessary capital investments out to 2050 would total US $2.671 billion (at 2009 prices) to protect roads and railways, river embankments, surrounding agricultural lands, and drainage systems and erosion control measures for major towns. With gradual climate change, however, required investments would be phased. Beyond these capital intensive investment, improved policies, planning and institutions are essential to ensure that such investments are used correctly and yield the expected benefits." One key challenge of the railway sector will be formulating strategies as well as raising funds to successfully deal with the consequences of climate change and resulting monsoon flooding. For instance, according to the Inter-Governmental Panel of Climate Change (IPCC), a warming trend in the larger Ganges Brahmaputra Meghna basin in South Asia, where Bangladesh is located, will result in an increase between 1-3 degrees Celsius by 2050, which will cause higher precipitation in the basin causing increased monsoon rainfall and subsequent flooding in Bangladesh. This will cause damage to Bangladesh's infrastructure and as a result it will be of utmost importance that investments are made to maintain the key infrastructure as well as to design future infrastructure projects in such a way as to minimize flood related damage. The study was able to forecast necessary capital investments in infrastructure by first understanding the current spatial distribution of infrastructure, and then adding to it projected expected changes by 2050 (in this study's analysis, it was assumed that the rail network in 2050 would be the same as the rail network in 2010, based on a historic lack of change). The length of railways (km) exposed to inundation risk for different types of track of rail was determined based on GIS overlays of maps of additional inundation risk with existing railway maps.[30]

Table 19 includes estimates of inundation areas by 2050, it should be noted that 50% of Bangladesh will constitute flood affected areas by 2050, indicating that a large percentage of the population in addition to a large percentage of infrastructure i.e. roads, railways, bridges, embankments, and drainage systems will also be at risk.

[28] Ministry of Railway

[29] Climate Proofing Infrastructure in Bangladesh, the World Bank, 2010

[30] Climate Proofing Infrastructure in Bangladesh, World Bank, 2010

Table 19 Inundation Area Estimates by 2050

Land Type	Baseline Scenario		Climate Change Scenario		Change due to Climate	
	km2	% of Total Area	km^2	% of Total Area	km^2	% of Total Area
Flood Free	69,439	52%	64,550	49%	-4,889	-3%
F0 (0.1-0.3m)	2,950	2%	2,251	2%	-699	
F1 (03-0.9m)	14,123	11%	11,975	9%	2,148	-2%
F2 (0.9-1.8m)	19,118	14%	20,723	15%	1,605	1%
F3 (1.8-3.6m)	22,115	16%	26,153	19%	4,038	3%
F4 (>3.6m)	5,777	4%	7,870	6%	2,093	2%
Total Flooded Area	60,750	45%	66,362	50%	5,588	5%

Source: Climate Proofing Infrastructure in Bangladesh, World Bank, 2010

Table 20 below provides a breakdown of the number of length (km) that are at risk of inundation due to climate change by 2050 based on the track type. Based on the table, it can be estimated that less than 2% of railway tracks in 2050 will be subject to greater than 1 meter of additional inundation, however, 85% of railway tracks will be subject to 0.5 metres of additional inundation risk. A total of 708.1 km of railway will be subject to additional inundation depths.

Table 20 Railway Tracks (km) at Risk of Inundation due to Climate Change by 2050

	Additional Inundation Depth (m)							
Railway track (km)	**0-0.5**	**0.5-1.0**	**1.0-1.5**	**1.5-2.0**	**2.0-2.5**	**2.5-3.0**	**>3.0**	**Total**
Meter gauge	173.3	10.8	2.4	1.7	-	-	-	188.1
Broad gauge	205.8	35.0	7.0	-	-	0.4	0.3	248.5
Meter gauge double	224.7	43.0	2.6	0.5	0.3	0.4	-	271.4
Total track	603.8	88.8	11.9	2.1	0.3	0.8	0.3	708.1

Source: Climate Proofing Infrastructure in Bangladesh, World Bank, 2010

As a result, the estimated cost of raising railway track to offset these additional risks, detailed in **Table 21** (cost in $ per km), is approximately $27 million; the break-up of cost as follows: cost of raising broad gauge tracks at $10 million, the meter gauge tracks at $6 million, and the double gauge tracks at $11 million.

Table 21 Cost per km to raise Railway Tracks (up to 0.5 meters, in $)

Description of Cost Component	Meter Gauge	Broad Gauge	Double Gauge
Carriage Cost			
Removal and replacement of ballast	741	892	892
Removal and replacement of rail and other heavy iron works	463	498	498
Permanent Way			
Dismantling an re-lay of track	12,745	17,039	17,039
Earthwork with sand	5,607	6,846	6,846
Procurement of 15% ballast and spreading	6,786	10,143	10,143
Mechanical temping at four stages	2,871	3,468	3,468
Total Cost (per km)	29,212	38,886	38,886

Source: Climate Proofing Infrastructure in Bangladesh, World Bank, 2010

As the railway sector already suffers from a backlog of maintenance and procurement requirements, in addition to new capital investments required to increase the quality of services, these additional fund requirement to climate proof the railway sector will be another challenge in Bangladesh Railway's myriad of challenges to overcome; simultaneously and strategically dealing with all these challenges will be of great importance for this sector.

3.7.5 Institutional Issues

The BR is characterized by a large mixture of department heads and subordinates and an incredibly large work force, this creates frequent coordination problems. In addition, even if important development projects are identified, a lack of quality personnel causes frequent delays in project completion, an emphasis on capacity building within BR must be made. Moreover, there is *no internal coordination amongst different transportation institutions* which leads to unnecessary competition between different modes which decreases the sustainable development of the entire transport sector; as a result there is limited intermodal connectivity and mobility.

In 1994-1998, an ADB funded, *Railway Recovery Program*, was initiated in order to increase the efficiency and reduce costs of the Bangladesh Railway; it has made some key changes in the sector:

- Improving labor productivity through reducing surplus employees (workforce was reduced to 35,000 from 58,000, as of 2013, the numbers reduced is only 26,000)
- Reducing losses by closing insolvent branch lines, stations, depots, and train services
- Improving operational efficiency through the optimal use of assets
- Exploiting commercially surplus land of the Bangladesh Railway
- Encouraging organizational reform, incorporating structural changes, and effective business practices.

All these initiatives in the *Railway Recover Program* indicate where weaknesses lie institutionally: a lack of labour productivity, poor business practices such as the continuation of insolvent branches and services, lack of operational efficiency, and a need for organizational reforms. The Bangladesh Railway must improve its internal operations systems in such a way that they are able to make meaningful changes in the transport sector; this will include many institutional revisions and changes.

3.7.6 Negative Perception

Another challenge for the Bangladesh Railway will be to change the current perception that road networks are the only form of operative transport for passengers and freight. This is primarily due to the fact that both passengers and freight can be transported directly door-to-door with roads, while the railway can only provide transport up until a certain point. The geographic nature of Bangladesh also offers other distinct benefits to the road sector, such as the fact that terrain is mostly flat, making it easily navigable by road, and the capital is in the centre of the country, further making the road networks favourable.

Factors contributing to its negative perception of the Bangladesh Railway include poor and worn out facilities such as low-quality seating, unhygienic toilet facilities, a lack of safety provisions, and operational issues, such as frequent delays; moreover, using BR to transport freight requires more occurrences of the on-loading and off-loading of goods, which can cause delays in journey, added financial costs, and the risk of theft. In addition, priority is commonly given to passenger trains which frequently lead to delays in freight trains - which further decrease its overall attractiveness to customers. It is important that the operating condition of the BR drastically improve in order to encourage passenger and freight usage and ensure long-term sustainability.

If the Bangladesh Railway works to improve the quality of its facility and operations, and then subsequently promotes itself as a comfortable and affordable transportation method for both freight and passengers, its market share in the transport sector will only increase. Marketing initiatives could include the marketing of positive testimonials, through print media, television commercials, and social media.

Table 22 Measures taken thus far by the Railway sector

Challenge	Response
Orientation Problems & Lack of Connectivity	• Dual gauge line (Dhaka-Tongi, Dhaka-Joydevpur) • Double tracking projects to increase capacity (Tongi-Bhairabazar, Laksam-Chinki Astana) • New track projects (Pachuria-Faridpur-Bhanga, Dohazari-Coxs Bazar, Kashiani-Tungipura, etc)
Geographical Constraint	• Bridge maintenance/new bridge projects under BBA, RHD, LGED, etc.
Historic Lack of Investment	• Railway Master Plan (235 projects in 4 phases, $30 billion) • Increasing ADP Budget • Development partners (ADB, Japan Bank for Intl. Cooperation) • Indian LoC • Railway Sector Improvement Project (ADB) ($430 million, multi-tranche)
Operational Deficit	• Recommendations for private sector involvement (leasing schemes for assets, ticketing, reservations, operations), container capacity increase (deregulation), corporatizing BR, divest in non-operational land holdings, more Government subsidies
Climate Change	• GoB has highlighted severe monsoon floods as a significant hazard and ensuring adequate flood protection infrastructure as a “pillar” of the Climate Change Strategy and Action Plan, (GoB, 2009) • GoB has already invested over $10 million (constant 2007 prices) in flood management embankments and emergency shelters
Institutional Issues	• Railway Recovery Program (ADB) (58,000-35,000 employees) • Discussion/consultation forums (Natl. Land Transport Policy)
Negative Perception	• DEMU passenger trains (attempt to revamp BR’s image as provided fast and quality services, however this attempt did fail)

3.8 Knowledge Gaps

Some of the knowledge gaps of the railway sector, defined as knowledge gaps that negatively affect the strategic operations and growth of the sector, include the following:

- **Lack of updated published data:**

  While doing the research for this baseline study, it became apparent that many key published data statistics, such as the freight modal share between the transport sub-sectors, the status of railway networks, maintenance requirements, etc. tended to either be dated or missing. This indicates that there has not been enough emphasis on accumulating data related to transport sectors – this can pose a problem when strategically planning the maintenance requirements as well as planning new infrastructure projects. Therefore, it is important for the Government's long term planning activities that transport sector data is regularly updated.

- **Lack of specificity in Government policies:**

  The GoB has prepared many key policies in relation to the country's transport sector, however many of these policies only point out the challenges in the sector and then proceed by offering ambiguous and open-ended solutions to these challenges. For instance, in the Government's *National Land Transport Policy* and *Integrated Multi-Modal Transport Policy,* many challenges are followed by a statement saying that the Government will address that challenge; however no specific action plan is included. There must be more focused Plans and Policies initiated by the Government that set proper plans of actions with timelines.

- **Lack of long-term planning and coordination**

  Many projects in Bangladesh are taken up and implemented without long-term planning. For example, no clear initiatives have been made by the Planning Commission to coordinate the building of the Padma Bridge with the Dhaka-Faridpur railway link which is a key railway component of the bridge. Government projects in the past have shown many examples of a lack of long-term outlook, for example, recently the Government proposed for the Dhaka-Chittagong Highway be updated with 6-lanes, when it is currently undergoing construction for 4-laning. It is of the utmost importance that all projects take into consideration future outlooks as well as work in a coordinated manner such that all projects belonging to different implementing agencies work cohesively together.

- **Lack of Prioritization of Projects**

  The GoB does a very good job in understanding the challenges, maintenance requirements, as well as outline necessary future infrastructure projects within the railway sector – however, there needs to be an adequate reconciliation between what is required in the roads and highways sector and what is financially and technically feasible. The 2013-2014 ADP for the Bangladesh Railway alone includes a list of 35 projects, which amount to fund requirements well beyond the actual yearly allocation of the ADP. In addition to that, many other projects have been planned that are outside of the ADP, such as projects under the Indian LoC. Each year, more and more projects are added on to the ADP program, with no real planning as to how many of the projects can realistically be completed given current funding. Instead of adding on so many projects each year, the Government should focus more on prioritizing certain projects to ensure that it is actually able to complete such projects.

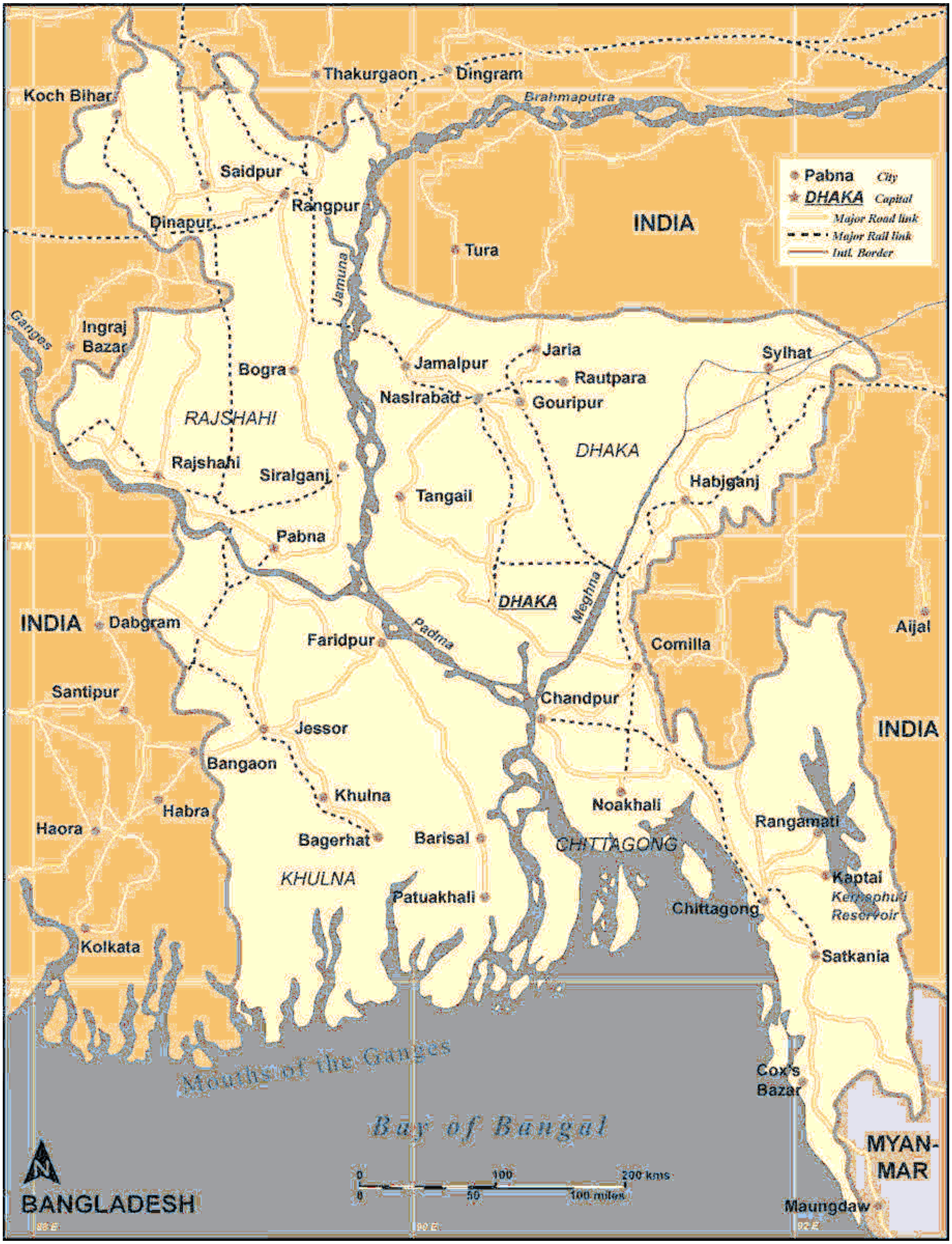
3.9 Recommendations

- If BR is developed through increased funding, enhanced planning and policy-building and adequate human resources, this transportation sector has the potential to provide many benefits, such as, it could provide the highest operational speeds and capacity, increasing the mobility of both passengers and freight. Additionally, it is more sustainable over time as it provides environmental benefits (less emission of pollutants) and requires less land. Railway usage is also more affordable and has proven to be more statistically safe. In order to develop BR to this level, intense modernization is required which will only be possible if BR works more like a corporation rather than a subsidized government entity, fares may increase as a result of this corporatization. However the increased quality of services and convenience will still allow it to remain competitive with other sectors. This will require an overhaul of management processes, which may include discontinuing operations of unprofitable routes and laying-off non-performing employees, internal restructuring, and a change in the organization's cultural mindset.
- Tariff reform is paramount. Tariffs for all passenger and freight routes must be reanalyzed and re-priced considering current price levels. Tariff reform will provide BR with the ability to set tariffs based on market situations and commercial considerations.
- BR should focus on inter-city passengers to increase its market share in the transport sector as well as help encourage the proper development of its already deteriorating capital city, Dhaka. Urban areas in Bangladesh are plagued by high population density and subsequently unbearable levels of traffic.
- Introduction of effective commuter rail lines for urban areas, essentially for commuters that live in towns neighbouring Dhaka but come into the city for work, the speed and frequency of this mode of transportation should be enhanced such that commuters continue to use these services. This will decrease the burden on roadways. These services must be planned in accordance with other existing or planned major projects – such as the MRT and BRT. Comfortable and reliable rail-based commuter services will encourage individuals to live in surrounding satellite towns and commute to Dhaka for work, which will decrease pressure on the capital.
- Railway plans should emphasize the development of freight and container transportation. A high-speed and modernized freight and container corridor for transporting goods from Dhaka to Chittagong Port must be developed. This corridor should be able to compete with road transport, in terms of offering faster mobility and safer transport. If this corridor is developed, railway revenues could be substantially increased.
- The Bangladesh Railway should enter the regional traffic market as soon as possible. If Bangladesh were to offer railway connections via Bangladesh to neighbouring countries, for example via the Trans-Asian Railway (of which Bangladesh is already a signatory) or allow the transportation of freight between India and its north-eastern states, the potential for revenue would increase dramatically which could help in improving BR's overall financial health as well as operational service quality. Therefore, BR should act fast in developing infrastructure for regional connectivity.
- Effective management and marketing of fixed assets, such as land, in order to increase revenues. The Government should pay adequate focus in helping alleviate BR from illegal occupiers on their land.
- The Government and relevant stakeholders, such as City Corporations, should aid BR in controlling the increasing density of level crossings in order to help ensure the safety of pedestrians as well as allow the BR to run their operations smoothly. This may include the disbursement of illegal occupiers as well as strict enforcement at level crossings in the form of patrol men.
- Relevant organizations should work with BR to plan and implement full grade-separations from roadways to help improve the traffic management system. As full grade-separations can be extremely costly, thorough analysis should be completed to understand which areas are the most beneficial (economically and socially) for full-grade separation. Grade separation is the method of aligning a junction of two or more surface transport axes at different heights (grades) so that they will not disrupt the traffic flow on other transit routes

when they cross each other. The composition of such transport can consist of a mixture of roads, footpaths, railways, canals, or airport runways. Partial grade separations will not fulfil long-term objectives of efficiency between all transportation modes, as evident by the traffic caused by partially grade-separated flyovers such as the Mohakhali and Khilgaon flyover.

- The Government should put more emphasis on consistently keeping data regularly updated, published, and available in one central location for all stakeholders to access. This data should have a set time update requirement, for instance, all data should be updated by the December 15th of each Fiscal Year, with one central committee within the BR responsible for accumulating and publishing that data. Data should include information from project status, projects in pipeline, railway track/locomotive/engine condition, freight modal shares, etc. A thorough list of key parameters to be measured should be set by relevant transport stakeholders, and the responsibilities of such data collection should lie with the transport organization most relevant for such parameters. Key parameters may include: average travel time, speed of passenger and freight trains, location-wise accident data, etc. The Planning Commission should be responsible for managing the collection of such data and publishing such data in an accessible online database that is available to the public.
- Government Policies should not only set broad agenda, but should set specific plans of action based on realistic timelines. These policies should also be reflected in the Five Year Plans. For instance, a large and important policy such as the Railway Master Plan should be formulated and detailed enough to include time-specific goals, which should be mostly mirrored in each subsequent Five Year Plan. Relevant stakeholder agencies, such BR, should base their yearly agenda on these Policies. Specific plans such as the Strategic Transport Plan, the Road Master Plan, or the Railway Master Plan should be updated every 5 years to take into consideration changing conditions.
- Too many projects are included in each FY's ADP plan; many projects have long time horizons, which aren't taken into consideration when formulating the next year's ADP. For instance, FY 2016 ADP should accurately consider the funds required by the previous years' ADP projects for completion, instead of assigning new projects which will only increase backlog and lower productivity. Essentially, the Government needs to pay more attention to prioritizing key projects instead of taking on too many projects at a time.
- Enhancing inter-modal connectivity should not only be a set broad agenda but should be taken into consideration with all project plans, for example, the double-tracking of rail lines should take into consideration how roadway capacity will be affected, train stations should be set in areas that allow an easy switch of transportation to roadways or waterways. All transport stakeholders should work in unison when setting their own transport agendas such that all modes do not unnecessarily compete with one another, but rather work together for the socioeconomic good of the people. Historically, the unguided nature of development activities has been a direct result of an absence of synergistic efforts between stakeholders.
- It is important for the Government to have an accurate idea of what the future railway network will be like in a future given year. This is for two reasons,
    - Sectors that are affected by the railway network, such as the agriculture sector, can anticipate how these changes will affect their sector
    - Future railway networks should take into consideration socio-economic and climate issues such as population changes, transport demand changes, and the impacts of climate change. The ability to adequately forecast a future road network is also heavily dependent on the recommendations being carried out.

4 Map of Bangladesh Railway Network



Source: Bangladesh Railway

5 References

Dasgupta, S., Huq, M., & Khan, Z. (2010). Climate Proofing Infrastructure in Bangladesh. *The World Bank,* 34-34. Retrieved October 1, 2014, from http://www.preventionweb.net/english/professional/publications/v.php?id=16426

TRANSPORT AND COMMUNICATION. (2008, January 1). Retrieved July 15, 2014, from http://www.mof.gov.bd/en/budget/er/2008/c11.pdf

Schwab, K. (2014). The Global Competitiveness Report 2013–2014. *World Economic Forum*. Retrieved July 18, 2014, from http://www.weforum.org/reports/global-competitiveness-report-2013-2014

Bangladesh Development Forum Meeting 2010. (2010, January 1). Retrieved August 12, 2014, from http://www.lcgbangladesh.org/bdf-2010/BG_ Paper/BDF2010_Session V.pdf

Integrated Multi-Modal Transport Policy Final Draft. (2008, January 1). Retrieved August 10, 2014, from http://fpd-bd.com/wp-content/uploads/2013/04/IMTP-Nov-2008-08.pdf

National Land Transport Policy. (2004). Retrieved July 20, 2014, from http://lib.pmo.gov.bd/legalms/pdf/National-Land-Transport-Policy-Bengali-english.pdf

National Sustainable Development Strategy (NSDS). (2013). Retrieved August 15, 2014, from http://www.plancomm.gov.bd/wp-content/uploads/2013/09/National-Sustainable-Development-Strategy.pdf

PERSPECTIVE PLAN OF BANGLADESH 2010-2021. (2012). Retrieved August 3, 2014, from http://www.plancomm.gov.bd/wp-content/uploads/2013/09/Perspective-Plan-of-Bangladesh.pdf

Budget Speech 2014-2015. (2014). Retrieved August 18, 2014, from http://www.mof.gov.bd/en/index.php?option=com_content&view=article&id=274&Itemid=1

Mid-Term Implementation Review of the Sixth Five Year Plan of Bangladesh. (2014). *Policy Research Institute of Bangladesh*.

SIXTH FIVE YEAR PLAN FY2011-FY2015. (2011). *Planning Commission*.

Ministry of Railways. (2014). *Ministry of Finance*. Retrieved September 12, 2014, from http://www.mof.gov.bd/en/budget/14_15/gender_budget/en/26_51_Railway_English.pdf

PROGRAMME COSTS AND PHASING. (n.d.). Retrieved from http://railway.portal.gov.bd/sites/default/files/files/railway.portal.gov.bd/page/69956fe3_d1f6_4b6f_9b57_80237fcf9813/9. Programme cost _Phasing.pdf

About LGED. (n.d.). Retrieved from http://www.lged.gov.bd/#

Transport and Communication. (2014). In *National Accounts Statistics 2013-2014*. Bangladesh Bureau of Statistics.

BASELINE STUDY: 14

Sustainable Transportation and Infrastructure

Part 3: **Inland Waterways & Ports**

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Executive Summary: Study 14 : Part 3 (Inland Waterways & Ports)

Bangladesh is crisscrossed by a network of about 24,000 km of inland waterways. It provides cheaper transit of passengers and goods; an important fact is that about 25.1 percent of rural population can access to rivers only for the purpose of transport. A World Bank Report titled *Revival of Inland Water Transport: Options and Strategies* revealed that modal share of IWT registered a gradual declining trend during last decades and estimated at 8.9% in passenger and 16% in freight movement in 2005, while in 1975 IWT modal share of passenger traffic was 16% and freight traffic 37%.

One of the main causes of declining trend of inland water transport identified in this Study is the deteriorating condition of the river system in Bangladesh caused by both morphological and natural processes, and withdrawal of water beyond the border and within the country. Length of navigable waterways determined by a comprehensive survey in 1989 was about 6,000 km in the wet season which used to be reduced to about 3,600 km during the dry period. Inland waterways were divided according to the least available depth (LAD) into four hierarchical classes in 1989 which were found to be inappropriate now in this Study with the change of navigability and change of transport pattern and type over the years. But no comprehensive survey has been conducted since 1989. However a Core Waterways Network of 1,822 km was recommended in the IWT Master Plan 2009.

So far Bangladesh Inland Water Transport Authority (BIWTA) has established 21 inland river ports and 380 landing stations in the country. Infrastructure and facilities now available in these ports and landing stations are very much marginal and primitive in nature to such extent that head-load remains the general means of loading and unloading cargo. BIWTA does not have detail traffic data of passenger and freight movement in inland waterways. In 2013-14, BIWTA recorded 87.40 million of passenger and 35.18 million tons of cargo throughput the nine major river ports. IWT is mainly used for transport of bulk, dry bulk and liquid bulk of construction materials, food grains, fertilizer, clinker, petroleum product etc. A large fleet of about 10,000 inland vessels are engaged in the carriage of goods and passengers. Besides there are approximately 750,000 country boats powered by the pump engines operating mainly in the rural waterways.

A Protocol on Inland Water Transit and Trade between Bangladesh and India has been in force since 1972 without any disruption for commerce between two countries and for passage of goods between mainland India and the land-locked north-east through the waterways of Bangladesh. A total volume of more than 19.33 million tons of cargo was transported under this Protocol in 2013-14 of which more than 98% were transported by Bangladesh vessels despite the provision of sharing the carriage of cargo on equal basis. In this regard IWT trade is dependent on only fly ash required by the cement manufacturing factories.

One of the main factors for revival of IWT would be container traffic in inland waterways. To meet the growing demand of transporting containers between Dhaka and maritime ports, utilization of inland waterways has become inevitable. Railway suffers from capacity constraint and the road does not have bearing capacity to accommodate trailers, so all the studies conducted recently recommended for inland waterways. An Inland Container Terminal has already been developed through a joint venture project of BIWTA and Chittagong Port Authority (CPA) with an annual handling capacity of 116,000 TEUs which is to be followed by another 4 inland container terminals under construction by private sector.

There are two maritime ports in Bangladesh, which serve the international sea borne trade; these are Chittagong Port located in the south-eastern part and Mongla Port located in the south-western part of the country. Chittagong is the gateway port, handling more than 90% of international sea borne trade cargo. In 2012-13, the Chittagong Port handled a total volume of 43.37 million tons of cargo, while Mongla handled about 3.147 million tons. In the same year Chittagong handled 1.469 million TEU of container as against about 44,000 TEU by Mongla. The international sea borne traffic in maritime ports is growing faster than the GDP growth in Bangladesh, the growth of tonnage is 10%

per annum while the growth of container traffic 12% per annum. The Chittagong Port has a total of 41 berths including private and public terminals and lightering operations in the outer anchorage. At the three main terminals of the port, General Cargo Berths (quay length 2,131 m), Chittagong Container Terminal (quay length 450 m) and the New Mooring Container Terminal (quay length 1,000 m), handling is being conducted by private local terminal operators. At the Mongla Port, there are 5 jetties, 5 mooring buoys, 8 anchor berths and 5 private jetty berths. The length of quay wall at Mongla Port is 940 m.

Some of the Government policies and strategic plans related to Inland waterways and maritime sector are the Sixth Five Year Plan, National Sustainable Development Strategy 2010-21, National Shipping Policy 2000, National Water Management Plan 2004, Integrated Multimodal Transport Policy 2013.

BIWTA is unable to recover its cost from revenue. In the FY 2013-14, the total revenue expenditure of BIWTA was Tk 3,164.06 million as against revenue earning of Tk 3,041.05 million. BIWTA had to incur a deficit of Tk 123.01 million. Of the total revenue earned by BIWTA, 55% on average comes from GOB grants and contribution.

The GOB has to support the Mongla Port Authority on regular basis to meet its revenue expenditures. But in recent years the financial picture of MPA looks brighter. The MPA was able to earn surplus of Tk 341.43, 433.32 and 480.95 million in 2011-12, 2012-13 and 2013-14 respectively.

The Chittagong Port Authority has been enjoying the monopoly in the trade of maritime port services with significant amount of surplus every year.

Financial Picture of CPA (million BDT)

Year	Income	Expenditure	Surplus
2011-12	15,259.20	6,526.20	8,773.00
2012-13	15,739.00	8,024.50	7,714.50

Some challenges in the inland water transport sector are as follows: incremental dredging demand to maintain navigability, lack of infrastructure, non-compliance of guidelines for construction of bridge over the rivers, encroachment in the rivers, lack of safe vessels and skilled workforce, lack of policy guidelines, poor governance, inadequate budget allocation, lack of intermodal coordination, poor level of regional cooperation etc.

Rivers are deteriorating and the dredging demand is increasing endlessly. Annual demand of dredging of 8.9 million m^3 as determined by expert committee in 1990s increased to the volume of 18 million m^3 in 2009 by the IWT Master Plan Study Report. The IWT had never been able to capture the rightful place in budget allocation as it has never been a popular political choice for development in Bangladesh. Against the modal share of 8.9% and 16% respectively in passenger and freight movement, the IWT received on average less than 5% of the total ADP allocation for surface transport. Poor governance and inadequate institutional capacity and inefficiency are very much evident in case of construction and registration of inland vessels in terms of ship safety and in case of management and operations of inland ports and inland waterways.

The main challenge of two maritime ports is the condition of fairways between the sea and the jetty berths. The Chittagong Port installations are situated along the bank of the River Karnaphuli 16 km from its outfall into the Bay of Bengal. The maximum permissible draft ranges from 8.50 to 9.20 m with length restriction of vessels being 188 m. As such vessels with more than 1,200 TEU cannot berth at Chittagong port, while the average capacity of the vessels calling at the South Asian ports is 3,500 TEU. The Mongla is located on the Pussur River about 130 km inland from the Bay and its permissible draft ranges from 7.00 to 8.50 m with length restriction of vessels being 225 m. In the context of regional standard, maritime ports in Bangladesh also suffer from inefficiency. The average handling of boxes per crane hour at CPA is 12-15 as against 25 of South Asian standard. The Study also found that dwell time at CPA is 6-8 days while it is 3-4 days in the South Asian ports.

The Study identified the knowledge gaps of updated network data, no database on IWT traffic, no statistics of country boats, climate change impact, pollution caused by transports etc.

No comprehensive hydrographic survey has been undertaken since 1989 and as such updated data of waterways network are not available. Similarly no O-D (Origin-Destination) traffic survey was undertaken to prepare a database on IWT traffic. Impact of climate change is already evident in the waterways. The Climate Change Action Plan and Strategy 2009 did not include IWT. So, no information is available to prepare an adaptation and mitigation program.

- The Government should prepare a mid-term and long term vision that will ensure a sustainable development of IWT sub-sector in line with the Integrated Multimodal Transport Policy. Modal option for development of transport sector should be based on social and environmental advantages.
- Inland waterways network should be reclassified according to sustainable navigability and traffic importance. The core waterways should include fairways between maritime ports and central region and intra regional routes. Network development and dredging strategy should be prepared in line with the National Water Management Plan. It will be justified to provide more resources for the development and maintenance of waterways. The new dredging strategy should coordinate and integrate programs of BIWTA and Water Development Board.
- More private participation should be ensured in the field of port management and operations, development of IWT infrastructure, dredging and maintenance of waterways, mechanization of cargo handling, development of inland container terminals and container traffic in the waterways. To this end, new guidelines and procedures should be prepared which will include:
    - The existing lease arrangement should be replaced by a mid-term and long-term concession arrangement to private stevedores and terminal operators to encourage investment for better services to users and maintenance of facilities. BIWTA should not involve itself in toll or revenue collection, it will rather monitor performance of private operators. Infrastructure at commercially attractive places should be developed and operated by private sectors or on a PPP basis. BIWTA should continue to develop landing stations in rural and coastal areas.
    - BIWTA should concentrate more in preparing dredging strategies and programs on the basis of comparative traffic importance against available resources. Actual dredging should be performed by the private sector. BIWTA should restrict itself in procurement of dredgers; it should rather lease out the existing fleet to private sectors.
    - Installation of navigation aids and maintenance in core waterways should be awarded to private sector. Pilotage service should be awarded to private sector.
    - Appropriate support should be given to private sector for construction of inland container terminals and for container traffic. Determining tariffs at such terminals should be deregulated and operators must have independence to fix an attractive and competitive tariff. Operation of Pangaon Container Terminal should be leased out to private terminal operator.
- The existing regulatory mechanism of inland ship safety and ship construction should be streamlined. Ship design, supervision of ship construction, awarding survey certificates, determining work force required for each ship should be licensed to qualified private houses. The Department of Shipping should more concentrate on monitoring performances of such private houses appointed for the purpose. Competency certificates to different categories of crew should be awarded by training institutes after successful completion of service and training modules for each category.
- To attract more regional and intra-regional traffic in waterways of Bangladesh mutual understanding and cooperation should further be developed. Under the existing Protocol on Inland Water Transit and Trade

between Bangladesh and India, the following joint initiatives and assurances should be committed by both Governments:

    - improve navigability of existing routes and find out new routes. Upstream cooperation and commitment to maintain navigability downstream.
    - find out most economic and efficient transport chain and establish connectivity with other modes.
    - *find out the benefits on socioeconomics and on environment.
    - *find out the appropriate technology to improve efficiency of inland navigation.
    - *find out the requirements for amendment, simplification, waiver of existing procedures.
- Institutional capacity building, reforms and restructuring.
- International sea borne trade in Bangladesh is growing fast. The existing maritime ports of Chittagong and Mongla have inherent limitations due to draft restrictions to accommodate larger vessels. As such, development of a deep sea port is indispensable to keep the rapid growth in Bangladesh.
- Efficient transport links to central region are required for development of traffic through ports of Chittagong and Mongla.
- More private sector involvement should be ensured through experience worldwide that demonstrates that Bangladesh maritime ports should apply a landlord model under which public port authorities should withdraw themselves from day to day operations and focus on regulation, planning , investing and market promotion.
- At all container terminals International Terminal Operators (ITO) should be engaged who will be responsible for all categories of container handling equipment.
- Efficiency of maritime ports should be enhanced through the following short-term actions:
    - private sector involvement initiative
    - empowering port authorities
    - substantial reduction in import related time
    - elimination of stuffing/ un-stuffing practices in ports
    - increase of container storage charges
    - private ICDs used for import
    - introducing automated system for custom data

1 Introduction

1.1 Background

An adequate and efficient country-wide transport system is a pre-requisite for initiating and sustaining economic development. Investment in improving transport efficiency is the key to the expansion and integration of markets – sub-national, national and international. In addition, it contributes to the generation of economies of scale, increased competition, reduced costs, systematic urbanization, export-led faster growth and a larger share of international trade. An efficient transport system is an important element of trade logistics cost and as such is a major determinant of export competitiveness. Efficient transport is also critical in enhancing the physical mobility of citizens. Efficient transport reduces the commuting time of general public, thereby contributing to their welfare.

The transport system of Bangladesh consists of roads, railways, inland waterways, sea ports, maritime shipping and civil aviation, catering to both domestic and international traffic. Besides an efficient transport system, a reliable power system (production, transmission and distribution) is an integral component to initiating and sustaining economic development.

1.2 The Objectives

The broader objective of the thematic baseline is to understand the core drivers within the context of Sustainable transportation and communication infrastructure aspects. These drivers will have to be analysed on the basis of their relevance and impact levels, among others.

The objectives of the thematic baseline study within the context of Sustainable transportation and communication infrastructure analysis therefore include:

- To evaluate existing challenges, developments, opportunities and (government) plans by transport system
- To evaluate expected challenges/opportunities in view of the long term (socio economic and climate) changes
- To identify existing trends and future developments
- To support the common knowledge base
- To identify on-going projects, projects in pipeline and long term perspectives/ideas particularly focusing on water transport system

1.3 Methodology

The methods for this baseline study (and its subsequent subsectors) build on fact finding and interviews by the study team with relevant institutions/stakeholders and the use of existing reports, plans as well as on information available on websites of the relevant institutions. Among this, information has also been gathered on on-going investment projects as well as future planned investment projects.

1.4 Key Sectors of the Study

Roads and Highways: Roads and Highways are considered as the bloodline of the internal communication. Therefore, understanding the present road network is very important

Railways: Railway has connects 44 districts and almost all the important places of the country and has a great contribution in accelerating the economic activities

Inland Waterways: Bangladesh is crisscrossed by thousands of rivers. Inland waterways always play a vital role in communication, especially transporting agricultural goods from one place to another

Ports and Maritime Shipping: (sea) ports and maritime shipping are crucial for import and export of goods (raw materials, such as coal for power stations, intermediary good, and end-products

Power: Power is considered as one of the top most priority sectors of Bangladesh. At present, it is the most critical growth driver of Bangladesh economy. Analysis of power sector and the present and future prospects of the sector in Bangladesh are very important.

1.5 Relationship to Delta Plan 2100

Transportation sector is a key sector which plays an important role in the economic development and urban planning of the country – for the present and the long run. As such the relationship between this infrastructure sector and the BDP 2100 is very important. During the preparation of this report, many discussions were held with roads & highways, railways, inland waterways & ports as well as the power sector. Apart from inland waterways and ports, which directly relates to the Delta Plan in terms of navigation and accessibility for shipping, the power sector, in terms of availability of cooling water and its consequences, are not directly related to Delta Plan strategies, and the various interventions/measures to be taken for the short, medium and long term up to 2100. However, when the Delta Plan is operational, their policies and accompanying (new) investment projects have to conform to the Delta Plan strategies and interventions including in particular, the spatial planning. Therefore, a mechanism has to be implemented, which can sort this out. In the Netherlands the so-called "Water Check" is carried out. For Bangladesh a comparable mechanism of conditionality have to be designed which can deal with (new) plans and (new) investment projects in the transportation infrastructure sector.

1.6 Relationship with other Baseline Studies

Roads & Highway and Railway Sectors

The Roads & Highways and Railway sectors are not directly related to the other Baseline studies, however they are related indirectly. The state of roads, highways, and railways in Bangladesh represent the country's infrastructure as well as the majority of the transport network, which in turn affects the overall economic development of the country. Economic development in turn affects all sectors of the country. Therefore the planning for any other sector (i.e. fisheries, agriculture), must take into consideration the state of the infrastructure.

On the other hand, the road and railway network are also influenced by other factors, such as population, climate change, and sectors that can either increase or decrease the transport sector's demand, such as agriculture. Issues such as population change and the development of dependent industries dictate the overall demand for transport, and therefore affect the way the transport network evolves over time. Climate change continuously affects the roads, highways, and railways, as made evident by the damages caused by persistent flooding. Therefore, it is important that infrastructure is planned in line with the changing dynamics of all directly and indirectly related sectors and issues.

Inland Waterways and Ports

The National Water Management Plan (NWMP) describes the river systems as the *life-blood* of Bangladesh. All those areas which are depending on or utilizing the river are directly linked with each other and integrated under the water management plan. As such, NWMP was prepared *in a comprehensive and integrated manner for the interests of all water related sectors and taking full account of other sectoral policies of the Government*. Accordingly, River Management and River Morphology are directly related with inland waterways.

Navigation requires water, availability of which ensures better eco-system. This way, the inland waterway is related with environment at large. Emission of carbon dioxide from the transport output is one of the largest contributors to global warming and climate change. Sustainable development of transport network must consider the issue of comparative carbon emission of different modes. So, Pollution is related with inland waterways. Rivers are directly and strongly affected by climate change and impact of climate change is already evident in the waterways of Bangladesh.

Power sector is also related with inland waterways as almost all power plants were developed by the side of the rivers. Constructions of power plants require certain navigability for the carriage of over-dimensional (O.D) equipment which cannot be transported by rail or road. River is also required after construction for a thermal power plant for continuous transport of coal and to meet the need of cooling water.

The Integrated Multimodal Transport Policy 2013 envisages *integration within and between different types of transport* with the objective of establishing an efficient transport network that is able to provide a cost and time effective door to door service. As such roads and highways, and railways are related with inland waterways and so with maritime ports.

Power Sector

The power sector is directly related to some other baseline studies, for example: Transportation specially water and railway, Environment and Hydrology etc.

The only way to transport heavy equipment's and machineries of power plants is waterway means rivers. According to the power system master plan there will be a big power generation hub in the northern part of Bangladesh. The rivers need to keep navigable during the construction phase. Fuel of power plant like coal can be transported by waterways and railways. The success in set up coal as main source of fuel of power generation is greatly dependent on related infrastructure development for coal transportation.

The large scale power plants are always located at the bank of river because it is convenient for equipment's and fuel transportation. Also a huge amount of river water is needed as the source of cooling water for thermal power plants. Important information like shifting of location of river, depth and availability of water in rivers, river erosion and location of flood prone areas based on baseline study on river system management are essential for identifying proper location of new large scale power plant.

According to second national communication of Bangladesh submitted to UNFCCC, The power generation subsector is the main source of greenhouse gases (GHGs) emission in Bangladesh. The power sector is also directly related to environment and climate change baseline studies. Among all power plants, the coal based power plants are having highest grid emission factor. In the future, the GHGs emission of power sector will increase considerably as coal will be the main fuel of power generation.

1.7 Structure of the Report

After the introductory Chapter 1, an overview of infrastructure development in Bangladesh including a comparison of the country's main transport infrastructure systems with the neighbouring countries has been described in Chapter 2. Thereafter, each of the main transport infrastructure system has been dealt with in a separate chapter. Subsequently, the following sub-sectors are analyzed and discussed: i) roads and highways, ii) railways, iii) inland water transport & ports and maritime shipping, and ix) power. The Chapter 3 in each report includes the history, present status, key policies, future outlook, key challenges, knowledge gaps and recommendations in the sub-sector concerned. An executive summary for each of the sub-sectors is presented at the beginning of this report. The relevant tables, figures, maps are enclosed as per the Table of Content.

It is important to note that data used in this study were primarily taken from government institutions, such as the Ministry of Road Transport & Bridges, Roads and Highways Division, Ministry of Railway, Ministry of Port, Shipping & IWT, Bangladesh Bureau of Statistics, Ministry of Finance, etc. However, the information/ data may often appear outdated due to unavailability of updated information. The most recently government published information was used for the majority of this report.

The report was initially prepared as one report containing all the sub-sectors under the title "Baseline Study: Sustainable Transportation and Infrastructure." However, it was decided later that the report would be divided into four parts, each one containing the baseline study of the relevant sub-sector. As it stands now, the four volumes of the report have been titled as follows:

Sustainable Transportation and Infrastructure Volume 1: Roads & Highways

Sustainable Transportation and Infrastructure Volume 2: Railways

Sustainable Transportation and Infrastructure Volume 3: Inland Water Transport & Ports

Sustainable Transportation and Infrastructure Volume 4: Power

However, the Executive Summaries of all sub-sectors are included in all the volumes. In addition, the introductory chapter (Chapter 1) and Chapter 2, giving an overview of infrastructure development in Bangladesh, are also included in all the four volumes.

2 Overview of Infrastructure Development in Bangladesh

A well-organized and dependable transport and communication system is essential for the socio-economic development of a country. According to data released by the Bangladesh Bureau of Statistics (BBS), in FY 2013-2014, the growth rate in this sector and its contribution to GDP at constant price were approximately 6.47% and 11.54% respectively.[5]

Table 1 Sectoral Shares of GDP (%) at Constant Prices (Base Year 2005-2006)

Sector	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Transport, Storage, & Communication	10.89	11.05	11.23	11.49	11.50	11.54
a. Land Transport	7.19	7.28	7.31	7.32	7.31	7.31
b. Water Transport	0.95	0.92	0.89	0.86	0.84	0.81
c. Air Transport	0.12	0.13	0.14	0.14	0.13	0.12
d. Support Transport Services, Storage	0.58	0.60	0.63	0.69	0.67	0.66
e. Post & Telecommunication	2.06	2.12	2.26	2.48	2.56	2.63

Source: Bangladesh Bureau of Statistics

The transport sector's (including transport, storage, & communication) high percentage contribution to GDP at constant price, 11.50% in FY 2012-2013 and 11.54% in FY 2013-2014,[6] indicates that the transport sector is an important component of the socioeconomic development of Bangladesh. Land transport represents the majority of the transport's sector's high percentage contribution to GDP with 7.31% in FY 2013-2014 (**Table 1**). However, according to **Table 2**, extracted from the *World Economic Forum's Global Competiveness Report 2013-2014*, Bangladesh has a score of 2.8 in terms of infrastructure, which includes measures in electricity, roads, railroads, and port. Considering other countries in the region, Bangladesh, along with Myanmar, ranks in the bottom two in terms of infrastructure. Pakistan, a country with a lower overall country ranking than Bangladesh, leads Bangladesh in infrastructure quality with score of 3.3. The only country with a lower infrastructure score than Bangladesh is Myanmar, with a score of 2.1. This indicates that Bangladesh is badly in need of strong many infrastructural improvements in order to boost its economy in the future.

[5] Bangladesh Bureau of Statistics

[6] Bangladesh Bureau of Statistics

Table 2 Global Competiveness Report 2013-2014, Comparison of Infrastructure Quality 2013-2014

Country	Country Ranking	Overall Infrastructure Score	Electricity	Roads	Railroads	Port
Bangladesh	**110**	**2.8**	**2.2**	**2.8**	**2.4**	**3.5**
India	60	3.9	3.2	3.6	4.8	4.2
China	29	4.3	5.1	4.5	4.7	4.5
Cambodia	88	3.9	3.2	3.7	2.0	4.0
Nepal	117	2.9	1.6	2.7	1.1	2.7
Bhutan	109	4.9	5.9	4.3	n/a	2.2
Myanmar	139	2.1	2.9	2.4	1.8	2.6
Pakistan	133	3.3	2.0	4.0	2.5	4.5
Sri Lanka	65	4.8	5.0	4.7	3.6	4.2
Thailand	37	4.5	5.2	4.9	2.6	4.5

Source: World Economic Forum, the Global Competitiveness Report 2013-2014

Note: Country Rankings are in descending order with “1” considered as the best performer. Overall Infrastructure score is in ascending order with “1” considered as a lower score.

In **Table 3**, a comparison of Bangladesh’s infrastructure score over a span of 8 years (2006-2014), shows some improvement over time. For instance, Bangladesh’s infrastructure score increased from 2.03 in 2006-2007 to 2.8 in 2013-2014, a result of improvements in the electricity and port sector.

Table 3 Bangladesh’s Infrastructure Score over time

Year	Overall Infrastructure Score	Electricity	Roads	Railroads	Port
2013-2014	2.8	2.2	2.8	2.4	3.5
2010-2011	2.7	1.6	3.0	2.5	3.4
2006-2007	2.03	1.6	3.1	2.3	2.4

Source: World Economic Forum, the Global Competitiveness Report

If the changes in infrastructure score over the past 4 years (2010-2014) are compared, there has only been a very small increase in the score, from 2.7 to 2.8, however this improvement is again due to improvements in electricity (1.6 to 2.2) and port (3.4 to 3.5) only. On the other hand, in the same span of 4 years, roads and railroads have decreased from 3.0 to 2.8 and 2.5 to 2.4 respectively. This is likely due to immense Government focus on increasing access to electricity as well as developing port facilities, although the Government should simultaneously focus on drastic improvements in the roads and railroads sector.

The Government of Bangladesh (GoB) has recognized that in order to achieve targeted GDP growth rates, it is important to further develop Bangladesh’s infrastructure. Bangladesh’s *Sixth Five Year Plan* (2011-2015), a Government plan for economic development over five years, has addressed this issue by setting certain strategic goals for the Bangladesh transport sector, which include primarily the following:[7]

- Undertaking an optimal mix of “market integration approach” and “poles of development approach” through the development of five main corridors: Dhaka-Chittagong, Dhaka-Northwest, Dhaka-Khulna, Dhaka-Sylhet, and Khulna-Northwest
- Building an integrated transport network by constructing Padma Bridge at Mawa-Janjira point (integrating inland water transport with existing or new road transport systems)
- Improving connectivity with neighbouring countries through the development of inter-modal transport network

[7] Mid Term Implementation Review of Sixth Year Plan, Policy Research Institute

- Improving resource mobilization through the introduction of user charges/fees in the entire transport network
- Ensuring the deficit free operation of the Bangladesh Railway
- Improving transport safety standards to reduce incidence of accidents
- Increasing private partnership in the transport sector through the PPP framework

Integrated multi-modal transport

The Govt. has also recognized that integrated multi-modal transport should be prioritized, as indicated by the *Integrated Multi-Modal Transport Policy*, which states that the sustainability of the transport sector will be heavily dependent on its ability to offer its stakeholders integrated and multi-modal transport, essentially meaning that the transport system must integrate:

1) Within and between different types of transport
2) With the environment
3) With land use planning
4) And with policies for education, health, economic growth, gender and social equity, and poverty reduction

Intermodal Connectivity

In the past two decades, the Govt. has been placing heavy emphasis on the development of the road sector at the cost of less development in the railway and inland waterway transport sectors. Certain geographic conditions of Bangladesh, such as the country being relatively flat, have contributed to this growth of road transport. To add, road transport offers more mobility and connectivity than other transport modes, partially due to its continuous development. Short-term planning has also resulted in the emphasis of roads versus inland waterways and railways. However, it is important that Bangladesh, a country of many inland waterways, and an exponentially increasing demand of transport pay special attention to the development of both its inland waterway and railway sectors.

Transportation connectivity in Bangladesh could be well enhanced and meet future demands of transport growth if an effective and full-proof plan for intermodal connectivity was followed. Railway offers certain distinct advantages, such as lower cost for the transportation of passengers and freight, as well as being more environmentally friendly. Inland waterways also offers advantages as they can contribute to the effective transportation of freight and if these same waterways were efficiently connected to railway and road, their importance and contribution to effective transport could only grow.

The *Integrated Multi-Modal Transport Policy* 2008 addresses this issue. Although, there is still a lack of integrated transport policy and planning framework that could result in the prioritizing of investments. This makes it difficult for the transport sector to allocate resources between sub-sectors effectively. Most importantly, there have been a number of transportation studies in recent years that advocate for intermodal connectivity, however, no real effort has been made for the actual functional integration of different modes of transport.

Increased intermodal connectivity could have positive effects on all economic activities; especially the carriage of freight, on agriculture. Nearly half of the population is employed in the agriculture sector, however rural areas, which are generally used for agricultural land, are yet to see efficient transportation infrastructure. This is understood by the fact that not enough rural areas have roads and if they do have roads, the majority of these roads are narrow and dirt roads (unpaved).In addition, many rural areas are unable to withstand the loads of heavy farm equipment; all of these factors taken together make the logistical costs between different parts of Bangladesh some of the highest in the world. If more investments were made into reliable infrastructure, the agricultural sector would improve. Agricultural supplies could more efficiently reach farm lands, and agricultural products could also efficiently reach markets through carriage on a mix of different transport modes: roads, railways, and inland waterways.

Inter-modal connectivity is especially important in and around Dhaka. Currently, the existing modes of transport act independently with each other and are often in competition, however, they should also benefit from each other. Passengers suffer due to a lack of connection between modes and poor scheduling, an integrated scheduling and ticketing system should be initiated in Dhaka within all modes of transport. For instance, an individual travelling by river from his/her village, should be able to connect to a railway link that can bring him/her into the heart of the city, and from there take a bus to his/her final destination with convenience. For example, Dhaka Airport has few direct bus connections, but the railway station is not very near. There is no high-speed form of transport, such as a metro line, from the airport; this only increases the transfer time many fold.

3 Inland Waterways & Ports Subsector

3.1 Introduction and Sector History

Being a land of rivers Bangladesh always enjoyed the natural advantage of inland navigation. The country is characterized by low lying flat land with alluvial soil that have poor engineering characteristics resulting in high costs for development and maintenance of overland transport infrastructure. On the contrary, the inland waterways being a natural, environment friendly and relatively cheap mode of transport, remains underutilized. It is important that about 25% of rural population have access to this cheaper mode (inland navigation) and is a natural choice of the poor people. Inland waterways have become the very important mode not only for maintaining transport link between various remote parts of the country, but also is a means of transporting export-import cargo.

Over a long period time, many rivers of the country have been deteriorated both for natural and morphological processes, anthropogenic reasons, and for withdrawal of water from the rivers beyond the border and within the country, thus decreasing the dry season navigability. This was further aggravated by poor or no maintenance of navigability and comparatively low allocation of budgetary funds and under-investment. During last few decades the country has not been able to reap the benefits that IWT can bring in terms of economic growth and poverty reduction in comparison to other modes of transport.

The Government of Bangladesh (GoB) has very recently formulated sound IWT related policies which recognized that to meet poverty alleviation and to attain the millennium development goals a well-developed sustainable and accessible multimodal transport network – with special focus on inland navigation – is of fundamental requirement for movement of people and goods. As such, functions of planning, implementing and monitoring within inland water transport sub-sector must be strengthened. It is also very important that a clear and continuous coordination between inland navigation and Integrated Water Resource Management be established. Flowing through the country, all rivers are destined for the sea and as such inland navigation remains the important modal option for distribution of Sea borne traffic to further inland.

Presently, there are two maritime ports which can be termed as the international Sea borne trade ports. Chittagong Port located in south-eastern part of the country is a gateway port handling more than 90% of total Sea borne trade cargo. This port is situated along the bank of the River Karnaphuli, about 16 km from its outfall to the Bay of Bengal. The maximum permissible draft ranges from 8.50 m to 9.20 m while the length of the ships is restricted to 188 m. The Mongla Port located in the south-western part on the Pussur River, about 130 km inland from the sea having permissible draft range from 7.00 m to 8.50 m with length restriction of the vessels being 225 m. It is seen that both the ports have inherent limitations to berth and accommodate large vessels. On the other hand, total tonnage of Sea borne trade is growing @ 10 % annually on average and container traffic growing by 12%. From these growth figures, it is evident that the two ports cannot meet the demand of a modern port services in the country. In view of above, the Government has decided to establish a deep sea port at Sonadia (island) and a third maritime port named as Paira Port on the Rabnabad Channel in Patuakhali district.

The use of inland waterways by mechanized vessel began in this part of the world more than 180 years ago in 1834. Commercial transport of passengers and goods were initiated in the 19th century with the creation of the India General Navigation and Railway (IGNR) in 1844. After few years another company, River Steam Navigation (RSN), also came into being. These two companies with their registered offices in London dominated the IWT trade with more than 70 percent share in passenger and cargo traffic in the IWT network of Bengal, Assam and Bihar. The British Government did not take any responsibility of developing or regulating the IWT. Improvement or maintenance were adjuncts to commercial requirement of companies and were conditioned by their profit motives.

Starting from the last decades of the British rule up to the first decade of Pakistan era, several proposals and recommendations were made by different committees and commissions to create a competent public statutory organization for development and control of inland water transport. Following these, the Government of East Pakistan promulgated an Ordinance in 1958 to set up an authority for development, maintenance and control of inland water transport and of inland waterways and accordingly the East Pakistan Inland Water Transport Authority (EPIWTA), now BIWTA, was created in the same year.

3.2 Inland Waterways System

Navigability of inland waterways is strongly influenced by river morphology and hydraulics. River systems in Bangladesh show a high water period and low water period caused by changing water discharge in course of the year. The low water period begins in December and continues up to May while the high water period lasts from June to November. During the low period navigation is not possible or vessels have to struggle to negotiate in many waterways. For a sustainable IWT planning the impact of the changing river behaviour on navigation is required to be monitored and disseminated regularly. From the beginning of inland navigation in this part of the world there had been no total study of navigability of waterways. First attempt of this kind was undertaken in the 1960s by NEDECO and they classified waterways in three groups. Again in 1980s the DHV Consultant through a comprehensive survey classified and listed all waterways in four hierarchical classes. No such attempts were made to update the navigability during last 25 years.

3.2.1 NEDECO Report

The Netherlands Engineering Consultants (NEDECO) published a Study Report in 1967 “Survey on Inland Waterways and Ports 1963-1967,” where NEDECO classified IWT Routes into three groups as can be seen in the Annex.

The main purpose of waterways classification by NEDECO was to distinguish between waterways in terms of:

- Guarantee (or not) on specified LADs (least available depths)
- Level of services in aids to navigation (higher/lower).
- The report estimated a total length of 12,000 km of waterways during monsoon
- The inland waterways were categorized according to roughness of water surfaces under weather influences. These were
    - Perennially smooth (PS),
    - Perennially rough (PR) and
    - Seasonally rough or smooth (SR or SS). The routes which remain smooth all the year round were called perennially smooth (PS), which remain rough all the year were perennially Rough (PR), the routes which become rough during the period between 15 March and 15 October and smooth during the remaining period are seasonally Rough or smooth (SS or SR)

3.2.2 DHV Report

The DHV Consulting Engineers of the Netherlands through a comprehensive survey revised and updated the NEDECO classification and described the inland waterways in Bangladesh into four hierarchical classes in its Report on Bangladesh Inland Water Transport MASTERPLAN (BIWTMAS) published in 1989. This can be seen in the following table (**Table 4**).

Table 4 Route Classification

Class	Indicated draft (m)	length (Km)	%
I	3.6	683	11
II	2.1	1,000	17
III	1.5	1,885	32
IV	<1.5	2,400	40
Total		5,968	100

Source: BIWTMAS, 1989 by DHV Consultants, the Netherlands

The mechanized vessels utilized for the large volume and long distance transport flows were the determining factors for classifying the waterways by DHV. This implied that loaded draught characteristics of vessels, determining the LAD requirement, should be the leading criterion in Route Classification.

The DHV Report classified the routes as follows:

- **Class-I:** Comprising the perennial Routes configuring the propeller-shaped spine of the system that interconnects Chittagong-Dhaka/ Narayanganj (and extending to Ashuganj/Bhairabbazar) – Khulna/Mongla via Barisal (Ilsaghat/Hizla) where the largest LAD of 3.60-3.90m is to be maintained all year round with a total length of about 685 km.
- **Class-II:** Routes (perennial) linking major inland ports in north-west and north-east hinterlands i.e. Baghabari/Nagarbari (and further north to Chilmari) and the Sylhet region to Class-I Routes where the next highest LAD of 2.10-2.40m to be maintained all year round with a total length of 1,000km.
- **Class-III:** Routes, where it is usually not feasible to maintain perennial Routes with a LAD exceeding 1.5-1.8m either transit Routes such as Zakiginj-Fenchuganj-Ajmiriganj-Dilalpur (on Kushiara and Kalni River) or feeder Routes connected with Class-I and Class-II Routes e.g. stretches of the Kangsha, Titas, Lakhya Rivers, route around Dhaka, Karnaphuli River and tidal rivers in the south west/south central region with a total length of 1,885km.
- **Class-IV:** Routes basically seasonal, where it is not feasible to maintain a LAD of 1.5m in the dry season with a total length of 2,400km.

DHV suggested a number of Routes to be improved in order to meet the classification standard, notably Class-II and Class-III routes which at that time were seasonal (Kushiara- Kangsa River and the route around Dhaka. In terms of network length, the classified perennial routes (Class-I, II and III) would eventually amount to almost 3,600 km and seasonal routes (Class-IV) to almost 2,400km, making a total of almost 6,000 km.

BIWTA agreed to the findings of DHV and accepted and approved the Route Classification proposed by DHV. BIWTA follow this Classification till date and no comprehensive hydrographic survey was carried out to update Classification during the last 26 years (since 1989). The Classified IWT Routes as listed in the DHV Report are given in the Annex at the end of this report.

The number of routes indicated a total of 88, but the perennial routes number only 41, which is significantly less than half of the total, plus less significant 45 seasonal routes.

The following causes were indicated by DHV as the principal causes for deterioration of the waterways:

- Abstraction of water or stream flow reduction
- Reduction in cross-boundary flow
- Silting up of off-takes
- Reduction in tidal volume
- Ongoing sedimentation

3.3 Present Status

Currently BIWTA performs hydrographic survey only in routes and areas which require priority attention. Such surveys or other related investigation have not been carried out over a vast portion of inland waterways network in recent years. It is therefore, not prudent to comment on current conditions of the network. However information gathered from BIWTA officials and IWT operators reveals navigation during high water period does not usually present a problem. During low water season, although long stretches of waterways with sufficient depth exist, sedimentation and shoals appear in many places, restricting the vessels' movement.

The IWT corridor between Dhaka/Narayanganj and Chittagong maritime port is of prime national importance. It is a Class-I route with a guaranteed LAD of 3.6 m at any point of time in the year. This waterway has adequate navigational draft for most of its length during low water period, except for spots where silt deposition takes place. One such chronic problem spot lies near Hizla on the lower Meghna River. Vessels plying between Dhaka/Narayanganj and Chittagong have to wait for the high tide at Chowkighata in the lower Meghna area, according to the operators and the owners.

The next important corridor is the waterway between Dhaka/Narayanganj and Mongla/ Khulna. This route is also important for the movement of vessels under the Bangladesh – India Protocol on IWT for the carriage of goods of inter-country and transit trade. The route connects the divisional headquarter of Barisal also. This is classified as Class-I where LAD of 3.6 m is guaranteed. Mongla-Ghasiakhali Canal in this route is an interconnector of the rivers; the canal was opened to traffic in 1974. This was declared closed for navigation for larger sized vessels in 2011 due to siltation. Prior to the closure of the Canal, vessels used to sail through the route Sanyasi-Ghasiakhali-Mongla with a length of 52 km. But due to deteriorating condition of navigability in the canal, at present the route operates through the Sundarbans, namely Bogi-Joymoni-Mongla with a distance of 123 km. As such the length of route has been increased by 71 km resulting in increased use of fuel leading to more cost and time as well. It was estimated that for navigation in the alternate route through Sundarbans during 2013-2014 cost an additional 1500 tons of diesels were used by the vessels.

The corridor from Dhaka/ Narayanganj to the north-eastern part of Bangladesh, especially to Chatak and Sylhet region is classified as Class-I up to Bhairab Bazar/ Ashuganj; the depth decreases thereafter to 2.1 -1.5 m levels and further decreases during low water period. As such, vessels are compelled to sail at half or three quarter of loading capacity restricting to achieve the desired economic benefit.

Baghabari River Port in the northern district of Sirajganj is of national importance on account of transportation of fuel and fertilizers which are distributed to the northern part of the country through this port. The Paturia- Baghabari route (Jamuna, Baral and Hurasgar Rivers) has been behaving erratically and unpredictably in low water periods in recent years, posing problems and sometimes even a threat to uninterrupted vessel movement.

An IUCN Report (Ecosystems for Life: Inland Navigation Situation Analysis 2012) revealed that a total of 717 km of waterways that have been considered by DHV as perennially navigable was no more navigable during the lean period. In the same report quoting BIWTA officials and operators, IUCN concluded that presently total length of navigable waterways during monsoon will not exceed 4,000 km and only 2,000-2,500 km are navigable during the low water period.

Need to Review the Existing Classification

Existing classification was made through comprehensive hydrographic survey during the period of 1985-1989, about a quarter of a century ago. During this period sufficient changes have occurred which have significantly influenced not only inland waterways and navigation quality, but also the transport pattern itself in the IWT sub-sector has been changed as well. The main causes for such changes are given below:

***i) Siltation*:** Siltation and formation of shoal in waterways is a natural process and is the outcome of river dynamics. They are generally formed at the bends of rivers at the confluences for navigations to larger cross sections. These shoals become unfriendly for navigation particularly during low water season when they pose as obstacles. Many such shoals could not be managed by dredging or river training due to non-availability of fund allocation. These result in accumulation of more sediment and/or enlargement of the shoals.

***ii) Dimension of Vessel*:** A gradual increase has taken place in the type, size and number of vessels in the country. To achieve more economic benefits, dimensions of the vessels have been enlarged. Besides the main deck, most of the passenger launches those regularly ply between Dhaka and southern districts have two additional upper decks. Static capacity has been increased also.

***iii) Restrictive Construction over Waterways*:** Due to construction of bridges and overhead high tension cables and wires in some places over the rivers, navigation has been restricted.

***iv) More River Ports*:** 11 (eleven) River Ports existed in 1989 as notified by the Government. This number has been increased to 21 in 2014. River ports play the role of nodal point and interface between modes of transport. Inland ports have a dominant role to traffic and economic importance.

***v) Construction of Jamuna Bridge*:** Construction of the bridge over the River Jamuna has completely changed the scenario of IWT sub-sector, especially in the northern region. It has influenced overall traffic pattern; change in the modal option and origin-destination pair and realigned the previously used traffic routes.

***vi) Volume of passenger and cargo traffic*:** Since 1989 volume of the cargo and passengers transported in the waterways have increased significantly.

***vii) Container Transportation*:** One Container Terminal by public authority has already been constructed at Pangaon, Dhaka and began operation. Four other such terminals are under construction by private sector. With these, the outdated route classification must be reviewed.

***viii) Morphological Changes*:** Morphological changes in the rivers caused charges in the meandering pattern of the rivers, also in shifting thalweg and deteriorating the navigability in general.

***ix) Reduced Cross-Border Inflow*:** The controlled inflow of water discharge from across the border caused reduction of draft in many waterways.

3.3.1 Development and Maintenance of Inland Waterways

Among many functions, the main objectives of the BIWTA as mentioned in the Ordinance under which this statutory authority was set up are:

i) River conservancy including river training works for navigational purposes
ii) Provision for aids to navigation
iii) Maintenance of pilotage and hydrographic survey services
iv) Program of dredging requirements for maintenance of existing waterways and for development of new channels and canals for navigation

Morphological and hydraulic problems of inland waterways demand maintenance and improvement strategies and methods. Development of shoals in navigable waterways required to be monitored regularly by sounding followed by dredging of fairways and where feasible by application of river training. For this, financial and logistic resources are required. Logistic resources include hydrographic survey equipment and apparatus and dredging apparatus. Maintenance and development of navigability in waterways management and functions need to be discussed for the following issues:

i) Hydrographic survey
ii) Dredging
iii) Bandalling
iv) Aids to navigation
v) Pilotage and dissemination of navigational information

3.3.2 Hydrographic Survey

Hydrographic survey is the reliable means of obtaining nautical conditions of waterways. BIWTA undertakes hydrographic survey by measuring the depth of the channel with echo sounders and fixing the position with Differential Global Positioning System (DGPS). BIWTA's DGPS have three reference stations at Dohazari (Chittagong), Rupchandrapur (Mymensingh) and Manirampur (Jessore) and one monitoring station at Narayanganj. GPS signal is received through reference stations and the necessary corrections are transmitted through some specific frequency to the users who receive the corrections by DGPS receiver and then calculate the exact position.

The available logistics and funds is not sufficient to survey all classified routes, rather survey are undertaken according to route based on priority. Being informed by the field offices and the vessel operators regarding the conditions of navigability, if BIWTA decides to undertake dredging works then the volume and shoals to be dredged are determined through hydrographic survey. BIWTA could not undertake any comprehensive survey since 1989. The hydrographic survey carried out during 2009-2014 is shown in the following table:

Table 5 Hydrographic Survey of Waterways

Year	Inland Waterways (km)	Coastal Waterways (sq. km)
2009-2010	2,162.10	1,111
2010-2011	1,208.00	1,190
2011-2012	834.00	1,190
2012-2013	2,052.25	1,200
2013-2014	2,769.54	1,200

Source: Hydrography Department BIWTA

3.3.3 Dredging

With limitation in the funds, BIWTA has to undertake the monitoring of navigability conditions of some important navigation routes with a view to identify morphological changes including shifting of sandbars. As such conservancy of navigability through dredging is an annual recurring necessity. BIWTA receive lists of dredging requirements from various parties and stakeholders. These include field offices of BIWTA, trade organizations related to IWT operations and the public sector company BIWTC. These are reviewed in meetings chaired by the Chairman BIWTA, and attended by representatives of both private and public stakeholders. Decisions are taken to prioritize the works. But for last three years such meetings are held with Chief Engineer (Dredging), BIWTA in the chair with no participation of private stakeholders. The Dredging Department of BIWTA separately estimates dredging related to development projects included in the ADP, then considering both development and maintenance dredging activities for the year vis-à-vis availability of resources. The works are prioritized according to their relative merits. This serves as an Annual Dredging Program for that particular year.

It is obvious from the above procedure that the difference of development and maintenance dredging only relates to the source of fund. In both cases dredging works are being performed in existing IWT routes with a few exceptions. Maintenance dredging are performed by the revenue budget of BIWTA while the development dredging by ADP allocation under an ongoing project. The volume of dredging performed in different IWT routes during 2009-2014 are presented in the **Annex**. A summarized version of both maintenance and development dredging is given in **Table 6**.

Table 6 Total Volume of Dredging (2009-2014)

Total Volume of Dredging (2009-2014) (in lakh m^3)			
Year	**Maintenance**	**Development**	**Total**
2009-2010	34.92	5.00	33.92
2010-2011	40.16	25.54	65.70
2011-2012	43.61	24.47	68.08
2012-2013	44.65	56.03	100.68
2013-2014	57.90	47.02	104.92

Source: Dredging Department BIWTA

Prioritization of Dredging Works

At present the Annual Dredging Program hardly follows any objective manner or method for preparation on the basis of available resources both financial and logistics. Opinions or requirements are received and listed, and the users' demands are heard. Meetings are held but the final dredging programs are prepared not according to any prescribed method. In many cases political influence determine the dredging program instead of doing it by the merits or priority. For example, Master Plan of the Haor Area of the Bangladesh Haor and Wetland Development Board, prepared by the CEGIS in 2012 envisaged the dredging requirement of waterways in the Haor area. The Master Plan revealed that there was hardly any dredging program for navigation during the last two decades. According to the report, it was estimated that in 2010 a total of 11.82 million passengers and 9.56 million of cargos were transported in the inland waterways in the Haor area. The Master Plan estimated that the Haor area shares about 37 percent of the total national IWT output, but in practice, the proportional justice was not done. Additionally, the inland waterways in the Haor area suffer more during the dry season navigability. **Table 7** will reveal the discrepancy.

Table 7 Dredging Volume in Haor Area

Year	**Volume (in lakh m^3)**	**Percentage**
2009-2010	3.33	8.34
2010-2011	Nil	-
2011-2012	Nil	-
2012-2013	2.13	2.12
2013-2014	3.94	3.75

Source: Calculated by consultant on data obtained from BIWTA

It is apparent in view of the overall IWT performance that inland waterways in the Haor area have failed to attract the attention of the decision makers. Moreover, users of inland waterways and stakeholders are very much critical of BIWTA's involvement in the dredging of ferry routes across the rivers between two road-heads. In fact, the ferry operation (loaded with vehicles) across the rivers between two road heads is the responsibility of the Roads and Highways Department. But considering the complicated navigational conditions ferry operations in the following routes have become the responsibility of the Ministry of Shipping:

i) Paturia-Daulatdia-Kazirhat
ii) Mawa-Charjanajat-Kathalbari
iii) Harinaghat-Alubazar
iv) Bhola-Laxmipur

BIWTA is responsible for maintaining navigability of the route and for maintaining embarkation/ disembarkation facilities for vehicles while operation of such ferry is the responsibility of BIWTC.

Since road transport network in Bangladesh gets priority over other modes of transport, dredging in the ferry routes between road-heads gets top priority in the Annual Dredging Program and as such the scarce funds go to dredging in the route which is ultimately availed by the road sub-sector, and IWT continues to suffer. The following table (**Table 8**) illustrates the top priority of ferry route.

Table 8 Dredging Volume in the Ferry Routes

Year	Volume	Percentage of total maintenance dredging
2009-2010	24.13	60.44
2010-2011	32.25	80.30
2011-2012	33.28	48.88
2012-2013	32.86	32.64
2013-2014	35.48	33.82

Source: Calculated by consultant on data from BIWTA

It is evident that half of the fund allocated for the maintenance dredging goes to the ferry routes' total length of which is not more than 100 km, the remaining for Class-I to III Routes with a length of 3600 km. Final Report of the Inland Water Transport Master plan study 2009 by Transport Sector Coordination wing, Planning Commission. Government suggested that "*ferry routes are in reality road links across the major rivers and relate to Roads: therefore funding should be arranged so that IWT budget meant for maintenance of waterways is not affected*." But in reality, it is not so.

3.3.4 Dredging Demand for Inland Navigation

The current method of determining the Annual Dredging Program is not the result of a comprehensive hydrographic survey. In reality knowledge gap of current conditions of navigability of Inland waterways exists as data were not updated nor any comprehensive hydrographic survey could be conducted since 1989. So it is not possible to ascertain the accurate volume of dredging required for the maintenance of classified IWT Routes. However at different times different Committees indicated different volume of dredging requirement. A Committee constituted by the Ministry of Shipping indicated a volume of 7.9 million m^3 annually. Again in 1999 a Committee constituted by Ministry of Water Resources indicated annual volume of 8.9 million m^3. In 2006 BIWTA estimated annual volume of 11.1 million m^3. Inland Water Transport Master Plan study (2009) prepared an Annual Dredging Requirement, presented in the tables under the **Annex A**.

BIWTA has undertaken and planned three projects of navigation dredging according to following:

i) Dredging of twelve important River Routs involving a total of 15.8 million m^3 duly approved by ECNEC
ii) Capital Dredging of 53 River Routes (1st phase 24 River Routes) involving a total of 104 million m^3 of dredging duly approved by ECNEC
iii) Capital Dredging of 53 River Routes (2nd phase 24 River Routes) involving a total of 382 million m^3 of dredging which is yet to be approved by GoB

In view of the above, BIWTA estimated an annual dredging requirement as presented in **Table 9**.

Table 9 Estimated Dredging Requirement

Sl. No.	Item of Dredging Works	Estimated Volume (in million m^3)	No. of years Planned	Volume/year (in million m^3)
1.	Capital Dredging of 65 River Routes	501.80	11	45.62
2.	Maintenance Dredging of River Routes after Capital Dredging (15% of Capital volume) 752.70 lakh m^3, taken 50% of the above Volume			37.60
3.	Maintenance of Ferry Routes and other Works			5.00
Total Dredging Requirement /year on average				88.22

Source: Dredging Department BIWTA

Available Dredging Capacity

Presently BIWTA has a fleet of 18 dredgers; 3 more dredgers are in the pipeline for delivery. Details of these dredgers are presented in Annex 5. With the three dredgers in pipeline of delivery total annual capacity of 21 dredgers will stand at 11.00 million m^3.

The full capacity of each dredger could never be utilized by BIWTA due to the following factors:

i) Deployment period and placement efficiency
ii) Two shifts of works
iii) Annual working days affected after deducting weekly and Government holidays
iv) Maintenance and repair time

DHV Consultants in its report titled Bangladesh Inland Water Transport Master Plan (1989) suggested suitable options to increase the number of productive hours of dredgers through the following:

i) Introducing a third (night) shift, raising productivity by about 30%, and/or
ii) Increasing the deployment time by 30% (from 27 dredger weeks to almost 35 dredgers weeks per year).

The above options are yet to be materialized.

Bangladesh Water Development Board (BWDB) has a dredger fleet with 8 million m^3 annual capacity. But almost all the BWDB dredgers are engaged for their own projects. The number of projects under implementation by BWDB and projects in pipeline for approval reveal that BWDB dredgers will never be utilized for navigational dredging in the years to come. So, only remaining alternative is to significantly involve and utilize private sector in navigational dredging. Very recently private sectors are coming forward for investment in navigational dredging. **Table 10** illustrates increasing participation of the private sectors.

Table 10 Private Sector Participation in Navigation Dredging

Year	Volume of Dredging (million m^3)
2009-2010	2.03
2010-2011	3.86
2011-2012	3.49
2012-2013	6.52
2013-2014	6.72

Source: Dredging Department BIWTA

3.3.5 Bandalling

BIWTA undertakes *Bandalling* works in non-tidal river systems of Jamuna/ Brahmaputra and Surma – Kushiara. It represents an alternative low cost indigenous method of maintenance of navigability in some specific stretches. It is applied for deepening a single channel and closure of a secondary channel.

3.3.6 Aids to Navigation and Pilotage

BIWTA is responsible for installation of navigational aids indicating the channel. These are indispensable for safe negotiation of a vessel. Day to day soundings of a stretch are taken by beat pilots and marksmen using a boat and a bamboo pole or a lead line. Soundings collected are reported to the sectional head. The pilot inspector of the stretch can take immediate action and shift the channel mark according to the condition of the channel. List of navigational aids in waterways is presented below (**Table 11**).

Table 11 Equipment of Navigational Aids in Waterways

Navigation aid Equipment	Number
Lighted Buoy	51
10m Tower Beacon	12
4.5m Tower Beacon	365
Spherical Buoy	81
P.C Pole Marks/Signs	427
Iron Marks/Signs	839

Source: Conservancy & Pilotage Department BIWTA

An efficient inland waterways network enabling the vessel to steam round the clock is necessary to decrease transportation time and increase turnaround of the vessel. But so far BIWTA could provide night navigational facilities to only one-fourth of the classified routes. Where no such facilities exist, vessels are not allowed to sail in the night and are compelled to anchor and wait for daylight .The following table (**Table 12**) illustrates current state of night navigation:

Table 12 Aids to day / night navigation

Classification of Waterways	Length (km)	Only Day (km)	Day & Night (km)
I	683	-	683
Ii	1,000	688	312
Iii	1,885	1,278	523
Iv	2,400	1290	43
Total	5,968	3,256	1,561

Source: Conservancy & Pilotage Department BIWTA

Other means of assistance to navigation in waterways are providing pilotage services to vessels in operation. The master of the inland ship is not knowledgeable about the unique condition of each stretch. Pilots guide the Master to keep the vessel on the right track. Pilots are engaged in 26 stations and provide services to the vessel at their respective beats (stretch). Present system of providing pilotage services increases operational time of the vessel due to (a) a vessel in operation for a long route is required to change pilots at not less than three pilot stations resulting delay in journey, (b) if any pilot is not available at a particular station, vessel will have to wait. The requirement of such services can be minimized by disseminating navigational information to the vessel in operation and intensifying aids to navigation. Total management of installation, maintenance and shifting of navigational equipment is directly performed by BIWTA; private participation in this regard is yet to be introduced.

3.3.7 Accidents and Safety

During the last decades substantial number of accidents happened in the inland waterways of Bangladesh and claimed thousands of lives. Such incidents created a public perception that waterway transport is unsafe. Despite the fact *the ratio of fatalities per billion of passenger-km is 158 for roads and 41 for IWT* (Revival of Inland Water Transport: Options and Strategies, World Bank, 2007).

Accident investigation reports revealed the following causes of marine accidents; overloading, collision, loss of balance/groundings, absence of pilots, breakdown, human errors, natural calamities like cyclones, storms, tornadoes etc. It was found that 56% of accidents occurred due to overloading or improper loading of passenger and cargo. But it was also found that the main cause was combined with other causes like quality of ship, human error and natural calamities. But in fact the accidents demonstrate the current state of poor governance that prevails in the field of ensuring ship safety and ship constructions. Only four surveyors are present for regulating the ship construction and awarding survey and registration certificates to inland vessels numbering more than 10,000. Lack of transparency and corruptions prevail in this field.

Movement of passenger vessels is regulated by BIWTA under the Time and Fare Table Approval Rules, 1970. Under the Rules every passenger vessel will have to take the approval from the Traffic Department of BIWTA for operating its passenger vessel. The approval will describe the origin and destination of each journey as well as the list of calling stations in between with a definite time schedule and a fare chart. Vessels having registration and survey certificates may apply for such approval. The responsibility of BIWTA is to oversee the loading/unloading activities in the inland ports. For this purpose, every port has a certain number of Traffic Inspectors. But, nobody is present to oversee the vessels journey of which does not originate from any inland port. Even in large ports only a few inspectors are present against a large number of vessels departing from that port. Master of the vessel has to submit a voyage declaration before each journey containing the number of passengers on board, life saving devices etc. But this is nothing but mere paper work. One of the main reasons of overloading is reduction of number of services in a definite route. For instance, according to approved schedule, six vessels are supposed to leave daily for Dhaka to Barisal directly and a similar number of vessels from Barisal to Dhaka. But companies involved in such operations mutually decided to sail four vessels daily from Dhaka and Barisal. As such, they invite overloading to increase their profit margin and decrease the operational cost even at the threat of an accident.

The most painful picture in this respect is observed immediately after the accidents. The Government is yet to have the capacity of undertaking instant salvage. This is done by local people and the country boats negotiating in that stretch. BIWTA have only four salvage units for this purpose. The oldest one was procured in 1964 with the lifting capacity of 60 tons. Another unit was procured in 1983 with the same capacity. Over the years, size and dimensions of inland vessels increased in such a way that the BIWTA salvage vessels were found to be incapable to rescue most of the capsized vessels. In view of the above the Government undertook a project for procurement of salvage cranes; under that project two units of salvage ships were procured from the Republic of Korea in 2013 at a cost of BDT 3.56 billion. But unfortunately these units could not help to undertake immediate salvage operations after the accidents. After each accident salvage units could only reach the spot in 24 hours time on average.

3.3.8 Management and Operations of Ports and Landing Stations

BIWTA has so far established 21 Inland Ports which were notified in the official gazettes describing the position and limit of each port. But in reality special port infrastructure and facilities are only available in 10 places. Management units of BIWTA are also not present at all 21 ports. The major ports have got their own management unit (for which size is depending on port's volume in terms of passenger and cargo throughput. The smaller ports like Ashuganj-Bhairab, Chatak, Narsingdi, Mawa-Charjanajat, Barguna, Noapara, Tongi etc. are not independent and are administered by the major port nearby.

Legal jurisdiction of a port Manager is limited in the respective port area. But beyond the port area the unit has got an administrative jurisdiction concerning the landing stations located outside the port area. Landing stations established and developed along the navigable inland waterways closer to the port are controlled by that port unit. No BIWTA person remains present at those landing stations to oversee the berthing of vessels or loading unloading of goods and passengers. It is estimated that about 1,200 such riverside landing stations are existing. So far, BIWTA have developed 380 landing stations providing marginal facilities like floating pontoons and shore connections.

Discharging and loading of inland ships at the facilities provided by BIWTA or any place in the port area are performed by the lessees appointed by BIWTA for a term of one year. All landing stations and cargo landing points in the port area are tendered annually and awarded to the highest bidder. Lessee takes the responsibility of loading/unloading and realizes toll at a rate fixed by BIWTA. There are certain points where the lessee realizes labor handling charge while BIWTA directly realize the landing/shipping charge on cargo. At all passenger terminals the entry fee is collected by BIWTA employees. Landing stations located outside the port area are operated by the lessee. Each landing station is under one lessee and realizes berthing charges from the vessel, entry fee from the passengers, landing/shipping charge from the cargo owner and labour handling charge as well.

Inland ships request the manager for a berth after arrival at the port. The manager provides berth to the vessel mainly according to the option of the owner. All passenger vessels have got certain berth for a certain time daily. Allocation of such berthing is fixed through discussion with private association.

The one year term lease is not conducive to private participation in port functioning or maintenance of infrastructure. If the lease arrangement would cover the medium term the lessee could be interested in maintenance (at least small repair including wear and tear). Such arrangements were also proved to be contradictory to the revenue interest. Every year BIWTA have to experience large number of litigation regarding lease arrangement resulting in loss of revenue. The port revenue consists of:

- annual lease,
- berthing charges from the ships and
- landing / shipping charges from the cargo loaded or unloaded in the port area.

3.3.9 Urban Transport in Dhaka City and IWT

The greater Dhaka city has got a natural advantage of circular waterways of 110.50 km length consisting of the rivers Buriganga, Turag, Balu, Sitalakhya and a small stretch of Dhaleswari. These rivers flow around Dhaka city through the districts of Dhaka, Narayanganj, Gazipur and Munshiganj.

The circular waterways around Dhaka had the significant potentials to contribute the urban transport in and around Dhaka. But due to lack of required and perennial navigability in about 50 percent of the waterways, it could not be utilized for the movement of passengers and freight. The IWT operations were limited mainly to the movement of passengers and cargo between Dhaka/Narayanganj and other parts of the country. Mechanized country boats of small sizes could only navigate during monsoon from Sadarghat, Dhaka to Mirpur area and from Demra (Narayanganj) to Tongi area. Such contribution to urban transport was insignificant and may be termed as no contribution.

To enhance the navigable waterways and to contribute to the urban transport in Dhaka through IWT services BIWTA undertook a project called "Development of Circular Waterways around Dhaka- 1st Phase" in 2000. The Project was completed in 2004 and a length of 29.50 km of waterways in Buriganga and Turag rivers was made navigable through dredging, including development of 10 landing stations along the waterways at a cost of BDT 360 million. The first phase included the waterways in the south-western, western and north-western parts of the city. The 2nd phase of the project was undertaken by BIWTA in 2007 for development of navigability, by dredging additional 40.50 km waterways with 3 landing stations in the northern and north eastern parts of Dhaka city, which included the Turag, Balu and Sitalakhya rivers. The project was completed in 2014 at a cost of BDT 540 million.

Benefits of these two projects were yet to be determined or estimated by BIWTA or any other Government agencies. But it was evident that implementation of the 1st phase of the project could not yield any benefit to passenger movements despite series of efforts by the public bodies. Immediately after the completion of the project, services of passenger launches were introduced. But these passenger launches could not continue services more than three days after inauguration. Then the public sector company the BIWTC came up and introduced a sea-truck service between Mirpur and Sadarghat. After a few days this service was also stopped. After that, with the instruction from the Ministry of Shipping, the BIWTC constructed three water buses and introduced services in that route. Apparently the last effort was also unsuccessful and the services have become very much irregular but it was not abandoned officially as yet. Different reports and reviews revealed the causes of failure to attract the passengers and are listed below.

a) Passenger movement between Mirpur and Sadarghat by waterways is not competitive with road transport in respect of time and cost
b) There exists inherent lacking of modal connectivity to and from the landing stations
c) Faster watercrafts cannot utilize the speed capacity due to the fact that the route is overcrowded by mechanized boats
d) Construction of a third road bridge over the river Buriganga has significantly reduced the traffic demand of passengers by river

On the contrary, freight movement on the route that was developed in the 1st phase of the project has shown a significant success even beyond the estimation of BIWTA. Total tonnage of freight movement was yet to be determined by BIWTA, but at any point of time in the year a lot of loading-unloading activities by vessels could be seen in the Gabtali-Aminbazar area or elsewhere along the route. Since BIWTA do not have any data on the quantum of cargo, the volume was estimated on the basis of revenue earned by BIWTA on account of loading-unloading of cargo at the points developed by the project. License of realization of revenue on account of cargo are tendered annually to private stevedores who actually operate the loading/unloading activities. Total cost and profits of all such stevedores were calculated and the total sum of money was converted into tons. Based on this method total cargo handled at the points located in the western and north-western points of the Dhaka city (which were developed by the project) is estimated and presented in **Table 13** below.

Table 13 Statistics of cargo handled in the western and north-western parts of the city

Year	**Cargo (million ton)**
2010-2011	1.62
2011-2012	1.68
2012-2013	1.71
2013-2014	2.01

Source: Consultant's estimation

Through discussions with BIWTA officials and with private stevedores it was understood that from total cargo handled at those points 60% are construction materials (sand, stone chips, bricks etc), 30% fertilizer and 10% others (mainly food grains, poultry feed and vegetables). It was also revealed during discussions that the ultimate destinations of these cargo are north and north-western parts of Dhaka city, Manikganj, Mymensingh, Gazipur, Tangail and a little portion to the northern region of the country. It was further found that prior to the improvement of navigability in this route cargo was handled at Aliganj, Pagla, Fatullah the south eastern part of Dhaka city by the side of the Buriganga, next transported by trucks which moved through the Dhaka city. It can be estimated that for the movement of 1.75 million tons of cargo a total of 100,000 trucks would be required from the southern part to the western, north-western and northern parts of Dhaka city.

According to above method benefits of the 2nd phase of the project could not be estimated since it was just completed. But officials in BIWTA maintained that it could yield some benefits of passenger movements as the route will be attractive for passengers between Tongi and Narayanganj in terms of time and cost.

3.3.10 STP and DHUTS in relation to IWT

The Government of Bangladesh undertook a study concerning a Strategic Transport Plan (STP) prepared in 2004 by Dhaka Transport Coordination Board (DTCB) under the Ministry of Communication. The Plan included comprehensive transport related issues and underscored the need for development of IWT towards urban transport. The STP stated the main challenge in Dhaka area was to identify and link together the most appropriate mode for any journey. Emphasizing the urgency for integrating different modes of transport, the STP formulated the following Policy 6: *The Government will implement a policy that removes the inefficient competition between modes in order to encourage the selection of most efficient mode or services of modes for each journey and integrate the modes.*

The significance of the need of inland waterways to urban transport in Dhaka city and the need to establish a green transport system in the area was described in the STP. Freight transport by waterways was given more importance and accordingly the STP formulated the following Policy 20: *The Government will integrate the inland waterways with the city land transport system so that the movement of freight traffic from motor launches landing stations into the city will be made more efficient.*

Further, the Government prepared a Dhaka Urban Transport Network Development Study (DHUTS) in 2010 with the objective of formulating the urban transport network development plan integrated with the urban development plan of Dhaka Metropolitan Area up to 2025. Unfortunately, the Study in its proposed projects and programs did not include the development of inland waterways or inland water transport in the transport network of Dhaka city.

Unfortunately, the above policies and plans have not been implemented in case of inland water transport around the Dhaka city. Efforts were taken to relocate existing markets of vegetables, fish, food grains, etc from the centre of the city to the riverside places but resisted and finally stopped due to political reason.

3.3.11 Port Infrastructure

Infrastructure and facilities available at major river ports and landing stations consist of terminal building, pontoon, jetty, gangway, warehouse, transit shed etc. These are marginal in real term with respect to safety and productivity.

Most of the river ports do not have their own warehouse. At some ports licensees of BIWTA have built warehouses and realized some money from its users.

Besides public jetties and facilities more than 250 private jetties in inland ports exist. Almost every industrial unit established by the riverside flowing through the port area has developed their own dedicated jetties under license from BIWTA.

3.3.12 Intermodal Connectivity

Poor or no intermodal connectivity at inland river ports and landing stations manifests the inherent inefficiency of transportation by inland waterways. A port is the interface of two or more modes of transport: this definition does not apply to river ports and landing stations in Bangladesh. At present there are about 380 landing stations in the country developed by BIWTA. Of these, two-third was developed in the rural areas with about 90 percent with no road link.

All 21 inland river ports (except Chandpur) do have road links. Only Narayanganj, Chandpur and Khulna have a railway link. But landing points and stages in these river ports are established in such a way that cargo transfer between vessel and truck is not possible except one point at Dhaka, as well as at Narayanganj and Khulna.

In consultation with BIWTA officials a list of 40 major landing and shipping stations of cargo was prepared according to traffic importance. The current state of intermodal connectivity of these stations is presented in the Annex A.

The Annex A shows that major landing stations have road links but do not provide connectivity in real sense. BIWTA officials could not provide the actual distance between the truck point and the jetty with the exception of a few. Against most landing stations they used the word "near". In course of the discussions it was revealed that the average distance is 250 m. This is very significant and beyond the reach of handling gears on board or shore crane on the jetty to provide direct transfer of cargo between vessel and truck. The method of trans-shipment is only by means of head load what prevailed in the last centuries. This outdated method causes increase in cost and transportation time. Consequently, IWT has lost its efficiency and competitiveness compared to other modes. The consequence of the current physical appearance of inland river ports and landing stations is that transportation by inland waterways is unimodal, segmented and to some extent isolated as well. Even with the massive development of road network in Bangladesh, most of the rural people depend only on the rivers for the purpose of transportation. They do not have access to actual market place due to lack of intermodal connectivity. They have to depend only on middle men who pay less to the grower and charge more from the end consumer. Middle men exist due to segmented transport chain, and prevail and dominate transportation and distribution of agricultural products. This affects the agricultural growth very much.

Since the 1980s development of roads has got most attention from policy makers, resulting in a segmented transport sector. Development planning of the transport sector was conducted in parallel ways. Road, inland waterways and rail are components of surface transport sector in Bangladesh. Coordination and connectivity among these modes could provide a multimodal transport system to establish an uninterrupted transport chain for door to door services. Development of roads and railways and the development of inland waterways had been conducted by two separate Ministries: Ministry of Communications and the Ministry of Shipping. Very recently Ministry of Communications was divided into two Ministries, namely Ministry of Road Transport and Ministry of Railways. Proposals are submitted in parallel ways by the Ministries to the Planning Commission which has to decide against available resources. As a result decisions are often taken by restoring to political considerations. As a matter of routine, IWT sub-sector is continuously neglected and given lesser priority, whereas the development of roads is a political priority all the time.

Intermodal coordination has been improving at the level of Planning Commission since the constitution of Transport Sector Coordination Wing (TSCW) with support of UK Department of International Development (DFID). This was further added by the approval of the Cabinet in August 2013 of the draft on National Integrated Multimodal Transport Policy, 2013. The policy aimed at making the country's multimodal transport system more environment-friendly, cost effective, safe and efficient. The NIMTP envisages to prioritize inland waterways and rail and to reduce the increasing dependence on roads. According to the policy a cabinet committee to monitor the implementation of the policy and a National Multimodal Transport Coordination Committee were supposed to be constituted but this was yet to be materialized. The policy was intended to extend choice in transport and secure mobility in a way that supports sustainable development. Achievement of the Millennium Development Goals was, in part, reliant on a cheap and efficient transport system. The policy recognized that road transport had in particular revolutionized lives, bringing great flexibility and widening horizons. But, the policy maintained, over concentration on road transport has a price for health, for the economy and for the environment. In view of the above, the policy emphasized maintenance of existing assets and infrastructure and also envisaged the need to encourage more investment in rail and inland water transport.

Availability of integrated logistics in the entire transport chain is the pre-condition of intermodal connectivity. A renewed focus has been given everywhere in the world on intermodal transport driven by changing requirements of the supply chain. With the changing pattern of traffic and transport technology, a new focus on logistics and supply chain requirements is needed for continued transport growth. But unfortunately, this did not happen in Bangladesh as yet due to lack of intermodal connectivity. Growth of international Sea borne trade is under serious threat due to lack of intermodal connections and particularly due to under-utilization of inland waterways for transport for Sea borne throughput (rate of production or processing) further inland from and to maritime ports. An efficient maritime port must integrate with other transport infrastructure. But over-dependence on road has made the maritime ports in Bangladesh inefficient to meet the challenge of growing trend of Sea borne trade. Of late, container traffic in inland waterways in the country has become a priority issue and most importantly the private sector has come forward significantly to invest in the integrated logistics for container transport by inland waterways (for details please see section 5.3.26: Container Traffic in Inland Waterways).

At the same time domestic cargo traffic by waterways suffers from lack of logistics in this sub-sector. Except a few jetties developed and operated by private sector companies on a dedicated basis, the present system of loading/unloading of cargo at public jetties is mainly by means of head load, because, as mentioned earlier, inland ports and landing stations are not connected with road or rail. The distance between the jetty and the place of waiting truck is such that it restricts opportunity of direct transfer of cargo required for uninterrupted transport chain. In some cases, vessels have their own handling gear. Such vessels may transfer cargo by the equipment to the jetty but not to the truck, for which head load is indispensable. Again, most vessels without handling gear have to depend on head load for the entire operation. These primitive methods are unfit for the modern day cargo handling. Also the existing infrastructure of inland ports and landing stations poses a problem of mechanization for cargo handling.

For a head load method, the size of gang of about 100 labourers is high, but productivity is low about 7-10 days to load/unload a vessel of 500 to 800 DWT. The use of mechanized equipment could reduce this time to one to two days. Long cargo handling time increases the turnaround time of a vessel and reduces the productivity. The increased turnaround time decreases the number of vessel trips which has direct impact on the cost of transportation by inland waterways. The following table (**Table 14**) reveals comparative transport costs and revenues for two productivity scenarios concerning head load and mechanized equipment.

Table 14 Cargo transport costs and revenue with head load and with equipment

	Manual labour	**Mechanized equipment**	**Variation Mechanized/Manual**
Number of annual round trips	12	26	+114%
Operating costs (Tk per ton-km)	0.90	0.67	-26%
Total annual tariff (0.92 Tk/ton-km)	2,7000,000	5,700,000	+114%
Total annual profit in Tk	60,000	1,600,000	

Source: Revival of Inland Water Transport: Options and Strategies, 2007, The World Bank

Note: Operating costs include depreciation, major overhaul, salaries and wages, fuel, lubricant, maintenance and tolls and taxes.

With mechanization, operating costs would be reduced by 26 percent achieved by a higher number of trips. Profit of vessel owner will increase, service will be competitive and integrated logistics costs would likely be reduced compared to the present system of head load. However, the current labourers may be unemployed initially which may create unrest and resistance, but in the long run by increasing productivity and increasing investments more opportunities of employment would be created. Such mechanization of handling is only possible through establishing an uninterrupted intermodal connectivity with both growers and retailers as beneficiaries.

3.3.13 Port Throughput

No data of cargo and passenger throughput in inland ports exist. The lessees do not submit any cargo or passenger return. Nor BIWTA undertakes any survey to estimate the cargo or passengers throughput from the ports. As such, revenue earned from cargo and passengers could be taken for estimating throughput. This is not very dependable as actual exploitation could not be ascertained. According to the above method statistics of throughputs received from BIWTA are presented in **Table 15**.

Table 15 Passenger and Cargo Throughputs of River Ports

Name of Port	2011-2012		2012-2013		2013-2014	
	Passenger (in millions)	Cargo (in million ton)	Pass (in millions)	Cargo (in million-ton)	Pass(in millions)	Cargo (in million-ton)
Dhaka	19.05	6.00	21.11	6.70	20.55	7.53
Narayanganj	23.13	10.53	22.72	12.76	24.17	13.61
Khulna	0.72	8.01	0.65	6.64	0.67	6.05
Chandpur	2.10	0.42	2.27	0.47	2.28	0.50
Barisal	5.75	0.60	5.81	0.66	6.47	0.68
Patuakhali	2.12	0.12	2.11	0.12	2.32	0.18
Mawa	13.50		14.98		16.70	
Aricha-Daulatdia	11.48	5.34	14.88	5.35	14.24	5.57
Baghabari		1.13		1.03		1.06
Total	97.85	32.15	84.53	33.73	87.40	35.18

Source: Port Department BIWTA

3.3.14 IWT Fleet

Bangladesh has a large IWT fleet adding up to 9,367 registered vessels (as of December 2013) in the Department of Shipping (DOS) under Inland Shipping Ordinance from 1976. Not all vessels are providing transport services. Mainly passenger vessels, cargo vessels, ferry, oil tankers, tug boats, dumb barges, sand carriers and speed boats are engaged in transport trading of people and goods. The following table (**Table 16**) describes the number of each type of vessels:

Table 16 Vessels Registered under Inland Shipping Ordinance (As of December 2013)

Type	2011	2012	2013
1. **Passenger Vessel**	970	984	1061
2. **Cargo Vessel**	1,930	2,048	2,213
3. Ferry	23	27	27
4. Oil Tanker	190	210	260
5. Tug Boat	75	83	89
6. Dumb Barge	180	202	216
7. Speed Boat	205	224	226
8. Inspection Boat	40	44	44
9. Sand Carrier	3,375	3,654	3,811
10. Dredger	620	794	857
11. Others	350	398	563
Total	7,958	8,688	9,367

With the above ISO registered vessels, some vessels registered under the Merchant Shipping Ordinance (1983) also operate in the inland waterways in Bangladesh. Such large size vessels provide transport services of dry bulk and liquid bulk mainly from maritime ports of Chittagong and Mongla to Dhaka/Narayanganj region and between Chittagong and Mongla/Khulna region. Approximately 100 coastal vessels and 143 oil tankers are engaged in such services. The figure of total registered vessel does not represent the actual number of operating vessels due to following reasons:

a) Department of Shipping does not maintain any record or information of vessels scrapped or destroyed/damaged and otherwise not operational anymore

b) Vessels not registered but operating with the advantage of weak enforcement

3.3.15 Country Boats

Country boats in Bangladesh have emerged completely informally to provide their services mainly in rural areas in competition with road (transport). Country boats are not only popular for its cost but also the only means of transport to remote areas without road access and to areas regularly disrupted due to flood. BIWTA guesstimate the number of country boats at 745,000 while the IWT Master Plan indicated the number at 1.01 million.

During 1982-1984 NORAD (Norway) and DGIS (Netherlands) assisted GoB in a socio economic study on country boats which demonstrated the dominant role of these boats in the rural economy. According to the study about 80 percent of Bangladesh's 68,000 villages are still largely dependent on country boats.

Hardly any infrastructure for operations of country boats exist. Pontoons placed by BIWTA in the wayside landing stations are too high to fit with country boats. In absence of efforts of public agencies for development of country boats facilities, local initiatives were taken at a few places. Landing stages for berthing of country boats were developed by the LGED and by the boat owners' association at their own costs but very small compared to the requirements of about one million country boats.

Number of committees constituted by the GoB aiming at development and regulation of country boats has sub-divided the mechanized boats into three categories:

a. Boats having more than 16 BHP engines
b. Boats having 16 or less BHP engines and
c. Bulk-heads

The existing law provides a boat having engine less than 16 BHP is beyond the purview of the law and thereby registration. But in reality a boat having engine of more than 16 BHP and even beyond 100 BHP does not bother to undergo for registration due to lack of law enforcement. The Mechanized Country Boat and Bulk-head Owners' Association maintained that all owners will comply with the Government's decision to prepare a separate regulatory framework for country boat and bulk-head containing easy and friendly procedures of registration.

Engines used for country boats are not safe for navigation. The engines are originally designed for irrigation pumps, which, when fitted on the boat hull, have no reversible gear to reduce or control the speed, causing hazards and increase the risks of accidents. Due to absence of a regulatory mechanism in respect of construction and movement of mechanized country boats and non-standard crafts, these are found in a large number at almost every stretch of the rivers. Almost all important consolidation and distribution centers by the side of rivers are overcrowded by such crafts. Since such boats do not have reverse gears, frequently they collide with other vessels causing fatal accidents. Such crafts have created a negative impact on the development of standard and larger size inland vessels, the main causes for which are the following:

a. loss of business to country crafts
b. investment and operating costs are much lower
c. no regulatory compliance is required
d. much cheaper
e. reachable area are larger and wide compared to larger vessel

In this context, it is understood that some cross cutting issues exist on the movement of mechanized country boats. On one hand country boats provide cheaper services and can reach remote and low water areas for which rural people at large are the beneficiaries. On the other hand, they do not provide or ensure safety of lives and properties and due to its decreased operating costs and reaching larger areas, the standard larger and safer vessels will be continuously kept out of the market. Vessel owners express frustration or reluctance to further invest for construction of standard and safe vessels. This is because country boats are yet to receive any Government support in respect of development and legal framework. If there had been a legal framework for construction and operation of country boats, a minimum safety standard could be established. And at the same time, the area for the movement of country boats could be determined and limited to only rural and low water areas.

Under the IDA financed Third Inland Water Transport Project, boat centers were intended to be established to provide technical assistance to boat owners for repair and improvement of their boats e.g., in respect of safety or gear box upgrading. Implementation of this component of the project was unsatisfactory. Out of targeted five centers, three centers were built but only two were completed. These centers did not provide any service to boat owners rather these centers were used for other purposes.

3.3.16 Impact of Climate Change on IWT

Gradually the flow of waterways has become alarmingly erratic causing huge siltation in the rivers. As a result inland navigation is becoming hazardous and is shrinking rapidly. Rivers have become so unpredictable that dredging could not yield benefit for navigation.

According to the Bangladesh Climate Change Strategy and Action Plan (2009), possible impacts in Bangladesh are the following:

- Increasingly frequent and severe tropical cyclones
- Heavier and more erratic rainfall
- River bank erosion
- Increased sedimentation on river bed
- Melting of the Himalayan glaciers
- Lower and more erratic rainfall
- Sea level rise

To determine the impact of climate change on inland water transport, studies should be conducted for adaptation to climate change. Some impacts envisioned due to climate change are:

- Loss of navigability due to increase in frequency and duration of dry spell may imply higher prices and losses
- Increase in frequency in wet and stormy period may imply higher costs due to weather disturbances and safety
- Gradual low flow conditions and resulting economic losses
- Large variations and reduced water depth
- Sharp increase in frequency of extreme costs
- Damage from cyclones and storm surges to IWT infrastructure

Despite BIWTA's aid to navigation support along the channel, change of river course has become unpredictable resulting in grounding of vessels which often cause economic losses. The impact of climate change is very much evident in case of 24 terminals developed by BIWTA in the early 1970s, which are also used as cyclone shelters in the coastal area. Not a single terminal is in use now as the rivers lost navigability or change their courses away from the terminal; some of the terminals disappeared due to river erosion. The equipment to navigation is vulnerable to cyclone and storm surge. This equipment is washed away regularly by onrush of flood water.

The cyclone SIDR in 2007 destroyed, damaged or washed away about 80% of such equipment installed in Khulna and Barisal Divisions. Of the total 380 landing stations developed so far by BIWTA, 43% are located in places registered under Khulna and Barisal divisions. About 35% of the landing stations in the two divisions were completely damaged, pontoons were displaced, damaged or capsized during SIDR cyclone. Landing stations located in the coastal area are exposed to saline intrusion also. Floating pontoons, jetties or shore connections cannot last long due to high salinity in the water.

Ports and landing stations were developed by BIWTA following the benchmark of Public Works Department (PWD) calculating the high and low water variation. As climate change factors were not considered, it is already seen in some places that the facilities developed in the past shifted towards the shore quite a distance away from the river, or in the mid-stream of the river without any shore connection. Floating pontoons are often shifted to another place due to change in course of the river or due to erosion, leaving behind the piles or spuds.

While BIWTA struggles to maintain the navigability, the vessels struggle to negotiate against the strong current. In late monsoon, due to flash floods and strong current in rivers, water increases in some stretches to such an extent that navigation becomes very dangerous. One such example is the confluence of the Meghna and Dakatia near Chandpur where dangerous whirlpool caused at least half a dozen marine accidents during recent years and claimed thousands of lives.

Managing the impact

Mitigation

Generation of Greenhouse gases in Bangladesh is low. In the Transport sector in Bangladesh emission of carbon dioxide is the lowest. It means use of waterways for the purpose of transport will result in increased saving in fuel and less emission of carbon dioxide.

Like other developing countries IWT performance in Bangladesh is achieved with old engine and technology which means further efficiency of fuel can be achieved. This improvement would make IWT more competitive and would increase modal shift from road to river, further reducing the impact on carbon footprint of the sector.

Technological developments with regard to i) vessel operation, ii) vessel design, iii) engine efficiency and propulsion system and iv) alternative fuel options, must be reviewed. Energy efficiency can be realized through each of the above categories against increased investment costs.

Adaptation

The vessel operators have adopted through practical experience to navigate in the deteriorating conditions of the rivers. Such conditions negatively influence costs of maintenance of vessels, infrastructure and allied services. Due to increased costs of maintaining the vessels, owners have reduced the quota of money for safety of passengers and cargo. As a result marine accidents have become more frequent.

Maintenance of navigability of waterways should be carried out properly. Dredging techniques and methods should be determined taking into account the erratic conditions of the river due to climate change. Through morphological and social studies dredge spoils may be discharged suitable places to raise the river bank. For sustainable navigability river training must be examined and carried out as well. It is evident that *bandalling* in some stretches of rivers is useful to some extent. So, for improvement of navigability, *bandalling* should be the first option where feasible.

Facilities in ports and landing stations should be made flexible in a way to smoothly adjust to the changing condition of the rivers due to climate change. For adapting the changing condition of the river, design and dimension of vessels must be reviewed and changed. The breadth of a vessel may remain unchanged but the draft and the overall length (LOA) must be changed. Deeper draft long vessels must be replaced by shallow draft shorter LOA vessels.

Financing Adaptation

For adapting to climate change in IWT, no action plan or fund exists. Although BIWTA very recently received an allocation from the Climate Change Trust Fund to remove the garbage from the bed of the Buriganga River and other rivers flowing around Dhaka city. The finance for adaptation and mitigation in IWT has to come from global source on a purely grant basis. To this end, GoB should take responsibility for working out the cost of implementing the Climate Change Action Plan which has to be included the IWT sub-sector.

3.3.17 Maritime Ports

International trade in Bangladesh, most important factor of GDP growth, is largely dependent on maritime port sector. Chittagong and Mongla are the only two sea borne trade ports in Bangladesh. Total tonnage of sea borne trade is presently over 45 million tons, growing over 10 percent per annum. Also the trend towards containerization persists and container traffic is growing over 12 percent per annum. Chittagong being the main gateway port of Sea borne trade is handling over 95 percent of total tonnage. Both ports are organizationally and operationally similar but a clear difference is observed in terms of traffic volume, operation, performance and future investment and development strategies. The installations of Chittagong Port are situated along the bank of the River Karnaphuli, 16 km from its outfall into the Bay of Bengal. The maximum permissible draft ranges from 8.50 m to 9.20 m with length restriction of a vessel being 188 m. The facilities of Mongla Port were developed along the bank of the River Pussur about 130 km inland from the bay. Its permissible draft ranges from 6.00 m to 8.50 m with length restriction of a vessel being 200 m. Therefore, both ports cannot accommodate large vessels to berth and lightering is indispensable for a substantial portion of import trade from the anchorage in the bay.

The current state of sea borne trade in Chittagong and Mongla Port is illustrated in **Table 17**.

Table 17 Current state of Sea borne Trade (2012-2013 FY)

Trade	Chittagong Port		Mongla Port	
	Volume (mil MT)	Percentage	Volume (mil MT)	Percentage
Import	38.312	92.86	2.946	7.14
Export	5.059	96.17	0.201	3.83
Total	43.371	93.23	3.147	6.77

Source: Calculated by consultant on data of Chittagong and Mongla Ports

Factors of Sea borne Traffic Growth

Growth of international sea borne trade in Bangladesh has been due to the following factors:

a) Economic Growth

Bangladesh has an impressive track record for growth and development in the past decades[8](despite world recession) and is aspiring to be a middle-income country by 2021. According to World Bank the country's GDP was USD 150 billion in 2013 and GDP growth rate was 6.00 percent. Human development went hand in hand as well. Poverty dropped by a third coupled with increased life expectancy, literacy and per capita food intake. More than 15 million people have moved out of poverty since 1990s.

b) Population

Maritime port services have a domestic market of more than 150 million of people. For consumption of many products people have to depend on import from abroad. Growth of population and increase of per capita food intake are the main factors for growing the international sea borne traffic.

[8]See Baseline Report on Socio Economic and Demographic Condition for further details

c) Foreign Direct Investment (FDI)

There was a net inflow of USD 861.73 million in 2010 which increased to USD 1.50 billion in 2013 (see **Table 18** below)

Table 18 Foreign Direct Investment - net inflows (in current USD)

Year	Amount
2010	861,736,237
2011	1,184,776,059
2012	1,474,542,605
2013	1,501,647,072

Source: The World Bank (data.worldbank.org)

Foreign Direct Investments are net factors of investment in acquiring a lasting management interest (10% or more voting stock) in an enterprise operating in an economy which differs from the investor's country of origin. It is the sum of equity capital, reinvestment of earnings, over long term and short term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors.

d) Export Processing Zone (EPZ)

Development of export processing zones in Bangladesh is also responsible for the growth of international Sea borne trade. Export processing zones share about 25 percent of total export. Presently, 8 EPZs are in operation (**Table 19**).

Table 19 Export Processing Zones in Bangladesh

EPZ	Land Area (acre)	Number of Industrial Plots
Chittagong	453.00	501
Adamjee	245.12	224
Dhaka	156.22	451
Comilla	267.46	238
Karnaphuli	222.42	255
Mongla	255.41	116
Ishwardi	309.00	290
Uttara (Dhaka)	212.00	202

Source: Banladesh Export Processing Zones Authority (www.epzbangladesh.org.bd)

According to Drewry Maritime Research (2010) total investment in 299 operating industries and 209 new established industries in EPZ areas adding up to USD 1,582 million up to June 2009.

e) Ready-Made Garments Sector

Emergence of Ready-Made Garments (RMG) sector in Bangladesh as a dominant economic activity influenced significantly and decisively the structure of the manufacturing sector. "Along with a growing share of GDP, manufacturing sector quickly dominated the export market and contributed to an expanding GDP share of exports. The RMG sector has emerged as an economic powerhouse in Bangladesh" (*General Economic Division, Planning Commission, Government of Bangladesh, Accelerating Growth and Reducing Poverty, 6th Five Year Plan: FY2011-2015, Part 1, p. 26)*. The Garments Manufacturers and Exporters Association (BGMEA) considered the prospect of the growth very favorable and maintained that target of exports of USD 45 billion would be achieved by 2020 doubling the current figure.

Domestic Market

Goods of international Sea borne trade are originating from or destined to places as follows:

Dhaka and surroundig area: 70 percent

Chittagong : 20 percent

Remaining areas : 10 percent

Being the largest market Dhaka decides which ports are to be used. Dhaka is connected by road, rail and inland waterways with Chittagong Port and comparatively reliable. On the contrary, Mongla does not have dependable connectivity with Dhaka. Main market of Mongla Port lies in south-western and northern parts of Bangladesh which do not share more than 6 percent of total trade. Mainly for this reason Chittagong has emerged as the monopoly port in Bangladesh. The following table (**Table 20**) illustrates mode of transportation of goods flow between hinterlands and respective maritime ports.

Table 20 Intermodal Options between Maritime Ports and Hinterland

Ports	Dhaka & Surroundings	Chittagong	Remaining Parts
Chittagong	Road Rail IWT	Road	Road IWT
Mongla	Road	IWT	Road

Source: BDP TEAM

Port Share

Table 21 below illustrates the share of sea borne trade by the two maritime ports of Chittagong and Mongla:

Table 21 Port Share of Sea-borne Trade

Trade	Category of goods	% of total tonnage	Share of Chittagong	Share of Mongla
Import	Food grain	11	98	2
	Cement and Clinker	24.4	93	7
	Fertilizer	5	74	26
	Sugar	4	99	1
Export	Jute and Jute Goods	20	80	20
	Readymade Garments	65	100	-
	Frozen Food	3	58	42

Source: Drewry Market Research, 2010

Traffic Forecast of Sea borne Trade

Asian Development Bank's Study Report on Bangladesh Port and Logistics Efficiency Improvement (2011) included a traffic projection of international sea borne trade of Bangladesh (**Table 22**). ADB used a regression analysis model taking into account close relationship between GDP and total sea borne trade tonnage during the period of 2000-2009. Key assumptions of the projection were:

- Forecast of base case of sea borne trade tonnage was based on an average annual GDP growth rate of 5.83% for the period 2010-2040. This had the reference of the July 2010 version of International Monetary

Fund's projection of Bangladesh's GDP during the period 2010-2015. GDP projection for the period of 2016-2040 was derived taking into consideration the average annual increase of 5.79% for the period 2000-2009,

- High case throughput projection was based on an average annual GDP growth rate of 6.36% during 2010-2040,
- Low case throughput projection was based on an average annual GDP growth rate of 5.36% during the same period.

Table 22 Traffic Forecast of International Sea borne Trade

Case	2010	2015	2020	2025	2030	2035	2040
GDP %	5.3	6.15	5.79	5.79	5.79	5.79	5.79
GDP % High	5.4	6.7	6.843	9.284	12.598	17.093	23.193
GDP % Low	5.38	5.65	5.29	5.29	5.29	5.29	5.29
Total Tonnage Base	33.55	44.23	57.96	76.16	100.28	132.25	174.61
Total Tonnage High	33.55	45.23	60.66	81.60	110.08	148.54	200.83
Total Tonnage Low	33.55	43.24	55.38	71.08	91.40	117.70	151.76
TEU Base	1.27	1.74	2.87	3.72	5.11	6.96	9.40
TEU High	1.27	1.94	2.83	4.04	5.68	7.90	10.91
TEU Low	1.27	1.83	2.52	3.43	4.60	6.12	8.08
Traffic Growth % Base	7.19	8.10	7.07	6.71	6.46	6.28	6.15
Traffic Growth % High	7.19	8.70	7.60	7.20	6.90	6.80	6.60
Traffic Growth % Low	7.19	7.49	6.53	6.20	5.97	5.80	5.68

Source:Port & Logistics Efficiency Improvement 2011, Asian Development Bank

3.3.18 Chittagong Port

Chittagong Port is the principal maritime port of Bangladesh with more than 90 percent share of total international sea borne trade. Growth of traffic in Chittagong Port is faster than GDP growth rate of the country. The Port is situated in tidal reaches of River Karnaphuli which follows a meandering course of 120 km from its origin in the Lushai hills in Mizoram, India, to enter the Bay of Bengal between Patenga and Norman's points. Chittagong was known as *Shetgang* to early European mariners. In the 16th century Portuguese sailors showed interest in the locality around Chittagong, popularly known as *Porte Grande*. The Port was first established at its present location in 1887 which is now a large expanding city developing around. Port installations extend from the entrance about 8 nautical miles upstream where the main container and general cargo berths are located.

Salient Physical Features

- Total 41 berths including public and private terminal berths and lighter operations in outer anchorage,
- Maximum permissible length of vessel is 188 m and fresh water draft of 9.5 m. Maximum vertical clearance is 52 m, air draft for Ro-Ro vessels and vehicle carriers is limited to 15 m. Night navigation is not allowed for vessel of 153 m LOA or more,
- A shallow near shore coastal area at the head of the Bay of Bengal,
- Bar at the port entrance has a least chartered depth of 5.8 m,
- Mid channel bars and siltation in the river channel,
- River channel bends, f.i. bend between canal 10 and 14 with a radius of 900 m,
- Strong tidal stream during spring tide with mean range 3.7 m,
- Strong Freshets during the period between May and October when rainfall can reach 0.2 m in 24 hours and ebb river current can be 8 knots high,

- Vessel is to arrive off the allocated berth during in-going tide , turn in the channel using the star board anchor, which is then recovered, then let-go the port anchor and manoeuvre to the berth with the assistance of tug,
- Thick fog often occurs in period between November and February,
- There are three outer anchorage areas: a) for vessels with more than 9.2 m, b) for vessels entering the Port within 24 hours, c) vessels for lightering and vessels not scheduled to enter the Port within 24 hours,
- Pilotage is mandatory for all vessels of more than 200 ton entering the Port. This service is available only during day light.

Infrastructure of Chittagong Port

a) General Cargo Berths

13 common user berths, total length 2,131 m with depth of 8.7-9.3 m are defined as general cargo berths (GCB). These berths remain mainly occupied by general cargo ships. Stevedoring services are awarded to private operators. GCB is also used for berthing of geared container vessels.

Various moorings and pontoon berths are present for handling of commodities like food grain, cement, clinker, and bulk oil to storage facilities nearby, also discharge to barges. These berths have different dimensions in length and depth. A number of facilities on either bank of Karnaphuli are now being operated by different private companies and handling mainly bulk cargo (**Table 23**).

b) Chittagong Container Terminal (CCT)

Chittagong container terminal is the only terminal dedicated for handling of containers having three feeder berths with a total length of quay of 450 m equipped with four ships to shore and alongside draft is 10 m. CCT is operated by Saif Powertec, a private terminal operator.

c) New Mooring Container Terminal (NMCT)

NMCT adjacent to CCT is under construction since long with a total quay length of 1,000 m. First three berths (1-3) have been operating since 2007; remaining berths 4 and 5 are scheduled to be in operation in 2015, if completed NMCT will have a capacity of 1.94 million TEU.

Table 23 Terminal Facilities at Chittagong Port

Terminal	Gantry crane	Operator	Max berth depth (m)	Quay length (m)	Yard System
New Mooring Container Terminal (NMTC)	0	CPA	8.5-9.5	1,000	
Chittagong Container Terminal (CCT)	4	Saif Powertec	8.5-9.6	450	RTG
General cargo	0	Different private operators	8.5-9.7	2,139	SC, RTG

Source: Traffic Department, Chittagong Port Authority

Container Handling

Presently the Chittagong Port has the following container handling facilities:

- Handling capacity: 32017 TEU
- Yards: 20 nos.
- CFS at GCB (5 nos): 45064 m^2
- Container storage yards at GCB: 240,271 m^2
- CFS at CCT: 13,671 m^2
- Container storage yard at CCT: 150,000 m^2

- Container storage yard at NMCT: 220,000 m^2
- Container storage yard at NCY: 62,532 m^2
- Railway container siding: 550 m^2
- Reefer points: 900 (415 volts)
- Standby generator: 8 MW (2X4)
- Water reservoir: 140,000 gallon
- Fire brigade: 1 unit

CPA has the following container handling equipment at its disposal (**Table 24**):

Table 24 Container Handling Equipment at CPA

Equipment	Capacity (ton)	Nos.
Quay gantry crane	40	4
Mobile harbour crane	84	2
Rubber tyre gantry crane	40	15
Straddle carrier (4 high)	40	36
Reach stacker	45	12
Forklift truck	25-42	6
Forklift truck	7-16	19
Reach stacker	7	6
Container mover	50	6
Terminal tractor	50	43
Trailer	50	55

Source: Traffic Department, Chittagong Port Authority

Inland Container Depot

Chittagong Port Authority has been operating an inland container depot by rail at Kamlapur, Dhaka since 1987 with an annual capacity of 90,000 TEUs. Kamlapur ICD has the following facilities:

- Holding capacity: 4,067 TEU
- Yard area: 136,954 sqm
- CFS: 8,182 sqm
- Equipment: RS 4 (45 ton), RS 3 (7 ton), low mast forklift 4 (3 ton), tractor trailer 8, low mast forklift 2 (5 ton),
- Railway wagon: 350
- Railway terminal (length of track) 1097 m.

Port Throughput

Volumes of cargo handled in recent years at Chittagong Port can be seen in **Table 25**.

Table 25 Cargo Handled at Chittagong (million ton)

Year	Import	Export	Total
2008-09	26.71	3.76	30.47
2009-10	32.81	4.19	37.00
2010-11	39.91	4.98	44.89
2011-12	**36.18**	4.72	40.90
2012-13	**38.31**	5.05	43.36

Source: Chittagong Port Authority (www.cpa.gov.bd)

Containers handled in the same period at Chittagong Port as well as in Dhaka ICD (Kamlapur) are presented in the following two tables (**Table 26** and **Table 27**).

Table 26 Container Handled at Chittagong (000 TEU)

Year	Import	Export	Total
2008-09	558	550	1,108
2009-10	613	600	1,213
2010-11	729	739	1,468
2011-12	676	667	1,343
2012-13	743	726	1,469

Source: Chittagong Port Authority (www.cpa.gov.bd)

Table 27 Container Handled at Dhaka ICD (000 TEU)

Year	Import	Export	Total
2008-09	36	37	73
2009-10	33	33	66
2010-11	32	33	65
2011-12	33	34	67
2012-13	31	**32**	63

Source: Chittagong Port Authority (www.cpa.gov.bd)

Port Connectivity

An efficient port must integrate itself with other transport infrastructure. Chittagong Port is comparatively better connected by other modes of transport than Mongla Port, but not good enough to be efficient.

Road

Road is the most used and popular mode or transport for distribution of cargo further inland. However, roads in Bangladesh are overcrowded, congested, narrow pass through many small townships and villages. Capacity of road is not suitable to accommodate tractor trailers. Even with all these problems, importers and exporters have to depend mainly on road to and from Chittagong. 70 percent of the imported containers are unstuffed at the Port premise then transported to Dhaka region by truck. As such containers do not penetrate further inland.

There is an ongoing project to develop a new dual carriageway road to and from Chittagong Port. Contractual disputes are delaying the implementation of this project. A port access road exists without travelling through the city but popular practice is to drive to off-dock ICDs through the city.

Railway

Bangladesh Railway (BR) has a line to Chittagong Port and tracks at the back of the Port where containers are loaded using straddle carrier. BR operates two services per day between Chittagong Port and Dhaka ICD at Kamlapur. Because of capacity constraint Dhaka ICD cannot meet more than 8 percent of total demand. ADB and JICA have been financing capacity enhance in the Dhaka-Chittagong railway corridor. This will increase the number of trains and wagons but capacity of ICD at Kamlapur will not be enhanced.

IWT

Dhaka-Chittagong IWT route is basically a natural waterway requiring little maintenance dredging annually at a few hot spots to maintain navigability for vessel at 3.6-3.9 m draft. Waterways include a stretch of coastal waterway and for this reason vessels of higher standard of design and construction are required. IWT vessels are mainly used for transporting bulk cargo from Chittagong Port to different destinations in Dhaka, Mongla-Khulna-Jessore in the south-western region, and Baghabari inland port in the northern region of the country.

Absence of container transport by river till date is one of the major weaknesses in the transport chain. 70 percent of the containers handled at Chittagong Port are destined for or originates from Dhaka and surrounding areas. 94 percent is transported by congested and ordinary bi-lane roads, while only 6 percent by rail. The roadway is not suitable for tractor trailers for which stuffing/unstuffing at port premise is inevitable. Only alternative remain is to transport the containers by river. This is not only cost-effective but also will remove congestion and reduce dwell time in the port. To this end, JICA conducted a Study and recommended to establish a riverside container terminal at Pangaon, Dhaka in the early 1990s. Two years ago, construction of a riverside container terminal was completed by BIWTA, funded by CPA. The terminal was officially opened in April, 2014 but yet to attract the users. This has many reasons but the most important is that private companies who were awarded licenses by the Ministry of Shipping to construct or own inland container vessels are still waiting for an ensured market. Subsequently, CPA procured three inland container vessels to take off container transport by river. Private participation in inland container terminal is very much encouraging. Construction of four more ICDs by river around Dhaka, all by private companies are underway.

Intermodal connectivity of Chittagong Port with major cargo originating places in Bangladesh is presented in the following table (**Table 28**).

Table 28 Connectivity of Chittagong Port

Origin-Destination	Rail	Road	IWT
Dhaka & Surrounding	Import: 20-30 days from vessel discharged to Dhaka ICD Export	12 hours from Dhaka factory /EPZ to Chittagong ICD	24 hours (travel 12 hours) from goods loaded at one port to goods offloaded at next, assuming no waiting time at discharge jetty.
Chittagong	NA	1-4 hours by covered truck to/from port and factories	NA
Jessore, Khulna & others	NA	20-24 hours from/ to factory and Chittagong Port	24 hours (travel 12 hours) from goods loaded at one port to goods offloaded at next, assuming no waiting time at discharge jetty

Source: Port & Logistics Efficiency Improvement, 2011 by Asian Development Bank

Critical Analysis of Port Efficiency

Traffic at Chittagong Port is growing rapidly, faster than the growth of Bangladesh GDP. Similar or faster growth rate is projected for foreseeable future. Chittagong Port has not responded as yet to this demand effectively, resulting in congestions and delays at the port, as well as high cost to port users. Delays and uncertainities in port services seriously undermine the productivity, economy, and the international trading links.

Some critical ares of port efficiency are given below:

Port Operators

CPA does not handle cargo directly by itself. For this purpose seven stevedoring companies have been engaged. The largest one is Saif Poweretec, handles all containers at CCT and NMCT berths. The other six operators are engaged at General Cargo berths and together handle half of total containers. As such limited competition exists. All these operators are local and work with CPA equipment and workers. The term of engagement ranges from 3 to 5 years. The standard practice including South Asia is to engage International Terminal Operator (ITO) for handling of containers. They will be engaged for a term of 20 years or more and will use their own equipment. These arrangements are in practice in 14 out of 16 major container terminals in South Asia.

Handling Speed and Dwell Time

The following table (**Table 29**) illustrates port efficiency in terms of handling speed and dwell time:

Table 29 Port Efficiency of CPA

Efficiency	CPA	South Asia	Leading practice
Handling speed: Boxes / crane hr	12-15	25	30-35
Dwell time (Days)	13-17	6-8	3-4

Source:KCT: Pre-Feasibility, 2014 bythe World Bank

Marine Service

Navigation is only possible during daylight in the hours before high tide, leaving limited few hours in a day to enter into and depart from the Port. Such arrangement causes poor utilisation of infrastructure, high berth occupancy and low berth working rate.

Turnaround Time and Idle Hours

Turnaround time of container vessels were recorded in 2008 and 2009 each year at 2.5 days which increased to 4.3 days in 2010. However, it was reduced to 3.2 days in 2011 and 2012. This could not be further decreased in the following years due to high idle hours. During the interview with Saif Powertec, private operato of CCT and NMCT, it was gathered that total idle hours at CCT was 62% while operational hours 38%. The high proportion of idle hours was due to

- Waiting for export containers from off dock container yards (ODCY) : 59%
- Yard congestion : 21%
- Other : 20%

Comments from World Bank

World Bank in its Report on KCT Pre-Feasibility Study under Bangladesh Trade and Transport Facilitation Programme (September 2014) commented the following:

Maritime Access: Navigational restrictions prevent large (deeper draft) vessels from trading to its ports thereby increasing freight and generalized costs.
Port Operations: Current services are inefficient, often lacking equipment and advanced operational practices related to container handling, container yard (CY) and gate management. Independent private sector concessions are not in place nor are recognized International Terminal Operators' (ITO) presence.
Inland Connectivity
Inefficient services and poor infrastructure across all modes result in very little container penetration inland and additional handling costs.
Customs and Clearance: Tend to be bureaucratic and lack transparency increasing cost and time.

SWOT Analysis

Strengths

- Well established terminals,
- Strong support from all market forces related to international trade,
- Comparatively better inland connectivity,
- Availability of financial resource for development.

Weaknesses

- Permissible draft of approach channel and at berth not suitable for larger size vessels,
- CY largely reliant on off-dock facilities,
- Turnaround time not conducive to be efficient,
- Surrounded by expanding city,
- Trade union practices not suitable for efficiency,
- Politics prevail

Opportunities

- Public investment for Dhaka-Chittagong transport corridor,
- Interest of the private sector participation,
- Presence of all shipping lines and agents.

Threats

- Capacity constraints to meet growing demand of international sea borne trade in future,
- Transport chain may shift to Mongla significantly with completion of the Padma bridge and
- Establishment of a deep sea port at Sonadia.

3.3.19 Mongla Port

Mongla Port was developed in the 1970s and is situated at Lat 21026.9^{0}N Long 890.34.4^{0}E on the left bank of River Pussur in Bagerhat District under Khulna Division. The Port is surrounded by the Sundarbans mangrove forest. The name Mongla is derived from River Mongla (popularly called by Mongla Nala), originated from the Pussur. Prior to the development of port facilities at the existing site cargo was generally unloaded from ships anchored in the river to lighters and delivered to Chalna. The present location of Mongla Port is given in the Google Map.

Facilities at Mongla Port

Main features of Mongla Port are:

- 940 m long quay, normal depth 8.50 m, divided into jetties 5 to 9.
- Construction of jetties 1 to 4 yet to be completed,
- Rail mounted quay cranes are beyond useful lives,
- Six sheds,
- Containers are mainly stacked on berth 9 and in adjacent port backyard,
- Unloading from ship is by ship's gear.

Total land area is about 950 ha with 90 percent at the water front. Main port facility is pile mounted concrete deck with length of 915 m almost in a straight line, providing berthing for five ships. In addition there are seven moorings, in-stream buoys and 14 anchorage areas. In the Port 26 ships can be accommodated simultaneously. It has four on dock transit sheds, each with about 20,000 m^2 and two warehouses of similar size. There exists one paved container yard of 3.6 ha which can store 2,200 TEUs including 120 reefer plugs (Asaf Ashar, A Study for Mongla Port's Strategic Development Options for the World Bank, April, 2010).

For handling of cargo in the river as well as alongside the jetties the Port provides the following facilities:

- Jetties 5
- Mooring buoys 5
- Anchor berths 8
- Private Jetty berths 5

Details of existing facilities are:

Berthing facilities: 2 ships at the jetty, 5 at mooring buoys and 7 ships at anchorage and at private jetties, total 14 ships at a time.

Channel condition: Draft ranges from 6.00 m to 8.50 m. There are 21 lighted buoys and one beacon, permissible length of vessel in the Pussur is 200 m.

Jetty/Warehouses/Yards: 5 jetties (length 182.92 m each), 4 transit sheds 4907 m^2 each and total capacity 18,000 tons), 2 warehouses (9815 m^2 each and total capacity 155,000 tons), 120 reefer plug points and three container yards (36,000 TEUs at one stack).

Electricity: 6 sub-stations and 5 power generating stations. Generators owned by MPA serve the reefer containers.

Vessels and Crafts: 3 tug boats, one fire-fighting tug, 2 pilot boats, 4 dispatch launches, 3 survey boats, 4 mooring boats, 1 buoy tender, 3 water crafts, 2 inspection launches, 1 oil storage vessel, 2 ferry boats, total 26 vessels and crafts.

Cargo handling equipment now available in Mongla Port is presented in **Table 30** below.

Table 30 Cargo Handling Equipment at Mongla Port

Equipment	Capacity	Operational	Non-Operational	Total
Mobile Crane	11-100 ton	2	5	7
Dockside Crane	5 ton	3	4	7
Heavy-duty Forklift Truck	16-35 ton	2	2	4
Forklift Truck	2-5 ton	4	13	17
Primover		0	2	2
Trailer 20'		5	3	8
Trailer 40'		2	0	2
Straddle Carrier		2	3	5
Terminal Tractor		6	2	8

Source: Traffic Department, MPA

Port Connectivity

a) Road

The distance between central market place of Dhaka/Narayanganj and Mongla Port is 170 km (by road), which is shorter than Dhaka-Chittagong road corridor. But in case of transporting cargo between Dhaka and Mongla this has become challenging due to river crossing ferry services in the Padma River at Mawa and Charjanajat. The ferry services are disrupted regularly due to deteriorating condition of navigability in the lean period and weather condition during wet season. Due to capacity limitation transport of passengers gets priority over transport of cargo resulting a very long travel time of cargo. However such problem does not exist in transporting cargo from Mongla to the south-western and northern places of Bangladesh. But Mongla Port is yet to attract the large market with respect to road connectivity. Now that a bridge over the Padma is going to be implemented soon, the revival of Mongla port may not be far away.

b) Rail

Presently, there is no rail connectivity between major cargo generating points in Bangladesh and Mongla Port. Existing rail connectivity in south-western and northern part of Bangladesh is up to Khulna. Recently GoB has undertaken the Khulna-Mongla Railway Project which is believed to provide smooth movement of cargo within the south-western and northern part of Bangladesh.

c) IWT

Inland waterways remain the principal modal option for transporting cargo between the central market in Dhaka/Narayanganj and Mongla. Improper overland transport connectivity enabled inland waterways to transport most of the volume. Distance between Dhaka and Mongla and between Dhaka and Chittagong are almost similar, 304 km and 307 km respectively. But for running between Dhaka and Mongla vessels do not need to cross the coastal waterway, which is the case with Dhaka and Chittagong. But, very recently inland waterways have come up with severe problems in the Mongla-Ghasiakhali Canal. Due to siltation this Canal was closed in 2011. A detour is used by vessels in the Sundarbans' Bogi-Joymoni Channel. This detour has increased the length by about 71 km. An oil tanker mishap and subsequent oil spillage in the mangrove forest in December 2014 led the Forest Department to impose restrictions on navigation through the forest to avoid further damage.

Condition of Fairways

For the purpose of navigation, fairways can be divided into three groups:

a) Outer bar: In the upper portion of the first 40 km of fairways in the Bay of Bengal there is an elevated area where the river drops sediment. Water depth at this point is 6.00 m. Ships with more draft have to wait for high tide. Ships with draft up to 7.50 m may go beyond this point in all seasons, but ships up to 8.50 m can move during monsoon only.

b) Hiron point to Mongla: Length of this stretch is 90 km; sailing is possible during second tide cycle which requires about six hours due to several shallow patches along the stretch.

c) Port basin: The upper segment includes the turning basin and jetties of the Port. This area is dredged to create a berthing pocket alongside the jetties. Another area about 5 km south of the Port is a naturally deep basin of about 8.50 m depth, used by clinker and other bulk for lightering to river barges.

The fairways can be seen in the Google Map.

Port Throughput

The Mongla Port has a handling capacity of 6.50 million tons of cargo per year and is heavily underutilized due to factors like:

I) Insufficient draft in the Pussur channel,
ii) Low frequency of ships calling at the Port,
iii) Improper connectivity with cargo generating places,
iv) Low industrialization in the south-western and northern regions of Bangladesh.

The Port handled less than one ship per week in 2012-13 FY and less than 1.5 ships in 2013-14 FY. The imported cargo, mainly bulk and break-bulk, accounted more than 95 percent of total volume handled at the Port. Major commodities imported are food grain, clinker, slag, fertilizer, gas, machineries and motor vehicles. Import traffic increased in recent years because of increase in import of food grain, fertilizer and general cargo and due to Government's mandate of importing some specific imports through Mongla Port only. Import traffic growth was higher in Mongla Port than in Chittagong.

Diversion of Ro-Ro vessels from Chittagong to Mongla Port in June, 2009 has helped Mongla to some extent to increase utilization of its jetties and Port storage area. There are now regular Ro-Ro vessels calling at this Port and additional land was developed to increase storage capacity.

To utilize the potential of Mongla Port the GoB is actively trying to activate the Port by promoting its use as gateway for land locked countries Bhutan and Nepal and as a transit port for passage of Indian goods. However, operational activity at the Port jetties has been declining for a long period of time. The Port was somehow active earlier with jute and jute goods. Since demand for jute in the world market diminished and jute industries in Bangladesh became sick, volume of cargo at Mongla Port registered a gradual declining trend since then.

Cargo handled at Mongla Port during 2000-2014 is given below (**Table 31**).

Table 31 Cargo Handled at Mongla Port (Ton)

Year	Import	Export	Total
2000-2001	2,462,420	304,041	2,766,461
2001-2002	1,947,384	305,496	2,252,880
2002-2003	1,450,248	350,268	1,800,516
2003-2004	1178544	315,687	1,494,231
2004-2005	1,254,374	221,798	1,476,172
2005-2006	1,215,072	267,572	1,482,644
2006-2007	662,263	252,112	914,375
2007-2008	518,309	204,525	722,834
2008-2009	929,714	208,112	1,137,826
2009-2010	1,502,050	147,233	1,649,283
2010-2011	2,529,853	166,418	2,696,271
2011-2012	2,482,432	137,465	2,619,897
2012-2013	2,946,222	201,352	3,147,574
2013-2014	3,402,402	141,547	3,543,949

Source: Mongla Port Authority (www.mpa.gov.bd)

Container handled at Mongla Port during the same period is presented in **Table 32**.

Table 32 Container Handled at Mongla Port

Year	Discharge	Shipment	Total container
2000-2001	9,539	9,389	18,928
2001-2002	10,490	10,437	20,927
2002-2003	11,730	12,007	23,737
2003-2004	13,678	13,470	27,148
2004-2005	12,993	12,656	25,649
2005-2006	12,733	12,838	25,571
2006-2007	12,553	12,789	25,342
2007-2008	10,588	10,297	20,885
2008-2009	10,437	10,764	21,201
2009-2010	10,280	10,371	20,651
2010-2011	13,699	13,424	27,123
2011-2012	15,460	14,585	30,045
2012-2013	21,994	21,879	43,873
2013-2014	21,947	21,060	43,007

Source: Mongla Port Authority (www.mpa.gov.bd)

Income and Expenditure of MPA

During the last decade Mongla Port Authority had to incur deficit every year. In recent years MPA registered revenue surplus in their books of account. But, this is not the result of port operation. Most revenue has been earned from land and other non-operational areas. Statement of Income and Expenditure of MPA during recent years is given in the following table (**Table 33**).

Table 33 Statement of Income and Expenditure of MPA (Lakh BDT)

SL	Year	Revenue Income	Revenue Expenditure	Profit/Loss
1	2009-2010	6,649.01	6,421.52	227.49
2	2010-2011	8,551.53	6,368.54	2,182.99
3	2011-2012	10,580.72	7,166.38	3,414.34
4	2012-2013	13,807.96	9,412.64	4,395.32
5	2013-2014 (Provisional)	14,529.34	9,719.84	4,809.50

Source: Mongla Port Authority (www.mpa.gov.bd)

SWOT Analysis

Strengths

- Captive hinterland in the south-western and northern parts of Bangladesh,
- Heavily underutilized port capacity, can accommodate more volume,
- The Government is very keen to activate the Port,
- Availability of land for development.

Weaknesses

- Drafts of approach channel and at berth restrict larger vessels to call at,
- Poor intermodal connectivity, no railway link,
- Insufficient handling equipment. Only geared container vessel can call,
- Share in the central market (Dhaka and surrounding) is too low and
- High dredging cost to maintain the navigability.

Opportunities

- Determination of GoB to construct the Padma bridge which will attract importers/exporters in central market (Dhaka and surrounding) to Mongla Port,
- Land available for development of port-oriented industries and
- Congestion, inefficiencies of Chittagong Port may bring about a port shift.

Threats

- Development plan and private participation in operations of Chittagong Port
- Plan to establish a deep sea port at Sonadia,
- Plan to establish a third maritime port at Payra, Patuakhali.

3.3.20 Payra Port

Existing two maritime ports of Chittagong and Mongla in Bangladesh are situated along the banks of the rivers. These have certain permissible drafts and length restriction of vessels to berths that constraint to meet growing demand of sea borne trade. Exploiting the 710 km of coast line of Bangladesh, development of a sea port that will have the capacity to serve vessels up to 14 m draft and LOA of 300 m was discussed in the Parliamentary Standing Committee on Ministry of Shipping. According to the decision taken at the 14th Meeting of the Committee, an expert committee was constituted with officials of CPA and BIWTA. The expert committee selected the site of Payra on the Rabnabad channel in Patuakhali District. The Committee envisaged the following benefits:

- Generation of opportunities of industrial development,
- Faster and easier export of agricultural goods,
- Easy fish processing; export will also enhance employment opportunity,
- Enhance economic network in the country and

- Enhance international trade facilities.

The Committee also recommended:

- Carry out detail bathymetric survey by BIWTA or Bangladesh Navy
- Conduct techno-economic feasibility and
- Planning for construction of shipyard to facilitate port activities

Following the recommendations of the pre-feasibility study, CPA entrusted the Institute of Water Modelling (IWM) to conduct a techno-economic feasibility to assess technicality of establishing a sea port on Rabnabad channel. In addition EIA had also been conducted. IWM carried out the study and submitted the Final Report in January 2014 titled *Techno-Economic Feasibility for the Development of Sea Port at Rabnabad Channel in the Patuakhali District.*

Main Features of IWM Report

a) Selection of site: Site selection was conducted on two candidate sites: Rabnabad channel and Baleswar River estuary, situated on the middle of the coast of Bay of Bengal. Those two sites were evaluated by the weighted scoring system prepared on the basis of current instances. Rabnabad scored 80.90 as against 70.95 by Baleswar. Finally Rabnabad was selected.

b) Structural intervention: The Report listed the requirement of following structural intervention for port development:

- Connectivity utilities and protective works,
- Fundamental infrastructure,
- Ancillary infrastructure
- Support service industries and allied facilities
- Project schedule: Implementation program of the schedule consists of drawing up programs and time schedule, purchase of land, actual construction and installation of equipment. Total time required for implementation is estimated 10 years.

The Report prepared a cost estimate involving USD 2,208.61 million.

Finally the Report recommended the following:

i) Sea port development at Rabnabad channel is technically feasible, environment friendly, socially acceptable and economically viable.
ii) Detailed feasibility study including offshore and near-shore wave climate, modelling and morphological analysis, detail design and costing shall be carried out before the implementation of the project.

Present Status

Payra Port is located on the west bank of the Rabnabad Channel, approximately 5 nautical miles upstream from harbour mouth. Considering the handling of future trade volume and export/import growth, the Govt decided to build a new sea port and an act was passed on national parliament on 5 November 2013. The Prime Minister inaugurated the 3^{rd} sea port of the country at Lalua Union, Kalapara Upazila of Patuakhali district on 19 November 2013. The Govt has already undertaken a project Detailed Techno-Economic Feasibility Study and a Conceptual Port Master Planning for the proposed port. Overall objective of the Project is to support sustainable economic growth and development in the country by increasing the efficiency of water-borne transports to and from Bangladesh's 3^{rd} Sea Port in an integrated and safe manner. Main objectives of the Consulting Services are to assist Payra Port Authority (PPA) and listed as follows:

- To specify and carry out survey in the approach channel (from Point A - $21^{0}23'$ $90^{0}09'$ Point B – $22^{0}01'$ 90 $^{0}24'$ and anchorage area (Bounded Area - $21^{0}30'$ $90^{0}08'$, $21^{0}30'$ $90^{0}25'$, $21^{0}10'$ $90^{0}30'$ and $21^{0}17.7'$ $90^{0}00'$).

- To specify and carry out survey for establishing training wall works on the safety of navigation, required dredging volumes, bank stability, etc as well as on erosion and siltation patterns along the banks and on the river bed, covering the Rabnabad Channel from its mouth to the Kajol River.
- To assess vessel types and sizes, required drafts, cargo types, number and types of berths required in the short, medium and long terms, land requirement for port operations, industry,
- Specific tasks under the studies will be as follows:
    - Prepare an inventory of Rabnabad Channel reach
    - Specify the survey for the approach channel and recommend training wall,
    - Collect and analyze historical data (river bathymetry, time series tide and discharge, satellite images, proposed jetties and other structures encroaching the river) and the various study reports on Rabnabad Channel,

  A conceptual Master Plan Study should contain the following content (minimum):

    - Inventory PPA requirements
    - Identify Project vessel types/sizes
    - Cargo analysis
    - Logistic study
    - Operational requirements
    - Port layout plan
    - Business case
    - Future developments
    - Inventory relevant regulations
    - Risk analysis
- Study the existing meteorological, hydrological, stream flow regimes and sediment discharge data of Rabnabad Channel from outer anchorage to Kajol River. In addition, study the marine conditions at the potential harbour site near Outer Anchorage. The study shall be based, among others, on analyses of river discharges, tides, waves at river mouth, wind surge records, subsurface water current and sedimentation transport characteristics. Where required, supplement the existing data by additional detailed field investigations.
    - Hydrographic (bathymetric and topographic) surveys,
    - Specify Geotechnical Surveys,
    - Hydraulic Modelling and Waterway Improvement
    - Planning, Layout Plans, Conceptual Designs and Cost Estimates
    - Assessment of Potential Market and Business Opportunities
    - Project Cost Estimates, Benefits and Economic Analysis
    - Social Impact Assessment
    - Environmental Impact Assessment

For any sea port, cargo handling and transportation to and from the hinterlands is an essential issue. But it is surprising to note that not a single study or report prepared till December 2014 mentioned the proposed or projected volume of cargo this sea port may handle.

3.3.21 Deep Sea Port at Sonadia

Present trend of international shipping is to have larger vessels to drive economies of scale. But the two maritime ports in Bangladesh have certain limitations to serve larger vessels despite the need and potential to have a large market of port services within the country and in neighbouring land locked region of India, China, Nepal and Bhutan due to its geographical advantage. To ensure proper services to import-export of the country and to attract the regional market with this port service, development of a port for deeper draft vessels was felt and recommended by experts. In the above context, GoB intended to have a techno-economic feasibility study for construction of a deep sea port (DSP) in the country by assessing the overall impact on the economy in general and the two existing ports in particular. Main objective of the study was to prepare a feasibility study for developing a DSP in Bangladesh on commercial basis, recommending the optimum location, facilities and details of infrastructure and services to be provided, through a detailed study/analysis on its technical, social, economic and financial viability.

Following the procedures GoB appointed the Pacific Consultants International (PCI), Japan, in association with Asian Engineering Consultants Corporation (Thailand), Dextrous Consultants, JPZ Consulting Ltd, Devconsultants LTD (Bangladesh) for the study. The PCI submitted its final Report in 2009.

The salient features of the study are as follows:

i) Location: The project site Sonadia was selected as the most preferable location for the development of deep sea port from 9 candidate sites. These candidate sites were Patenga, Kutubdia Point, Middle island, Kutubdia channel, Sonadia Island, Maheshkhali channel, Elephant point, St. Martin's island and Pussur River (Akram point). For comparative analysis Consultant reviewed 16 factors and Sonadia scored 84.29 out of 100 followed by Kutubdia channel (71.25) and Kutubdia point (66.88) .Finally, the study recommended that the port facilities would be developed on low lying land between Sonadia and Maheshkhali islands at around 100 km south of Chittagong.

ii) Rationale: The study forecasted that at the target year 2020 container traffic to and from Bangladesh would increase up to 2.78 million TEUs while general cargo except clinker and liquid bulk would increase to 11.09 million tons, which is not possible to be handled by the two existing ports. So, construction of a deep sea port is necessary.

The DSP container and general cargo volume as projected in the study are shown in the following three tables (**Table 34** to **Table 36**).

Table 34 Target Container Volume for Each Port (in 1,000TEU)

Port	2015	2020	2035	2055
DSP	0	1,780	7,142	17,572
Chittagong	1,833	1,500	2,000	2,000
Mongla	33	47	89	211

Source: Final Report: Techno-Economic Feasibility Study of a Deep Sea Port (Volume I, 2009)

Table 35 Target General Cargo Volume from Each Port (in 1,000ton)

Port	2015	2020	2035	2055
DSP	0	3,290	16,528	39,556
Chittagong	7,169	8,000	8,000	8,000
Mongla	361	709	1,134	1,424

Source: Final Report: Techno-Economic Feasibility Study of a Deep Sea Port (Volume I, 2009)

The study suggested that DSP should have water depth of -14m CD (Chart Datum) which will enable DSP to serve 80% of world container fleet. The dimensions of target vessels are as follows:

Table 36 Dimension of Target Vessels for DSP

Vessel type	Capacity (DWT)	Length (m)	Breadth (m)	Summer draft (m)
General cargo ship	50,000	212	31.5	12.5
Container ship	50,000	266	**32.3**	13

Source: Final Report: Techno-Economic Feasibility Study of a Deep Sea Port (Volume I, 2009)

iii) Project components: The study listed the following components for Sonadia DSP in **Table 37**.

Table 37 Project Components

Item	Quantity
Approach channel	3,700m
Harbour basin	1,700m
Navigation aids	3 units
Dredging volume	40.6 million cum
Port terminal land	272 ha
Back up land	700 ha
Revetment	12,000m
Customs fence & gates	5,900m
Fill material volume	40.6 million cum
North breakwater	2,250m
South breakwater	1,950m
Navigation aid	2 units
-14m Quay wall	3,400m
-5m Quay wall	1,700m
Container terminal	71.5 ha
General cargo terminal	46.8 ha
IWT and small crafts berth	28.0 ha
Other areas inside customs fence	20.7 ha
Drainage system	L.S.
Container terminal	35,000 sq m
General cargo terminal	32,400 SQ M
Quay gantry crane	20 units
RTG	48 units
Multipurpose shore crane	4 units
Jib crane	4 units
VTS	1 unit

Source: Techno-Economic Feasibility of a DSP 2009

iv) Project cost estimate: The project cost in the study was estimated to be USD 2,229 million of which direct construction cost was USD 1,649 million. The exchange rate was considered for 2008 rate for 1 USD = BDT 68.

v) Public Private Partnership: For PPP the study recommended following approach:

1. GoB will construct strategic port infrastructure, which then would be leased to the private sector on a PPP agreement with one or more private partners
2. The PPP must complete the remaining of the non-strategic infrastructure
3. Construction of terminals will be on BOT basis

Present Status

Government's commitment and determination were expressed on many occasions to develop the DSP but nothing progressed so far. The Govt is trying to attract foreign investors in this regard. In the meantime, China, Dubai and the Netherlands had expressed their interests but in the end, no understanding could be reached. Finally, the Govt has constituted a Committee with the Principal Secretary as Head to explore the foreign investment.

3.3.22 Trans-Boundary Inland Navigation

After the independence of the country, both the Governments of Bangladesh and India signed a Trade Agreement on 28 March, 1972. Article V of the Trade Agreement envisaged making mutually beneficial arrangements for the use of their road, rail and waterways for commerce between the two countries and for passage of goods between two places in one country through the territory of the other. Under this Article of the Trade Agreement a Protocol on Inland Water Transit and Trade (PIWTT) between Bangladesh and India was signed on 1 November, 1972 and came into force from the date of the signature. The first Protocol was in force for a period of five years. Since the signing, the Agreement is in force till date, but from 1986 each Protocol was signed for a term of two years not exceeding the term of the Trade Agreement. Due to some inevitable reasons the Protocol could not be signed or renewed at times. The term of the Protocol was extended for a period of three months or six months through exchange of letters between the countries.

Main Features of the Protocol are as follows:

- Carriage of cargo of bilateral trade and transit trade;
- Carriage of cargo between mainland India (Kolkata/Haldia) and the North-East of India (Pandu/Karimganj) through the territory of Bangladesh;
- Each country shall ensure smooth navigation in the route within respective jurisdiction and will extend necessary facilities required for navigation. Night navigation is allowed where such facilities exist;
- A total of eight routes are nominated in the Protocol. Main corridors are Kolkata-Narayanganj (cross-border trade); Kolkata-Karimganj (transit trade), Kolkata-Pandu (transit trade) and Karimganj-Pandu (transit trade)
- A total of 10 Ports of Call, five on each side, are agreed for loading/unloading of cargo of bilateral trade; the Indian ports are: Kolkata, Haldia, Pandu, Silghat and Karimganj and the Bangladeshi ports are: Narayanganj, Mongla, Khulna, Sirajganj and Ashuganj;
- The stretches between Sirajganj and Daikhawa (upstream of Chilmari near Bangladesh-India border) and between Sherpur and Zakiganj in Bangladesh have been mutually identified as the Routes primarily maintained for Indian transit traffic and the Government of India shall pay an agreed amount of money (now 10 crore BDT annually) towards the cost of maintenance;
- Trans-shipment between vessels and trucks is allowed at Sherpur and Ashuganj;
- There is one Standing Committee at Joint Secretary level to review the operation of the Protocol and recommend for the development; the committee will meet at least once in every six months.

The routes under the Protocol and the Ports call may be seen in the at the back of the report.

3.3.23 Traffic Statistics under the Protocol

The following table will present total tonnage of cargo transported by vessels from 2001-2002 to 2013-2014 and share of Bangladesh and India vessels (**Table 38**).

Table 38 Statistics of Movements of Vessels & Cargo under PIWTT

Year	**Quantity of goods (M ton)**		**Total (M ton)**	**Number of trips by Bangladeshi vessels**	**Number of trips by Indian vessels**	**Total trips under protocol**	**Ratio of goods carried by Bangladesh & India Vessels**
	Carried By Bangladeshi vessels	**Carried By Indian vessels**					
1	2	3	2+3=4	5	6	(5+6)=7	
2001-2002	47,858	58,170	106,028	170	258	428	45:55
2002-2003	122,335	87,100	209,435	458	390	848	58:42
2003-2004	121,926	61,627	183,553	372	120	492	66:34
2004-2005	376,839	36,993	413,832	1,142	90	1,232	91:09
2005-	538,020	--	538,020	1,492	00	1,492	100:00

Year	Quantity of goods (M ton)		Total (M ton)	Number of trips by Bangladeshi vessels	Number of trips by Indian vessels	Total trips under protocol	Ratio of goods carried by Bangladesh & India Vessels
	Carried By Bangladeshi vessels	Carried By Indian vessels					
2006							
2006-2007	881,011	--	881,011	1,540	00	1,540	100:00
2007-2008	994,345	1900	996,245	1,976	02	1,978	99:01
2008-2009	930,094	14,328	944,422	1,329	11	1,340	98:02
2009-2010	127,7436	4,474	1,281,910	1,918	16	1,934	99:01
2010-2011	42,4767	12,697	1,437,464	2,063	21	2,084	99:01
2011-2012	142,9444	55,558	1,485,002	2,033	36	2,069	96:04
2012-2013	1,507,357	46,661	1,554,018	1,977	32	2,009	97.03
2013-2014	1,912,622	21,327	1,933,949	2,332	31	2,363	99 :01

Source: Ports & Traffic Department, BIWTA

The statistics show a tremendous growth of tonnage of bilateral trade transported under the provisions of the Protocol along with the movement of vessels of both countries. From the very beginning of the operation of this Protocol, participation of Bangladesh vessels were few and were completely nil in most of the years up to 2000. From 1972 vessel movement was limited to only public sector companies, i.e. Bangladesh Inland Water Transport Corporation (BIWTC) and Central India Water Transport Corporation (CIWTC). Private sector in Bangladesh was not interested to take port in the Protocol Operation. While in India particularly in the region of West Bengal and Assam private sector participation in the IWT sub-sector is yet to be emerged. Bangladesh private sector came forward in the carriage of goods under Protocol from 2000 and gradually Bangladesh vessels were able to outnumber the India vessels.

Cargo of Inter-Country Trade:

The following table (**Table 39**) shows total tonnage of cargo of bilateral trade transported through inland waterways under provisions of PIWTT.

Table 39 Cargo of Bilateral Trade (in ton)

Year	Indian Vessel	Bangladesh Vessel	Total
2006-2007	-	881,011	881,011
2007-2008	1,900	994,345	996,245
2008-2009	-	930,094	930,094
2009-2010	-	1,277,436	1,277,436
2010-2011	12,697	1,424,176	1,4,36,873
2011-2012	55,558	1,429,443	1,485,001
2012-2013	39,256	1,507,357	1,546,613
2013-2014	18,953	1,912,622	1,931,575

Source: Ports & Traffic Department, BIWTA

It is apparent that growth of inter-country trade cargo is very attractive. Total tonnage was more than 19 lakh tons in 2013-2014 as against about 9 lakh in 2006-2007. But this is, in fact, not very healthy with respect to sustainable trade. Only one commodity, namely fly ash required by the cement factories in Bangladesh shares more than 90 percent of total cargo. Other commodities are coal, gypsum, slag, steel coil, M.S. wire, iron ore, food grains etc. On the other hand cargo flow is from India to Bangladesh only; less than 4,000 tons of cargos were exported from Bangladesh to India between 2006-2007 and 2013-2014.

Cargo of Transit Trade:

There are five transit routes under the Protocol: i) Kolkata- Pandu, ii) Pandu- Kolkata, iii) Kolkata- Karimganj, iv) Karimganj- Kolkata and v) Karimganj- Pandu. The following table (**Table 40**) presents volume of cargo of transit trade transported mainly between Kolkata and Karimganj and between Kolkata and Pandu during recent years:

Table 40 Volume of Transit Trade

Year	Volume (in tons)
2006-2007	12,557
2007-2008	8,230
2008-2009	14,628
2009-2010	4,474
2010-2011	590
2011-2012	2,695
2012-2013	18,685
2013-2014	2,373

Source: Ports & Traffic Department, BIWTA

Table 40 shows inconsistency in the transit trade: compared to the period of 1972 up to the middle of 1980s, volume of transit trade registered a sharp decline. The main reasons are:

i) Development of overland transport infrastructure in the state of Assam. Transporting cargo between the upper Assam (Pandu) and mainland India (Kolkata or elsewhere) by surface transport is more economic by time and/or cost instead of waterways between Kolkata and Pandu through Bangladesh.

ii) The lower Assam (Karimganj) and the neighbouring north-eastern states of Tripura, Meghalaya and Mizoram are still not easily accessible by road or by rail; so transport connectivity by waterways through Bangladesh is attractive in terms of time and cost. But the Protocol route between Ashuganj and Zakiganj in Bangladesh (the stretch between Kolkata and Karimganj) remains navigable only between June and October; vessels cannot ply during the rest period.

3.3.24 Current State of Navigation

Turnaround Time:

Table 41 shows the high turnaround time of a vessel operating in the main commercial routes of Bangladesh-India transboundary inland navigation:

Table 41 Average Turnaround Time

Sl. No.	Route		
1.	Narayanganj-Kolkata	Inter-country trade	40 days
2.	Kolkata-Karimganj	Transit trade	45 days
3.	Kolkata-Khulna	Inter-country trade	25 days
4.	Kolkata-Pandu	Transit trade	50 days

Source: Private Protocol Operator during interview

Causes for such high time for turnaround are:

a) Poor navigational quality in some river reaches,

b) High time for loading and unloading due to lack of appropriate handling facilities,

c) Absence of night navigation facilities,

d) Present procedures of customs and immigration,

e) Efficiency of the vessel and crew.

In course of discussion with the private operators under the Protocol revealed that from total turnaround time one-third is required for actual navigation and the remaining for loading-unloading and customs and immigration formalities.

Current State of the Protocol Routes:

The current state of the Routes under Protocol in Bangladesh is given in **Annex A.**

Bangladesh waterways' problems also prevail in inland waterways in Indian Territory. From River Notices issued by BIWTA, it is evident that a vessel with 3.5m draught may navigate between Raimangal (entry/exit point at the border) and Narayanganj/ Ashuganj loaded with 1,500 tons of cargo. But due to navigational problems at some spots in the Protocol route in India especially downstream of Namkhana, vessels cannot load more than 1,000 tons. On the other hand vessels destined for Dhubri/Pandu cannot load more than 500-600 tons due to navigational conditions in the route between Mohanpur/Ganga-Meghna confluence) and Saheberagla (entry/exit point at the border). The route between Ashuganj/Bhairab Bazar and Zakirganj (entry/exit point at border).can be used only during monsoon (July to October).

3.3.25 Cross Border Trade and Trans-boundary Inland Navigation

India is the second largest exporter to Bangladesh, next to China. Cross border trade between the countries is very much dominant in EXIM trade. Road and IWT are the principal modes while railway shares a few. It is evident that IWT trade between the two countries depends only on one category of cargo, which is fly ash. Wide varieties of cargo are transported through land ports located in the border. The following table (**Table 42**) shows total volume of cargo of EXIM trade transported through land ports in the recent years.

Table 42 Export Import through all Land Ports (In MT)

Year	Export	Import	Total
2004-05	-	1,277,986	1,277,986
2005-06	-	867,862	867,862
2006-07	-	1,092,895	1,092,895
2007-08	698,611	3,155,951	3,854,562
2008-09	914,639	2,511,422	3,426,061
2009-10	948,403	2,834,003	3,782,406
2010-11	1,144,279	3,539,251	4,683,530
2011-12	1,189,248	4,631,402	5,820,650
2012-13	1,162,684	4,990,896	6,153,580
2013-14	731,433	6,866,286	7,597,719

Source: Bangladesh Land Port Authority

Of all land ports, Benapole and Sona Masjid share more than 70 percent of total cargo. The following table (**Table 43**) represents the cargo volume at Benapole during recent years:

Table 43 Import of Goods (Category wise) by Benapole

SL	Description	QTY (MT)		
		2011-2012	**2012-2013**	**2013-2014**
1	Cotton, not carded or combed	114,246.69	142,839.50	135,194.62
2	Wheat	179,881.63		
3	Ferrous products obtained by direct reduction of iron ore, in lumps	71,080.95	61,742.38	51,246.08
4	Semi-milled or wholly milled rice	63,825.22	11,721.12	139,869.50
5	Cane or beet sugar, in solid form, Nes including chemically kue sucrose	52,087.04	9,430.85	
6	Sodium polyhydroxy, Aluminium mono carbonate complex	48,797.08	14,771.30	22,292.37
7	Semi-products of iron/steel, <0.25% carbon, of squarish section	48,754.19	34,215.66	43,612.55
8	Onions, fresh or chilled, nes	22,878.35	47,730.34	25,092.10
9	Denim, with >=85% Cotton, >=200g/M2	21,656.43	25,731.02	22,637.32
10	Goods vehicles, with diesel or semi-diesel engines	21,441.45	17,023.06	46,160.06
11	Oil-cake and other solid residues, of other vegetable fats and oils	19,495.12	7,613.68	6,057.82
12	Anionic surface-active agents, (excl. soap)	19,258.99	23,683.11	21,907.91
13	Oil-cake and other solid residues, of soya-bean oil	17,867.49	23,754.81	3,497.16
14	Other paper & paperboard, multi-ply paper & paperboard	15,634.08	11,075.63	14,427.96
15	Combed single cotton yarn, with >=85% cotton, Nprs,>=714.29 Decitex <=14mn	14,780.03	15,148.09	10,127.78
16	Railway sleepers	11,743.35	13,083.04	21,003.44
17	Fish, fresh or chilled	11,541.12		
18	Imported by vat registered iron/steel product & transformer manufacturer industry	11,025.80	9,433.16	14,989.12
19	Tractors (excl. Tractors of 87.09), nes	10,522.49	4,289.11	4,545.65
20	Others	423,690.21	598,751.03	581,656.42
Total		**1,200,137.68**	**1,072,036.88**	**1,164,317.87**

Source: National Board of Revenue

Table 44 reveals the volume of cargo handled at Sona Masjid during recent years.

Table 44 Statistics of Import: Sona Masjid L.C. Station

	Category of Goods	2011-12 (M tons)	2012-13 (M tons)	2013-14 (M tons)
1	Stone Chips and Boulders	295,448.00	354,484.00	515,252.00
2	Maize	275,878.15	126,409.86	283,368.87
3	Soybean Extraction	240,753.19	205,287.17	111,376.69
4	Onion	222,311.90	244,210.01	186,538.94
5	Dry Fly Ash	212,385.70	274,094.50	233,922.10
6	Wheat	126,590.36	267,124.34	153,778.47
7	Rape Seed Extraction	56,962.93	115,768.82	89,317.70
8	Grapes	21 050.43	13,728.26	
9	Orange	12,915.72	131 02.48	
10	Apple	10,227.00	16,391.53	
11	China Clay	11,931.00	13,589.00	14,372.00
12	Non-Basmati Rice	9,430.00	8,756.24	41,697.30
13	Rice Bran	8,231.00	6,432.12	22,069.11
14	Others	52,391.63	45,979.60	133,666.00
Total		**1,535,456.58**	**1,692,255.45**	**1,785,359.18**

Source: L.C. Station, Sona Masjid

Modal Option and Possibility of Model Shift

Apparently, IWT is attractive in terms of cost, but the market forces are not interested in this mode of transport (IWT). This issue was discussed in a meeting with the operators/owners of the vessels, who mentioned the following problems:

Problems for Modal Shift

i. Vessels sailing from Indian Port of Call loaded with goods of inter-country trade have to encounter customs at four places: a) Indian Port of Call, b) exit point in India (Hemnagar), c) entry point in BD (Sheikhbaria) and finally d) BD Port of Call.
ii. Land Ports are located in the border area? After customs clearance at L.C. Station, goods are free to travel to any destination. While under PIWTT vessels must arrive at nominated Port of Call, even if the final destination of goods is elsewhere.
iii. No night navigation facilities exist throughout the route between Ports of Call. Most Bangladeshi vessels do not have night plying certificate from the appropriate authority.
iv. High waiting time of loading-unloading due to lack of infrastructure and inappropriate handling facilities
v. Absence of regular container service between Indian Ports of Call and Pangaon Inland Container Terminal, Dhaka.
vi. No navigational arrangement between Dhulian in India and Rajshahi in Bangladesh
vii. Small size of consignment
viii. Poor knowledge and lack of confidence of market forces regulating IWT

Suggested Measures

i. Hemnagar in India and Sheikhbaria in BD are now customs check posts. These should be upgraded as L.C. Stations. Once customs assessment and clearance are done, the vessel should be allowed to proceed towards any destination along the Protocol routes for unloading. This will help to create a level playing field for both IWT and road transport. This has the reference of Article 21 of the PIWTT.
ii. Installation of night navigation facilities along the Protocol routes should be made a mandatory provision under the Protocol. According to provision now in force night navigation is allowed where such facilities already exist (Article 2.1).
iii. All vessels must have night plying certificate for obtaining voyage permission from the Competent Authorities
iv. Appropriate infrastructure and handling facilities must be developed.
v. Regular container service should immediately be commenced from Indian Ports of Call to Pangaon Inland Container Terminal, Dhaka. Either Pangaon should be nominated as additional Port of Call or be recognized as an 'extended place' of the Narayanganj Port of Call under Article 18 of the Protocol.
vi. Both countries should undertake joint initiative for operation of the Protocol Routes 5 & 6 (Dhulian-Rajshahi and vice versa). Extension of this route from Rajshahi to Aricha (211 km) will not only increase the volume of goods under inter-country trade, but also transit cargo will be increased.
vii. Under the BD customs order, import of certain goods like cotton from India through all Call Stations except Benapole is prohibited. This must be waived in case of Narayanganj, the main consumption centre of cotton. IWT will be attractive for these goods.
viii. Small size of consignment remains the main problem for modal shift and use of waterways. Modal option is made on segmented transport demand. Joint initiatives are required to accumulate substantial number of consignment to ensure the use of waterways. In such case service providers must take responsibility of transporting goods and consignee receives the goods at the Port of Call. This will reduce transport cost to a considerable extent and will be competitive in respect of transportation time as well.

ix. IWT requires a strong promotional exposure to concerned market forces. Both IWAI and BIWTA should be proactive to motivate and attract market forces and stakeholders for utilization of rivers for the purpose of commerce. Workshops, Dialogues, Seminars may be arranged to this end.

Possibility of Modal Shift: Goods and L. C. Station wise

Benapole: Cotton, wheat, iron ore, rice, oil cake, gypsum and similar goods which are now being imported through this L. C. Station have got significant potentials of modal shift to IWT with respect to cost. From Kolkata up to Dhaka/Narayanganj area, transport cost of these goods is $18 per ton by road, while it will be $15 by river including cost of trans-shipments. Average transportation time is 8 days by road in normal traffic as against 9 days by river. Simplification of customs requirements and uninterrupted navigation may reduce the time further to 5-6 days.

Problem of small consignment may be removed if Protocol operators and shipping agents of both countries come forward with the idea of consolidation and accumulation of consignments by opening up joint venture companies. Consignees will be attracted as the responsibility of transport to the Port of Call will go to such companies. Consignees will be assured of certain cost and time. Commencement of container service will further add impetus in IWT trade.

Sona Masjid: Goods which are now being handled at this station will continue to be transported by road. Because almost all goods except a few are mainly destined for the northern region. But stone chips and boulders, fly ash, poultry feed are mainly destined for the central region. Operationalizing of Dhulian - Rajshahi Protocol Route will enable modal shift in favour of IWT in case of those categories. Time and cost will be reduced to a greater extent. It may be mentioned that with the commencement of works for the Padma Bridge soon, demand of boulders and chips will increase by almost ten times.

3.3.26 Container Traffic in Inland Waterways

Container traffic to and from Bangladesh is growing very fast, @12 percent per annum. In 2012-2013 total containers handled at maritime ports of Chittagong and Mongla were 1,512,586 with 97 percent share of the Chittagong Port. 70 percent of containers handled at maritime ports are destined for or originating from Dhaka/Narayanganj area being the main consumption and distribution centre. Due to lack of appropriate intermodal distribution system of containers, further traffic growth is restricted. In absence of a dedicated railway line for freight and container movement between Dhaka and Chittagong, container movement by rail is to share with preferential passenger movement. The existing road does not have the bearing capacity to carry containers; presently 90 percent of the containers are stripped/ staffed in the ports of Chittagong and Mongla and transported as conventional general cargo. Only 10 percent of containers are loaded on rail and transferred to Kamlapur Inland Container Depot in Dhaka, managed and operated by Chittagong Port Authority.

In view of the above a couple of studies recommended to utilize inland waterways for container traffic. In 1991 a JICA Study recommended the site of Pangaon, Dhaka on the bank of the Buriganga River to develop an Inland container terminal. The navigation channel is straight at this point with a width of 250m and provides a Class-I waterway that ensures LAD of 3.6 m perennially. Accordingly, an Inland container terminal had already been developed at that site and began experimental operation in 2013 with the following facilities:

i)	RCC jetty (upstream)	: 1,411 m^2
ii)	RCC jetty (downstream)	: 1,411 m^2
iii)	CFS	: 280 m^2
iv)	Paved area (marshalling yard)	: 60,000 m^2
v)	Bank protection work	: 60,250
vi)	Administration Office Building	: 1 no
vii)	Workshop	: 1 no

This ICT has the handing capacity of 116,000 TEUs with further scope of handling 160,000 TEUs per year. For introducing container service between Chittagong and Pangaon, Chittagong Port Authority hurriedly procured three reconditioned inland container vessels and put them into operation. But such experimental effort of the public port authority could not be successful, as such infrastructure developed at Pangaon are still unitized. Officials of CPA, BIWTA and market forces considered the following main causes of the failure of Pangaon:

1. Insufficient vessels to ensure regular container service. Three ships procured by CPA are not operational any longer.
2. Long waiting time between sailings.
3. High waiting time of trans-shipment/transfer of containers from feeder vessel to inland vessel.
4. Only one handling crane available at Pangaon; procurement of an additional container is underway which will take 18 months.
5. Tariffs are high as against the present structure of costs of transporting cargo between Dhaka and Chittagong.
6. Shipping companies are still following a 'wait and see' policy.
7. No port promotion strategy on the part of public port authority.

Report of the World Bank on "Revival of Inland Water Transport: Options and Strategies" published in 2007 identified container traffic and container handling trade as one of the attractive areas of private sector participation. The Report indicated that the tariff to transport a 20-foot container between Dhaka and Chittagong is around Tk. 600 per ton by IWT, compared to Tk. 1200 for rail and Tk. 6000 for road.

The private sector has come forward in a big way to invest in container movement by waterways. GoB has formulated one procedure for according approvals for construction of riverside container terminals. In the meantime five companies were allowed to construct such inland container terminals near Dhaka-Narayanganj region. Status of construction of such ICTs may be seen in **Table 45**.

Table 45 Status of construction of private sector ICTs (As of January 2015)

Sl.	Company	Location	Planned capacity (TEU)	Land area (acre)	Physical progress	Expected time of operation
1.	SAPL	Mirkadim, Munshiganj	Phase 1: 60,000 Phase 2:: 60,000	Phase 1: 15.15 Finally: 20	75%	2015
2.	Rupayan Group	Bandar, N'ganj	375,000	30	40%	2016
3.	Ananda Group	Sonargaon, N'ganj	–	–	–	–
4.	A.K.Khan Group	Palash, Narsingdi	Phase 1: 140,000 Phase 2: 70,000 Finally:330,000	Phase 1: 30 Finally: 50	35%	2016
5.	Kumudini Trust	Khanpur, N'ganj	–	–	–	–

Source: Planning Department, BIWTA

The Ananda Group has obtained approval from the Government but the company is yet to finalize its project. While the Kumudini Trust is very much keen to engage the CONCOR, A Govt. of India enterprise of container company as the terminal operator. To this end, a feasibility study had already been completed and decision of the Govt. of India is in the offing. The Kumudini Trust will act as the landlord while CONCOR will be responsible for the operations of terminal.

In addition to the above private sector initiatives, the Governments of Bangladesh and India have mutually agreed to develop a multipurpose port at Ashuganj, Brahmanbaria for handling of containers and break bulk cargo. The port will mainly handle container and cargo transported between Kolkata and Agartala in India through the territory of Bangladesh. Development of this port will be financed by Indian credit line as agreed by both Governments. A feasibility study to this end has been completed in 2014 and both Governments are now considering the investment project. According to the study, development of this port will involve a total amount of BDT 4.41 billion BDT (land cost BDT 2.00 billion to be borne by Bangladesh and BDT 2.41 billion construction cost by India).

Besides, the GoB has decided to develop an inland container terminal at Khanpur, Narayanganj on a Build-Operate-Transfer (BOT) basis. Feasibility Study for this PPP project is currently underway.

3.4 Organizational Structure

3.4.1 Institutions

Public institutions responsible for development, maintenance, management and operation of inland navigation and inland and maritime ports in Bangladesh are shown in the following figure (**Figure 1**)

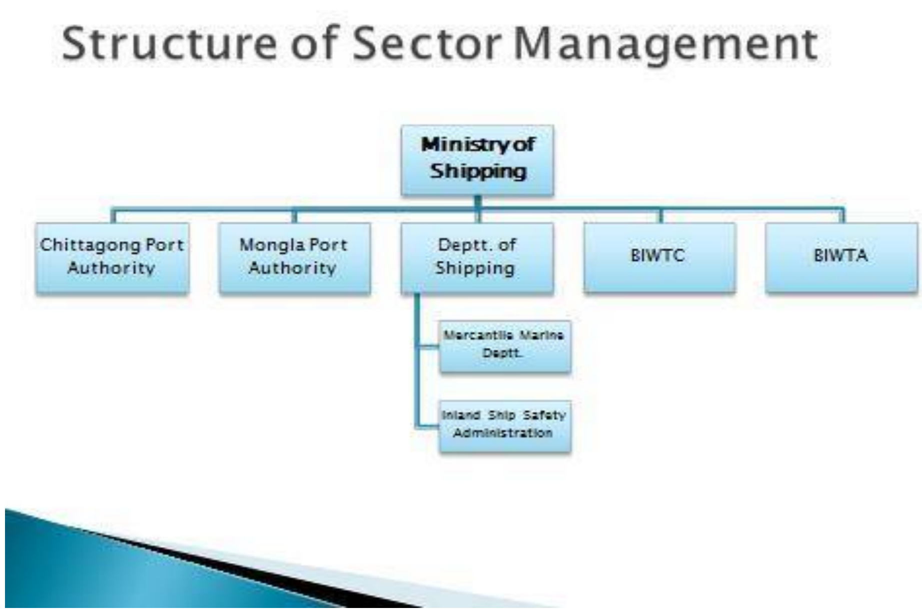


Figure 1 Structure of Sector Management

Under the Ministry of Shipping, the Department of Shipping is a Government Department, while the others are semi Government autonomous organizations and were set up according to respective laws.

I) *Department of Shipping*: This department (DOS) was set up under the Merchant Shipping Ordinance, 1983. But under the Inland Shipping Ordinance 1976, the Government delegated the powers and functions of inland ship safety, ship registration and survey to the DOS. Inland Ship Safety Administration (ISSA) under DOS is responsible for enforcement of ship safety and registration and survey of inland ships.

II) *Bangladesh Inland Water Transport Authority*: BIWTA is responsible for development, maintenance and control of inland water transport and navigable waterways. Main functions of BIWTA include; (a) development and maintenance of navigability by dredging and river training, (b) hydrographic survey, (c) provision for aids to navigation and pilotage, (d) development, maintenance and operation of inland ports and landing stations, (e) approval of time tables and fare charts for passenger launches, (f) operation of the IWT Protocol between Bangladesh and India and (g) research and training.

III) *Bangladesh Inland Water Transport Corporation*: BIWTC is a state owned corporation providing passenger and freight shipping services. Over the years with the growth of private sector in inland shipping, main activities of BIWTC are concentrated in providing ferry services in major river crossings and passenger services in southern region and the coastal area.

IV) *Chittagong Port Authority*: CPA is responsible for improvement, management and operation of the main maritime port of Bangladesh: Chittagong Port.

V) *Mongla Port Authority*: MPA is responsible for development, management and operation of the second maritime port in Mongla.

VI) *Payra Port Authority*: Payra Port will be the third maritime port located at Rabnabad channel in the southern Patuakhali district as decided by the Government. The PPA was set up in late 2013. A detailed feasibility study is now underway for development of port infrastructure.

Besides public institutions, the following trade bodies in private sector are also involved in IWT sub-sector:

- Bangladesh Inland Water Passenger Carriers' Association (BIWPCA)
- Bangladesh Launch Owners' Association (BLOA)
- Bangladesh Cargo Vessels Owners' Association (BCVOA)
- Bangladesh Coastal Ship Owners' Association
- Bangladesh Oil Tankers Owners' Association
- Bangladesh Bulk-Head and Engine Boat Owners' Association
- Dredger Owners' Association of Bangladesh

3.4.2 Management of IWT Sub-Sector

DOS is responsible for ship safety, ship registration and survey while BIWTA exercise control of movement of inland ships in waterways and also of loading-unloading of passengers and goods at inland ports and landing stations. DOS employees have the legal power to vessels committing offence against the law. A total of 62 DOS staff are engaged in inland shipping, as such they could hardly be seen in the port. On the other hand, BIWTA personnel remain present at ports and landing stations but they do not have the judiciary power to take actions against vessels violating law and orders.

DOS has got only four surveyors to exercise control of ship construction and periodical survey of inland vessels. Survey certificates issued in favour of as many as 10,000 inland vessels by four surveyors invite the issue of transparency in this matter. BIWTA undertake training programs for crew but certificate of competency to crew is awarded by DOS.

Though, IWT is comparatively safer than road transport in terms of fatal statistics and in terms of traffic output, it was evident from reports of various investigation committees that about 85 percent ship accidents occurred due to human error or negligence. DOS could not take any actions to those persons who are responsible.

Financial Mechanism of BIWTA

Income and expenditure statement received from BIWTA provides most objective representation of BIWTA's financial position. In FY 2013-2014 BIWTA expenditures exceeded revenue with more than 31 crore Taka. The financial situation was better in previous two FYs.

The following three (**Table 46, Table 47, Table 48**) provide an overview of BIWTA revenue, government grant and expenditures respectively for the period 2010-2014:

Table 46 BIWTA Revenues 2010-2014 (in lakh Tk)

	2010-11	2011-12	2012-13	2013-14
Govt. Grant	13,975.32	13,882.05	16,122.00	17,839.20
Port Revenue	5,644.85	8,365.00	8,926.03	8,187.30
Conservancy & Pilotage	1,036.76	994.44	1,111.08	1,220.15
Canal Revenue	296.14	240.10	232.28	233.56
Dredging Rev	570.75	1,325.17	471.51	960.00
Other (Misc)	1,277.18	3,377.13	5,620.12	1,970.31
Grand total	22,801.00	28,183.89	32,483.02	30,410.51

Source: Finance Department, BIWTA

Table 47 Percentage of Govt. Grant and Self Earning

Year	Govt. Grant	Self-Earning
2010-11	61.29	38.71
2011-12	49.26	50.74
2012-13	49.63	50.74
2013-14	58.67	41.33

Source: Calculation by consultant on BIWTA data

Table 48 BIWTA Expenditures 2010-2014 (in lakh Tk)

Head	2010-11	2011-12	2012-13	2013-14
Salary	6,672.12	6851.15	7,708.46	8,495.01
CPF/Pension Gratuity	1,614.74	1,369.01	1,392.52	1,500.00
Repair & Maintenance	5,799.69	6,211.73	8,280.23	9,443.08
Depreciation	3,346.85	3,643.96	4,176.85	3,964.00
Training	5.00	14.57	30.00	11.49
Fuel	1,782.93	2,692.78	2,773.60	3,347.69
DSL	1,944.15	1,944.15	1,944.15	1,944.15
Misc.	1,792.97	1,803.49	2,127.09	2,935.20
Total	**22,958.45**	**24,530.84**	**28,432.90**	**31,640.62**
Surplus/ (Deficit)	(157.54)	1,787.07	1,969.39	(3,134.73)

Source: Finance Department, BIWTA

Besides Revenue Budget, allocations of ADP in the Development Budget during 2009-14 and its utilization is shown in the following table (**Table 49**).

Table 49 BIWTA: ADP Allocation and Utilization (In lakh Tk)

Year	Allocation	Utilization
2008-09	4,607	4,584
2009-10	7,995	6,904
2010-11	23,202	23,101
2011-12	16,421	16,452
2012-13	40,486	38,643
2013-14	40,518	38,551

Source: Finance Department, BIWTA

SWOT Analysis

Strengths

1. Natural advantage of reaching remote parts of the country
2. Natural linkage of waterways with India
3. Geo-strategic advantage of exporting transport services for transmitting goods between mainland and landlocked north-east India through waterways of Bangladesh
4. Dominating private sector participation in all types of investment and operations
5. Choice of poor people in respect of cost
6. Comparatively attractive in bulk and container transport

Weaknesses

1. Deteriorating conditions of rivers and natural morphological processes
2. Inefficiency and corruption due to absence of effective governance mechanism
3. Low productivity due to manual labour based operations
4. Lack of confidence of market forces
5. Under-investment by Government compared to road and rail
6. Poor management capacity
7. Lack of intermodal connectivity and coordination
8. Overloading due to unhealthy competition and regulated pricing policy
9. Knowledge gaps
10. Absence of mutual trust and respect for public-private partnership
11. Lack of recognition to importance of country boats
12. Less participation of development partners

Opportunities

1. Current Government policies and strategies
2. Commitment of Government to combat deteriorating conditions of rivers
3. Environmental advantage in respect of carbon emission
4. Private sector participation in dredging
5. Increased transportation of bilateral traffic and transit traffic
6. Increased bilateral cooperation in respect of inland navigation
7. Development of container traffic between maritime ports and Dhaka-Narayanganj area by rivers
8. Increased private sector investment

Threats

1. Development of road network in opposition to IWT
2. Poor water management at national and regional levels
3. Construction of bridges and culverts with no compliance
4. Construction of the Padma Bridge
5. Replacement of riverside consolidation centres of cargo by Growth Center Markets (GCM) developed by LGED
6. Increasing marine accidents

3.5 Government Policies and Strategies

3.5.1 National Policy for Ports, Maritime Shipping and Inland Water Transport, 2000

This policy envisages Government's aim for IWT ensuring that Bangladesh has a safe and efficient inland and coastal water transport system able to support national development activities. This policy provides comprehensive guidelines for the sub-sector covering its management and administration, IWT infrastructure, services, safety and environment, technology and financing. Main features of the policy are:

a. Private sector participation in IWT;
b. Evaluation of further potential aspects/advantages for the sub-sector in view of gradual loss of inland waterways assets;
c. Inclusion of Myanmar in development of cross-border IWT trade;
d. Improvement of aids to navigation;
e. Development of ferry operations on secondary routes;
f. Close consultation and participation of all stakeholders in the policy; and
g. Combating pollution caused by IWT.

3.5.2 National Water Management Plan, 2004

The NWMP envisages that the main river system will be comprehensively developed and managed for multipurpose use through a variety of structural and non-structural measures. To reduce the impact of gradual siltation, measures will be implemented to augment surface water flow including dredging of rivers using labour intensive methods. The NWMP stated that a comprehensive dredging plan would be prepared covering short to long term dredging requirements as well as dredging operations and role of private sector. The plan also provided for capital dredging (development of new routes or improvement of existing routes) and for maintenance dredging of major rivers. NWMP included two inland waterways development projects: MR011 and MR006.

The need for river engineering for navigation may however in certain instances conflict with activities of Bangladesh Water Development Board (BWDB), especially where for navigation purposes, improvements such as channelization will impact other river control works, BWDB is primarily responsible for all structural-oriented river functions which include i) development and control of rivers, river basins, embankments, flow regulators and other flood management structures, ii) dredging of waterways, canals, water bodies for improvement of river flow or flow diversion for irrigation, fishing, shipping and other environmental management, iii) land reclamation and management of river estuaries, iv) construction of coastal embankments. So it is necessary that BIWTA and BWDB will work closely together when drawing up programs for their respective purposes.

3.5.3 National Strategy for Accelerated Poverty Reduction

The NSAPR recommended a long term strategy to develop IWT acknowledgement and confirmation of Government's commitment to utilize full potentials of inland waterways. Preserving navigation for country boats was considered as a means of poverty reduction. The NSAPR identified the following factors for consideration:

I) Setting and enforcing standard for bridges;
II) Increased coordination of different public authorities to ensure sufficient clearance under bridges;
III) Participation of owners of country boats in design of sluice gates and
IV) Encouraging local authorities to develop facilities through self-financing by user charges.

3.5.4 Inland Water Transport Master Plan, 2009

The following principles were used to phase required investments over the total duration of the Master Plan (2009-2029) and to prioritize programs and works:

a. Maintain existing assets;
b. Reclassification of IWT routes to recognize routes of national importance;
c. Enhance dredging capacity and utilize private sector in dredging;
d. Take advantage of the opportunity of container traffic;
e. Procurement of salvage vessel;
f. Enhance safety and reduce risks of accidents;
g. Improve sub-regional cooperation for IWT trade;
h. Augmentation of main river ports and
i. Study for efficiency and safety of country boat.

Total cost for implementation the package of projects under the above prioritization amounts to 114,640 million Tk (estimated in 2009 prices).

3.5.5 Integrated Multi-modal Transport Policy

The IMTP prioritized the following areas in the IWT sub-sector:

i) Investment and improved efficiency in dredging;
ii) Greater private sector participation;
iii) Investment in existing river ports and new ports;
iv) Provide door-to-door services in cooperation with other modes;
v) Development of inland container depots;
vi) Improve efficiency and safety in country boat sector;
vii) Improve navigational aids;
viii) Rationalization of regulations and regulatory agencies;
ix) Ensure clearance on inland waterways are maintained and
x) Improve inter country and transit protocol provisions for revival of IWT.

The IMTP further proposed alternative financing measures through transfer of resources collected on fuel from users of the river network to a special Inland Waterways Maintenance Fund allocated for dredging and maintenance of waterways.

3.5.6 Guidelines for Development and Operations of Riverside Inland Container Terminal by Private Sector, 2013

These guidelines were issued in September, 2014 with the following objectives:

i) Providing policy guidelines for development of river side inland container terminal by private sector;
ii) Facilitation of trade and commerce and acceleration of landing and shipping and allied economic activities and
iii) Providing similar facilities to all inland container terminals to be developed for the purpose of transit and trans-shipment in the foreshore within the port area or outside any port area along navigable waterways.

The guidelines provided comprehensive procedures of construction, maintenance and operation of inland container terminals. Under the guidelines BIWTA have been appointed as the competent authority. The above guidelines did not include any commitment/support from the Governments toward increased private sector participation in ICT development and operations and container ship construction/ procurement and operations. Besides, conflict between existing legal framework and free trade practices is also missing.

Main problems and challenges for increased private sector participation (not included in the Guidelines) are:

1. No support/assurance of the Government for private sector investment in development and operations of inland container terminal.
2. No support of the Government for procurement/construction of inland container ship.
3. No assurance of the Government of keeping perennial navigability in the fairway.
4. No assurance of deregulation of determining tariffs by private terminal operators.
5. No assurance from the Government in respect of perpetual ownership of water-front land.
6. No assurance of public bodies of deregulating existing manual pilotage service causing increased transportation time.

3.5.7 6th and 7th Five Year Plans

Table 50 shows target and achievement against 6th FYP as well as target fixed for the 7th FYP.

Table 50 Target and Achievement under 6th and 7th FYP

Works/Item	Target 6th FYP	Achievement 6th FYP	Target 7th FYP
1. Development of Waterways by Dredging	3,120 km	2,500 km.	4,000 km.
2. Procurement & Installation of Navigational Aids	6,000 km (monsoon)	5,828 km.	6,500 km.
3. Development Riverside ICT	3	1	3
4. Development of Port Infrastructure	22	16	22
5. Procurement & Installation	575	480	700

Source: Planning Department, BIWTA

3.6 Future Outlook

3.6.1 Modal Option for Development

A sustainable development strategy for transport network should consider costs and benefits inclusive of every element. Costs of a transport mode include development and maintenance of a network, ownership of vehicles and its operation and maintenance costs. These are referred to internal costs or sometimes termed as direct costs. Costs, which could be fixed and/or variable, have been the primary determinant of costs of haulage in Bangladesh or elsewhere in South Asia. However, there is a growing realization that every mode of transport carries what is known as external costs, hidden costs that burden not only users of the mode but also society at large. Most prominent externalities that impose such costs in a particular mode are accidents, pollution, climate change, congestion and land side infrastructure development.

There has been an alarming rise in road accidents in Bangladesh over the past few years. According to a Study conducted by Accidents Research Center (ARC) Of Bangladesh University of Engineering and Technology (BUET), road accidents claim on average 12,000 lives and lead to 35,000 injuries. According to the World Bank statistics annual fatality rate from road accidents in Bangladesh was found to be 85.6 per 10,000 vehicles.

Similarly, cost of road congestion particularly in Dhaka city was estimated by the Metropolitan Chamber of Commerce and Industries, Dhaka through a Study conducted by two engineers of RHD and one transport economist of MCCI according to table below (**Table 51**).

Table 51 Cost of Traffic Congestion in Dhaka city

Factor	Cost (billion BDT)
Loss of business hours	118
Environment	22
Transport industry	20
Additional fuel	5.75
Accident	0.50
Total	195.55

Source: MCCI Study in 2010

Road vehicles pollute air with carbon monoxide, hydrocarbon, particulates and NOx leading to a host of respiratory diseases including asthma, bronchitis and setting the stage for growing incidence of cardiovascular disease. Emission of carbon dioxide from road vehicles causes global warming.

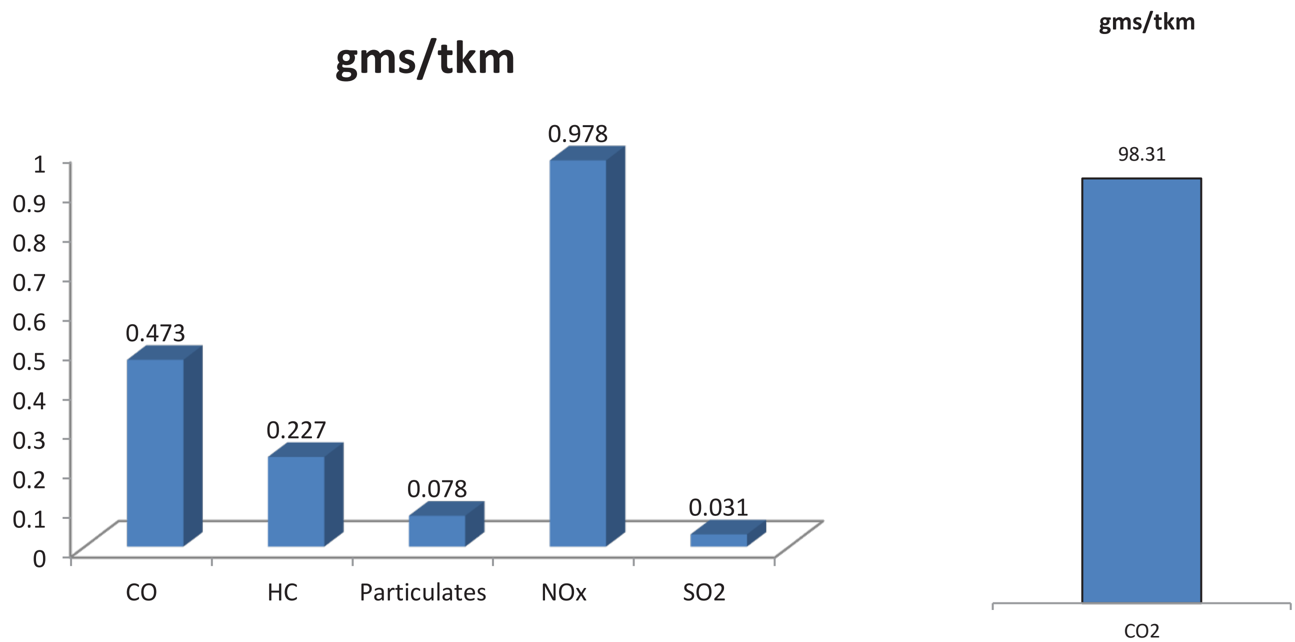


Figure 2 Road Transport Emissions

Source: EU Progress Report on Short Sea Shipping, 1999

The European Union (in 2002) determined that for every 1,000 ton-km of cargo hauled, road transport carries a total hidden external cost of Euro 24.12 as against Euro 12.35 in rail and only Euro 5 for IWT. Reliable estimates of such external costs in the context of Bangladesh or elsewhere in South Asia are not available. But given the general conditions of our roads and trucks, it would be eminently reasonable to assume that external costs in Bangladesh of road transport exceed those of IWT by a factor that is decidedly higher than in the EU (**Figure 3**).

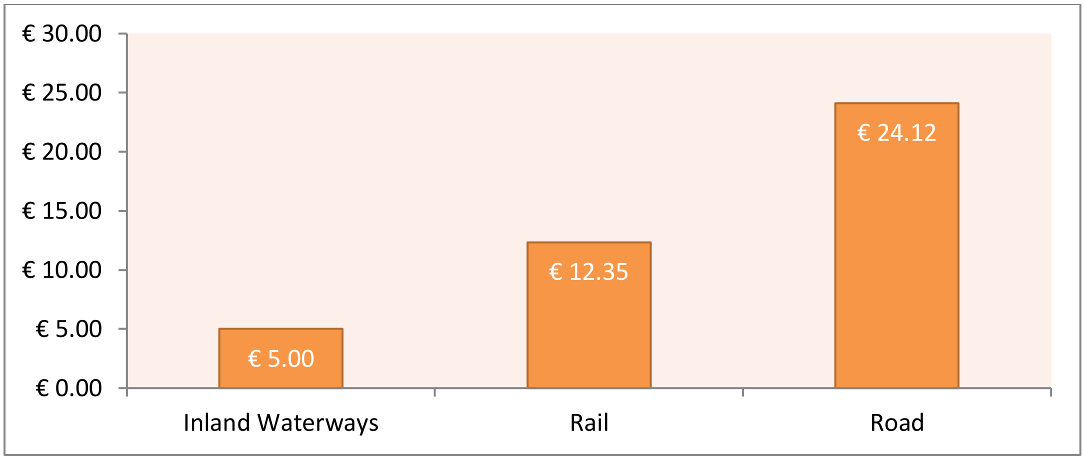


Figure 3 External Costs of Transport Modes in the EU

Source: Transportation cost and benefit, TDM Encyclopaedia

Modal option for development strategy of transport sector environment must be a determinant factor. IWT always remain on the top in terms of carbon saving. One litre of fuel in the river produces 100-200 ton-km of transport output as against 25 ton-km in road, four to eight times lower. The World Bank in its Report on *Revival of Inland Water Transport: Options and Strategies, 2007* revealed that with an estimated 1.95 billion ton-km performed by IWT in 2005 (excluding country boats), about 58.5 million litre of fuel were saved by using IWT instead of road. Using the Integrated Pollution Prevention and Control (IPPC) conversion factors, this represents 155,000 tons of carbon dioxide.

Modal option for future development strategy should also be based on social issues. IWT contributes directly to social benefits nationwide by providing a cheaper mode of transport and employment opportunities. According to the above-mentioned World Bank report, total employment in IWT sub-sector is more than 4.64 million. A substantial portion of rural population has no access to any mode of transport other than river.

In view of the country's economy, public investment for future development of IWT is significant and reasonable. The World Bank estimated an amount of savings at BDT 7.5 billion in transport costs of cargo resulting from use of IWT instead of road (WB Report, 2007). Cost of dredging was estimated at 0.6 billion BDT at BDT 100 per cum. In other words, benefit of BDT 7.5 billion at the cost of BDT 0.6 billion which is economically justified. The minimum traffic necessary to justify the cost of dredging was obtained by dividing total costs of dredging by average benefit from dredging per kilometre. The average cost of dredging per km was obtained by dividing total cost of dredging by length of navigable IWT network. The average benefit from dredging per kilometre was obtained by dividing difference between IWT and road cost by number of ton-kilometre for IWT output. This was derived from the volume of cargo traffic transported by inland waterways by formal sector vessels only. The output of informal sector was not included as those can sail in all conditions. The following **Table 52** illustrates the comparative per ton-km costs of each mode:

Table 52 Comparison of Cargo Tariff by Modes (BDT/ ton-km)

Mode	Dhaka-Chittagong (264 Km)	Dhaka-Sylhet (346 km)
Road	4.50	**4.34**
Rail	2.74	3.78
IWT	0.99	0.63

Source: Revival of IWT by the World Bank, 2007

The World Bank report also revealed that in terms of productivity per kilometre of network of different modes, railway is the best followed by IWT and road at the bottom. IWT has more than twice the productivity of road for the carriage of cargo as illustrated in the following table (**Table 53**).

Table 53 Productivity of Different Modes

Comparison	Road	Rail	IWT
Network (km)	274,000	2,800	24,000
Productivity Passenger-km	359,000	1,500,000	369,000
Productivity Ton-km	57,000	293,000	127,000

Source: The World Bank in National Workshop on IWT, 2005

3.6.2 Future Network to be Maintained

The length of navigable IWT network in Bangladesh (seasonal and perennial) was determined by the DHV Consultants, the Netherlands way back in 1989. The network is yet to be surveyed to determine the updated length. Due to deteriorating condition of rivers and the information and data gathered from the field, it is very much reasonable to assume that the length reduced significantly over the years. It is also evident from the River Notices published monthly by BIWTA.

Maintenance of a network of 6,000 km may not be cost effective and dredging or human intervention otherwise may not result any benefit. Economic justification is there where large or medium inland vessels navigate. No rationale exists to augment the navigability in thousands of kilometre used exclusively by mechanized boats and the smallest size of inland vessels. The rural waterways are being used by country boats and smaller inland vessels under existing condition.

The Inland Water Transport Master Plan Study 2009, limited public responsibilities of maintaining navigability to the following routes termed as Core Waterways Network.

It is evident from the chart table of distance, the length mentioned above (BIWTA) were not accurate. However according to traffic and economic importance almost all routes were included in the recommended network. The waterways linking two maritime ports and Dhaka/Narayanganj area and routes under the Bangladesh-India Protocol on IWT were marked as priority routes. In addition, the following routes should be added considering the present situation.

- Raimangal-Khulna-Noapara 165 km as route under Protocol
- Rajshahi-Daulatdia, 173 km, this could be an important domestic route and a route for transit traffic,
- Tongi- Narayanganj, 35 km, this route may contribute modal shift of passengers of greater Dhaka to remove congestion on roads.

Table 54 Core Waterways Network Recommended in IWT Master Plan 2009

IWT Route	Length (km)
1. Dhaka- Narayanganj -Chittagong	306
2. Dhaka-Barisal-Mongla	418
3. Chandpur-Bhairab Bazar/Ashuganj	102
4. Mohonpur-Daikhawa	385
5. Bhairab-Chatak	228
6. Jamuna/Hurasagar-Baghabari	15
7. Dilalpur-Fenchuganj	191
8. Chatak-Sylhet	53
9. Mongla-Khulna-Noapara	80
10. Dhaka-Tongi	40
11. Barisal-Patuakhali	85
12. Barisal-Barguna	97
13. Narayanganj-Narsingdi	77
14. Narayanganj-Meghna Ghat	42
Total	**1,822**

Source: IWT Master Plan, Final Report, 2009

3.6.3 Passenger and Freight Movement

Modal share of IWT in respect of passengers is gradually declining. This trend will continue further as time is valued more than before. With the completion of Padma Bridge, IWT passenger will be decreased to a significant volume as the present principal passenger corridors between Dhaka and the districts in the southern region will inevitably experience of large modal shift.

On the contrary, freight movement will certainly experience a significant increasing trend. IWT will emerge as the principal modal option for the carriage bulk, break bulk (cargo other than containers) and liquid bulk. Pacific Consultants International, Japan in its Report on Techno-Economic Feasibility Study on Deep Sea Port projected traffic volume of general cargo at the ports of Bangladesh at 12 million ton in 2020, 35.66 million ton in 2035 and about 50 million in 2055. IWT will share 38% of the modal split.

3.6.4 Container Transport

Container traffic to and from the maritime ports in Bangladesh is growing at the rate of 12% per year. Due to the growth of international trade container traffic must continue. Major problem of container movement is the inadequate hinterland connectivity. Due to inherent weakness and limitations of road and rail transports, river transport is given importance by all concerned. Significantly, the private sector has come up in a big way in this trade. Construction of four riverside terminals is underway. The Pacific International, Japan estimated container traffic volume in the ports of Bangladesh at 3.33 million TEU, 8.52 million and 19.60 million respectively in 2020, 2035 and 2055 while modal split in IWT will be 38%. The number of inland container vessels will be 55 in the short term, 152 in the mid-term and 305 in the long term. Number of container terminals will be 5 in the short term, 10 in mid-term and 24 in long term.

The World Bank in the KCT Pre-Feasibility Study, 2014 under the Bangladesh Trade and Transport Facilitation Program projected as follows (**Table 55**):

Table 55 Projection of IWT Container Traffic (000 TEU)

Year	Setting Sail	The World Wears Bangla
2021	1,299	1,588
2022	1,402	1,763
2023	1,514	1,958
2024	1,635	2,175
2025	1,766	2,415
2030	2,469	3,790

Source: The World Bank Study on Chittagong Port Efficiency, 2014

Setting sail assumes growth potential of inland waterway is unlocked and modal share of IWT (containers in TEU) rises from 5 to 45%[9] over the period 2014-2018 and maintains share at that level. **The World Wears Bangla** allows for GDP growth to accelerate over previous trends but is below the Government of Bangladesh target of 8-10 percent.

3.7 Challenges

3.7.1 Incremental Dredging Demand for Maintenance of Navigability

The DHV Consultants in BIWTMAS, 1989 recommended increasing the dredging efforts of BIWTA to the volume of 7 million cubic meters per year in about 15 years of time. In 1997, a committee constituted by the Ministry of Shipping estimated dredging demand to the volume of 7.9 million m^3 annually. An expert committee constituted by the Ministry of Water Resources in 1999 estimated navigation dredging requirement of 8.9 million m^3 year. The IWT Master Pan in 2009 estimated 18 million m^3 per year.

As observed in the above paragraph, the dredging demand for navigation is never-ending and always incremental with the passage of time. Main morphological and hydraulic problems call for such never- increasing dredging requirement. Very recently BIWTA have prepared a long-term dredging plan with 88.2 million m^3 of dredging (45.6 development and 42.6 maintenance) annually. To meet this challenge, dredgers of Bangladesh Water Development Board (BWDB) will not be able to contribute as those will remain engaged to implement BWDB's own projects. The dredger fleet (21 dredgers) of BIWTA having the annual capacity of 11 million m^3 and the capacity of private dredgers will be enhanced to the volume of 14 million m^3 per year. To meet the further requirement of 63.2 million m^3 BIWTA have put forward a project for procurement of 20 dredgers with annual capacity of 26.5 million m^3.

It is interesting to note that BIWTA or BWDB had never been able to utilize the capacity of dredgers to the full extent. Due to inherent weaknesses of public authorities, introduction of third shift and increase deployment time cannot be materialized.

3.7.2 Lack of Appropriate Infrastructure at Ports and Landing Stations

Due to marginal infrastructure and other facilities available at river ports and landing stations, head load still remains main means of landing and shipping of cargo. Embarkation and disembarkation facilities for passengers are not comfortable and safe claiming lives regularly. Of about 1,200 landing stations used by inland vessels only 380 have been developed so far. Facilities of these wayside landing stations cannot be availed by mechanized country boats. Loading/unloading of mechanized country boats are generally performed by natural advantage of river banks. Most of the landing stations developed by BIWTA are provided with a floating pontoon with no jetty or shore connection

[9] World Bank estimated this forecast in its Report "KCT Pre-Feasibility Study" under Bangladesh Trade and Transport Facilitation Program, September 2014 (Para 3.3 Page 15). The Report indicated three forecasts: Scenario A: Anchored, Scenario B: Setting Sail and Scenario C: World Wears Bangla. Scenario A did not include any container traffic in inland waterways up to 2030.

facilities. BIWTA could not spend more than 8 percent of its revenue budget on average annually towards maintenance and repair of the infrastructure.

3.7.3 Non-Compliance of Guidelines for Construction of Bridge/Culvert and Cables/ Wires over Rivers

Construction of bridge or culvert is always felt necessary at the cost of navigational clearance and even drainage of water to the decision making hierarchy. There exists a vertical and horizontal standard of every navigable stretch depending on the dimension of vessels which sail in the stretch. But in many cases the standards were not followed. This was happened in case of construction of Friendship Bridge over the Buriganga River. Since it is a stretch of Class-I waterway, vertical clearance was set at 60 feet at the highest high water level. Ultimately the bridge was constructed with a vertical clearance of 40 feet, which restricted movement of larger size coastal vessels upstream of the bridge. Navigation in 110 km of waterways around Dhaka is not possible due to the existence of such low height bridges. As such waterways around Dhaka city could not contribute to urban transport to remove congestion on the roads. Similarly culverts in the rural area are constructed with unspecified vertical clearance restricting even the movement of a tiny boat. Road-biased development plans not only restricted the navigational facilities, but also stopped the natural flow of the river. At some places, sluice gates constructed by BWDB also restricted navigation of water crafts and the natural water flow. Similar restrictions happen with overhead cables and high tension lines at some places.

3.7.4 Encroachment in Rivers

Being a land scarce country Bangladesh has a serious problem due to encroachment of rivers. Unauthorized encroachment by a section of influential people threatens not only the navigation; it has emerged as a vital environment issue as well. River port areas are most vulnerable places of such encroachment. Port channels have been narrowed over the years restricting safe navigation. More than 5 acres of foreshore land around Dhaka have been encroached. BIWTA frequently undertake eviction programs but after sometimes the (foreshore) land is again encroached and occupied.

3.7.5 Lack of Safe Vessels and Skilled Workforce

There exist rules and regulation of ship design and ship construction, but these are not applied generally in case of construction. Prior to construction of a vessel design prepared by registered naval architect must be approved by the Department of Shipping. In most of the cases construction of a vessel does not fit the approved design, but the DOS does not bother for such deviation. Only paperwork is done after construction of an inland vessel. So, quality of inland ships in Bangladesh is always questionable.

Another factor which threatens the safety is the skill of the members of the crew on board. Training facilities for crew available in Bangladesh are not sufficient to meet the demand of such large fleet. Besides, private sector owners are hardly interested to send their crew for training. Members of the crew only depend on experience and not on education and knowledge obtained through training.

Investigation reports of recent passenger vessels accidents reveal that 70 percent of vessels were constructed deviating from the approved design and in many cases one of the causes of accident was lack of efficiency of the master (pilot).

3.7.6 Lack of Policy Guidelines

There are many policies for the development of IWT in Bangladesh. But those are appeared to be paper documents only. No guidelines are available to translate those policies into reality. Progress of implementation of such policies is not monitored or reviewed regularly.

3.7.7 Poor Governance, Institutional Inadequacy and Lack of Transparency in Revenue Earning

One of the main reasons of gradual declining trend of inland water transport is the lack of good and efficient governance. Apparently, poor governance prevails in almost all areas of regulations and management: approval of ship design, construction of inland ships, issuance of registration and survey certificates in favour of inland ships, port management, enforcing rules and regulations for navigation, issue of competency certificates to master and engine drivers, port revenue earning etc.

Approval of ship design, supervision of construction of inland ships, issue of registration and periodical fitness survey certificates, awarding competency certificates to members of crew and enforcing rules and regulations are responsibilities of DOS. The DOS has only 4 surveyors who issue certificates to as many as 10,000 inland ships. It is understood that surveyors cannot supervise the construction of the ship nor they can physically inspect the ship prior to issue of certificates. A 62 member team of DOS is responsible for the whole sub-sector. There exist only 7 inspectors to exercise control of movement of vessels under rules and regulations.

BIWTA is responsible for providing services to users. Inland ports and landing stations are administered by BIWTA. Actual handling operations are performed by the lessees appointed by BIWTA. Term of lease arrangements is only one year. For such short term the lessee does not take any responsibility of maintenance of infrastructure or facilities available in his jurisdiction. Condition of lease arrangement is so ambiguous that before the year ends, BIWTA regularly faces litigations from the lessees. In most cases the court of law issues an interim order of stay in favour of the lessee and he continues beyond his term. This has a serious impact on revenue earning of the port.

Collection of tolls directly by BIWTA employees is not transparent. Generally entry fee from passengers in the terminal of the port are collected by BIWTA. Overloading is a popular allegation against passenger vessels, while total collection of BIWTA is not more than 40 percent of the registered capacity of departed vessels.

3.7.8 Disparity in Budget Allocation and Utilisation

The inland water transport sub-sector had never been able to attract attention of decision making hierarchy in terms of development and public expenditures. Of the three modes of surface transport IWT has always been the third option. IWT shared 8 % of passenger movement and 16 % of freight movement in 2005 according to a World Bank Report *Revival of IWT.... 2007*. The following table (**Table 56**) describes that IWT is yet to capture the rightful place in public expenditures.

Table 56 ADP Allocation in the Surface Transport in Percentage

Year	Road	Rail	IWT
2009-2010	76.20	20.57	3.33
2010-2011	74.60	20.71	4.69
2011-2012	64.55	31.03	4.42
2012-2013	57.89	37.98	4.13
2013-2014	71.42	25.47	3.11

Source: BIWTA Planning Department

On average IWT received 3.9% of total ADP allocation. It should be mentioned that this is the best scenario in favour of IWT. Earlier IWT received on average only 1 percent of ADP allocation.

Similarly disparity prevails in BIWTA's expenditures. Most of BIWTA's expenditures are allocated for the central region, next to river crossing ferry points. Haor area in the north-eastern region contributes 37 percent of national IWT output according to the Haor Master Plan, but expenditures for maintenance of waterways and landing stations in the Haor area are the lowest in BIWTA'S budget.

3.7.9 Lack of Intermodal Coordination

Inland river ports and landing stations suffer from lack of intermodal connectivity. Ports are interface of different modes of transport. But unfortunately river ports and landing stations do not have adequate accessibilities to other modes with few exceptions. This has appeared to be a uni-modal transport network. Most of the ports are connected by road network but no access road exists at the jetty heads. This has left IWT operations depend only on head loads resulted longer time for loading/unloading. Such segmented connectivity hinders introducing mechanization of loading/unloading. Most of the wayside landing stations does not have road connectivity.

3.7.10 Poor Level of Regional Cooperation

India is connected with Bangladesh by inland waterways. Despite a Protocol on IWT trade exists between the two countries, the advantage of resources could not be utilized to full extent. This is due to the poor level of cooperation between the countries in this regard. There are many issues unresolved for long in the bilateral forum. Ashuganj in Bangladesh was designated as a Port of Call and at the same time a trans-shipment place, which is yet to be materialized. If it is materialized IWT trade could be enhanced significantly due to transportation of cargo between land-locked north-eastern region of India and its mainland. Bangladesh could be benefitted through foreign exchange earnings by exporting transport services. In this part of India, logistics resources are not available to accommodate transport demand. Indian cargo owners have to depend on Bangladesh vessels. The issues which were discussed in recent bilateral talks but still pending for decision are as follows:

- i) Term of the Protocol;
- ii) Inclusion of tourism;
- iii) Night navigation facilities;
- iv) Extension of routes;
- v) Introduction of container service;
- vi) Landing permission of Bangladesh crew while in India;
- vii) Mutual exchange of navigational information and navigational charts.

3.7.11 Capacity Constraint to Accommodate Growing Demand of International Seaborne Trade

Bangladesh's future development strategy is aimed at achieving middle-income status by 2021 or before. This will largely depend on international trade and for that reason international seaborne trade is very important. The trade body of the RMG sector, the BGMEA, is confident to achieve the target of doubling the export to USD 45 billion by 2020. With the growth of GDP and other driving forces of international trade and to meet growing demand a vibrant, an efficient and competitive port system along with total transport chain is required.

But presently total capacity of maritime ports is not sufficient to accommodate projected container throughput in foreseeable years. Existing container handling capacity of Chittagong Port is estimated at 1.846 million TEU (General cargo berths 715, CCT 351 and NMCT 780) per year. Meanwhile container throughput at Chittagong is close to the maximum capacity. The World Bank in its Briefing Note on Bangladesh Port Sector under Bangladesh Trade and Transport Facilitation Program described the situation as illustrated in **Table 57**.

Table 57 Balance Statement of Container Throughput against Existing Capacity

Year	Projected throughput (1,000TEU)	Status against existing capacity (1,oooTEU)
2015	1,821	+25
2016	1,966	-120
2017	2,123	-277
2018	2,292	-447
2019	2,475	-630

Source: The World Bank, Bangladesh Port Sector Briefing Note, 2014

The World Bank commented, "Delaying investment in container handling capacity and efficiency improvements exposes the port and Bangladesh importers and exporters to high risk of congestion and damaging disruption to supply chains."

3.7.12 Maritime Access

Both maritime ports of Chittagong and Mongla are situated along the banks of rivers and their respective permissible draft and length restrictions of vessels do not allow the large modern vessels to call at for achieving economy of scale. Average vessels calling at the ports from the Far East and the South Asia has a capacity of 3,800 TEUs while average vessels call at Chittagong with 1,200 TEUs. Furthermore, navigability of channel is conditioned by tidal and seasonal fluctuations and weather condition as well. Maintenance of fairways requires high dredging costs.

3.7.13 Intermodal Connectivity

An efficient port depends on inland connectivity to its hinterland. The road, rail and IWT network lack efficient infrastructure to meet the growing demand of transporting throughput from and to maritime ports.

3.8 Knowledge Gaps

No Updated Data or Information of Network Navigation

BIWTA undertake hydrographic survey on the basis of prioritized programs. It could not undertake comprehensive hydrographic survey since 1989. They do not have any data or information of the whole network. BIWTA determine the navigational information on the basis of the report of by the field offices, quality of which is not dependable.

3.8.1 No Database on IWT Traffic

Despite traffic survey is one of the responsibilities of BIWTA, no traffic data could be gathered from BIWTA or from port offices. When required they estimate throughputs on the basis of revenue earning. This method is not dependable but there are no other alternatives. Lack of traffic database not only hinders the process of development planning, but estimating the lease price of the particular point is also suffering.

3.8.2 No Statistics Regarding Country Boat

Country boat in Bangladesh has emerged as a large economic force in the country and provides local transport service of passengers and cargo. Total output of country boat is believed to be more than the formal sector. Construction and operation of country boats is still not under any regulatory framework. As such number, type and area of operation the country boats is still unknown. Quoting source of BIWTA, number of such country boats given BBS is 745,000. This is not an outcome of any census or survey. Master Plan of Haor area estimated that about 100,000 country boats are in operation in the Haor area. For the development of safety and efficiency and for regulating the construction and operation of country boats – number, type and other information of country boats are necessary.

3.8.3 Climate Change Impact

IWT is the important mode of transport in Bangladesh. It is predicted that climate change, through increased sea level, more flooding and increased deposition of sediment will change the conditions of waterways. Impact of climate change is already very much evident and visible in IWT. But, unfortunately no study has been undertaken so far to ascertain the impact on IWT. Nor any action plan has been drawn for adapting to climate change and mitigation. Bangladesh has formulated a comprehensive action plan under Bangladesh Climate Change Strategy and Action Plan, 2009 which was acclaimed by all within the country and beyond the border. But surprisingly, the IWT sub-sector was not listed nor included in the action plan.

3.8.4 Pollution Caused by Transport

Pollution is certainly caused by different modes of transport but the actual extent of such pollution caused by each mode is yet to be determined. IWT has a comparative advantage over other modes of transport in respect of carbon footprint. Using the Integrated Pollution Prevention and Control (IPPC) conversion factor this comparative advantage can be determined which would be useful to the decision making hierarchy to prepare a development strategy at the backdrop of carbon footprint.

In respect of water pollution caused by navigation no data or information exist, nor any attempt to make vessels fuel efficient. Protecting flora and fauna and the environment at large, a dredging method and technique is yet to be determined.

3.9 Recommendations

Inland waterways and inland ports

- The Government should prepare a midterm and long term vision that will ensure a sustainable development of IWT sub-sector in line with the Integrated Multimodal Transport Policy. Modal option for development of transport sector should be based on social and environmental advantages.
- Inland waterways network should be reclassified according to sustainable navigability and traffic importance. The core waterways should include fairways between maritime ports and central region and intra-regional routes. Network development and dredging strategy should be prepared in line with the National Water Management Plan. It will be justified to provide more resources for the development and maintenance of waterways. The new dredging strategy should coordinate and integrate programs of BIWTA and BWDB.
- More private participation should be ensured in the field of port management and operations, development of IWT infrastructure, dredging and maintenance of waterways, mechanization of cargo handling, development of inland container terminals and container traffic in the waterways. To this end, new guidelines and procedures should be prepared which will include:
    - The existing lease arrangement should be replaced by a midterm and long term concession arrangement to private stevedores and terminal operators to encourage investment for better services to users and maintenance of facilities. BIWTA should not involve itself in toll or revenue collection, rather will monitor performance of private operators. Infrastructure at commercially attractive places should be developed and operated by private sector or on a PPP basis. BIWTA should continue to develop landing stations in rural areas and in coastal areas.
    - BIWTA should concentrate more in preparing dredging strategies and programs on the basis of comparative traffic importance against available resources. Actual dredging should be performed by the private sector. BIWTA should restrict itself in procurement of dredgers, it should rather lease out the existing fleet to private sector.

- Installation of aids to navigation and maintenance in core waterways should be awarded to private sector. Pilotage service should also be awarded to private sector.
    - Appropriate support should be given to private sector for construction of inland container terminals and for container traffic. Determining tariffs at such terminals should be deregulated and operators must have independence to fix an attractive and competitive tariff. Operation of Pangaon Container Terminal should be leased out to private terminal operator.
- The existing regulatory mechanism of inland ship safety and ship construction should be streamlined. Ship design, supervision of ship construction, awarding survey certificates, determining workforce required for each ship should be licensed to qualified private houses. The Department of Shipping should concentrate more in monitoring performances of such private houses appointed for the purpose. Competency certificates to different categories of crew should be awarded by training institutes after successful completion of service and training modules for each category.
- To attract more regional and intra-regional traffic in the waterways of Bangladesh mutual understanding and cooperation should further be developed. Under the existing Protocol on Inland Water Transit and Trade between Bangladesh and India, the following joint initiatives and assurances should be committed by both Governments:
    - Improve navigability of existing routes and find out new routes. Upstream cooperation and commitment to maintain navigability in the downstream.
    - Find out most economic and efficient transport chain and establish connectivity with other modes.
    - *Find out the benefits on socio-economy and environment.
    - *Find out the appropriate technology to improve efficiency of inland navigation.
    - *Find out the requirements for amendment, simplification, waiver of existing procedures.
- Institutional capacity building, reforms and restructuring.

Maritime ports

- International seaborne trade in Bangladesh is growing fast. The existing maritime ports of Chittagong and Mongla have inherent limitations due to draft restrictions to accommodate larger vessels. As such, development of a deep sea port is indispensable to keep the growth moving in Bangladesh.
- Efficient transport links to central region are required for development of traffic through ports of Chittagong and Mongla.
- More private sector involvement should be ensured through experience worldwide that demonstrates that Bangladesh maritime ports should apply a landlord model under which public port authorities should withdraw themselves from day to day operations and focus on regulation, planning , investing and market promotion.
- At all container terminals International Terminal Operators (ITO) should be engaged who will be responsible for all categories of container handling equipment.
- Efficiency of maritime ports should be enhanced through the following short-term actions:
    - *private sector involvement initiative
    - *empowering port authorities
    - *substantial reduction in import related time
    - *elimination of stuffing/ unstuffing practices in ports
    - *increase of container storage charges
    - *private ICDs used for import
    - *introducing automated system for custom data

4 Annex

A1: List of Classified Routes by NEDECO

	Class I:	These were the main arteries of traffic flow and were the major concern of EPIWTA (now BIWTA) as regards conservancy and maintenance. The users had a guarantee of the specified navigability within reasonable limits throughout the year. This was to be attained by dredging or bandalling as required. The following Routes with their respective LAD were listed in Class-I Route:
		1. Dhaka/ Narayanganj- Chandpur- Chittagong (12ft.) 2. Dhaka/ Narayanganj- Daudkandi (6ft) 3. Chittagong- Barisal- Jhalkathi- Chalna (12ft) 4. Chalna- Jhalkathi- Chandpur- Dhaka/Narayanganj (12ft) 5. Chalna- khulna (12ft) 6. Nagarbari- Aricha- Goalondo (6ft)
	Class II :	These were the routes with important traffic links. The necessary aids to navigation such as marking of channels by buoys and beacons, notifications of depths were provided. But no guarantee could be given for the availability of specified depth throughout the year. Dredging works were undertaken occasionally as determined case to case. Following Routes Were listed in this group: 1. Chandpur-Goalondo (6ft) 2. Dhaka/ Narayanganj- Madaripur- khulna (4.5ft) 3. Barisal- Madaripur (6ft) 4. Dhaka/ Narayanganj- Narsingdi- Bhairabbazar (9ft) 5. Dhaka/ Narayanganj- Narsingdi- Bhairabbazar- Chatak (4.5ft) 6. Narayanganj-Ghorasal (4.5ft) 7. Arialkhan-Kaukhali (6ft)
	Class III:	There were traffic links of local importance. BIWTA carried out simple channel markings as required. Navigability could be expected during the greater part of the year not perennially. Following Routes were listed : 1. Chittagong- Chandraghona (3ft) 2. Dhaka/ Narayanganj- Bhairabbazar-Manumukh (4.5ft) 3. Dhaka/ Narayanganj- Manikganj (4.5ft) 4. Barisal- Patuakhali- Khepupara (6ft) 5. Barisal- Amtali (6ft) 6. Barisal- jhalakhathi- Patharghata (12ft) 7. Barisal- Charbiswas (3ft) 8. Kumarkhali- Bagherhat (12ft) 9. Burdia-Naldi (4.5ft) 10. Khulna-Naldi (3ft) 11. Khulna- Elberchar- Pratabnagar (6ft) 12. Khulna- Madinarabad (6ft) 13. Goalando-Chilmari (6ft) 14. Goalanda-Kushtia-Kumarkhali (4.5ft)

A2: Classified IWT Routes

Class		Route	Description (river/town)	Distance (km)
I	1	Dhaka-Chittagong	Buriganga, Dhaleswari, (Lower) Meghna, Shah- bazpur, Hatia Channel, Karnaphuli river	306
	2	Shambhupura-Demra	Lakhya river-Narayanganj	22
	3	Shambhupura- Bhairab Bazar	Upper Meghna-Ashuganj	85
	4	Chowkighata- Maheswarpasha	Lower Meghna, Arial Khan, Kirtankhola, Gab Khan, Baleshwar, Mongla-Ghsiakhali Canal, Pussur, Khulna, Kazibacha, Bhairab	270
			Class I Total:	**683 km**
II	1	Bhairab Bazar-Chattak	Upper Meghna, Kalni, Surma river	228
	2	Mohanpur- Daikhawa	Meghna-Chandpur, Padma, Jamuna (Barhmaputra)	385
	3	Deara-Barisal Via Nandibazar	Meghna, Jayanti, Arial Khan	84
	4	Pussur-Chalna-Raimangal	Sutarkhali, Sibsa, Bajboza, Sekbaria, Arpangasi, Malanchi-Border	143
	5	Hizla-Shaistabad	Meghna-Azimpur/Dharmaganj, Arialkhan	30
	6	Sattal-Daudkandi	Meghna	24
	7	Chandpur-Ichuli	Dakatia Nullah	7
	8	Chittagong-Cox's Bazar	Karnaphuli, Kutubdia & Maiskhal Channels, Bagkhali	99
			Class II Total:	1,000 km
III	1	Dilalpur-Markuli-Sherpur	Meghna, Kalni, Kushiyara rivers	168
	2	Sherpur-Zakiganj	Kushiyara river	117
	3	Gaglajor-Mohnganj	Kangas river	43
	4	Chitri-Nabinagar-Kuti Bazar	Meghna, Pagla, Buri rivers	20
	5	Mahisherchar-Salimganj	Meghna,Titas rivers	31
	6	Marichakandi-Narsingdi	Meghna river	8
	7	Narsingdi-Katiadi	Old Brahmputra	84
	8	Demra-Ghorasal	Lakhya river	37
	9	Dhaka-Mirpur-Tongi-Demra	Turag, Tongi, Balu rivers	53
	10	Buriganga mouth-Saidpur	Dhaleswari	15
	11.	Nakalia-Baghabari	Hurasgar rivers	15
	12	Khulna-Bhairab- manikdah-Kalikapur	Bhairab, Atai, Madhumati, Beel route, Upper Kumar, Arial Khan	138
	13	Arai/Bhirab Confluence-Abalganti	Atai river	15
	14	Kalikapur-Madaripur-Namdibazar	Arial Khan, Jayanti	56
	15	Kaukhali-Jugirkanda-Babuganj	Swarupkati, Tengrakhali (Amtali)	52
	16	Ghasiakhali-Bagerhat	Ghasiakhali river	18
	17	Kobadak-Tepakhali	Kapatakshi river	85
	18	(Chalna)-Paikgacha-Assasuni-Patharghata	Sibsa, Harikhali, Kholpetun river	85
	19	Jhalakati-Barguna-Patharghat	Gazalia, Bishkali rivers	89
	20	Dapdabia-Angaria-Mizaganj-Amtali-Taltalipar	Khairabad,Rajaganj, Bighat, Buriswar rivers	115
	21	Charpower-(Bhola) Patuakhali-Galachipa_Bara Baishdia	Tetulia, Karkhan Lohalis, galachipa Rabnabad,Agumukha (estuarium)	137
	22	Bara Baishdia-Khepurara	Nilganj river	19
	23	Khepurar-Mohipur-Kuakata	Nilganj, Khprabhanga, Andaramanick river	36
	24	Badartoni-Rajapur	Naya Bangani R/Muladi N	35
	25	Bhla-(Charpower) Nazirpur-Ghserhat-char Montaz	Tetulia, Bura, Gauranga, Bay of Bengal	95
	26	Chittagong-Kaptai dam	Karnaphuli river	65
	27	Rangamati-Kaptai	Kaptai Lake	29
	28	Kaptai-Belaichari	Kaptai Lake	20
	29	Rangamati-Choto	Kaptai Lake	64
	30	Rangamati-Mahalchari	Kaptai Lake (Chiringa Khal)	44
	31	Rangamati-Marisha	Kaptai Lake (Myani River)	97
			Class III Total:	**1,885 km**
IV	1	Markuli-Dirai	Kalni river	19
	2	Takerghat-Lalpur	Baulai river	48

Class		Route	Description (river/town)	Distance (km)
	3	Chattak-Atgram	Surma river	141
	4	Mohanganj-Thakurkona	Kangsa river	46
	5	Ghoradiga-Netrakona	Mogra river	130
	6	Ghorassl-Toke	Lakhya, Old Brahmaputra	62
	7	Savar-Nayarhat-Dhamrai	Bansi river	10
	8	Mirpur-Savar	Karnapara, Dhaleswari r	15
	9	Rustampur-Kaliakir	Turag river	55
	10	Saidpur-Singaair-Tilli	Dhaleswari	80
	11	Paragaon-Tara-Shajani	Dhaleswari river	86
	12	Katpatty-Gourganj	Ichamati R.-Taltala C.	22
	13	Dubldia-Kalikapur	Dubaldia Bullah	39
	14	Kabirajpur-Tepakhola	ArislKhan	36
	15	Kaukhali-Manikdah	Madhumati river	67
	16	Bardia-Talbria	Madhumati, Gorai river	170
	17	Bardia-Naril-Gazirhat	Upper Nabagange, Chitra rivers	75
	18	Khulna-Manikdah	Attarabanki river	43
	19	Khulna-Alaipur-Bagerhat	Bhairab river	43
	20	Assasuni-Ellarchar	Harikhali, Morirchap river	21
	21	Sripur-Bhola Kheyaghat-Ganga-Pur/Bhola town	Tetulin, Bholakhal	285
	22	Aricha-Salimabad	Padma/Ganges, Mhananda rivers	307
	23	Aricha-Salimabad	Jamuna river	22
	24	Baghabari-Badalgachi	Hurasgar, Baral, Gumani, Atrai, Gurgu R.	163
	25	Bag bari-Ullapara	Karatoya river	32
	26	Saidpur-Sreenagar	Ichamati river	18
	27	Saidpur-Salla	Dhaleswari river	10
	28	Cox's Bazar- St. Martin's islan		111
	29	St. Martin's Island-Teknaf		31
	30	Kuti Bazar-Saldanadi-Gokrnaghat	Pagls, Saldanadi	13
	31	Toke-Trimohint-Kaoraid	Banar, Kaoraid rivers	20
	32	Madna-Habiganj-Shaistaganj	Barak river	62
	33	Manumukh-Manlavibazar	Manu river	20
	34	Sachna-Suwals-Tahirpur	Nawa river	37
	35	Ichuli-Faridganj	Dakatia Nullah	64
	36	Char Pagla-Raipur	Dakatia river	20
	37	Prtuakhali-Mirzaganj	Patuakhali river	10
	38	Khntakhata-Mati Bhanga	Baleswar river	52
	39	Aorabania-Mirzaganj	Srimanta Nullah	18
	40	Pakhira-Naria	Palang R, Naria Kh.	37
	41	Bhitabria-Gazipur	Sialkati Bullah	9
	42	Badla-Tarail	Batnal river	33
	43	Tepurakandi-Kazirtak	Padma river	21
	44	Bahadurabad-Balashi	Old Brahmaputra	22
	45	Shajani-Bochamara	Jamuna river	27
			Class IV Total:	**2,400 km**

A3: Dredging in 2009-2010

A. Maintenance Dredging		
Spot/Route/Shoal	**River**	**Volume (lakh m^3)**
1. Paturia Ferryghat	Padma	6.72
2. Daulatdia Ferryghat	Padma	3.61
3. Mawa-Charjanajat Ferry Route	Padma	11.19
4. Dhaka-Barisal Route	Meghna, Arialkhan	3.26
5. Paturia – Baghabari Route	Jamuna, Hurasagar	1.27
6. Barisal Port Area	Kirtankhola	0.68
7. Harinaghat-Alubazar	Meghna	0.89
8. Bhairab-Chatak Route	Surma, Baulai	3.33
9. Munshiganj-Dahuri Route	Ichamoti	0.33
10. Hosnabad-Torki Route	Palordi	0.11
11. Laharhat-Tungibari Route	Saheberhat Canal	0.58
12. Lahahat-Bheduria Ferry Route	Tetulia	1.74
13. Ghasiakhali-Mongla Route	M.G.Canal	1.21
Sub Total (A)		34.92
B. Development Dredging		
Ashulia_kanchpur Route	**Turag, Balu**	**5.00**
Sub Total (B)		**5.00**
Total (A+B)		**39.92**

A4: Dredging in 2011-2012

A. Maintenance Dredging		
Spot/Route/Shoal	**River**	**Volume (lakh m^3)**
1. Paturia Ferryghat	Padma	2.73
2. Daulatdia Ferryghat	Padma	10.21
3. Mawa-Charjanajat Ferry Route	Padma	16.47
4. Paturia-Baghabari	Jamuna,Hurasagar,Boral	1.90
5. Dhaka-Barisal	Meghna,Arialkhan,Kirtankhola	2.85
6. Gabkhan Canal	Gabkhan Canal	0.70
7. Hosnabad-Torki	Palordi	1.37
8. Harina-Alubazar	Meghna	2.24
9. Laharhat-Bheduria Ferry Route	Tetulia,Kalabadar	1.63
10. Patuakhali Port Area	Lohalia,Laukathi	0.97
11. Dhaka-Hularhat	Arialkhan	0.23
12. Bhla & Lalmohon Ghat	Tetulia,Lalmohon Canal	1.13
13. Syedpur-Bandura	Ichamoti	1.18
Sub Total (A)		43.61
B. Development Dredging		
I)Project : Circular waterways around Dhaka		
1. Tongi Rail Bridge-Hardibazar	Balu,Turag	5.85
Ii) Project : Dredging of Madaripur-Charmuguria-Tekerhat-Gopalganj Route		
1. Madaripur-Gopalganj	Arialkhan,Lower Kumar,Beel Route	12.17
Iii) Project : Modernization of Barisal Port Area		
1. Barisal Port Area	Kirtankhola	1.91
Iv) Development of Noapara,Bhairab-Ashuganj and Barguna River Port		

1. Barguna Port Area	Khagdon	0.60
V) Improvement of Navigability for Establishment of Power Plant		
1. N'ganj-Daudkandi	Meghna,Gumti	2.91
2. Hularhat-Charchapail-Gopalganj	Modhumoti	1.04
Sub Total (B)		**24.47**
Total (A+B)		**68.08**

A5: Dredging in 2012-2013

A. Maintenance Dredging		
Spot/Route/Shoal	**River**	**Volume (lakh m^3)**
1. Paturia Ferryghat	Padma	5.26
2. Daulatdia Ferryghat	Padma	7.81
3. Mawa-Charjanajat Ferry Route	Padma	19.41
4. Dhaka-Barisal	Meghna	1.91
5. Syedpur-Bandura	Ichamoti	3.47
6. Bhola-Lalmohon	Lalmohon Canal	0.87
7. Bhola-Ramgati	Meghna	0.47
8. Bhairab-Fenchuganj & Bhairab-Chatak	Dhakinala, Kushiara	2.13
9. Narsingdi-Salimganj	Titas	0.85
10. Patuakhali-Golachipa	Lohalia, Laukhathi	1.24
11. Gabkhan Canal	Gabkhan Canal	0.25
12. Bhola-Laxmipur	Meghna	0.38
13. Aricha-Kazirhat	Jamuna	0.60
Sub Total (A)		44.65
B. Development Dredging		
I) Project : Circular Waterways around Dhaka (2nd Phase)		
1. Tongi Rail Bridge_Hardibazar	Balu,Turag	2.18
Ii) Project : Dredging of Madaripur-Charmuguria-Tekerhat-Gopalganj		
1. Madaripur-Gopalganj	Arialkhan,Lower Kumar	26.81
Iii) Project : Development of River Ports at Noapara,Bhairab-Ashuganj, Barguna		
1. Barguna Port Area	Khagdon	0.71
Iv) Project : Dredging of 12 Important River Routes		
1. Jajira-Kawrakandi	Arialkhan	2.94
2. Paturia-Baghabari	Jamuna,Hurasagar	0.51
3. Laharhat-Bheduria	Tetulia	9.11
4. Saheberhat-Laharhat	Tetulia	1.65
5. Demra-Polash	Sitalakhya	1.68
6. Dhaka-Madaripur	Arialkhan	0.83
7. Chandpur-Hularhat	Dakatia,Sandhya,Arialkhan	2.76
8. N'ganj-Daudkandi	Meghna,Gumti	2.81
9. Sureswar-Madaripur	Suresswar,Arialkhan	2.60
10. Sadarghat_Birulia	Buriganga,Turag	1.44
Sub Total (B)		**56.03**
Total (A+B)		**100.68**

A5: Dredging in 2012-2013 (cont'd)

A. Maintenance Dredging		
Spot/Route/Shoal	**River**	**Volume (lakh m^3)**
1.Daulatdia Ferryghat	Padma	10.74
2. Mawa-Charjanajat	Padma	21.26
3. Dhaka-Barisal	Meghna,Arialkhan,Kirtankhola	4.52
4. Syedpur-Bandura	Ichamoti	7.64
5. Bhairab-Fenchuganj	Kushiara	0.78
6. Patuakhali Port Area & Patuakhali-dapdapia	Lohalia	1.88
7. Bhairab-Chatak	Surma,Baulai	3.16
8. Bhola-Laxmipur	Meghna	2.40
9. Barguna Port Area	Khagdon	0.38
10. Mirkadim nPort & Gazaria	Dhaleswari	0.19
11. Aricha-Kazirhat	Padma,Jamuna	0.94
12. N'ganj Port Area	Sitalakhya	0.62
13. Laharhat-Bheduria	Tetulia	0.752
14. Paturia-Kaulia	Jamuna	0.93
15. Pangaon ICT	Buriganga	0.14
16. Dhaka-Bhyandiria	Pona	1.04
17. Mongla-Ghasiakhali	M.G.Canal	0.58
Sub Total (A)		57.90
B. Development Dredging		
I) Project : Dredging of Madaripur-Charmuguria-Tekerhat-Gopalganj Route		
1. Madaripur-Gopalganj	Arialkhan	22.48
Ii) Project : Dredging of 12 Important River Routes		
1. Jajira-Kawrakandi	Arialkhan	0.21
2. Paturia-Baghabari	Jamuna,Hurasagar	3.23
3. Saheberhat-Laharhat	Tetulia	1.42
4. Demra-Polash	Sitalakhya	4.43
5. Chandpur-Hularhat	Dakatia,Sandhya,Arialkhan	2.28
6. Dhaka-Madaripur	Arialkhan	5.62
7. N'ganj-Daudkandi	Meghna,Gumti	2.38
8. Sureswar-Madaripur	Suresswar	3.45
Iii) Project : Capital Dredging in 53 River Routes		
1. Barisal-Jhalkathi-Barguna-Patharghata Route	Kirtankhola, Bishkhali,Khagdon	1.00
Sub Total (B)		**47.02**
Total (A+B)		**104.92**

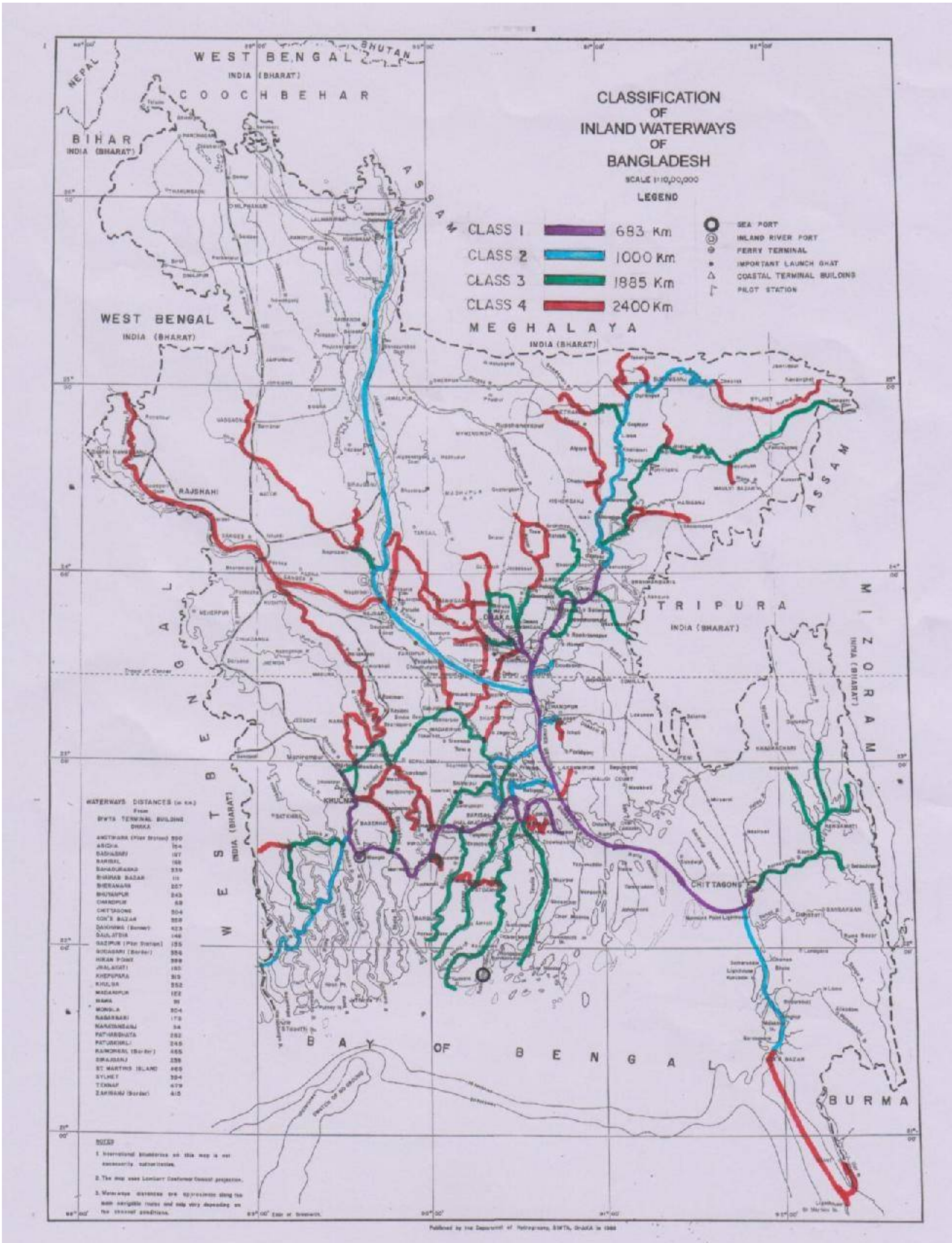
A6: Existing Dredger fleet of BIWTA

Sl. No.	Name of the Dredger	year of Procurement	Annual Production Capacity (in lakh m^3)
1.	Delta-I	1972	3.00
2.	Delta-II	1972	3.00
3.	Delta-35	1975	4.00
4.	Delta-36	1975	4.00
5.	Delta-37	1975	4.00
6.	Delta-38	1975	4.00
7.	Delta-139	1975	4.00
8.	Kushiara	2011	6.00
9.	Karnafuly	2011	6.00
10.	Kopotakhsa	2011	6.00
11.	Delta-1420-1	2014	7.00
12.	Delta-1420-2	2014	7.00
13.	Delta-1418-1	2014	6.00
14.	Delta-1418-2	2014	6.00
15.	Delta-1418-3	2014	6.00
16.	Delta-1418-4	2014	6.00
17.	Delta-1418-5	2014	6.00
18.	Delta-1418-6	2014	6.00
Existing Capacity			**94.00**
Three dredgers being procured to be delivered in 2014			16.00
Total Annual Capacity			**110.00**

A7: Current State of Protocol Routes

Route			**Shoal**			Provision for navigational aids
Name	Indicative draft	Distance (km)	Number	Length (km)	Min. depth (m)	
Raimangal-Chandpur route						
Raimangal-Chalna	2.5	119	2	1.7	1.6 and 2.2	D
Chlna-Mongla	3.9	16	1	0.5	2.1	D/N
Mongla-Ghasiakhali	3.9	31	1	20.0	0.5	D/N
Ghasiakhali-Chandpur	3.9	200	-	-	-	D/N
Chandpur-Daikhawa route						
Chandpur-Aricha	2.5	119	-	-	-	D
Aricha-Sirajganj	2.5	92	6	6.0	(-)1.3 to (+)1.8	D
Sirajganj-Bahadurabad	2.5	88	5	5.0	(-)1.3 to (+)1.0	D
Bahadurabad-Chilmari	2.5	62	5	5.0	(-)1.2 to (+)2.2	D
Chilmari-Daikhawa	2.5	37	3	3.0	0.1 to 1.5	D
Chandpur-Zakiganj route						
Chandpur-Bhairab Bazar	3.9	123	NA	-	-	D/N
Bhairab Bazar-Madna	1.5	63	1	10.0	1.2	D
Madna-Ajmiriganj	1.5	47	1	23.0	(-)1.0	D
Ajmiriganj-Sherpur	1.5	71	-	-	-	D
Sherpur-Zakiganj	1.5	115	1	1.5	1.5	D

Map 1: BIWTA Route Map



5 References

Surveys of Inland Waterways and Ports, 1967, the Netherlands Engineering Consultants

Bangladesh Inland Water Transport Master Plan (BIWTMAS), 1989, DHV Consultants, the Netherlands

Protocol on Inland Water Transit and Trade between Bangladesh and India from 1972 to 2011 including agreed minutes of the meetings

Agreed minutes of 15 meetings of the Standing Committee under PIWTT from August 1973 till September 2012

Bangladesh Integrated Transport System Study, 1998, Planning Commission

Inland Water Transport Authority Ordinance, 1958 (as amended up to 1997)

Inland Shipping Ordinance, 1976 (as amended up to 2005)

Consultancy Services for IWT System in Bangladesh, 2006, Khan Parvez Ali Anwar

Revival of Inland Water Transport: Options and Strategies, 2007, World Bank

National Workshop on Development Strategy for Inland Water Transport, 2005, BIWTA and World Bank

Annual Ports and Traffic Reports, 1995-1999, BIWTA

River Notices, January 2010 to November 2014

Situation Analysis on Inland Navigation, 2012, International Union for Conservation of Nature and Natural Resources

National Shipping Policy, 2000, Ministry of Shipping

National Water Policy, 2001, Ministry of Water Resources

National Water Management Plan, 2004, Ministry of Water Resources

Integrated Multimodal Transport Policy, 2013, Roads Division, Ministry of Communication

Bangladesh Climate Change Strategy and Action Plan, 2009, Ministry of Environment and Forest

Inland Water Transport Master Plan Study, Final Report, 2009, Transport Sector Coordination Wing, Planning Commission

Port of Chittagong: Efficiency Study, 2014, World Bank

Port of Mongla: Efficiency Study, 2014, World Bank

KCT Pre-Feasibility Study, 2014, World Bank

Bangladesh Port Sector Briefing Note, 2014, World Bank

A Brief Note on the Port Sector in Bangladesh, 2007, World Bank

Master plan for Development of Haor Area, 2012 CEGIS

Techno-Economic Feasibility of a Deep Sea Port in Bangladesh, final Report, 2009, Pacific

Consultants International, Japan

Techno-Economic Feasibility for Development of and Inland Container River Port at Ashuganj, Bangladesh, 2014, WAPCOS, India

Bangladesh: Port and Logistics Efficiency improvement, 2011, Asian Development Bank

Foreign Direct Investment (data.worldbank.org/indicator/BX.KLT.DINV.WD.GD.ZS)

Techno-Economic Feasibility and Environmental Study for the Development of Sea Port at Rabnabad Channel in Patuakhali District, 2014 by the Institute of Water Modelling

BASELINE STUDY: 14

Sustainable Transportation and Infrastructure

Part 4 : **Power**

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Executive Summary : Study 14 (Part 4 : Power)

Bangladesh power sector is experiencing a transition period at present. Till now the power sector is heavily dependent on the local natural gas. The gas reserve of Bangladesh is declining. So, it is expected that in the near future the power sector will shift its dependence from natural gas to imported coal and then local coal. Therefore the power sector will be more dependent on transportation sector especially on rail and waterways. Bangladesh has quite a good reserve of high grade coal, but due to the dense population it is difficult to evacuate a vast area of land to explore the coal. Government is yet to decide how to explore the national coal reserve, whether it should go for open mining or tunnelling method or underground coal gasification method. Coal is the cheapest alternative to natural gas for near future power solution. Bangladesh is aspiring to have nuclear based power generation and is planning to have approximately 4000 MW of electric power capacity from nuclear by 2030. In future, CO_2 emission from coal based power plants, safety of nuclear power plants and source of cooling water for these power plants will be of great concern.

The government has developed the Power System Master Plan-2010 (PSMP-2010) where a time span up to 2030 has been considered in the planning. For this baseline study, various documents and reports have been consulted; such as, the above-mentioned PSMP-2010, The National Energy Policy, National Renewable Energy Policy-2008, 6th Five Year Plan, the Annual Reports of Bangladesh Power Development Board, the Annual Reports of PetroBangla, Published documents of Ministry of Power, Energy and Mineral Resources (MoPEMR) and the websites of its line agencies.

Bangladesh Power Development Board (BPDB), formerly a part of Bangladesh Water and Power Development Authority (WAPDA), was established on May 1, 1972 and was solely responsible for power generation, transmission, distribution and planning of Electricity throughout the whole country. BPDB under the Power Division of the Ministry of Power Energy and Mineral Resources started its operation with Installed Generation capacity of only 200 MW. As part of reform and restructuring, a number of Generation and Distribution companies have been created. The Power Grid Company of Bangladesh (PGCB) is a government owned company which is solely responsible for power transmission. Generated power of different power plants all over the country is evaluated and transmitted through PGCB's integrated grid system by 400 kV, 230 kV and 132 kV transmission lines and substations. Rural Electrification Board (REB) is responsible for electrification of rural areas of Bangladesh. Several other distribution companies were created later for distribution of power in the urban and semi-urban areas, like DESA, DESCO, DPDC, WZPDCO etc.

The study shows that the installed capacity of 200 MW in FY 1972-73 which has been increased to 10,416 MW in FY 2013-14. The contribution of natural gas is 62.16 % of total installed capacity of 10,416 MW. The coal based power plant of 250MW came into existence in 2006 which was only 2.4% of present installed capacity. There is only one hydropower plant in Bangladesh with a capacity of 230 MW. The total installed capacity of liquid fuel (HFO, HSD) based power plant was 503 MW in FY 1996-97 which has been increased to 2,961 MW in FY 2013-14 shows an increase by 5.89 times in 17 years. An increase by 1,039 MW can be noticed in the installed capacity of HFO based power plant in FY 2011-12. In FY 2013-14, the electricity generated by gas was 30,559 GWh which is more than double compared to FY 2000-01. On the other hand, the electricity generation by liquid fuel (HFO and HSD) is 7,745 GWh in FY 2013-14 which is increased by seven times compared to FY 2000-01. The import of electricity from India has started in FY 2013-14 and the total imported electricity was 2,265 GWh in the first fiscal year. In FY 2013-14, the transmission loss was reduced to 14.12%. At present the highest amount of electricity is consumed by domestic sector followed by the industry sector. The year-wise CO_2 emission from electricity generation has been calculated. According to report of Department of Environment, Ministry of Environment and Forest, the gird emission factor is 0.67 ton CO_2 /MWh in 2013.

At Present, 68% of the total population has access to electricity (including renewable energy), and per capita electricity generation is 348 kWh (Including Captive). Among selected South Asian countries, Bangladesh stands third in term of production of electricity but ranks highest in usage of natural gas (88.84 %) for production of electricity. As on December 2014, the total installed capacity is 10,861 MW and total derated capacity is 10,266MW. The 54% of the total installed capacity comes from public sector which is equal to 5,880 MW and remaining 4,981 MW (46%) comes from the privately owned companies. During the last six years (2009-14), total 5,804 MW (Including 500 MW import from India) of electricity has been added to the national grid, among which 60% has been installed in the private sector and remaining 40% in the public sector. The percentage of natural gas, liquid fuel (HFO, HSD and Duel Fuel) and imported power in this 5,804MW of electricity are 51, 40 and 9 respectively.

The Renewable Energy Policy 2008 envisions that 5% of total energy production will have to be achieved by 2015 and 10% by 2020. Under the existing generation scenario of Bangladesh, Renewable Energy has a very small share to the total generation. The share of Renewable Energy exceeds more than 1% till now. Government has already launched "*500 MW Solar Power Mission*" to promote the use of Renewable Energy to meet the increasing demand of electricity. Power Division of the Ministry is hosting 500 MW solar power development programs which is the largest ever solar power development initiative in Bangladesh and so far among any LDC country. Out of 500 MW solar power, 340 MW will be implemented by Private sector and rest 160 MW will be implemented by public sector. A nodal agency called Sustainable and Renewable Energy Development Authority (SREDA), as envisioned in the Renewable Energy Policy, is established and in the process of staffing the organization. This organization will provide policy support to the government as well as work to promote, expand and develop the renewable energy and to enhance energy efficiency both in public and private sectors. Government utilities are involved in large scale grid-connected renewable energy based power project development. On the other hand, private sector is involved with off-grid home-based renewable energy solutions. At present total renewable energy capacity is about 174 MW. Some major projects under implementation by Bangladesh Power Development Board are 7.4 MWp Grid Connected Solar PV Power Plant at Kaptai Hydro Power Station at Rangamati, 4.2 MW solar-diesel hybrid (2.2 MWp solar) power system for off grid Hatiya island and 650 KWp (400 kW load) Solar Mini Grid Power Plant at remote Haor area of Sullah upazila in Sunamganj district.

In private sector, about 3.5 million Solar Home Systems (SHS) have already been installed under the SHS program of Infrastructure Development Company Limited (IDCOL) in the off-grid rural areas of Bangladesh till December, 2014. As a result, the beneficiaries getting solar electricity numbers around 13 million, which is around 9% of the total population of Bangladesh. IDCOL has a target to finance 6 million SHS by 2017, with an estimated generation capacity of 220 MW of electricity. IDCOL initially received credit and grant support from the World Bank and GEF to start the program. Later, GIZ, KfW, ADB, IDB, GPOBA, JICA, USAID and DFID came forward with additional financial support for expansion of the SHS Program. At present 47 Partner Organizations (PO) are implementing the program in the field level. After the success of SHS program, IDCOL initiated Solar PV based mini-grid projects in remote areas of the country where possibility of grid expansion is remote in near future. These projects provide grid quality electricity to households and small commercial users and thereby encourage commercial activities in the project areas. So far, IDCOL has financed one 100 kWp solar micro-grid project in Sandwip Island. The mini-grid project is currently supplying electricity to adjacent 250 shops, 5 health centers and 5 schools.

Another four projects of different capacity (100~177kWp) have been approved by IDCOL which are in various stages of construction. IDCOL has a target to finance 50 solar mini-grid projects by 2017. The World Bank, KfW, GPOBA, JICA, USAID, ADB and DFID are providing financing support in these projects. Another program of IDCOL is Solar based irrigation systems which are environment friendly solution for the agro-based economy of Bangladesh. The program is intended to provide irrigation facility to off-grid areas and thereby reduce dependency on fossil fuel. IDCOL has approved 114 solar irrigation pumps of which 38 are already in operation. IDCOL has a target to finance 1,550 solar irrigation pumps by 2017. The World Bank, KfW, GPOBA, JICA, USAID, ADB and Bangladesh Climate Change Resilience Fund (BCCRF) are supporting this initiative.

Sixth Five Year Plan, Power System Master Plan (PSMP) 2010 and Renewable Energy Policy have been analyzed to draw the future trend of Bangladesh power sector. The peak demand of electricity will be 33,708 MW by 2030 according to the forecast made in PSMP 2010. On the other hand, the demand will be 28,537 MW by 2030 to achieve 7% GDP. To meet this demand, the generation capacity will be increased to approximately 17,500 MW in public and private sectors by FY 2021 as a short-term plan. According to PSMP 2010, the fuel composition ratio would be Coal 50% (30% domestic coal and 20% imported coal), Natural gas 25% (including LNG), Liquid fuel 5%, Nuclear, Renewable and Cross-Border Trade will be 20% by 2030 as a long-term generation plan. Therefore the coal based power plants will be the main contributor of CO2 emission as coal will be the primary source of energy by 2030. According to PSMP 2010, 19,650 MW of electricity will be added from coal based power plants by 2030. The coal centers will be located in Sonadia, Matarbari and Chittagong from where coal will be transported to coal based power plants by waterway and railway.

As a part of future expansion of power sector, the first nuclear power plant will be built at Rooppur on the bank of the Padma River, 200 km north-west of Dhaka, in Ishwardi, a sub-district of Pabna District, in the northwest region of the country. Bangladesh Atomic Energy Commission under the Ministry of Science and ICT is the government agency responsible for implementing the project. The project is the initial stage and the detail report and design documents will be prepared based on the feasibility evaluation, Engineering survey, Environment studies, by June 2017. The construction of the first reactor is scheduled to start in 2017. Power System Master Plan 2010 also identified several inter-connection points for regional power trade with neighbouring countries like India and Myanmar. It is mentioned in the 6th five year plan that along with other necessary facilities, at least the infrastructure of the two terminals of 500 MMCFD will be built, to receive the imported LNG to meet the shortage of gas supply.

The power sector is facing many challenges such as: lack of adequate resources (private/ public/ external); issues relating to Good Governance; lack of adequate co-ordination; lack of appropriate cost and asset accounting system; irregular and insufficient gas supply; inadequate maintenance of power plants; tariff rate and structures; delay in implementation of power projects; organizing funds for project implementation; lack of prioritization of projects, load shedding; lack of maintenance budget; failure in routine maintenance and forced shutdown of power plants and blackout. In addition, the power sector will face more challenges in future mainly due to expansion of the sector. The future challenges include transportation of fuel, lack of cooling water due to the changing situation, project financing, transportation of fuel, safety of nuclear power plants, human resource development for new technologies, limited budget of research & development on new technologies and overdependence on Imported Power.

The knowledge gaps for implementing the future plan have been identified. The main knowledge gaps are the lack of qualified and experienced local experts and also lack of experience of Giga Watt (GW) scale coal power plant, coal mining and coal transportation, lack of knowledge and manpower for nuclear power plant operation and maintenance and safety issues, lack of experience in financing and management of large scale projects, realization of LNG terminal and deep sea port, lack of assessment on the impact of importing electricity from neighbouring countries on the operation and safety of national grid, lack of background study of CO_2 emission from coal based power plants.

- Government should take immediate decision as to how to explore the national coal reserve; whether to go for open mining or tunnelling method, or underground coal gasification method.
- Bangladesh is aspiring to have nuclear based power generation and it is planning to have approximately 4,000 MW of electric power capacity from nuclear energy by 2030. Qualified and experienced local experts should be employed and human resources need to be developed for the safe operation and maintenance of nuclear power plant.
- Source of cooling water is going to be a major issue for Rooppur Nuclear Power Plant as well as for large scale thermal power plants. The natural draft cooling tower technology could be a solution if adequate water cannot be arranged from the respective rivers.
- According to the power system master plan there will be a big power generation hub in the northern part of Bangladesh. The inland waterways need to be kept navigable by regular dredging during the construction phase and also for fuel transportation like coal and LNG.
- Coal can be transported by waterways and railways. The success in setting up coal as a main source of fuel for electricity generation is greatly dependent on related infrastructure development.

- According to second national communication of Bangladesh submitted to UNFCCC, the power generation subsector is the main source of green house gases (GHGs) emission in Bangladesh. Among all power plants, the coal based power plants are having highest grid emission factor. Preventive measures like pulverized coal and ultra super critical pressure technology should be taken to reduce GHGs emission from coal fired power plants.
- Development in transportation sector is equally important; without developing the transportation sector, the real benefit of improvement in power sector cannot be harnessed as uninterrupted power supply and free movement of heavy vehicles are preconditions of economic development.

Upgrading of protection devices and real time fault detection is essential so that the national grid would be capable to handle power feeding from different power sources like imported power from neighbouring countries, nuclear power plant and MW scale coal based power plants, and the national grid should withstand any interruption from these power plants or from other sources.

1 Introduction

1.1 Background

An adequate and efficient country-wide transport system is a pre-requisite for initiating and sustaining economic development. Investment in improving transport efficiency is the key to the expansion and integration of markets – sub-national, national and international. In addition, it contributes to the generation of economies of scale, increased competition, reduced costs, systematic urbanization, export-led faster growth and a larger share of international trade. An efficient transport system is an important element of trade logistics cost and as such is a major determinant of export competitiveness. Efficient transport is also critical in enhancing the physical mobility of citizens. Efficient transport reduces the commuting time of general public, thereby contributing to their welfare.

The transport system of Bangladesh consists of roads, railways, inland waterways, sea ports, maritime shipping and civil aviation, catering to both domestic and international traffic. Besides an efficient transport system, a reliable power system (production, transmission and distribution) is an integral component to initiating and sustaining economic development.

1.2 The Objectives

The broader objective of the thematic baseline is to understand the core drivers within the context of Sustainable transportation and communication infrastructure aspects. These drivers will have to be analysed on the basis of their relevance and impact levels, among others.

The objectives of the thematic baseline study within the context of Sustainable transportation and communication infrastructure analysis therefore include:

- To evaluate existing challenges, developments, opportunities and (government) plans by transport system
- To evaluate expected challenges/opportunities in view of the long term (socio economic and climate) changes
- To identify existing trends and future developments
- To support the common knowledge base
- To identify on-going projects, projects in pipeline and long term perspectives/ideas particularly focusing on water transport system

1.3 Methodology

The methods for this baseline study (and its subsequent subsectors) build on fact finding and interviews by the study team with relevant institutions/stakeholders and the use of existing reports, plans as well as on information available on websites of the relevant institutions. Among this, information has also been gathered on on-going investment projects as well as future planned investment projects.

1.4 Key Sectors of the Study

Roads and Highways: Roads and Highways are considered as the bloodline of the internal communication. Therefore, understanding the present road network is very important

Railways: Railway has connects 44 districts and almost all the important places of the country and has a great contribution in accelerating the economic activities

Inland Waterways: Bangladesh is crisscrossed by thousands of rivers. Inland waterways always play a vital role in communication, especially transporting agricultural goods from one place to another

Ports and Maritime Shipping: (sea) ports and maritime shipping are crucial for import and export of goods (raw materials, such as coal for power stations, intermediary good, and end-products

Power: Power is considered as one of the top most priority sectors of Bangladesh. At present, it is the most critical growth driver of Bangladesh economy. Analysis of power sector and the present and future prospects of the sector in Bangladesh are very important.

1.5 Relationship to Delta Plan 2100

Transportation sector is a key sector which plays an important role in the economic development and urban planning of the country – for the present and the long run. As such the relationship between this infrastructure sector and the BDP 2100 is very important. During the preparation of this report, many discussions were held with roads & highways, railways, inland waterways & ports as well as the power sector. Apart from inland waterways and ports, which directly relates to the Delta Plan in terms of navigation and accessibility for shipping, the power sector, in terms of availability of cooling water and its consequences, are not directly related to Delta Plan strategies, and the various interventions/measures to be taken for the short, medium and long term up to 2100. However, when the Delta Plan is operational, their policies and accompanying (new) investment projects have to conform to the Delta Plan strategies and interventions including in particular, the spatial planning. Therefore, a mechanism has to be implemented, which can sort this out. In the Netherlands the so-called "Water Check" is carried out. For Bangladesh a comparable mechanism of conditionality have to be designed which can deal with (new) plans and (new) investment projects in the transportation infrastructure sector.

1.6 Relationship with other Baseline Studies

Roads & Highway and Railway Sectors

The Roads & Highways and Railway sectors are not directly related to the other Baseline studies, however they are related indirectly. The state of roads, highways, and railways in Bangladesh represent the country's infrastructure as well as the majority of the transport network, which in turn affects the overall economic development of the country. Economic development in turn affects all sectors of the country. Therefore the planning for any other sector (i.e. fisheries, agriculture), must take into consideration the state of the infrastructure.

On the other hand, the road and railway network are also influenced by other factors, such as population, climate change, and sectors that can either increase or decrease the transport sector's demand, such as agriculture. Issues such as population change and the development of dependent industries dictate the overall demand for transport, and therefore affect the way the transport network evolves over time. Climate change continuously affects the roads, highways, and railways, as made evident by the damages caused by persistent flooding. Therefore, it is important that infrastructure is planned in line with the changing dynamics of all directly and indirectly related sectors and issues.

Inland Waterways and Ports

The National Water Management Plan (NWMP) describes the river systems as the *life-blood* of Bangladesh. All those areas which are depending on or utilizing the river are directly linked with each other and integrated under the water management plan. As such, NWMP was prepared *in a comprehensive and integrated manner for the interests of all water related sectors and taking full account of other sectoral policies of the Government.* Accordingly, River Management and River Morphology are directly related with inland waterways.

Navigation requires water, availability of which ensures better eco-system. This way, the inland waterway is related with environment at large. Emission of carbon dioxide from the transport output is one of the largest contributors to global warming and climate change. Sustainable development of transport network must consider the issue of comparative carbon emission of different modes. So, Pollution is related with inland waterways. Rivers are directly and strongly affected by climate change and impact of climate change is already evident in the waterways of Bangladesh.

Power sector is also related with inland waterways as almost all power plants were developed by the side of the rivers. Constructions of power plants require certain navigability for the carriage of over-dimensional (O.D) equipment which cannot be transported by rail or road. River is also required after construction for a thermal power plant for continuous transport of coal and to meet the need of cooling water.

The Integrated Multimodal Transport Policy 2013 envisages *integration within and between different types of transport* with the objective of establishing an efficient transport network that is able to provide a cost and time effective door to door service. As such roads and highways, and railways are related with inland waterways and so with maritime ports.

Power Sector

The power sector is directly related to some other baseline studies, for example: Transportation specially water and railway, Environment and Hydrology etc.

The only way to transport heavy equipment's and machineries of power plants is waterway means rivers. According to the power system master plan there will be a big power generation hub in the northern part of Bangladesh. The rivers need to keep navigable during the construction phase. Fuel of power plant like coal can be transported by waterways and railways. The success in set up coal as main source of fuel of power generation is greatly dependent on related infrastructure development for coal transportation.

The large scale power plants are always located at the bank of river because it is convenient for equipments and fuel transportation. Also a huge amount of river water is needed as the source of cooling water for thermal power plants. Important information like shifting of location of river, depth and availability of water in rivers, river erosion and location of flood prone areas based on baseline study on river system management are essential for identifying proper location of new large scale power plant.

According to second national communication of Bangladesh submitted to UNFCCC, The power generation subsector is the main source of green house gases (GHGs) emission in Bangladesh. The power sector is also directly related to environment and climate change baseline studies. Among all power plants, the coal based power plants are having highest grid emission factor. In the future, the GHGs emission of power sector will increase considerably as coal will be the main fuel of power generation.

1.7 Structure of the Report

After the introductory Chapter 1, an overview of infrastructure development in Bangladesh including a comparison of the country's main transport infrastructure systems with the neighbouring countries has been described in Chapter 2. Thereafter, each of the main transport infrastructure system has been dealt with in a separate chapter. Subsequently, the following sub-sectors are analyzed and discussed: i) roads and highways, ii) railways, iii) inland water transport & ports and maritime shipping, and ix) power. The Chapter 3 in each report includes the history, present status, key policies, future outlook, key challenges, knowledge gaps and recommendations in the sub-sector concerned. An executive summary for each of the sub-sectors is presented at the beginning of this report. The relevant tables, figures, maps are enclosed as per the Table of Content.

It is important to note that data used in this study were primarily taken from government institutions, such as the Ministry of Road Transport & Bridges, Roads and Highways Division, Ministry of Railway, Ministry of Port, Shipping & IWT, Bangladesh Bureau of Statistics, Ministry of Finance, etc. However, the information/ data may often appear outdated due to unavailability of updated information. The most recently government published information was used for the majority of this report.

The report was initially prepared as one report containing all the sub-sectors under the title "Baseline Study: Sustainable Transportation and Infrastructure." However, it was decided later that the report would be divided into four parts, each one containing the baseline study of the relevant sub-sector. As it stands now, the four volumes of the report have been titled as follows:

Sustainable Transportation and Infrastructure Volume 1: Roads & Highways

Sustainable Transportation and Infrastructure Volume 2: Railways

Sustainable Transportation and Infrastructure Volume 3: Inland Water Transport & Ports

Sustainable Transportation and Infrastructure Volume 4: Power

However, the Executive Summaries of all sub-sectors are included in all the volumes. In addition, the introductory chapter (Chapter 1) and Chapter 2, giving an overview of infrastructure development in Bangladesh, are also included in all the four volumes.

2 Overview of Infrastructure Development in Bangladesh

A well-organized and dependable transport and communication system is essential for the socio-economic development of a country. According to data released by the Bangladesh Bureau of Statistics (BBS), in FY 2013-2014, the growth rate in this sector and its contribution to GDP at constant price were approximately 6.47% and 11.54% respectively.[5]

Table 1 Sectoral Shares of GDP (%) at Constant Prices (Base Year 2005-2006)

Sector	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Transport, Storage, & Communication	10.89	11.05	11.23	11.49	11.50	11.54
a. Land Transport	7.19	7.28	7.31	7.32	7.31	7.31
b. Water Transport	0.95	0.92	0.89	0.86	0.84	0.81
c. Air Transport	0.12	0.13	0.14	0.14	0.13	0.12
d. Support Transport Services, Storage	0.58	0.60	0.63	0.69	0.67	0.66
e. Post & Telecommunication	2.06	2.12	2.26	2.48	2.56	2.63

Source: Bangladesh Bureau of Statistics

The transport sector's (including transport, storage, & communication) high percentage contribution to GDP at constant price, 11.50% in FY 2012-2013 and 11.54% in FY 2013-2014,[6] indicates that the transport sector is an important component of the socioeconomic development of Bangladesh. Land transport represents the majority of the transport's sector's high percentage contribution to GDP with 7.31% in FY 2013-2014 (**Table 1**).

However, according to **Table 2**, extracted from the *World Economic Forum's Global Competiveness Report 2013-2014*, Bangladesh has a score of 2.8 in terms of infrastructure, which includes measures in electricity, roads, railroads, and port. Considering other countries in the region, Bangladesh, along with Myanmar, ranks in the bottom two in terms of infrastructure. Pakistan, a country with a lower overall country ranking than Bangladesh, leads Bangladesh in infrastructure quality with score of 3.3. The only country with a lower infrastructure score than Bangladesh is Myanmar,

[5] Bangladesh Bureau of Statistics

[6] Bangladesh Bureau of Statistics

with a score of 2.1. This indicates that Bangladesh is badly in need of strong many infrastructural improvements in order to boost its economy in the future

Table 2 Global Competiveness Report 2013-2014, Comparison of Infrastructure Quality 2013-2014

Country	Country Ranking	Overall Infrastructure Score	Electricity	Roads	Railroads	Port
Bangladesh	**110**	**2.8**	**2.2**	**2.8**	**2.4**	**3.5**
India	60	3.9	3.2	3.6	4.8	4.2
China	29	4.3	5.1	4.5	4.7	4.5
Cambodia	88	3.9	3.2	3.7	2.0	4.0
Nepal	117	2.9	1.6	2.7	1.1	2.7
Bhutan	109	4.9	5.9	4.3	n/a	2.2
Myanmar	139	2.1	2.9	2.4	1.8	2.6
Pakistan	133	3.3	2.0	4.0	2.5	4.5
Sri Lanka	65	4.8	5.0	4.7	3.6	4.2
Thailand	37	4.5	5.2	4.9	2.6	4.5

Source: World Economic Forum, the Global Competitiveness Report 2013-2014

Note: Country Rankings are in descending order with "1" considered as the best performer. Overall Infrastructure score is in ascending order with "1" considered as a lower score.

In **Table 3**, a comparison of Bangladesh's infrastructure score over a span of 8 years (2006-2014), shows some improvement over time. For instance, Bangladesh's infrastructure score increased from 2.03 in 2006-2007 to 2.8 in 2013-2014, a result of improvements in the electricity and port sector.

Table 3 Bangladesh's Infrastructure Score over time

Year	Overall Infrastructure Score	Electricity	Roads	Railroads	Port
2013-2014	2.8	2.2	2.8	2.4	3.5
2010-2011	2.7	1.6	3.0	2.5	3.4
2006-2007	2.03	1.6	3.1	2.3	2.4

Source: World Economic Forum, the Global Competitiveness Report

If the changes in infrastructure score over the past 4 years (2010-2014) are compared, there has only been a very small increase in the score, from 2.7 to 2.8, however this improvement is again due to improvements in electricity (1.6 to 2.2) and port (3.4 to 3.5) only. On the other hand, in the same span of 4 years, roads and railroads have decreased from 3.0 to 2.8 and 2.5 to 2.4 respectively. This is likely due to immense Government focus on increasing access to electricity as well as developing port facilities, although the Government should simultaneously focus on drastic improvements in the roads and railroads sector.

The Government of Bangladesh (GoB) has recognized that in order to achieve targeted GDP growth rates, it is important to further develop Bangladesh's infrastructure. Bangladesh's *Sixth Five Year Plan* (2011-2015), a Government plan for economic development over five years, has addressed this issue by setting certain strategic goals for the Bangladesh transport sector, which include primarily the following:[7]

[7] Mid Term Implementation Review of Sixth Year Plan, Policy Research Institute

- Undertaking an optimal mix of "market integration approach" and "poles of development approach" through the development of five main corridors: Dhaka-Chittagong, Dhaka-Northwest, Dhaka-Khulna, Dhaka-Sylhet, and Khulna-Northwest
- Building an integrated transport network by constructing Padma Bridge at Mawa-Janjira point (integrating inland water transport with existing or new road transport systems)
- Improving connectivity with neighbouring countries through the development of inter-modal transport network
- Improving resource mobilization through the introduction of user charges/fees in the entire transport network
- Ensuring the deficit free operation of the Bangladesh Railway
- Improving transport safety standards to reduce incidence of accidents
- Increasing private partnership in the transport sector through the PPP framework

Integrated multi-modal transport

The Govt has also recognized that integrated multi-modal transport should be prioritized, as indicated by the *Integrated Multi-Modal Transport Policy*, which states that the sustainability of the transport sector will be heavily dependent on its ability to offer its stakeholders integrated and multi-modal transport, essentially meaning that the transport system must integrate:

1) Within and between different types of transport
2) With the environment
3) With land use planning
4) And with policies for education, health, economic growth, gender and social equity, and poverty reduction

Intermodal Connectivity

In the past two decades, the Govt has been placing heavy emphasis on the development of the road sector at the cost of less development in the railway and inland waterway transport sectors. Certain geographic conditions of Bangladesh, such as the country being relatively flat, have contributed to this growth of road transport. To add, road transport offers more mobility and connectivity than other transport modes, partially due to its continuous development. Short-term planning has also resulted in the emphasis of roads versus inland waterways and railways. However, it is important that Bangladesh, a country of many inland waterways, and an exponentially increasing demand of transport pay special attention to the development of both its inland waterway and railway sectors.

Transportation connectivity in Bangladesh could be well enhanced and meet future demands of transport growth if an effective and full-proof plan for intermodal connectivity was followed. Railway offers certain distinct advantages, such as lower cost for the transportation of passengers and freight, as well as being more environmentally friendly. Inland waterways also offers advantages as they can contribute to the effective transportation of freight and if these same waterways were efficiently connected to railway and road, their importance and contribution to effective transport could only grow.

The *Integrated Multi-Modal Transport Policy* 2008 addresses this issue. Although, there is still a lack of integrated transport policy and planning framework that could result in the prioritizing of investments. This makes it difficult for the transport sector to allocate resources between sub-sectors effectively. Most importantly, there have been a number of transportation studies in recent years that advocate for intermodal connectivity, however, no real effort has been made for the actual functional integration of different modes of transport.

Increased intermodal connectivity could have positive effects on all economic activities; especially the carriage of freight, on agriculture. Nearly half of the population is employed in the agriculture sector, however rural areas, which are generally used for agricultural land, are yet to see efficient transportation infrastructure. This is understood by the fact that not enough rural areas have roads and if they do have roads, the majority of these roads are narrow and dirt roads (unpaved).In addition, many rural areas are unable to withstand the loads of heavy farm equipment; all of these factors taken together make the logistical costs between different parts of Bangladesh some of the highest in the world. If more investments were made into reliable infrastructure, the agricultural sector would improve. Agricultural supplies could more efficiently reach farm lands, and agricultural products could also efficiently reach markets through carriage on a mix of different transport modes: roads, railways, and inland waterways.

Inter-modal connectivity is especially important in and around Dhaka. Currently, the existing modes of transport act independently with each other and are often in competition, however, they should also benefit from each other. Passengers suffer due to a lack of connection between modes and poor scheduling, an integrated scheduling and ticketing system should be initiated in Dhaka within all modes of transport. For instance, an individual travelling by river from his/her village, should be able to connect to a railway link that can bring him/her into the heart of the city, and from there take a bus to his/her final destination with convenience. For example, Dhaka Airport has few direct bus connections, but the railway station is not very near. There is no high-speed form of transport, such as a metro line, from the airport; this only increases the transfer time many fold.

3 Power Subsector

3.1 Sector History

When the British colonial rulers left in 1947, power generation and distribution of the country was in the hands of some private companies. The power supply to the-then 17 provincial districts was within the township in a limited way. The generation voltage was 400 volts (45), and the power used to be supplied to most of the districts during night time only. Only exception was the Dhaka city where power used to be supplied by two 1500 kW generators and the generation voltage was 6600 volts, which was the highest supply voltage that time (45). The generation capacity of the power utility companies together was only 7 (seven) MW and there was no transmission system.

In 1948, Electricity Directorate was created in order to plan and improve power supply situation. A decade later in 1959, Water and Power Development Authority (WAPDA) was created and the power sector stated taking shape. In 1960, Electricity Directorate was merged with WAPDA. The philosophy was to give more autonomy to an organization for development of the power sector. At that time relatively higher capacity plants were built at Siddhirganj, Chittagong and Khulna (highest plant size was only 10 MW Steam Turbine at Siddhirganj). The Kaptai dam was under construction under the Irrigation department; the unit size of Kaptai was 40 MW, which for that time was considered to be a large power plant. Simultaneously, the construction of Dhaka-Chittagong 132 KV transmission line was in progress. Construction of Kaptai dam and commissioning of Dhaka-Chittagong 132 KV transmission line in the year 1962 may be taken as milestone of power development in this country.

In 1972, after the emergence of Bangladesh through the liberation war as an independent state, Bangladesh Power Development Board (BPDB) formerly a part of Bangladesh Water and Power Development Authority (WAPDA) was established in May, 1972 as a statutory body by the Presidential Order No. 59 with the responsibility of power generation, transmission, distribution and planning of Electricity throughout the whole country.

After 1972, a number of reform measures were taken in the power sector. Since then the chronological development of the power sector may be listed as follows:

- By the ordinance (Ordinance No-LI of 1977) Rural Electrification Board (REB) was established in October 1977, for the development of electricity in the rural areas for the effective benefit of rural people.

- Under the reform program, Dhaka Electric Supply Authority (DESA) was created for proper management and electrification in Dhaka city and its adjoining districts in 1990.
- In 1996, Dhaka Electric Supply Company (DESCO) was formed to take over part of the distribution system from DESA, with a view to give better service to the people.
- DESA has been functioning as Dhaka Power Distribution Company (DPDC) since July 2008.
- Under the Companies Act 1994, Power Grid Company of Bangladesh (PGCB) was created in 1996 to look after the transmission system.
- Ashuganj Power Station has been converted into Ashuganj Power Station Company Ltd. (APSCL) in 1996.
- West Zone Power Distribution Company Ltd. (WZPDCL) was created in 2002 to look after the distribution system of Barisal and Khulna Zone.
- Electricity Generation Company of Bangladesh (EGCB) has been formed as a Generation Company since 2004. EGCB implemented 622 MW Power Plant. EGCB has started construction of 335 MW CCPP Power Plant at Siddhirganj.
- North West Power Generation Company (NWPGCL) was created in 2008. Existing Installed capacity of NWPGCL is 368 MW. NWPGCL has started construction of 360 MW CCPP Power Plant at Bheramara.

Now, Bangladesh Power Development Board (BPDB) is in the process of identifying Strategic Business Unit (SBU) for its generation and distribution sectors as a new reform initiative.

3.1.1 Generation Capacity

Age wise Installed capacity of the existing power plants (up to December, 2014) is listed in the following table (**Table 4**). Among all the generation plant the oldest running plant is the Kaptai Hydroelectric power plant's unit 1 and 2 (40 MW each). A total of 5,804 MW has been added to the national grid in the last six years (including 500 MW power imported from India), which indicates a significant growth in generation capacity achieved by the Government (45).

Table 4 Age-wise Installed Generation Capacity up to December 2014

Age Group (Years)	Installed Generation Capacity (MW)	Percentage of total capacity (%)
49 – 53	80	0.8
44 – 48	128	1.2
39 – 43	150	1.4
34 – 38	20	0.2
29 – 33	526	5.0
24 – 28	987	9.5
19 – 23	517	5.0
14 – 18	1,380	13.2
09 – 13	1,015	9.7
04 – 08	2,712	26.0
0-3	2,901	27.9
Total	10,416	100

Source: Bangladesh Power Development Board

Generation capacity decreases with the age of a power plant. So the installed capacity does not reflect the ability of power supply of a power plant. The present generation capacity of a power plant is always less than its installed capacity and it is known as derated capacity of the power plant. Historical record of installed and derated capacity of power plants from FY 1974-75 to FY 2013-14 is shown in **Table 5**. The installed capacity was only 667 MW in FY 1974-75 which was increased to 10,416 MW in FY 2013-14 (45).

Table 5 Historical Installed & Derated Capacity

FY	Installed Capacity (MW)	Derated Capacity (MW)	FY	Installed Capacity (MW)	Derated Capacity (MW)
1974-75	667	490	1994-95	2,908	2,133
1975-76	766	606	1995-96	2,908	2,105
1976-77	767	571	1996-97	2,908	2,148
1977-78	752	557	1997-98	3,091	2,320
1978-79	718	571	1998-99	3,603	2,850
1979-80	822	625	1999-00	3,711	3,549
1980-81	813	707	2000-01	4,005	3,830
1981-82	857	712	2001-02	4,234	3,883
1982-83	919	810	2002-03	4,680	4,368
1983-84	1,121	998	2003-04	4,680	4,315
1984-85	1,141	1,018	2004-05	4,995	4,364
1985-86	1,171	1,016	2005-06	5,245	4,614
1986-87	1,607	1,442	2006-07	5,202	4,623
1987-88	2,146	1,859	2007-08	5,305	4,776
1988-89	2,365	1,936	2008-09	5,719	5,166
1989-90	2,352	1,834	2009-10	5,823	5,271
1990-91	2,350	1,719	2010-11	7,264	6,639
1991-92	2,398	1,724	2011-12	8,716	8,100
1992-93	2,608	1,918	2012-13	9,151	8,537
1993-94	2,608	1,881	2013-14	10,416	9,821

Source: Bangladesh Power Development Board

The installed capacity of electricity by fuel type from FY 1996-97 to FY 2013-14 is as shown in **Table 6**. Natural gas is the primary fuel source having contribution of 62.16 % in total installed capacity in FY 2013-14. The coal based power plant came into existence in 2006 and its capacity was 250 MW which was only 2.4% of total installed capacity. There is only one hydropower plant in the country with a capacity of 230 MW (2 units of 40MW and 3 units of 50 MW) and it is located in Chittagong hill tracts. In recent years, the installed capacity of liquid fuel based power plant is increasing gradually. The total installed capacity of such power plants (HFO, HSD) was 503 MW in FY 1996-97 which has increased to 2,961 MW in FY 2013-14. An increase of 1,039 MW in installed capacity of HFO based power plant from 802 MW to 1,841 MW can be noticed in FY 2011-12 (45).

Table 6 Historical Installed Capacity by Fuel Type

Year	Hydro (MW)	Natural Gas (MW)	HFO (MW)	HSD (MW)	Coal (MW)	Import (MW)	Total (MW)
1996-97	230	2,175	242	261			2,908
1997-98	230	2,365	242	254			3,091
1998-99	230	2,575	462	336			3,603
1999-00	230	2,675	462	344			3,711
2000-01	230	3,281	346	149			4,006
2001-02	230	3,513	342	149			4,234
2002-03	230	3,956	340	155			4,681
2003-04	230	3,956	336	158			4,680
2004-05	230	4,271	342	152			4,995
2005-06	230	4,271	342	152	250		5,245
2006-07	230	4,228	339	155	250		5,202
2007-08	230	4,354	283	188	250		5,305

Year	Hydro (MW)	Natural Gas (MW)	HFO (MW)	HSD (MW)	Coal (MW)	Import (MW)	Total (MW)
2008-09	230	4,768	283	188	250		5,719
2009-10	230	4,822	335	186	250		5,823
2010-11	230	5,301	802	681	250		7,264
2011-12	230	5,862	1,841	533	250		8,716
2012-13	230	6,175	1,963	533	250	500	9,651
2013-14	230	6,475	2,107	854	250	500	10,416

Source: Bangladesh Power Development Board

3.1.2 Retirement Schedule of Power Plants

Power plants with total capacity of 8,613 MW will be dismantled by 2040, among which 4,843 MW from the public sector and 3,770 MW from the private sector (45). A quantity of 3,770 MW from the private sector is scheduled to go to retirement by 2026. The following Table shows the retirement schedule of power plants from FY 2012 to FY 2040 (**Table 7**).

Table 7 Retirement Schedule of Power Plants from FY 2012 to 2040

FY	Retired Derated Capacity (MW)			FY	Retired Derated Capacity (MW)		
	Public	Private	Total		Public	Private	Total
2013	0	53	53	**2027**	104	0	104
2014	81	110	191	**2028**	0	0	0
2015	185	0	185	**2029**	190	0	190
2016	72	33	105	**2030**	105	0	105
2017	188	0	188	**2031**	203	0	203
2018	0	525	525	**2032**	538	0	538
2019	118	643	761	**2033**	177	0	177
2020	0	0	0	**2034**	0	0	0
2021	280	405	685	**2035**	150	0	150
2022	611	501	1,112	**2036**	210	0	210
2023	206	21	227	**2037**	142	0	142
2024	180	472	652	**2038**	313	0	313
2025	0	197	197	**2039**	0	0	0
2026	570	810	1,380	**2040**	220	0	220

Source: Bangladesh Power Development Board

3.1.3 Historical Net Electricity Generation

The historical net electricity generation from FY 1970-71 to FY 2013-14 is shown in the following bar chart (**Figure 1**). The electricity generation is increaseing with an average rate of 939 GWh per year. The total generation of electricity was 42,195 GWh in FY 2013-14. It can be observed that the installed capacity of the power plants has increased significantly in recent years but the generation has not increased proportionalydue to shortage of fuel. The installed power plants in the recent time are mostly liquid fuel based. The cost of generation for the liquid fuel is much higher, so these power plants are operated in low plant factor. As a result the net energy generation has not increased that much as the installed capacity increased.

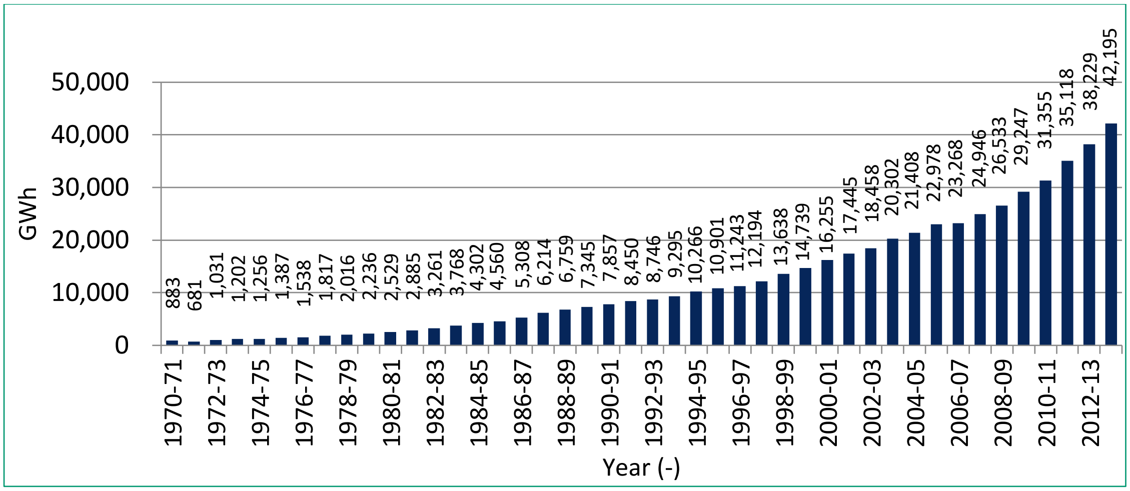


Figure 1 Historical Net Electricity Generation

Source: Bangladesh Power Development Board

The electricity generation by fuel type from FY 2000-01 to FY 2013-14 is presented in the following table (**Table 8**). In FY 2013-14, the electricity generated by gas was 30,559 GWh which was more than double compared to that of FY 2000-01. On the other hand, the electricity generation from liquid fuel (HFO and HSD) was 7,745 GWh in FY 2013-14 which was almost seven times of that of FY 2000-01. It shows liquid fuel consumption for electricity generation is increasing at a higher rate compared to the consumption of natural gas. The gas reserve in Bangladesh is declining and the supply of gas to the power plants cannot be done according to the demand. The electricity generation from hydropower was lowest in FY 2008-09 and highest in FY 2000-01. The electricity import from India started in FY 2013-14 and the total imported electricity was 2,265 GWh in the first fiscal year. The liquid fuel based power generation is costly and higher than the average tariff of the electric energy. So, liquid fuel based power plants are run at much lower plant factor. It is reflected by the power generation data of the power plants in the country. Installed capacity wise gas based power plants occupy the 62% of total generation capacity; 72% electricity has been generated by gas in FY 2013-14.

Table 8 Electricity Generation by Fuel Type (GWh)

FY	Gas	HFO	HSD	Coal	Hydro	Import	Total
2000-01	14,161	905	222		967		16,255
2001-02	15,815	797	157		677		17,445
2002-03	16,492	957	175		833		18,458
2003-04	18,079	1,158	268		798		20,302
2004-05	19,017	1,243	283		865		21,408
2005-06	20,350	1,283	342	380	623		22,978
2006-07	20,316	1,023	280	1,081	566		23,267
2007-08	21,603	1,069	286	1,038	950		24,946
2008-09	23,572	996	521	1,031	414		26,533
2009-10	26,093	877	517	1,031	729		29,247
2010-11	25,750	1,780	2,174	780	872		31,355
2011-12	27,796	4,164	1,498	883	777		35,118
2012-13	29,866	5,568	746	1,156	894		38,229
2013-14	30,559	6,516	1,229	1,038	588	2,265	42,195

Source: Bangladesh Power Development Board

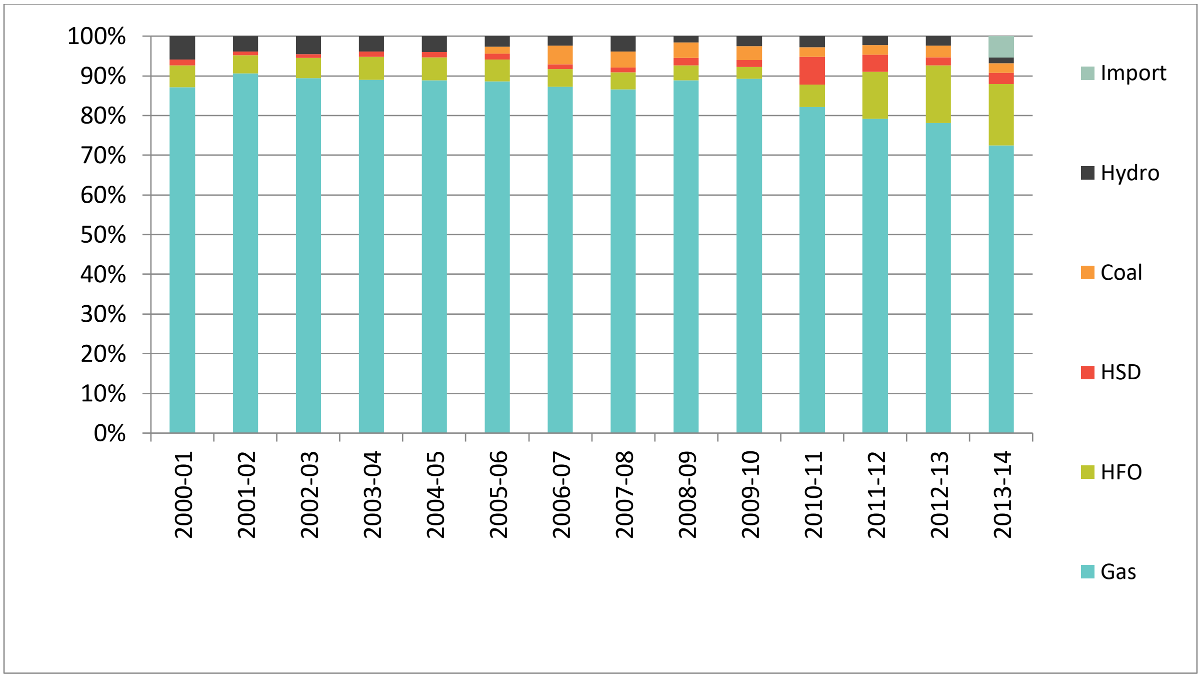


Figure 2 Electricity Generation by Fuel Type

Source: Bangladesh Power Development Board

The graphical representation of electricity generation by fuel types shows nearly 90% electricity was generated by gas in FY 2000-01 which was gone down to around 72% in FY 2013-14 (**Figure 2**). As mentioned early that the contribution of liquid fuel (HFO and HSD) is increasing as the gas reserve is decreasing gradually. It can be assumed that in future main source of primary energy will be the coal, which is also envisioned in the power system master plan 2010 (PSMP 2010). According to the PSMP 2010, coal will be the main source of primary energy for electricity generation by 2030 (54).

3.1.4 Public-Private Power Generation Share

The share of private sector in power generation has been increased in the recent time and the share is now more than public sector. However the public sector will maintain its dominant share over the planning horizon, FY 2015-FY 2021 (**Table 9**).

Table 9 Electricity Installed Capacity and Generation by Public and Private Sectors

	Sector	FY-2009	FY-2010	FY-2011	FY-2012	FY-2013	FY-2014
Installed Capacity (% of total capacity)	**Public sector**	67	64	55	56	59	56
	Private Sector	33	36	45	44	41	44
Electricity Generation (% of total generation)	**Public sector**	58	55	47	43	47	47
	Private Sector	42	45	53	57	53	53

Source: Bangladesh Power Development Board

3.1.5 Transmission & Distribution Loss (T & D Loss)

The transmission loss was 28.43% in FY 2000-01 which was decreased to 14.11% in FY 2013-14. The decreasing rate has become slow in the recent years (from FY 2009-10 to FY 2013-14). The transmission and distribution losses include technical and non-technical losses.

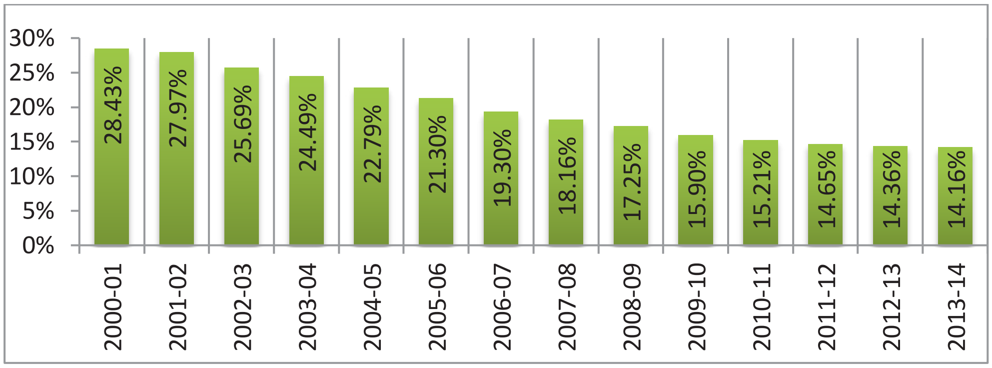


Figure 3 Historical Transmission and Distribution Loss in Percentage of Total Power Transfer

Source: Bangladesh Power Development Board

3.1.6 Fuel Consumption History

The power sector of Bangladesh is highly dependent on natural gas and the dependency is increasing as shown in the following figure expect the last FY 2013-14. The figure shows gas consumption by power sector including captive power plants since FY 1985-86 to FY 2013-14. A sharp increase in gas consumption can be noticed after the FY 1998-99 and till FY 2012-13.Gas consumption by power sector has been reduced in the last FY 2013-14. It can be foresee that from now on (FY 2014-15) the gas consumption by power sector will decline unless Bangladesh is blessed with any new gas reserve.

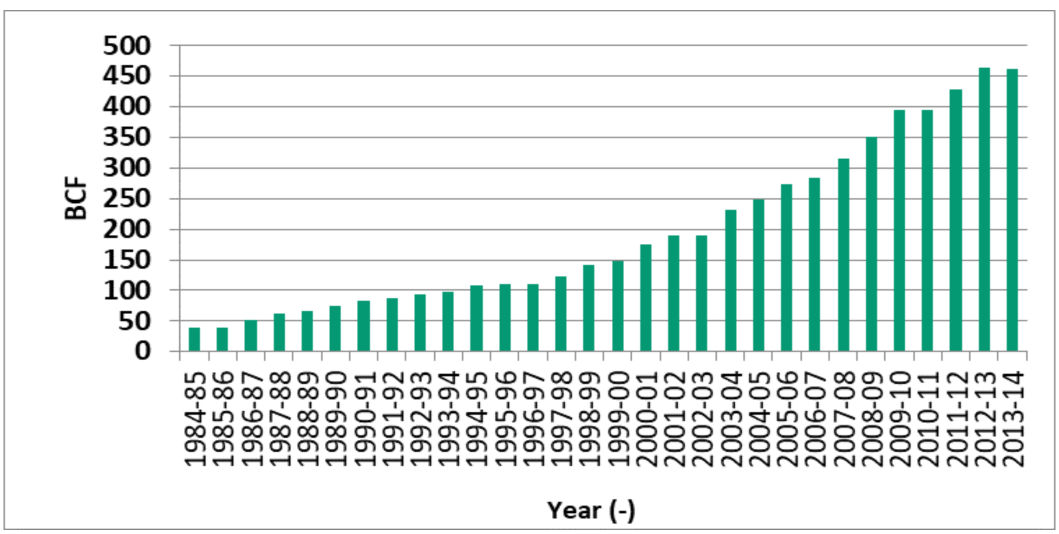


Figure 4 Natural Gas Consumption by Power Sector

Source: Petrobangla Annual Report 2012 & MIS 2014

The following Figures show the gas, liquid fuel and coal consumption from FY 1975-6 to FY 2013-14 by public sector power plants (46). The gas and liquid fuel like Diesel, Furnace Oil have been used from FY 1975-76 but using of coal has been started from FY 2005-06 only. The gas consumption has been increasing over the period time except the previous fiscal year 2013-14.On the other hand, maximum liquid fuel consumption was 600 million litre in last FY 2013-14.

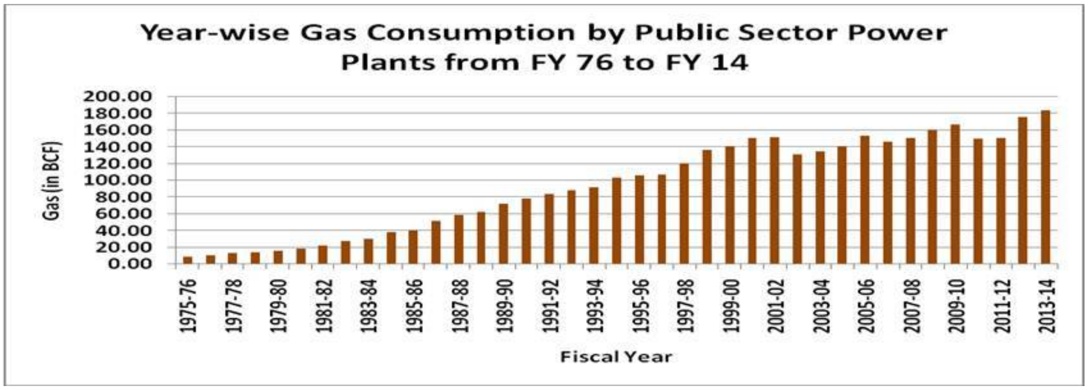


Figure 5 Year-wise Gas Consumption by Public Sector Power Plants, FY 1975-76

Source: Annual Report 203-14, Bangladesh Power Development Board

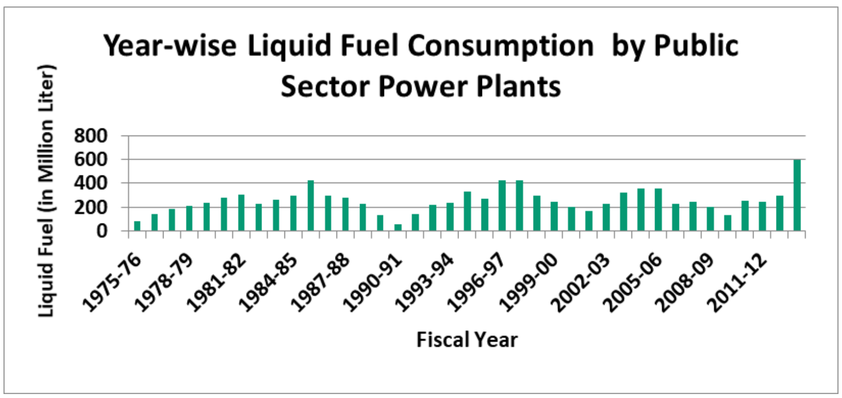


Figure 6 Year Wise Liquid Fuel Consumption by Public Sector Power Plants, FY 1975-76

Source: Annual Report 203-14, Bangladesh Power Development Board

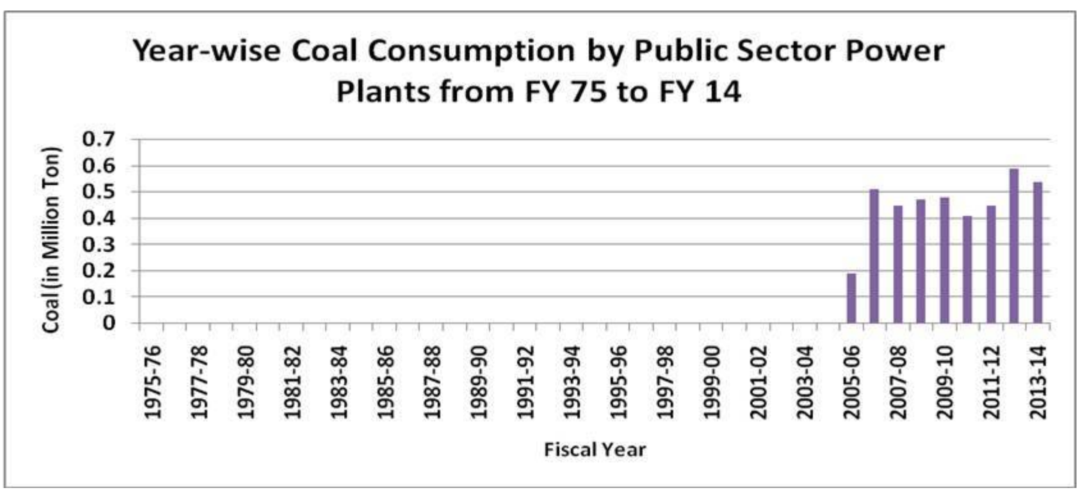


Figure 7 Year Wise Coal Consumption by Public Sector Power Plants, FY 2005-06

Source: Annual Report 2013-14, Bangladesh Power Development Board)

3.1.7 Demand Supply History

The maximum demand and supply dynamics from FY 1996-97 to FY 2013-14 is as shown in **Figure 8** below. According to Power System Master Plan (PSMP) 2010, there is a gap of 1,915 MW between maximum demand and supply in FY 2013-14. The maximum demand as per National Load Dispatch Centre (NLDC) and Power System Master Plan (PSMP) is represented by red and blue coloured bars respectively.

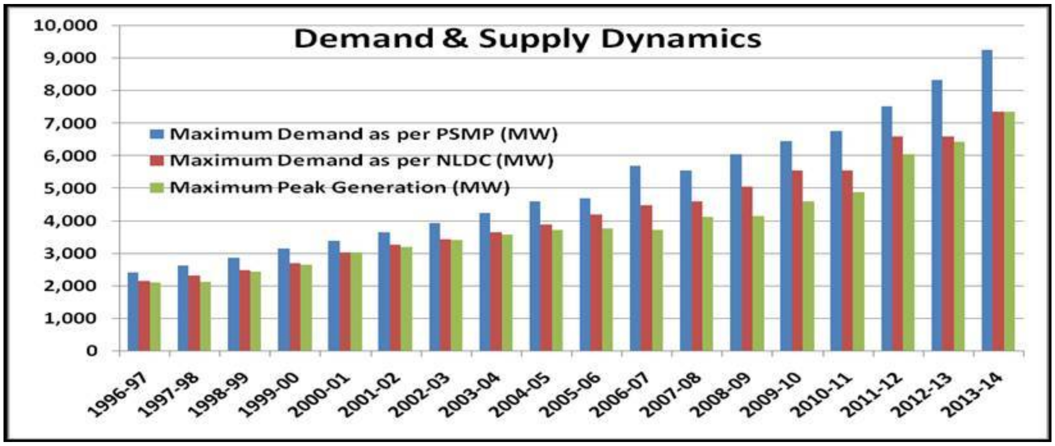


Figure 8 Demand and Supply Dynamics

Source: PSMP-2010

3.1.8 History of CO2 Emission

There is a very close relation between electricity generation and CO_2 emission. With the increase in fuel consumption for electricity generation, the CO_2 emission from the power sector is also increasing as shown in the following figure (**Figure 9**). It is worth to mention here that according to second national communication submitted by Bangladesh to UFCCC, the power sector is the main source of CO_2 emission in Bangladesh. The grid emission factor (0.67 ton CO_2 /MWh) in 2013 has been used to calculate the year- wise CO_2 emission (47). The emission factor for coal and HFO based power plant is higher than the gas based power plants. As gas reserve is declining and the power sector is going to be dependent on coal in the future, the grid emission factor will definitely increase in the coming years.

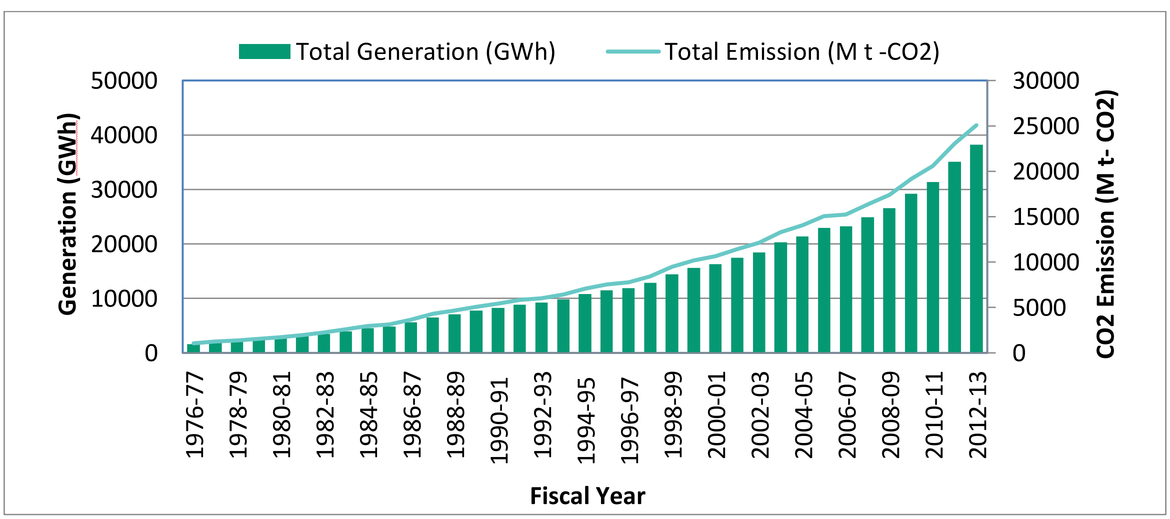


Figure 9 Year wise Total Electricity Generation & Total CO2 Emission

Source: PSMP 2010 and Department of Environment, Ministry of Environment and Forest.

3.2 Organization Structure

Power Division of Ministry of Power, Energy and Mineral Resources (MoPEMR), is responsible to formulate policy relating to power, and to supervise, control and monitor the developmental activities in the power sector of the country. To implement its mandate the Power Division is supported by a number of organizations, related with generation, transmission and distribution as shown below (**Figure 10**):

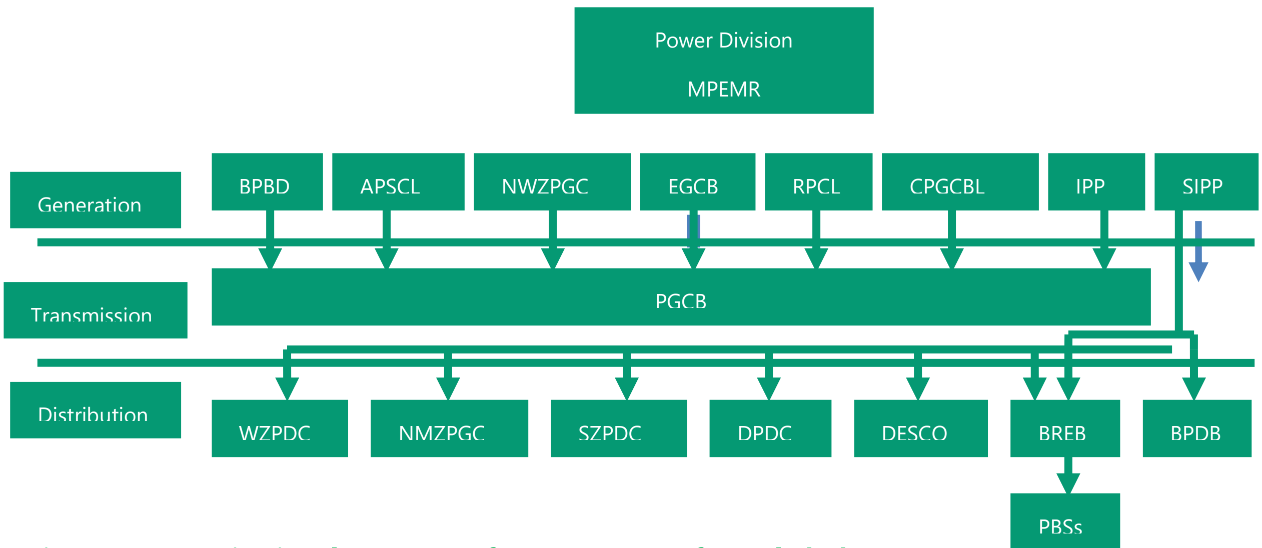


Figure 10 Organizational Structure of Power Sector of Bangladesh

Source: Ministry of Power Energy and Mineral Resources

3.2.1 Generation

As a part of reform and restructure, a number of generation companies have been created. The list of public limited companies and independent power producers is as follow:

1. Bangladesh Power Development Board. (**BPDB**)
2. Ashuganj Power Station Co. Ltd (**APSCL**)
3. Electricity Generation Company of Bangladesh Ltd. (**EGCB**)
4. Rural Power Company Ltd. (**RPCL**)
5. North West Power Generation Company Ltd. (**NWPGCL**)
6. Coal Power Generation Company Limited.
7. Independent Power Producers (**IPPs**)

Bangladesh Power Development Board (BPDB)

Bangladesh Power Development Board (BPDB) was established in 1972 as an integrated utility, responsible for power generation, transmission and distribution. The BPDB is responsible for major portion of generation and distribution of electricity, mainly in urban areas of the country. The Board is now under the Power Division of the Ministry of Power, Energy and Mineral Resources. In its 43 years of service the generation capacity has increased from a mere 200 MW to over 4,100 MW in FY-2013. Likewise the electricity consumers have also increased manifold. The Board is headed by a Chairman and six members, all appointed by the government.

Functions of BPDB:

- Purchases and Sells power as 'Single Buyer'
    - Purchases from generators (Public and Private)
    - Sells to distribution entities
    - Prepares least cost generation expansion plan
    - Implements new generation projects
- Power Generation (operates about 40% of total generation capacity)
- Nationwide distribution function in urban areas except Dhaka and West Zone of Bangladesh

Ashuganj Power Station Company Ltd (APSCL)

Ashuganj Power Station owned by APSCL is the second largest power station in the country. At present, the total capacity of its 8 units is 642 MW. APSCL is a public limited company registered under the Companies Act and was incorporated on 28 June, 2000 and a subsidiary company of BPDB.

Electricity Generation Company of Bangladesh Ltd (EGCB)

Electricity Generation Company of Bangladesh Ltd (EGCB) was incorporated with Registrar of Joint Stock Companies on February 16, 2004. It is now operating with two power plants of Capacity 622 MW at Siddhirganj and Haripur. A power station of 335 MW capacity is now under construction at Siddhirganj and expected to be commissioned in March 2016. EGCB will eventually become a leading electricity generation company of the country. EGCB Board of Director consists of Chairman and nine members.

Rural Power Company Ltd (RPCL)

Rural Power Company Ltd (RPCL) is the first Bangladeshi Independent Power Producer (IPP). RPCL registered as a public limited company under companies Act and was incorporated on 31 December, 1994. Its entire equity investment is mobilized locally. Rural Electrification Board (REB) owns 20% share and the rest 80% is owned by 9 Palli Biddyut Samity (PBS). Mymensingh Power Station (MPS) is one of its power generation plants with a capacity of 210 MW power and another two liquid fuel based power plants of total capacity of 77 MW. RPCL is going to install another 150 MW power plant in Gazipur (EPC contract signed in January 2013).

North-West Power Generation Company Ltd (NWPGCL)

North-West Power Generation Company Ltd (NWPGCL) is an enterprise of Bangladesh Power Development Board, which intends to establish three power plants at different locations in North-Western Zone of Bangladesh. Presently total installed capacity is 368 MW and another 360 MW Combined Cycle Power plant at Bheramara is under construction.

Coal Power Generation Company Ltd (CPGCL)

To diversify and secure energy in future with the PSMP, coal fired power plant will be 50% of the total generation of electricity by 2030. With this target of setting up coal power generation plants, the government recently set up a company named Coal Power Generation Company Limited. The first plant under this company will be the Matar Bari Coal power plant with a capacity of 1,200 x 2 MW.

Independent Power Producers (IPPs)

The Government has adopted a strategy for the development of the power sector with private participation in the sector. As part of that strategy, the Govt decided that some new generation capacity would be installed and operated by the private sector.

Following adoption of the Private Sector Power Generation Policy ("PSPGP") in 1996, the first Independent Power Producer ("IPP") became operational in 1998. Since then, contribution from private sector power generation to the installed capacity has reached approximately 4,480 MW, which is almost 44% of total installed capacity supplying the national power grid in the country.

3.2.2 Transmission

The Power Grid Company of Bangladesh (PGCB) is a public limited company which is solely responsible of power transmission. Generated power of different power plants all over the country is evacuated and transmitted through PGCB's integrated grid system of 400 kV, 230 kV and 132 kV transmission lines and substations. At present there are 165 ckt km of 400 kV line, 3,066 ckt km of 230 kV line and 6,080 ckt km of 132 kV line throughout Bangladesh under PGCB (48). The transmission structure of PGCB up to July 2014 is as follows (**Table 10**):

Table 10 Length of Transmission and Distribution Lines since FY 2009

Particulars	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014
Length of 400 KV & 230 KV line (circuit km)	2,645	2,647	2,647	2,647	3,020	3,231
Length of 132 KV line (circuit km)	5,685	5,818	5,969	6,302	6,302	6,305
Distribution line (Lakh km)	2.60	2.70	2.74	2.81	2.89	3.03

Source: Bangladesh Power Development Board

Table 11 Total Number and Capacity of Substations of PGCB

Substation Capacity	Total Number of Substation	Total Capacity of Substation
400 KV	1	500 MW HVDC Back to Back
230/132 KV	18	8,775 MVA
132/33 KV	88	10,846 MVA

Source: PGCB

The PGCB has only one 400 KV substation in Bheramara for importing power from India. The capacity of the substation is 500 MW and it is a high voltage DC back- to-back substation. There are 18 substations of 230/132 KV with the total capacity of 8,775 MVA. The total capacity of the 132/33 KV substation is 10,846 MVA and the total number is 88. The transmission voltage is upgraded gradually from 230 and 132 KV to 400 KV as generation and demand is increasing. The distribution voltage is 33 KV and 11 KV. The supply voltage is 220 V (single phase) with 50 Hz frequency. The National Grid Network of Bangladesh as of August 2014 is represented in the following map (**Figure 11**). The location of power plants (existing, under construction and planned), substations (existing, under-construction and Planned) and gas fields are also indicated in the map. The national grid is divided into east and west zone by the Jamuna River. The two zones are interconnected by the 230 KV transmission lines across the Jamuna, which is known as east-west interconnector. Gas fields are located in the eastern part of the country but the coal fields are located is in the north-west part.

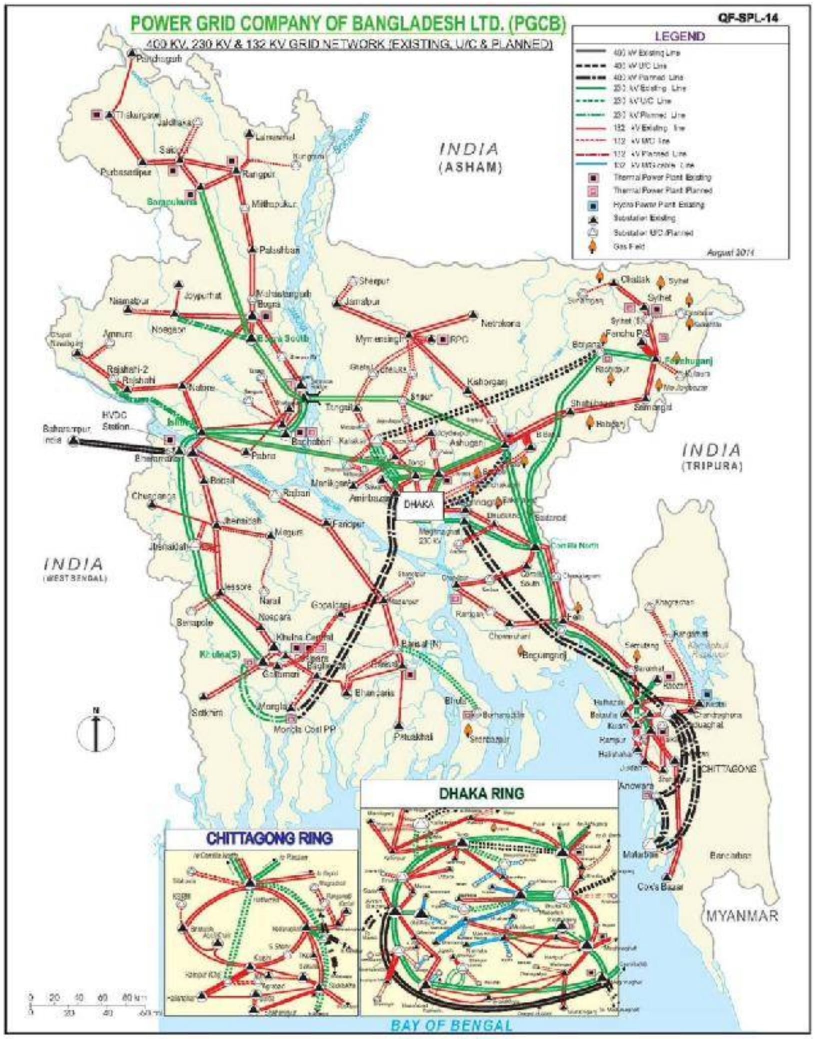


Figure 11 Grid Network

Source: Power Grid Company Bangladesh Ltd. (PGCB)

3.2.3 Distribution

The electricity is disseminated to different parts of the country by five distribution companies. The list of these companies is as follow:

BPDB	Bangladesh Power Development Board
WZPDCL	West Zone Power Distribution Company Ltd.
DPDC	Dhaka Power Distribution Company Ltd.
DESCO	Dhaka Electric Supply Company Ltd.
BREB	Bangladesh Rural Electrification Board

BPDB distributes electricity mainly in urban areas except Dhaka and west zone of the country. DPDC and DESCO are responsible agencies for electricity distribution in Dhaka city. Electricity distribution in west zone of the country is done by WZPDCL. And BREB distributes power in the rural areas with help of the co-operative societies known as *Palli Biddyut Samities* (PBSs, may be termed as Village Electricity Association in English).

Bangladesh Power Development Board

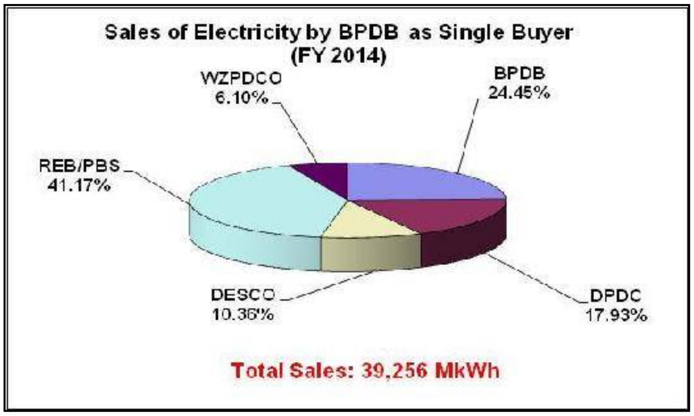
As a single buyer BPDB generates power from its own power plants and purchases power from public sector plants, IPP, SIPP & Rental power plants. BPDB sells this power to DPDC, DESCO, REB, WZPDCL and its own distribution zones. Sales of electricity (in MkWh) by BPDB to distribution companies from FY 1994 to FY 2014 are shown in **Table 12** below. From FY 1994 to 2002, BPDB sales highest amount of electricity to its distribution zones but from FY 2003 to 2014, the highest amount of electricity is sold to Rural Electrification Board.

Table 12 Sales of Electricity by BPDB to Distribution Companies since FY 1994 (in MkWh)

FY	BPDB	DPDC	DESCO	REB	WZPDCL	TOTAL	Increase over Pre. Year (%)
1994	3,022	2,362		765		6,149	
1995	3,220	2,664		1,050		6,934	12.77
1996	3,363	2,919		1,172		7,454	7.50
1997	3,361	3,241		1,220		7,822	4.94
1998	3,485	3,463		1,435		8,383	7.17
1999	3,726	3,590		1,989		9,305	11.00
2000	4,041	3,582		2,460		10,083	8.36
2001	4,420	3,858		3,131		11,409	13.15
2002	4,736	3,410	494	3,895		12,535	9.87
2003	4,838	3,475	676	4,888		13,877	10.71
2004	4,941	3,178	1,408	5,805		15,332	10.48
2005	4,753	3,590	1,536	6,457		16,336	6.55
2006	4,062	3,834	1,682	7,403	1,147	18,128	10.97
2007	4,426	3,915	1,897	7,443	1,095	18,776	3.57
2008	4,791	4,148	2,293	7,985	1,198	20,415	8.73
2009	5,199	4,453	2,475	8,519	1,310	21,956	7.55
2010	5,838	4,979	2,674	9,629	1,477	24,597	12.03
2011	6,380	5,251	2,848	10,480	1,628	26,587	8.09
2012	7,149	5,657	3,111	12,264	1,793	29,974	12.74
2013	7,693	5,942	3,412	13,754	1,939	32,740	9.23
2014	8,456	6,341	3,722	15,582	2,132	36,233	10.67

Source: Annual Reports, Bangladesh Power Development Board

Sales of electricity by BPDB to different distribution companies in FY 2014 are as shown in the following figure (**Figure 12**). Total 39,256 MkWh of electricity has been sold by BPDB in FY 2014 and 41.17% of total electricity has been sold to Rural Electrification Board (REB).



Source: Bangladesh Power Development Board

Figure 12 Sales of Electricity by BPDB

The following **Figure 13** shows the electricity consumption by different sectors from the year 2001 to 2014 and the main sectors are Domestic, Agriculture, Industry and commercial customers. Among all the sectors, the highest amount of electricity is consumed by domestic sector followed by the industry sector. Back in 2001 the prime consumer of electricity was the industry sector but the trend changed over the years and recently domestic sector has become the prime consumer.

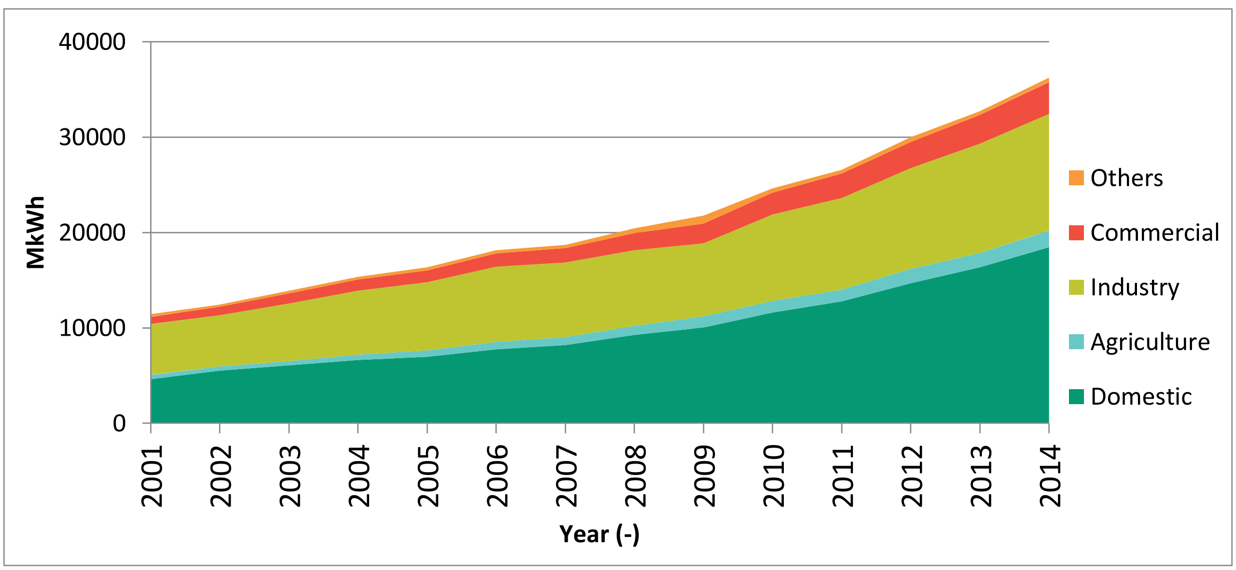


Figure 13 Electricity Consumption by Sector [2001 - 2014]

Source: Bangladesh Power Development Board

The growth in the number of consumers (in Lakh) of different sectors from FY 2005-06 to 2013-14 is shown in **Table 13**.

Table 13 Number of Consumers (in Lakh)

FY	Domestic	Industrial	Commercial	Agriculture	Others	Total
2005-06	80.93	1.85	11.95	2.16	0.46	97.35
2006-07	87.00	1.91	12.5	2.26	0.56	104.23
2007-08	90.39	1.97	12.65	2.34	0.57	107.92
2008-09	96.05	1.97	13.46	2.82	0.74	115.04
2009-10	100.87	2.08	13.55	2.69	0.69	119.88
2010-11	104.10	2.14	13.83	2.76	0.68	123.51
2011-12	114.87	2.26	14.51	2.95	0.84	135.43
2012-13	121.36	2.31	14.93	2.97	0.75	142.32
2013-14	132.79	2.36	15.28	2.98	1.00	393

Source**:** Bangladesh Power Development Board

Rural Electrification Board (REB)

Rural Electrification Board (REB) was established in 1977 as a semi-autonomous government organization; it is responsible for electrification in the rural areas. Since then REB has been providing service to rural consumers through founding cooperatives. As of December 2014, there are 70 operating rural electricity co-operatives called *Palli Bidyuit Samity* (PBS), which bring service to approximately 93 lakh connections. REB has expanded its distribution networks significantly in past years and has thus made immense contribution in increasing agricultural production and expanding SMEs activities in rural areas. REB consists of a Chairman, four full time members appointed by the government and four part time members nominated from relevant departments. Continued support from the government, the donor community, consulting partners and the valuable consumer members helps this program to continue and expand, providing electricity to millions of rural households, businesses and industries.

Dhaka Electric Supply Co. Ltd (DESCO)

DESCO is the first electricity distribution company, registered under the Companies Act in 1994, and established in November, 1996. Its distribution area comprises 220 sq km areas of the city of Dhaka, namely, Mirpur, Pallabi, Kafrul, Kalyanpur, Cantonment, Gulshan, Banani, Uttara, Uttarkhan, Dakkhinkhan, Badda, Baridhara and Tangi. DESCO Board of Directors consists of one Chairman and 9 members.

Dhaka Power Distribution Company Ltd (DPDC)

Dhaka Power Distribution Company started functioning as a company from July, 2008. DPDC distribution area comprises 350 sq km of Dhaka and Narayanganj. DPDC Board of Directors consists of one Chairman and 10 members.

West Zone Power Distribution Co. Ltd (WZPDCL)

WZPDCL was registered in November, 2002. WZPDCL is responsible for electricity distribution in 21 districts of Khulna and Barisal Division as well as greater Faridpur district. It has started functioning from March, 2005.

3.2.4 Utilities and Related Organizations

Office of the Electrical Advisor & Chief Electrical Inspector and Energy Monitoring Unit (EA & CEI)

The office of the Electrical Advisor and Chief Electrical Inspector (EA & CEI) emphasizes on thrift, simplicity and safety. It has been established, in order to ensure proper control of life and property in generation, transmission and distribution of electricity. Main responsibility of this office is to inspect installations, substations and lines as well as to grant license for high tension and medium tension consumers. Besides, it issues license to electrical contractors, engineers and electricians. The Energy Monitoring Unit (EMU) is a sub-unit under this office. The objective of EMU is to ensure efficient use of energy in industries and to induce energy conservation.

Power Cell

The Power Cell was established in 1995 in order to assist the Power Division in developing design and strategies, facilitating and monitoring various reform measures, so that the power sector can achieve desirable consumer satisfaction and reach optimum growth. It basically acts as a technical unit of the Power Division. Since inception, Power Cell has played a pivotal role in reforming the private power generation, power tariff evaluation and establishing regulatory commissions. Power Cell is headed by a Director General, appointed by the government and is assisted by a number of directors. In the recent past a number of generation and distribution companies have been created under its reform programs.

3.3 Present Status

As of December 2014, 68% of the total population of the entire country (including renewable energy) has access to electricity and per capita electricity generation is 348 kWh (including Captive). In the year 2009, the per capita electricity consumption of Bangladesh was 220 kWh which was the second lowest after Nepal among the south Asian countries as shown in following figure (**Figure 14**).

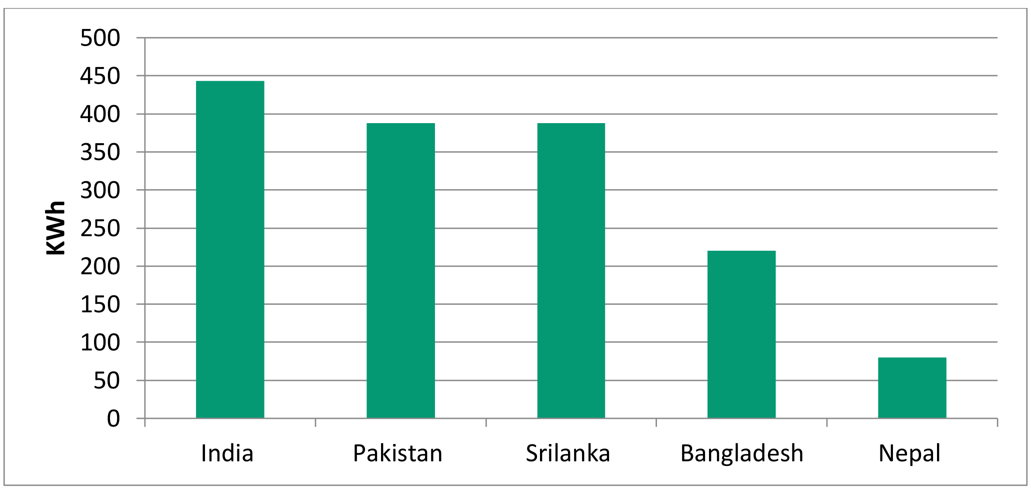


Figure 14 Per Capita Electricity Consumption of South Asian Countries in kWh (2009)

Source: CIA, The World Factbook

3.3.1 Comparative Position of Bangladesh Power Sector in South Asia

Comparative position of the power sector of Bangladesh compare to selected SAARC countries are presented in the following table (**Table 14**). It can be seen that among the selected South Asian Countries i.e. India, Bangladesh, Pakistan, Sri Lanka and Nepal – Bangladesh stands third in term of production of electricity but ranks highest in usage of natural gas (88.84 %) for production of electricity. The overwhelming dependence on natural gas is followed by the use of fossil fuel (second) and coal (third), albeit insignificantly. Despite being the lower riparian country, her hydropower generation capacity is the lowest among the neighbouring countries and so has the lowest ratio of alternative use of renewable and nuclear sources in total generation capacity. In Bangladesh, the percentage of population having access to electricity stands second from the bottom, just above Nepal.

Table 14 Comparative Role of Power Sector in Bangladesh and Selected SAARC Countries

Country	Electricity production (billion KWh)	Coal based power(% to total power)	Natural gas based power (% to total power)	Oil based power (% to total power)	Hydro Power (% to total power)	Renew-able Source (% to total power)	Nuclear power as (% to total power)	Access to electricity (% of population)
	2009	2009	2009	2009	2009	2009	2009	2009
Bangladesh	26.5	3.88	88.84	5.72	1.56	legible	legible	47
India	899.4	68.6	12.4	2.9	11.9	2.2	2.1	66.3
Nepal	3.1	0.0	0.0	0.4	99.6	0.0	0.0	43.6
Pakistan	95.4	0.1	29.4	38.0	29.4	0.0	3.0	62.4
Sri Lanka	9.9	0.0	0.0	60.3	39.5	0.2	0.0	76.6

Source: World Development Indicators for 2011, World Bank, Washington D C

3.3.2 Installed Capacity as of December 2014

As of December 2014, the total installed capacity is 10,861 MW including 500 MW imported power. The 54% of the total installed capacity comes from public sector which is equal to 5,880 MW and remaining 46% comes from the privately owned companies which are in total 4,981 MW. The government owned generation companies are Bangladesh Power Development Board (BPDB), Ashuganj Power Station Company Ltd. (APSCL), Electricity Generation Company Bangladesh Ltd (EGCB), North West Power Generation Company Ltd (NWPGCL) and Rural Power Company Ltd (RPCL). In the private sector, Independent Power Producers (IPPs), Small Independent Power Producers (SIPPs) (capacity less than 10 MW) and Rental Power Plants generate electricity. Currently 500 MW of electricity is imported from India through Bheramara - Bahrampur 400 kV substation.

Table 15 Present Installed Capacity (MW) as of December 2014

Public Sector	Installed Generation Capacity (MW)	Private Sector	Installed Generation Capacity (MW)
BPDB	4,126	IPPs	2,019
APSCL	687	SIPPs (BPDB)	99
EGCB	622	SIPPs (REB)	251
NWPGCL	368	15 YR. Rental	167
RPCL	77	3/5 YR. Rental	1,945
		Power Import	500
Subtotal	5,880(54%)	Subtotal	4,981 (46%)
Total		10,861	

Source: Bangladesh Power Development Board

3.3.3 Derated Capacity by Fuel Type

The total derated capacity of power plants as of December 2014 is 10,266 MW. And derated capacity of gas fired power plants is 6,222 MW which is 61% of the total derated capacity. The contribution of liquid fuel based power plants to total derated capacity is 30% (3,114 MW). The remaining 9% is hydro, coal and imported power, totalling to 930 MW (**Table 16** and **Figure 15**).

Table 16 Derated Capacity of Power Plants by Fuel Type as of December, 2014

Fuel Type	Current Capacity (MW)
Gas	6,222
Liquid Fuel	3,114
Hydro	230
Coal	200
Imported	500
Total	**10,266**

Source: Bangladesh Power Development Board

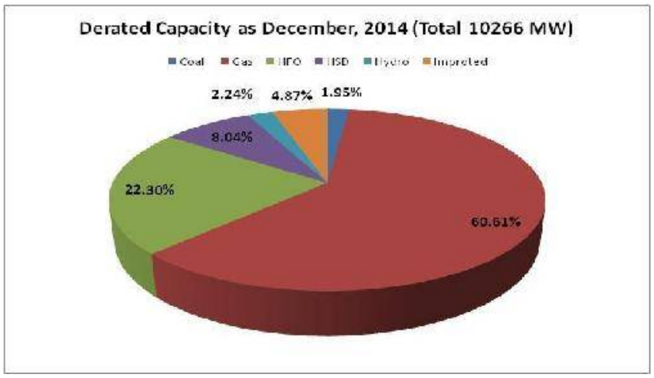
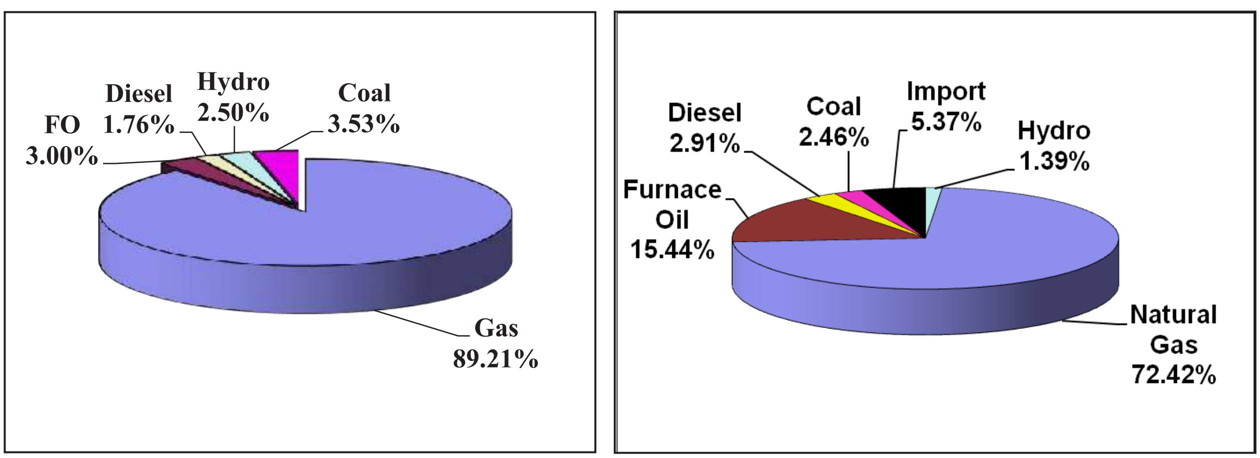


Figure 15 Derated Capacity of Power Plants by Fuel Type as of December, 2014

Source: Bangladesh Power Development Board

3.3.4 Electricity Generation:

In FY 2014, 72% electricity has been generated by gas and 18% has been generated by liquid fuel (HSD and HFO). The usage of gas has been reduced from 89.21% in 2010 to 72% in 2014 but the usage of liquid fuel has been increased to 18% in 2014 which was 5% in 2010. As a result the electricity generation cost has increased in the recent time (**Figure 16**).



Total Generation (FY 2010): 29,247 MkWh **Total Generations (FY 2014): 42,195 MkWh**

Figure 16 Electricity Generation by Fuel Type in FY 2010 and FY 2014

Source: Bangladesh Power Development Board

3.3.5 *Recently Completed Projects*

A substantial growth in the power generation sector can be noticed in the recent years. In the last six years, a total of 5,804 MW (Including 500 MW import from India) of electricity has been added to the national grid. Contribution of private sector-owned power plants in this growth is more than the public sector (**Figure 17**).

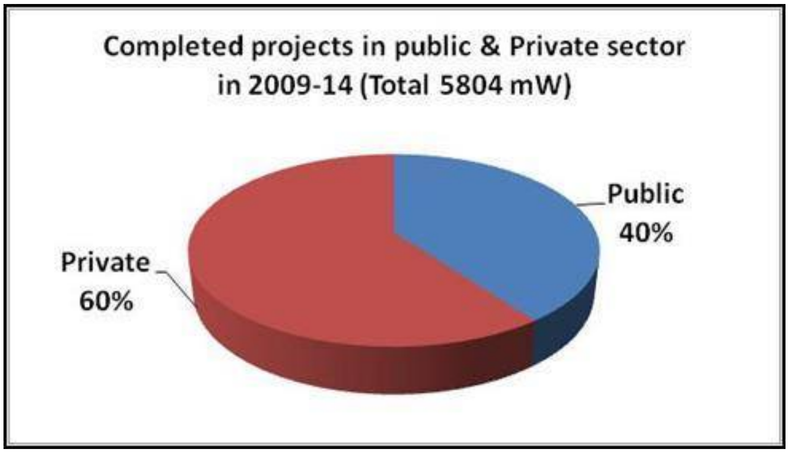


Figure 17 Completed Projects in Public and Private Sector from 2009 to 2014

Source: Bangladesh Power Development Board

The Government has adopted a strategy for the development of the power sector which envisages private participation in the sector. Following adoption of the Private Sector Power Generation Policy (PSPGP) in 1996, the first Independent Power Producer (IPP) became operational in 1998. Since then, contribution from private sector power generation to the installed capacity has reached approximately 4,500 MW, which is almost 41% of total installed capacity supplying to the national power grid in Bangladesh.

Few advantages for the private sector to invest in the power sector of Bangladesh are mentioned below:

- Sovereign Credit Rating BB - (S&P) and Ba3 (Moody's) indicates relatively better investment environment
- Bangladesh is one of N11 (Next Eleven) countries by Goldman Sachs
- 23 billion US $ export, 12 billion US $ remittance and 20-22 billion US $ foreign exchange reserve indicates capability of IPP payment
- Existing policy and concessions will be continued
- Tested and successful approach to IPP development and management will be continued;
- Transparency and "level playing field" in the selection of Bidders ensured
- Project Agreements are of international standard with properly allocated risks;
- IPPs are operating about 50 % of total generation and making profit;
- IPPs and BPDB (power purchaser) have met their obligations under the PPA without problems or controversy
- Many IPPs are presently operating their businesses with local managers, engineers and technical staff to the benefit of all concerned
- Increased interest reflected in the recent biddings by private sector developers
- One stop service in BOI
- Independent Regulation to protect industry and consumer's interest
- Some highlighted Private Sector Power Generation Policy of Bangladesh is given below:
- Tariff based bidding Capacity Charge: ensures reasonable return on investment;
- Energy Charge : fuel cost is pass through item in the tariff

- Sovereign guarantee from the Government for obligations of Government entities through Implementation Agreement (IA)
- Assistance in getting clearances from various agencies
- Attractive incentive packages

Some of the incentives provided by the government to the IPPs

- Exemption from corporate income tax for a period of 15 years.
- Plant and equipment (full value) and spare parts (10% of original plant cost) without payment of customs duties, VAT and any other surcharges.
- Repatriation of equity along with dividends.
- Tax exemption and repatriation facilities on royalties, technical know – how and technical assistance fees
- Avoidance of double taxation on the basis of bilateral agreements
- The Bangladeshi currency, Taka is freely convertible for FDI
- Easy entry easy exit

Payment of the IPPs are Guaranteed by government. Following are the important features of the PPA (Power Purchase Agreement)

- Implementation Agreement (IA) and PPA ensure fair and reasonable risk allocation, and payment by the Purchaser is guaranteed by GOB
- Two component tariff - 'Capacity Price' and 'Energy Price' - ensures sufficient cash flow to recover investment and return
- Payments under the PPA continue in the event of fuel supply disruption or dispatch failure
- Payment under the PPA is ensured by Letter of Credit
- Payment to ' Escrow Account' ensures lenders re - payment

The important thing is to notice that only gas and liquid fuel (HSD, HFO) based power plant has been installed in last six years (2009-14, **Figure 18**). Some of the power plants are also duel fuel type which means gas and liquid fuel both can be used.

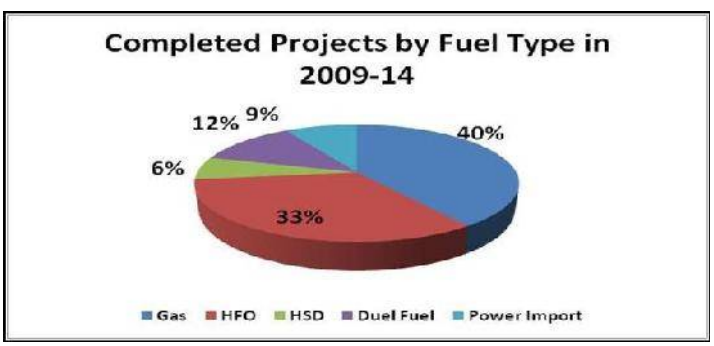


Figure 18 Completed Projects by Fuel Type from 2009 to 2014

Source: Bangladesh Power Development Board

3.4 Renewable Energy

The Government is gradually implementing the PSMP 2010 to develop the power sector as an energy balanced and sustainable plan. Under the new generation expansion plan, substantial proportion of power will be generated from coal. Development of renewable energy is one of the important strategies adopted as part of Fuel Diversification Program in PSMP 2010. According to the plan, 15% of total electricity generation will come from renewable and new energy sources (54).

In line with the Renewable Energy policy 2008, the government is committed to facilitate both public and private sector investment in Renewable Energy projects to substitute indigenous non- renewable energy supplies and scale up contributions of existing Renewable Energy based electricity productions. The Renewable Energy Policy envisions that 5% of total energy production will have to be achieved by 2015 and 10% by 2020. Under the existing generation scenario of Bangladesh, Renewable Energy has a very small share to the total generation. The share of Renewable Energy exceeds more than 1% till now. But the government is placing priority on developing Renewable Energy resources to improve energy security and to establish a sustainable energy regime alongside the conventional energy sources. Government has already launched "*500 MW Solar Power Mission*" to promote the solar energy to meet the increasing demand of electricity.

3.4.1 Renewable Energy Potential in Bangladesh

Bangladesh is expected to have enormous potentiality in renewable energy development. The country is blessed by considerable solar radiation, and receives an average daily solar radiation of 4.6 kWh/m^2 per day (49). Solar photovoltaic (PV) are gaining acceptance for providing electricity to households and small businesses in rural areas. Development of off-grid solar home solutions has achieved international benchmark. According to a survey, there is an existing market size of 6 million households for Solar Home Systems (SHS) on a fee-for-service basis in the off-grid areas of Bangladesh.

However, potential of other renewable resources is still at the exploration stage. Potential of Wind Energy is mainly in coastal areas and offshore islands and to determine the extent of potential wind resource mapping project is in process. Some of the development partners and companies come forward for wind mapping in different parts of the country. It is expected that a full picture of wind energy potential will be available by the end of 2015.

Bangladesh has strong potential for biomass gasification based electricity. More common biomass resources available in the country are rice husk, crop residue, wood, jute stick, animal waste, municipal waste, sugarcane, etc. Exploration of these resources for electricity generation is still at preliminary stage. Potentials for utilizing biogas technologies derived mainly from animal, kitchen and municipal wastes may be one of the promising renewable energy resources.

Micro hydro and mini hydro have limited potential with the exception of Chittagong Hill Tracts. Hydropower assessments have identified some possible sites from 10 kW to 5 MW. Other renewable energy sources include bio-fuels, gasohol, geothermal, river current, wave and tidal energy. Potentialities of these resources are yet to be explored.

3.4.2 Renewable Energy Expansion Initiative

The Government has taken a systematic approach towards renewable energy development. The initiative includes development of awareness, legal and regulatory framework, institutional development and financing mechanism to drive the sector.

Renewable Energy Policy 2008

Renewable Energy Policy has been approved in 2008. Through this policy the government is committed to facilitate both public and private sector investment in renewable energy projects to substitute indigenous non- renewable energy supplies and scale up contributions of existing renewable energy based electricity productions. The policy envisions 5% of total generation from renewable sources by 2015 and 10% of the same by 2020.

Institutional Development

A nodal agency, i.e. Sustainable and Renewable Energy Development Authority (SREDA) as envisioned in the Renewable Energy Policy is established and in the process of manning this organization so that it can work according to the requirement of the people. This organization will provide policy support to the government as well as work to promote, expand and develop the renewable energy and to enhance energy efficiency both in public and private sectors. Also facilitate private sector to get involved in renewable energy and energy efficiency business. SREDA will start functioning very soon in full length. Simultaneously a separate wing under the guidance of an Additional Secretary of the Government has been set up in Power Division, MoPEMR. This wing has two distinct units of Renewable Energy and Energy Efficiency headed by two Deputy Secretaries of the Government. There is a new wing on Sustainable Energy that has been set up under Power Cell, the technical unit of Power Division. The wing comprises one Director with other necessary officials is extending technical support to the Renewable Energy Wing of Power Division in formulating relevant program and policy. Establishment of separate directorates in the public utilities has been established to carry forward research and development of Renewable Energy Technologies. With this purview, independent renewable energy directorates have been set up under BPDB and REB. The directorates under the EPDB and REB are functioning in full swing. With the above governmental institutional support it is envisaged that Renewable Energy Development Program will gain momentum to reach the expected target.

500 MW Solar Power Development Program

In line with the Government's Renewable Energy Policy, Power Division has adopted 500 MW solar power development program, which is the largest ever solar power development initiative in Bangladesh and so far among any LDC country. Under this program a total of 500 MW solar power will be implemented as commercial and social projects in private and public sector. The commercial projects will be implemented by private sector. The private sector would be the project developer, technology supplier and in most cases O&M manager. Out of 500 MW, an amount of 340 MW will be implemented by private sector and the remaining 160 MW will be implemented by public sector (**Table 17**). The categories of projects to be implemented by the private sectors are:

- Grid tie solar park
- Solar Irrigation
- Solar Mini Grid
- Solar system at Industrial and residential Roof Top

Social projects will be implemented by the different government agencies as their commitment towards society. Categories of projects to be implemented as social responsibilities are:

- Solar Electrification at Rural Health Centre
- Solar Electrification at remote Educational Institutions
- Solar Electrification at Union E- Centres
- Solar Electrification at remote Railway Stations
- Installation of Solar System at Religious Establishment
- Solar PV system in Government offices

Table 17 Expected Private Sector Participation (through IDCOL)

Category	Average Unit Capacity	Target	Total Capacity (MW)
Solar Home System	39 W	6,000,000	234
Biogas Plant for cooking gas	2.6 m^3	1,00,000	40
Solar Mini Grid	150 KW	50	7.5
Solar Irrigation Pump	10 KW	1,550	15.5
Biogas based Power Plant	50 KW	140	7
Biomass Based Power Plant	300 KW		1.5
Total			**305.5**

Source: Infrastructure Development Company Limited

3.4.3 Achievement in Renewable Energy Development in Bangladesh

Government utilities are involved in large scale grid connected renewable energy based power project development. On the other hand, private sector is involved with off-grid home-based renewable energy solutions. At present total renewable energy capacity is about 174 MW as shown below (**Table 18**):

Table 18 National Achievement in Renewable Energy

Sl. No	Description	Capacity (MW)
1	Solar Home system (3.5 Million)	150
2	Solar system at Government/non-government. office	3
3	Solar system at commercial building & shopping mall	1
4	Solar PV for new electricity connection	11
5	Solar irrigation pump (93)	1
6	Wind power	2
7	Biomass	1
8	Biogas	5
	Total	**174**

Source: Bangladesh Power Development Board

3.4.4 Renewable Energy Development in Public Sector

Renewable Energy Development by BPDB

The Government has taken a systematic approach towards renewable energy development. In line with the Government approach, BPDB formed the Directorate of Renewable Energy and Research & Development in 2010. Since the very beginning of establishment the directorate is dedicated to keep a sign for the enhancement of Renewable Energy use in the power sector. BPDB has taken systematic steps for developing Renewable Energy projects as well as implementing and promoting Energy Efficiency Measures for the last few years to achieve the target of the Renewable Energy Policy, 2008. The directorate is established for feasibility study, planning, evaluation, examination, monitoring of such projects and to perform necessary research based works in related fields.

Solar Power Projects

Implemented Projects

Under the Hill Tracts Electrification Project, BPDB has already implemented three solar projects in Juraichori, Barkaland and Thanchi Upazila of Rangamati District. Different solar PV systems have been installed under this project as follows:

- 1,200 sets Solar Home Systems of 120 Wp each,
- 30 sets Solar PV Street Light Systems of 75 Wp each,
- Solar PV Submersible Water Pumps of 1,800 Wp each,
- 6 sets Solar PV Vaccine Refrigerators for the Health Care Centres of 360 Wp each, and
- 2 sets 10 kWp capacity Centralized Solar System for market electrification

So, a total of 173.81 kWp Solar PV Systems have been installed in the three upazilas as mentioned above under the Hill Tracts Electrification Project. BPDB implemented 20.16 KWp Solar PV System and that was inaugurated by Prime Minister at the Office at her office in December 2009.

A part from the Hill Tracks Electrification Project, the solar PV systems have been installed by BPDB from FY 2010 to FY 2013 as follows,

Major solar PV systems implemented by BPDB in the fiscal year 2010-2011 are

- 32.75 kWp at WAPDA Building, Motjheeel
- 2.82 kWp at Chairman Bungalow, BPDB
- 6 kWp at Agrabad Bidyut Bhaban, Chittagong
- 1.8 kWp at Cox's BPDB Rest House

Major solar PV systems implemented in the fiscal year 2011-2012 are:

- 37.5 kWp Solar Roof Top System on15th floor of Bidyut Bhaban
- 3 kWp at PC Pole Factory, Chittagong
- 3 kWp at Khagrachori BPDB Rest House
- 2.16 kWp at Swandip Power House and Rest House
- 2.16 kWp at Sales & Distribution Division, HatHajari
- 3.12 kWp at Sales & Distribution Division, Fouzdarhat
- 3.12 kWp at Sales & Distribution Division, Rangamati
- 1.6 kWp Solar Power System at Titas 50 MW Peaking Power Plant
- 1.6 kWp Solar Power System at t Baghabari 50 MW Peaking Power Plant
- 1.6 kWp Solar Power System at Bera 70 MW Peaking Power Plant
- 1.5 kWp Solar Power System at Chittagong Power Plant
- 3.5 kWp Solar Power System at Ghorashal Power Plant

In the fiscal year 2012-2013, BPDB has installed the following solar PV systems:

- 4 kWp Solar Power System at Khulna Power Statio

- 1.6 kWp Solar Power System at Faridpur 50 MW Peaking Power Plant
- 1.6 kWp Solar Power System at Goplagonj 100 MW Peaking Power Plant
- 2 kWp at Sales & Distribution Division, Bakolia
- 2 kWp at Sales & Distribution Division, Pathorghata and Madarbari
- 2 kWp at Sales & Distribution Division, Stadium
- 2 kWp at Sales & Distribution Division, Agrabad
- 2 kWp at Sales & Distribution Division, Halishohor
- 2 kWp at Sales & Distribution Division, Khulshi
- 2 kWp at Sales & Distribution Division, Pahartoli
- 2 kWp at Sales & Distribution Division, Mohora
- 2 kWp at Distribution Division, Patiya
- 2 kWp at Distribution Division, Bandarban
- 6 kWp at Regional Civil Construction Division, Medical centre and Magistrate Building
- 2 kWp at Sales & Distribution Division, Feni
- 2 kWp at Sales & Distribution Division, Chowmuhuni, Noakhali
- 1 kWp Solar Power System at the non-residential building and 2 kWp Solar Power System at the residential building of Santahar 50 MW Peaking Power Plant
- 1 kWp Solar Power System at the non-residential building and 2 kWp Solar Power System at the residential building of Katakhali 50 MW Peaking Power Plant
- 1.6 kWp Solar Power System at Dohazari 100 MW Peaking Power Plant
- 27.2 kWp Solar Power System at Chandpur 150 MW Combined Cycle Power Plant
- 25 kWp Grid Tied Power System at Chittagong Power Station

On-going Projects

The major on-going project is 650 KWp (400 kW load) Solar Mini Grid Power Plant at remote haor area of Sullahupazila in Sunamgonj district under Climate Change Trust Fund (CCTF) on turnkey basis. Other ongoing projects of BPDB are listed below:

- 7.4MWp Grid Connected Solar PV Power Plant at Kaptai Hydro Power Station at Rangamati on turnkey basis
- 4.2 MW solar-diesel hybrid (2.2 MWp solar) power system for off grid Hatiyaisland
- 3 MWp Grid Connected Solar PV Power Plant at Sharishabari, Jamalpur on IPP basis
- 30 MWp Solar Park Project adjacent to new Dhorola Bridge, Kurigram on IPP basis
- Solar Street Lighting Projects in seven (7) City Corporations of the country

Apart from the solar PV power plant projects, installation of Solar Roof Top Systems in all BPDB offices across the country is a continuous process. More than 223 kWp solar PV systems have already been installed and installations of about 407 kWp solar PV systems are under planning/implementing stages.

Projects under Planning

BPDB has planned to install Solar Mini Grid Power Plant on turnkey basis under Climate Change Trust Fund (CCTF) at remote and inaccessible areas such as

- 500 kWp Solar Mini Grid Power Plant at Swandip Upazila of Chittagong district
- 500 kWp Solar Mini Grid Power Plant at Thanchi Upazila of Bandarban district

BPDB has planned to implement Solar Park Projects on IPP/PPP basis under the Roadmap of ADB's 500 MW Solar Power Mission such as

- Rangunia 60 MWp Solar Park Project on IPP basis at Karnafuli river side, Rangunia, Chittagong
- 40-45 MWp Solar Park Project adjacent to BangabandhuBridge, Tangail and Sirajganj area
- 2-3 MWp Solar Park Project adjacent to PGCB Grid Sub-station compound AtIshwardi.
- 1-2 MWp Solar Park Project adjacent to PGCB Grid Sub-station compound, Jhenaidaha

Wind Power Projects

Implemented Projects

The potential of wind energy is limited to coastal areas, off-shore islands, riversides and other inland open areas with strong wind regime. In order to generate electricity from Wind Energy, BPDB installed 4x225 KW = 900 KW capacity grid connected Wind Plant at Muhuri Dam area of Sonagazi in Feni. Another project of 1,000 KW Wind Battery Hybrid Power Plant at Kutubdia Island was completed in 2008 which consists of 50 Wind Turbines of 20 kW capacity each.

- **On-going Projects**

- Repairing work of the existing 900 kW grid connected Wind Power Project at Muhuri Dam of Sonagazi in Feni is going on
- Repair and operation & maintenance of the existing Kutubdia 1,000 kW Wind Battery Hybrid Power Project is underway
- Steps have been taken to install 15 MW Wind Power Plant across the coastal regions after 1 year Wind Resources Assessment in Muhuri Dam Area of Feni, Mognamaghat of Cox's Bazar, Parky Beach of Anwara in Chittagong, Kepupara of Borguna and Kuakata of Patuakhali.
- Wind Mapping is going on at Muhuri Dam area of Feni and at Mognamaghat of Cox's Bazar by Regent Power tech Ltd. of India.
- Installation of Wind Monitoring Stations at Inani Beach of Cox's Bazar, Parky Beach of Anwara, Sitakundu of Chittagong and at Chandpur under USAID TA project is underway.

Projects under Planning

BPDB has planned to implement 50-200 MW Wind Power Project at Parky Beach area, Anwara in Chittagong on IPP basis. Power Division and BPDB have primarily identified 22 potential sites for Wind Resource Mapping in Bangladesh. Wind monitoring stations will be installed at these sites for comprehensive Wind Resource Assessment (WRA).BPDB has also plan to expand On-shore Wind Power Plants along the coastline of coastal regions.

Micro/Mini Hydro Projects

Implemented Projects

Micro/ mini-hydro have limited potential in Bangladesh with exception of Chittagong Hill Tracts region. A 50 kW micro-hydro plant was installed at BarkalUpazila of Rangamati district in 2005.

On-going Projects

- 50-70 kW Mohamaya Irrigation-cum-Hydro Power Project at Mirersorai, Chittagong
- Rehabilitation of 50 kW Micro-Hydro Power Plant at Barkal Upazila of Rangamati district

Projects under Planning

Micro-hydro power projects on the potential streams/chars/rivers of Chittagong Hill Tracts regions will be implemented after detail feasibility study.

Research Activities

Alongside above mentioned projects, the Directorate of Renewable Energy & Research and Development of BPDB is also continuing its own research works in different renewable energy sectors. Currently engineers of the directorate are constructing fully operational prototype based Wind Turbine System, Hydro Emulator Set, Solar Power Converter. The wind turbine system consists of three different types of turbine technology including horizontal axis and vertical axis turbine. The total capacity of the system is expected to be 200 W depending on wind velocity. Complete design, assembly and installation of the turbine system have been done by respective engineers. The Hydro Emulator Set will be a small prototype based hydro turbine system which consists of two different types of turbine technology, Pelton wheel and Kaplan turbine. The turbine system will run from a small water reservoir tank. Generation capacity of the two turbines is expected to be 20 W. The design of the Emulator Set was done by the engineers of the respective directorate. The engineers of the directorate are also trying to design Solar Power Converter with innovative ideas and new concept. All the prototypes will be installed at the concern office Lab.

Renewable Energy Development by BREB

BREB is a pioneer of introducing Solar Home System (SHS) for the first time in Bangladesh during 1993 through "Diffusion of Renewable Energy Technologies" project, assisted by France. Under Renewable Energy Program, recently BREB has installed 15 Nos. of hybrid type 30 kWp Rooftop Solar Power Plant at 15 Upazila Complex through Climate Change Trust Fund (CCTF). BREB has also installed a 49 kWp Solar Power Plant on the rooftop of Training Academy Building by its own fund. A project with 20 nos 5 HP Solar Powered Irrigation Pump and 300 household connections in 8 PBSs has been implemented through Climate Change Trust Fund (CCTF). Through the technical and financial assistance of Korea International Cooperation Agency (KOICA), 20 (twenty) 5 HP Solar Powered Irrigation Pump and 1,250 Solar Home System (SHS) in 7 PBSs have been successfully installed. All of these plants are running satisfactorily.

Since inception, BREB has installed an aggregate up to June 2014, a number of Solar Power/Irrigation plants and 30,785 SHS through different projects and new consumer connection, from which the capacity now stands at 3.75 MWp (**Table 19**).

Table 19 Total Capacity of Solar System Installed by BREB

Sl No.	Description of the System		Quantity Installed	Installed Capacity (kWp)
01	SHS Installed by REB under different projects		15250	826
02	SHS against PBS new consumer connection as per Govt. rules (Up to 30.06.2014)		15535	2,140
03	Rooftop Solar Project	High School	1	2
04		REB H/Q Training Academy Building	1	49
05		72 PBS Office		45
06		Upazila Complex Building	15	450
07	Solar Powered Irrigation Pump		40	239
Total Installed Capacity				**3751**

Source: Bangladesh Rural Electrification Board

Renewable Energy Promotional Activities of REB

- BREB has established Solar Related Display & Information Centre at 70 PBS to make general people familiar with Solar Home System and provide necessary information.
- Trained up more than 1,000 officials & technicians on SHS installation, operation & maintenance.
- To increase public awareness for utilizing renewable energy resources BREB has published circulars in national daily newspapers, distributed leaflets, motivated stakeholders through field inspection and providing necessary information & suggestions.

Renewable Energy Development by WZPDCL

Solar Power System with a capacity of 2.6 KWp was already established in 84 offices of West Zone Power Distribution Power Company Limited **(**WZPDCL) and 3.0 KWp Solar Panel is added at Head Quarter, WZPDCL in FY 2011-12. Moreover a capacity of 36.0 KWp was established in the 399 service lines of different areas in WZPDCL (50).

3.4.5 Solar Home System based Rural Electrification Program

The first significant solar PV-based rural electrification program was the Narshingdi project initiated with financial support from France. Since the inception of SHS so far 3.5 million units have been installed and ever increasing due to an integrated program undertaken by the government through its financial institution named Infrastructure Development Company Limited known as IDCOL(51). IDCOL's program is considered as a successful model for installation of SHSs in the world.

Infrastructure Development Company Limited (IDCOL) was established in May 1997 by the Government. The Company was licensed by the Bangladesh Bank as a non-bank financial institution (NBFI) in January 1998. Since its inception, IDCOL is playing a major role in bridging the financing gap for developing medium to large-scale infrastructure and renewable energy projects in Bangladesh. The company now stands as the market leader in private sector energy and infrastructure financing in the country.

In its drive towards promoting alternative sources of energy, IDCOL finances projects and programs that utilize various forms of renewable sources. Through start-up subsidy, concessionary credit, and capacity development support, IDCOL complements the Government's mission of generating five percent of the country's total electricity from renewable sources by 2015. IDCOL's objective is to ensure financial and economic sustainability of the sector with an ultimate goal of commercialization.

IDCOL started the SHS program in 2003 to ensure access to clean electricity for the energy starved off-grid rural areas of Bangladesh. The program supplements the Government's vision of ensuring 'Access to Electricity for All' by 2021. About 3.5 million SHSs have already been installed under the program in the off-grid rural areas of Bangladesh till December, 2014. As a result, 13 million beneficiaries are getting solar electricity, which is around 9% of the total population of Bangladesh. IDCOL has a target to finance 6 million SHS by 2017, with an estimated generation capacity of 220 MW of electricity. IDCOL initially received credit and grant support from the World Bank and GEF to start the program. Later, GIZ, KfW, ADB, IDB, GPOBA, JICA, USAID and DFID came forward with additional financial support for expansion of the SHS Program. At present 47 Partner Organizations (PO) are implementing the program. IDCOL provides refinancing and grant support as well as necessary technical assistance to the Pos. Pos install the SHSs, extend credit to the end users and provide after sale services. More than 65,000 SHSs are now being installed every month under the program with average year to year installation growth of 58%. The program replaces 180,000 tons of kerosene having an estimated value of USD 225 million per year. Moreover, around 70,000 people are directly or indirectly involved with the program. The program has been acclaimed as one of the largest and the fastest growing off-grid renewable energy program in the world.

Growth of Solar Home System Program

Solar home system program was kicked off in the last decade of 20th century. In the beginning, the use of SHS was limited to some off-grid governmental establishments like railway signal, navigation and Boarder Guard Bangladesh (BGB) camps at boarder etc. In this period there was no specific body to monitor and govern this program. Later, in the beginning of the 21st century, GoB's private enterprise IDCOL stared to govern and monitoring the SHS program in Bangladesh. IDCOL's innovative initiatives in that time were accelerated the growth of SHS in Bangladesh, the growth rate can be seen as exponential in the graph. As of December 2014, about 3.5million solar home systems have been installed throughout the country (**Figure 19**).

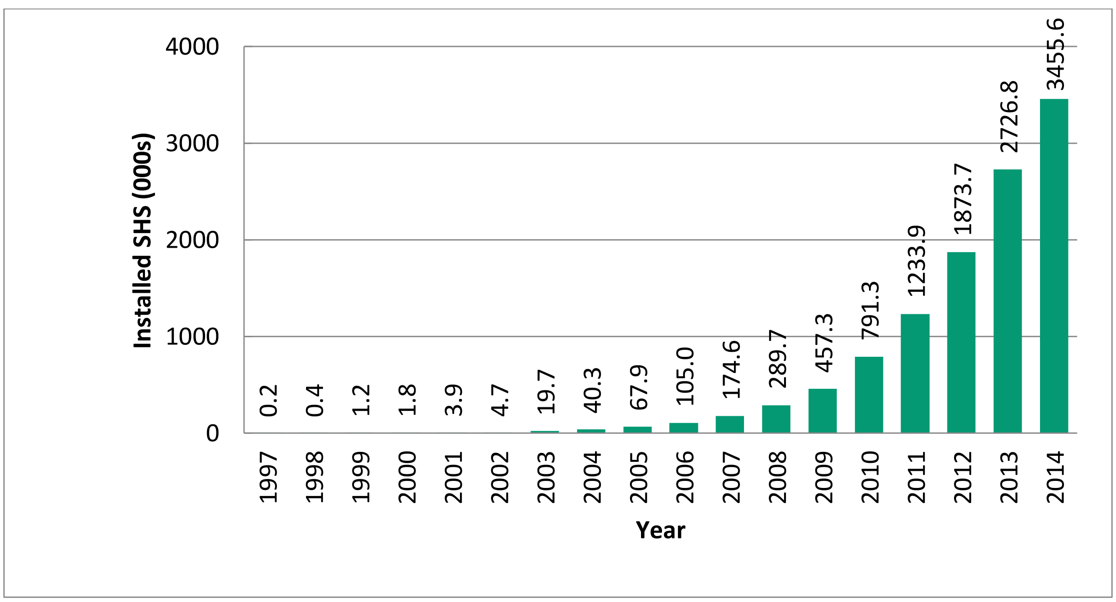


Figure 19 Installed SHS under Solar Home System Program of Bangladesh

Source: IDCOL

SHS Coverage Map

The map (**Figure 20**) shows the coverage of SHS in Bangladesh. It can be seen in the map that Patuakhali and Sunamganj districts have the highest penetration of solar home system and the figures are 169,379 and 176,705 respectively.

Solar Mini-Grid Projects

Solar PV based mini-grid projects are installed in remote areas of the country where possibility of grid expansion is remote in near future. These projects provide grid quality electricity to households and small commercial users and thereby encourage commercial activities in the project areas. So far, IDCOL has financed four solar micro-grid project in four different remote areas of Bangladesh. These mini-grid projects (100 – 177 kWp) are currently supplying electricity to adjacent households, shops, schools, mosques, madrasas, and small commercial and industrial enterprises. Another seven projects of different capacity (100~228kWp) have been approved by IDCOL which are in various stages of construction. IDCOL has a target to finance 50 solar mini-grid projects by 2017. The World Bank, KfW, GPOBA, JICA, USAID, ADB and DFID are providing financing support in these projects.

Solar Irrigation Program

Solar based irrigation systems are environment friendly solution for the agro-based economy of Bangladesh. The program is intended to provide irrigation facility to off-grid areas and thereby reduce dependency on fossil fuel. IDCOL has approved around 300 solar irrigation pumps of which around 150 are already in operation. The remaining pumps are expected to come into operation shortly. IDCOL has a target to finance 1,550 solar irrigation pumps by 2017. The World Bank, KfW, GPOBA, JICA, USAID, ADB and Bangladesh Climate Change Resilience Fund (BCCRF) are supporting this initiative.

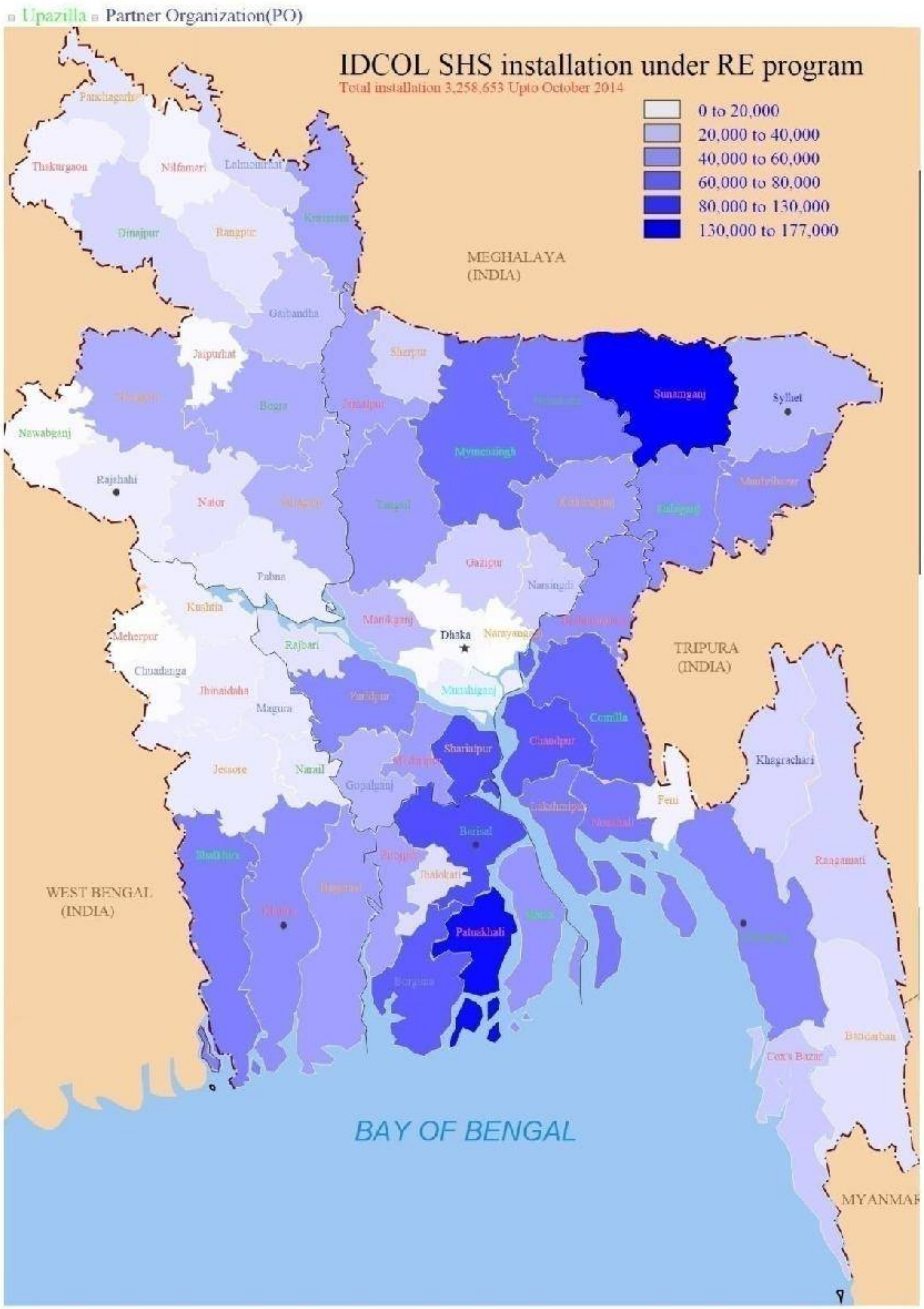


Figure 20 Penetration of SHS in Bangladesh

Source: IDCOL

3.5 Financial Situation

3.5.1 Production Cost and Tariff of Electricity by Fuel Type

The power sector is facing serious gas crises and daily 700-1,000 MW of electricity could not be produced due to gas shortage. However electricity demand is increasing. The government has chosen liquid fuel as a short term solution of the gas shortage and in the long term, the fuel diversification is to be achieved largely by coal, nuclear and LNG based power plant.

Due to increasing use of liquid fuel for power generation, the electricity generation cost has been increased but bulk tariff could not be increased simultaneously (**Table 20** and **Table 21**). Historical price of different fuels are shown in **Table 22**. In international market, liquid fuel price has doubled in last five years.

Table 20 Electricity Production Cost in Bangladesh by Fuel Type (Tk/kWh)

Sl No.	Fuel Type	2010-11	2011-12	2012-13	2013-14
01	Gas	2.13	2.50	2.55	2.50
02	Hydro	1.03	0.90	0.88	1.43
03	HFO	11.51	16.42	17.67	17.06
04	HSD	16.00	19.62	28.95	27.91
05	Coal	5.54	6.52	5.71	6.22
06	Power Import	--	--	--	5.06
	Average (Tk./kWh)	4.06	5.36	5.79	6.27

Source: Bangladesh Power Development Board

Table 21 Electricity Production Cost and Bulk Tariff (Tk/kWh)

	2010-11	2011-12	2012-13	2013-14
Average Generation Cost (Tk/kWh)	4.06	5.36	5.79	6.27
Average Supply Cost (Tk/kWh)	4.20	5.52	5.99	6.46
Average Bulk Tariff (Tk/kWh)	2.61	4.02	4.70	4.70

Source: Bangladesh Power Development Board

Table 22 Historical Price of Fuels from 2009-2013

Effective Date	GAS (Tk/1000Cft)	HFO (Tk/Litre)	HSD (Tk/Litre)	COAL (US$/M Ton)
13-01-09	73.91	30	42.71	71.5
15-03-09	73.91	26	42.71	71.5
01-08-09	79.82	26	42.71	71.5
01-07-10	79.82	26	42.71	84
01-01-11	79.82	35	42.71	84
01-04-11	79.82	40	42.71	84
05-05-11	79.82	42	46	84
19-09-11	79.82	50	51	84
11-11-11	79.82	55	56	84
30-12-11	79.82	60	61	84
01-02-12	79.82	60	61	105
04-01-13	79.82	60	68	105

Source: Bangladesh Power Development Board

3.5.2 Subsidy/Budget Support in Power Sector

In recent years, the absolute level of subsidy/budget support in the power sector has increased. The magnitude of subsidy/budget support in the power sector has increased from about Tk 1,000 crore in 2008-10 to Tk 4,000 crore in 2010-11 and further to Tk 6,000 crore in 2011-12. From 2010-11 to 2011-12, the subsidy/budget support in power sector has increased by 50 per cent.

The subsidy/budget support in the power sector was 0.5 per cent of GDP in 2010-11; it increased to 0.7 per cent in 2011-12. But the subsidy/budget support in the power sector in relation to the aggregate subsidy/budget support has fallen from 23.3 per cent in 2010-11 to 20.5 in 2011-12. It shows that the subsidy in the power sector has increased relatively less faster than in other sectors. The following table gives the amount of subsidy for power sector during the previous four years (2008-09 to 2011-12) and its share in GDP and aggregate subsidy.

Table 23 Subsidy/Budget Support for Power Sector

Fiscal Year	Amount of Subsidy/ Budget support (BDT crore)	Subsidy/budget support (% of GDP at current market prices)	Subsidy/budget support (% of Total Subsidy)
2008-09	1,007	0.2	10.3
2009-10	994	0.1	10.7
2010-11	4,000	0.5	23.3
2011-12	6,000	0.7	20.5

Source: Finance Division, Ministry of Finance, Government of Bangladesh.

There are two principal reasons for the increase in the absolute level of subsidy support in the power sector. The first and the foremost reason is the significant rise in the prices of petroleum products in the international market. Second is the high cost of producing power in the country, arising in large part from the use of outdated technology and worn out machinery in a number of power plants.

The first issue mentioned above i.e., the rise in the international price of petroleum products has been addressed by the Government through a twin measure of aligning their domestic prices with the prices prevailing in international market, and altering the mix of power generation from fuel oil to coal-fired and gas-based power plants. The Government has started adjusting the petroleum product prices; the main input for power generation at present is in line with the international prices, as far as possible and practicable. Fuel prices have been raised five times in 2011 alone; not a mean job in a low income country such as Bangladesh, when the prices of similar products in the neighbouring countries, notably India, remained relatively lower. The prices have been raised in small increments at regular intervals so as to minimize the intensity of hardship of the users by thinly spreading the quantum of price hike.

3.5.3 Annual Development Programme (ADP) Allocation and Expenditure of Power Sector

Government has declared *Vision 2021: Electricity for All* and has given special emphasis on development of power sector. In last two fiscal years (FY 2012-13 and 2013-14), the annual development programme (ADP) allocation for Power Division was second in rank (16% and 13% of total national development budget respectively) after Local Government Division. The amount of allocation for Power Division were BDT 85.61 billion and BDT 79.30 billion in FY 2012-13 and 2013-14 respectively (**Figure 21**).

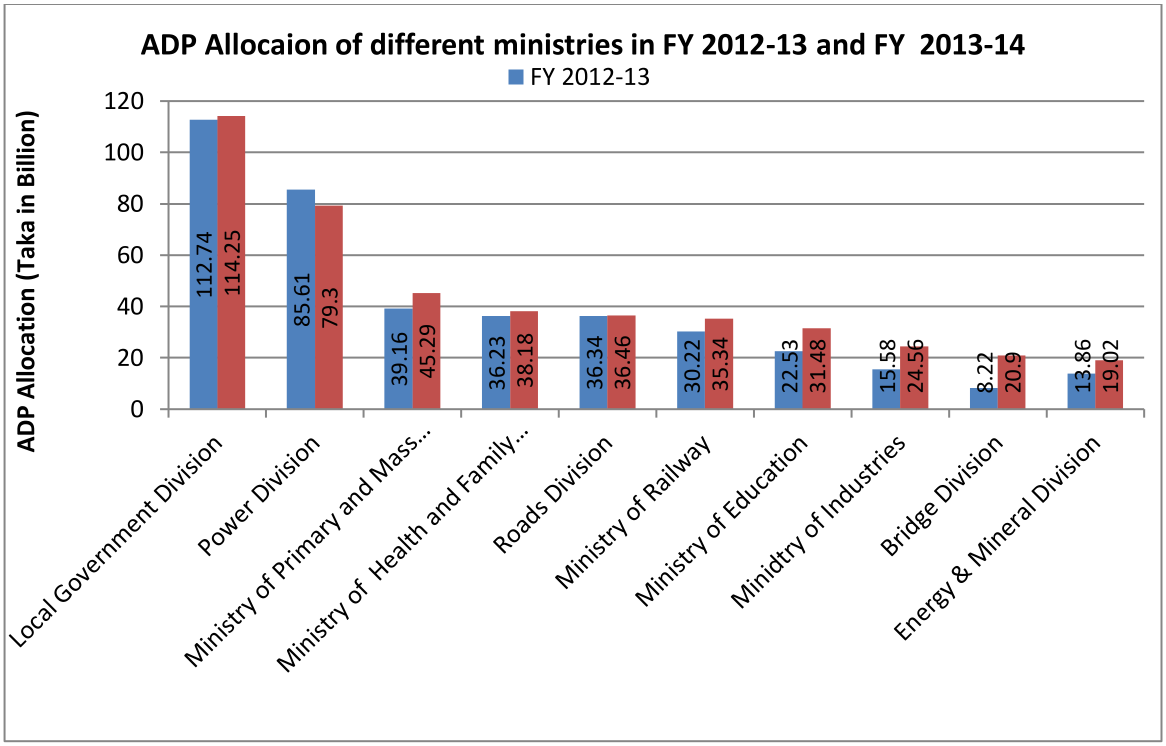


Figure 21 Ministries with Highest Revised Annual Development Programme (RADP) Allocation in FY 2012-13 and 2013-14

Source: Ministry of Finance, Government of Bangladesh

Figure 22 shows the ADP allocation and expenditure of power sector. In FY 2008-09 the ADP allocation for power sector was BDT 26.77 billion and has increased to BDT 79.28 Billion in FY 2013-14, which is almost three times.

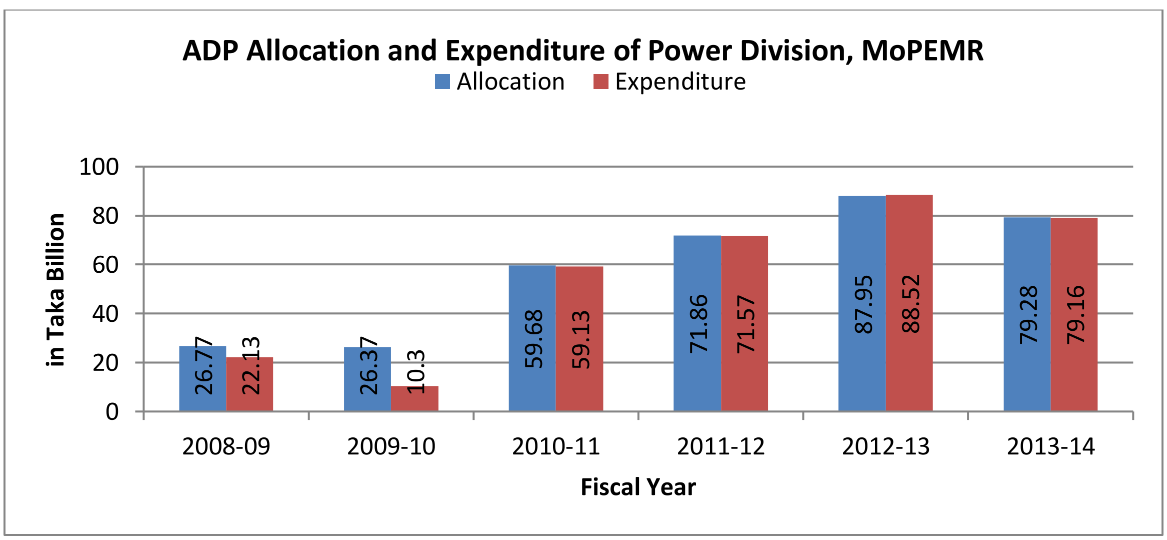


Figure 22 ADP Allocation and Expenditure from FY 2008-09 to FY 2013-14 (BDT billion)

Source: Ministry of power, energy and mineral resources, Government of Bangladesh

The historical revised ADP allocation for power sector from FY 1975-76 to FY 2013-14 is shown in **Figure 23**. The ADP allocation for power sector can be divided into three major categories namely generation, transmission and distribution as shown in the graph. The historical revised ADP allocation for power sector reveals that there is a boost in ADP allocation for electricity generation since FY 2011-12 which reflects in the present generation capacity also. More than five thousand megawatt generation capacity has been added in the last six years. This allocation will increase in the coming years to achieve the target of providing electricity to all by 2021.

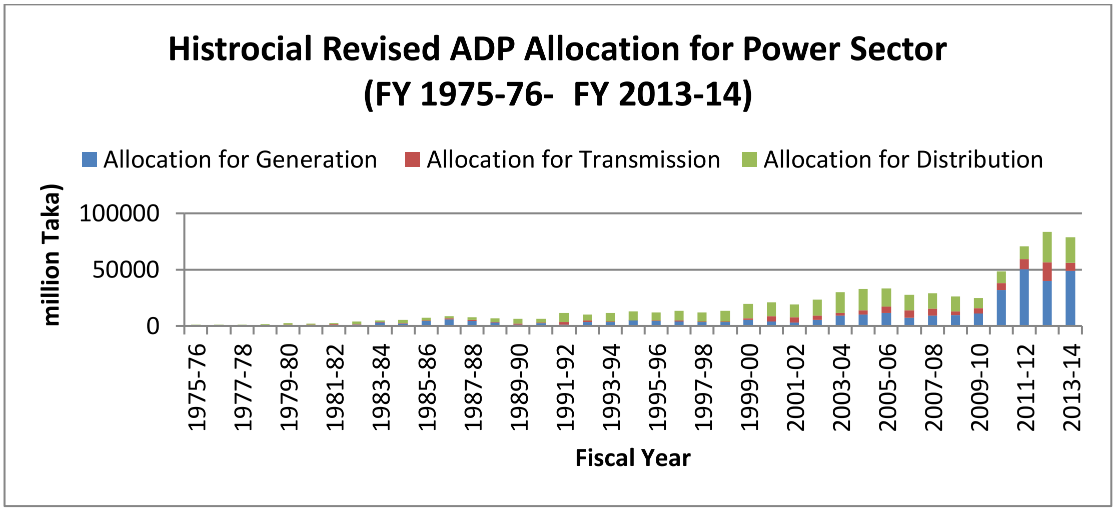


Figure 23 Historical Revised ADP Allocation for Power Sector since FY 1975-76

Source: Central Library, Ministry of Planning, Government of Bangladesh

3.5.4 Generation Cost of Electricity by Public and Private Sectors

In fiscal year 2012-13, generation cost of BPDB's own plant was BDT 4,709 crore, power purchase cost from IPP was BDT 3,750 crore and from public plant was BDT 1,083 crore which was in total DBT 19,881 crore. Energy sales during FY 2012-13 was BDT 16,171 crore compared to BDT 11,185 crore of the preceding year. The breakdown of the total generation cost in the FY 2012-13 is as shown in **Table 24**. The BPDB's own generation cost and energy purchase from IPP, Rental increased by 3.64%, 11.23%, and 7.95% respectively, compared to the FY 2011-12 but the energy purchase cost from public plant is decreased by 2.24%.

Table 24 Breakdown of the Total Generation Cost in the FY 2012-2013 of BPDB

Particulars	Amount (BDT Crore)
BPDB's Generation	4,708.51
Purchase from IPP	3,750.15
Purchase from Rental	10,340.05
Purchase from Public Plant	1,082.62
Interest on budgetary support	452.92
Provision for Maintenance and Development fund	718.67
Total	21,052.92

Source: Annual Report 2012-2013, BPDB

3.5.5 *Sales of Electricity to Distribution Companies*

During FY 2012-2013, the amount of electricity sales to BDPB's own consumer and other distribution companies (DPDC, DESCO, WZPDCL, REB, and PGCB) are given below (**Table 25**).

Table 25 Sales of Electricity by BPDB in the FY 2012-2013

Particulars Sales	Sales (BDT Crore)
PDB's own Consumer	4,271
DPDC	3,413
DESCO	1,954
WZPDCL	940
REB	5,592
PGCB	1
Total	16,171

Source: BPDB Annual Report 2012-13

3.5.6 *Revenues and Expenses of BPDB*

Table 26 shows year-wise trend of revenue income from sales of electricity with the operating expenses. The operating expenses include fuel cost, generation expenses (excluding fuel cost), electricity purchase from IPP, Rental and Public plants, provision for maintenance and development, wheeling charge to PGCB, distribution expenses and general and administrative expenses. In FY 2012, the fuel cost was BDT 3,252 crore which was increased by 30% compared to the FY 2011-12; this was possible because of increasing use of liquid fuel for power generation. The expense of electricity purchase from Rental power plants was BDT 10,340 crore which was 48% of the total expense in the fiscal year 2012-13, and was increased by 17.05% in comparison with the previous fiscal year.

Table 26 Year-wise Revenue to Operating Expenses

Financial Year	Total Revenue (BDT Crore)	Operating Expenses (BDT Crore)
2007-08	4,958	5,637
2008-09	5,594	6,251
2009-10	7,116	7,512
2010-11	8,161	12,276
2011-12	12,000	18,134
2012-13	16,883	21,396

Source: Annual Report 2012-13, BPDB

3.6 Analysis of Policies and Strategies

Following is the list of major acts, ordinances, policy documents, guidelines, etc related to power sector:

List of Acts, Ordinances, Long Term Plan, Policies, guidelines of the Power Division	
Acts, Ordinances	• The Electricity Act, 1910 • Special Act for quick procurement in Power and Energy sector • Sustainable Energy Development Authority Act, 2011 • Bangladesh Energy Regulatory Commission Act, 2003 • The Bangladesh Power Development Boards Order, 1972 (President's Order) • The Rural Electrification Board Ordinance,1977

List of Acts, Ordinances, Long Term Plan, Policies, guidelines of the Power Division	
Plan, Policies, Guidelines	• Power System Master Plan (PSMP) • National Energy Policy, 1996 • Private Sector Power Generation Policy of Bangladesh, October 1996 • Policy Guidelines for Small Power Plants (SPP) in Private Sector, 1998 • Power Pricing Framework (Approved by the Government in Jan 2004) • Remote Area Power Supply System Guideline (RAPSSG), 17 May 2007 • Policy Guidelines for Enhancing Private Participation in Power Sector, 2008 • Renewable Energy Policy of Bangladesh, 18 December 2008 • Guidelines for the implementation of solar power development program
Vision Paper	• Vision on Power Sector, January 2000

Existing Policies of Power Division

Existing Policies	**Major Issues**
Power System Master Plan 2010	Providing quality and affordable electricity to all citizens through the creation of a power network and sustainable fuel mix.
National Energy Policy 1996 (Revision at final stage)	Providing policy guidelines in power and energy sector, power and energy sector reforms, functions of and relation between various agencies in MOPEMR etc. National Energy Policy 2013 is at final stage accommodating all polices in power and energy sector.
Private Sector Power Generation Policy of Bangladesh-October 1996	Enabling private power generation (i.e. IPP), procurement method, security packages, incentive packages etc.
Policy Guidelines for Enhancing Private Participation in Power Sector 2008	Enabling merchant plants, open access grid, allowing government to procure power from merchant plants etc.
Renewable Energy Policy of Bangladesh- 2008	Harnessing renewable energy, incentive packages for RE, target set for RE, identifying RE sources, enabling govt. as a facilitator etc.
Policy Guidelines for Small Power Plants (SPP) in Private Sector, 1998	Allowing SPPs in the country, allowing govt. to procure power from SPPs, incentive packages for SPPs etc.
Remote Area Power Supply System Guideline (RAPSSG), May 2007	Defining RAPSS projects, identifying the RAPSS areas, selection of RAPSS projects, RAPSS funds etc.
Guidelines for the implementation of solar power development program.	Define general guideline for implementation of solar power project both in public and private sectors.

3.6.1 *Sixth Five Year Plan*

1. Name	**2. Policy Domain**
Sixth Five Year Plan	Country Wide Policy
3. Status & Timeframe	**4. Spatial - Geographical Focus**
FY 2011-2015	National
5. Implementing agency(ies) related to power sector	
Power Division, Ministry of Power Energy and Mineral Resources	
6. Objectives & Indicators related to power sector	
• To ensure energy security. • To make the power sector financially viable. • To increase generation capacity of electricity • To introduce a new corporation culture in the power sector entities • To improve the reliability and quality of electricity supply • To diversity fuel use in power generation i.e. coal, liquid fuel etc • To make the power sector more efficient in terms of generation, transmission and distribution. • To increase private sector participation in the form of public-private (national) –private (international)/ private (national/international) to mobilize resources in electricity, gas and other energy supply • To reduce demand-supply gap both in primary (fossil fuel) and secondary (electricity) sector. • To conserve both power and energy. • To intensity 'Energy Manager' in energy industries and 'Energy Auditing System' with a view to optimizing energy use. • To introduce labelling system with a view to ensuring the use of energy the use of energy efficient equipment • To appraise the producing gas fields • To raise price of gas, liquid fuel and electricity step by step compatible with international price • To encourage energy trade including energy cooperation with neighbours. • To develop facilities to enable import of LNG • To develop coal fields thereby reducing dependency on natural gas • To finalize the coal policy • To finalize the extraction plan • To intensity exploration activities for coal and other minerals especially in the north-western part of the country • To increase use of renewable energy by 5% of electricity demand by the plan period • To consider gender dimension in polices, programs/projects in the energy sector	
7. Included Measures – Projects – Programs	
• Establish Coal-based power plant using domestic and imported coal • Installation of Nuclear Power Plant at Ruppur • Finding new oil and gas fields in both offshore and onshore through extensive exploration • Huge investment in projects in electricity generation and transmission as well as in oil and gas exploration through Public-Private Partnership Projects • Participation of local investors in the power sector • Import LNG • Engage in energy trade including grid connectivity for power with neighbours • Development of coal fields • Increase refining as well as storage capacity of liquid fuel • Development renewable energy sources	

3.6.2 Power Sector Master Plan 2010

1. Name	2. Policy Domain
Power Sector Master Plan 2010	Power Sector
3. Status & Timeframe	**4. Spatial - Geographical Focus**
2030	National
5. Implementing agency(ies)	
Power Division, Ministry of Power Energy and Mineral Resources	
6. Objectives & Indicators	
• The diversification of fuel resources including an optimum power development plan • Identification of the potential power plant sites based on the fuel diversification. • To attain stable power supply by achieving the 3Es i.e. Economic Growth, Energy Security and Environmental Protection simultaneously. • To acquire the fuel composition ratio would be coal 50% (30% domestic coal and 20% imported coal), natural gas 25% (including LNG), 5% liquid fuel and 20% nuclear including renewable and cross-border trade. • To achieve the best mix of energy supply including imported resources, it would be required to use economical and stable power source in consideration of environmental protection. • Especially coal will be an important resource as the primary energy supply due to its price stability and lower volatility compared with oil and natural gas, Longer reserve production ratio compared with oil and natural gas, Wide spread availability throughout the world and is expected to be supplied stably.	
7. Included Measures – Projects – Programs (including status: proposed, in implementation, finalized)	
• Diversification of fuel sources in power plant (focused on Coal based power plant) • Introduction of LNG facilities • Construction of the oil fired power station • Cross border trade of electricity from neighbouring countries and import power generated by hydropower from the neighbouring countries or joint development • Introducing a high efficient power supply and low CO_2 emission technology • Improving 10 points thermal efficiency on average funding volume from each of the funding sources to fill the gap. • Improve and expand power system with the diversification of fuel sources and cross border trade. • Increase fund volume in national budget (including ODA assistance by donors) government scheme for PPP promotion, donor's assistance to IPPs • Escalation of bulk tariff. • Increase energy generation from renewable sources.	

3.6.3 Renewable Energy Policy 2008

1. Name	2. Policy Domain
Renewable Energy Policy 2008	Power Sector
3. Status & Timeframe	**4. Spatial - Geographical Focus**
2020	National

5. Implementing agency(ies)
Power Division, Ministry of Power Energy and Mineral Resources
6. Objectives & Indicators
• Harness the potential of renewable energy resources and dissemination of renewable energy technologies in rural, peri-urban and urban areas; • Enable, encourage and facilitate both public and private sector investment in renewable energy projects; • Develop sustainable energy supplies to substitute indigenous non-renewable energy supplies; • Scale up contributions of renewable energy to electricity production; • Scale up contributions of renewable energy both to electricity and to heat energy; • Promote appropriate, efficient and environment friendly use of renewable energy; • Train; facilitate the use of renewable energy at every level of energy usage. • Create enabling environment and legal support to encourage the use of renewable energy. • Promote development of local technology in the field of renewable energy. • Promote clean energy for CDM; and • Achieve the targets for developing renewable energy resources to meet five percent of the total power demand by 2015 and ten percent by 2020.
7. Included Measures – Projects – Programs (including status: proposed, in implementation, finalized)
• An institution, Sustainable Energy Development Agency (SEDA) has been established as a focal point for sustainable energy development and promotion, 'sustainable energy' comprising renewable energy and energy • SEDA in conjunction with the Power Division of the MPEMR shall be responsible for determining the priorities for renewable energy technology development and program implementation. • SEDA shall support capacity building, technology development, and market development sufficient to boost the share of electricity generated from renewable energy technologies. • All power utilities, Local Government Engineering Department (LGED), other interested government departments, private agencies and NGOs are to develop renewable energy development program for implementation throughout the country. • Electricity generated from renewable energy projects, both in public and private sectors may be purchased by power utilities or any consumer through mutual agreement (less than 5 MW). • Renewable energy project sponsors may use existing electricity transmission and distribution systems, if there is adequate capacity, to supply electricity to its customers through mutual agreement between the project sponsor and the owner of transmission/distribution facilities. The sponsor will be required to pay a wheeling charge to the owner of transmission/distribution facilities. The wheeling charges shall be determined by BERC in consultation with the Power Division of MPEMR. • In addition to electricity generation, renewable energy for solar heating and biogas or other means like cooking etc shall be developed. • SREDA will encourage human resource development and local production of renewable energy equipment, facilitate and monitor quality of renewable energy equipment, and will assist to setup quality control laboratory to test the renewable energy equipment. • For large biomass electricity projects (i.e. greater than 1 MW) the project developer must demonstrate that the biomass is being sustainably harvested and that no adverse social impact will result from that development. • Production and use of bio-fuels may be encouraged in limited scale without jeopardizing the existing crops.

3.7 Future Outlook

3.7.1 Future Demand

The forecasted demand of electricity till 2030 in PSMP 2010 is shown in the following figure along with forecasted electricity demand targeting GDP growth rate 6 and 7 percent (54). The projected peak demand of electricity in PSMP 2010 is 33,708 MW by 2030 which is higher than the peak demands required to attend GDP growth rate 6 and 7 percent (**Table 27** and **Figure 24**).

Table 27 Demand Dynamics with GDP Growth Rate and Electricity Growth Rate

FY	GDP growth rate	Elasticity	Effect of DSM	Electricity growth rate	Total Demand without DSM	Total Demand with DSM	Off-grid Captive demand	Grid System Demand with DSM
Unit	[%]	-	[%]	[%]	[MW]	[MW]	[MW]	[MW]
2010	5.5%	1.50	5.0%		7,454	7,454	1,000	6,454
2011	6.7%	1.50	5.0%	4.5%	8,203	7,793	1,027	6,765
2012	7.0%	1.50	5.0%	10.5%	9,064	8,611	1,093	7,518
2013	7.0%	1.50	5.0%	10.5%	10,016	9,515	1,166	8,349
2014	7.0%	1.50	5.0%	10.5%	11,068	10,514	1,246	9,268
2015	7.0%	1.50	5.0%	10.5%	12,230	11,618	1,335	10,283
2016	7.0%	1.50	5.0%	10.5%	13,514	12,838	1,433	11,405
2017	7.0%	1.50	5.0%	10.5%	14,933	14,186	1,542	12,644
2018	7.0%	1.50	5.0%	10.5%	16,501	15,676	1,662	14,014
2019	7.0%	1.50	5.0%	10.5%	18,233	17,322	1,794	15,527
2020	7.0%	1.40	6.0%	8.6%	20,020	18,819	1,515	17,304
2021	7.0%	1.35	6.5%	8.9%	21,912	20,488	1,649	18,838
2022	7.0%	1.30	7.0%	8.5%	23,906	22,233	1,790	20,443
2023	7.0%	1.25	8.0%	7.6%	25,998	23,918	1,925	21,993
2024	7.0%	1.20	9.0%	7.2%	28,182	25,645	2,064	23,581
2025	7.0%	1.15	10.0%	6.9%	30,450	27,405	2,206	25,199
2026	7.0%	1.10	11.0%	6.5%	32,795	29,187	2,349	26,838
2027	7.0%	1.05	12.0%	6.1%	35,205	30,981	2,494	28,487
2028	7.0%	1.00	13.0%	5.8%	37,670	32,773	2,638	30,134
2029	7.0%	1.00	14.0%	5.8%	40,306	34,664	2,790	31,873
2030	7.0%	1.00	15.0%	5.8%	43,128	36,659	2,951	33,708

Source: Power System Master Plan 2010

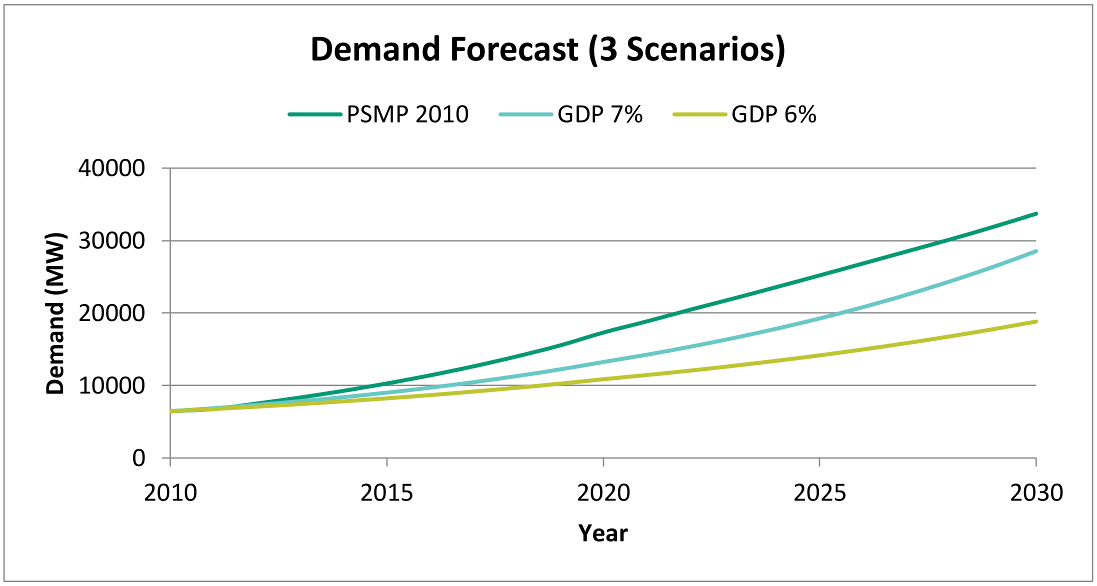


Figure 24 Demand Forecast

Source: Power System Master Plan 2010

3.7.2 Future Generation

The generation of electricity from different fuel sources (Gas, Coal, FO, HSD, Other: Renewable, Nuclear, Imported) up to 2030 is shown in the following graph. The fuel composition ratio would be Coal 50% (30% domestic coal and 20% imported coal), Natural gas 25% (including LNG), Liquid fuel 5%, Nuclear Renewable and Cross-Border Trade 20% by 2030 as forecasted in PSMP 2010.

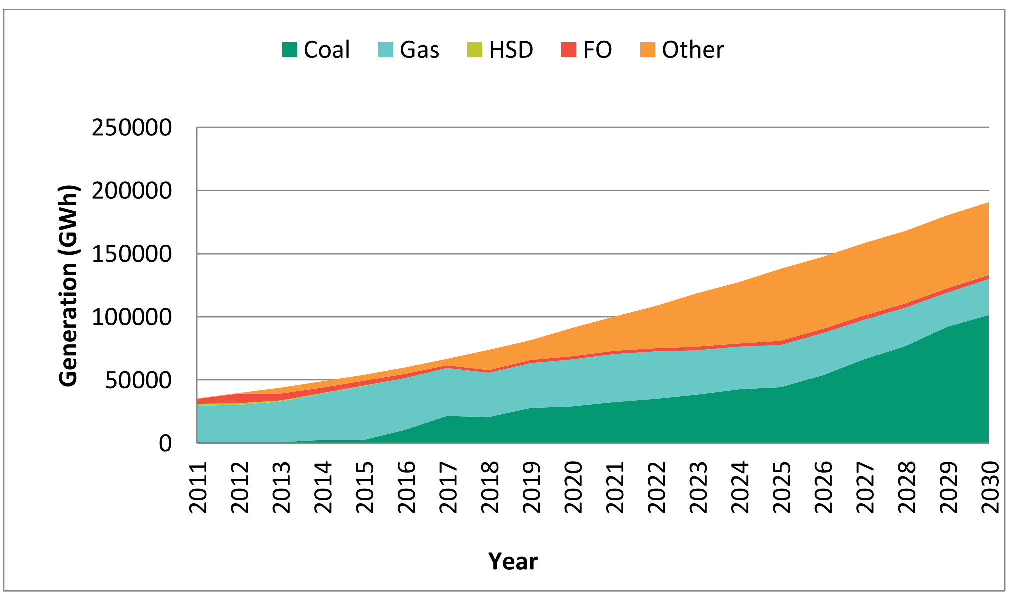


Figure 25 Year-wise Growth in Generation by Fuel Type up to 2030

Source: Power System Master Plan 2010

3.7.3 *Forecasted Emission by 2030*

The emission by 2030 has been forecasted from the future generation by 2030 according to PSMP 2010, and grid emission factor prepared by Department of Environment, Ministry of Environment and Forest. The following graph (**Figure 26**) shows coal will be the main contributor of CO_2 emission in future as it will be the primary source of energy by 2030.

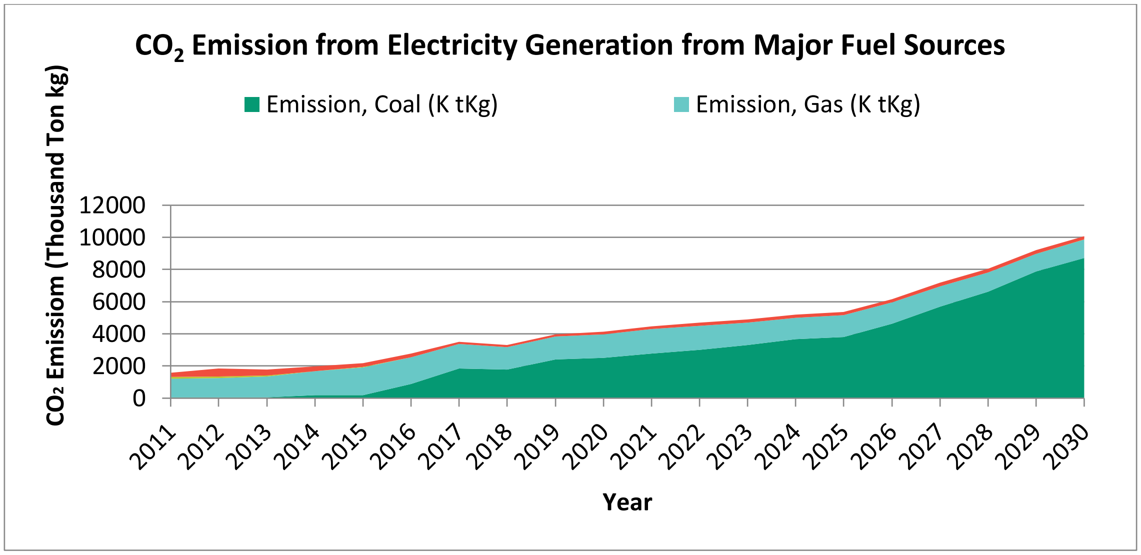


Figure 26 CO2 Emission from Electricity Generation from Major Fuel Sources

Source: Power System Master Plan 2010 and Department of Environment (DoE)

3.8 Future Plan

3.8.1 *Short Term Generation Plan (2014-2021)*

In line with the vision 2021, the Government has prepared a generation expansion plan for FY 2014- FY 2021 time frame considering the availability of primary fuel supply. Due to the present persistent shortage of gas and uncertainty in future gas supply to the base load power plants, the Government has emphasized on fuel diversification. Liquid fuel is considered for peaking power plants to mitigate short-term power shortage.

In line with the generation expansion plan, about 17,500 MW of electricity will be added to the national grid by FY 2021. To achieve this target, a number of gas based plant projects in public and private sector have been undertaken as a midterm planning. But in the long run, large scale coal and nuclear based power plants are expected to take over the base loads (**Table 28** and **Table 29**).

Table 28 Generation Plan in Public and Private Sector up to FY 2021

Fiscal Year	14-15 (MW)	15-16 (MW)	16-17 (MW)	17-18 (MW)	18-19 (MW)	19-20 (MW)	20-21 (MW)	Total (MW)
Public	492	937	2,599	1,076	1,320	1,750	1,200	1436,945
Private	1,016	287	954	367	1,716	1,247	612	2223,979
Power Import		100		500			1,300	1,900
Total	1,508	1,324	3,553	1,943	3,036	2,997	3,112	3662,824

Source: Bangladesh Power Development Board

Table 29 Generation Plan by Fuel Type (2015 - 2021)

Fuel Type	Public Sector (MW)	Private Sector (MW)	Total (MW)
Gas	4,723	857	5,580
Coal	2,794	3,575	6,369
HFO	104	1,048	1,152
Duel Fuel	738	629	1,367
LNG	1,000	0	1,000
Power Import	0	1,900	1,900
Renewable	15	90	105
Total	865,517	1582,523	122,368

Source: Bangladesh Power Development Board

3.8.2 Implementation of the Short Term Generation Plan

Total capacity of 5,805 MW including 500 MW imported power from India has been added to the national grid in last six years. 19 projects of total capacity 3,634 MW are now in various stage of procurement process right from tender invitation to contract initiating. In addition to that 77 projects of total capacity 11,509 MW are in pipeline and 75 contracts related to these projects have signed up to December 2014 (**Table 30**).

Table 30 Generation Projects

Type of Power Plant	No. of Power Plant Project	Installed Capacity (MW)
	Ongoing Projects	
Public	35	6,515
Rental	20	1,653
IPP	22	3,341
Sub Total	**77**	**11,509**
	Project under procurement Process	
Public Sector	4	296
Private Sector	15	3,338
Sub Total	**19**	**299,338**
	Approved (ECNEC) Projects	
Public Sector	9	8,405
Private Sector	-	-
Sub Total	**9**	**8,405**

Source: Bangladesh Power Development Board

3.8.3 Ongoing Projects

The list of ongoing projects in public and private sector at different locations of the country is given in the following tables (**Table 31** to **Table 36**). All new gas based power plants will be combined cycle power plant. The total capacity of gas based power plant implementing by public sector is 3,607 MW and total capacity of privately implementing gas based project is 536 MW.

Table 31 List of Ongoing Projects Based on Gas

Project Location	Plant Capacity (MW)	Expected Date of Completion	Completed work (in percentage)	Remark
	Public Sector			
Ashuganj	225	September, 2015	94%	CCPP
Bhola	195	October, 2015	52%	CCPP
Siddirganj	335	March, 2016	73%	CCPP
Ashuganj	373	August, 2015	73%	CCPP
Bibiana	400	January, 2018	2%	CCPP
Shahaji Bazar	332	March, 2017	14%	CCPP
Ghorashal	363	January, 2018	0%	CCPP
Ashugnaj	381	January, 2017	28%	CCPP
Ghorashal	206	February, 2017	0%	Repowering
Bheramara	414	March, 2017	20%	CCPP
Bibiyana	383	January, 2018		CCPP
Sub total	**3,607**			
	Private Sector			
Bibiana 2	341	December, 2015	54%	CCPP
Ashugnaj	195	March, 2015	70%	Modular
Sub total	**536**			
Total	**4,143**			

Source: Bangladesh Power Development Board

Table 32 List of Ongoing Projects Based on HFO

Project Location	Plant Capacity (MW)	Expected Date of Completion	Completed Work (in percentage)
Chapai Nawabganj (Public)	104	October 2016	0%
Bosila, Karaniganj (Private)	108	June, 2015	48%
Nawabganj (Private)	55	June, 2015	40%
Alirtek, Nawabganj (Private)	53	January,2016	18%
Manikganj (Private)	55	March, 2016	10%
Karaniganj (Private)	100	July,2016	0%
Gabtoli, Dhaka (Private)	108	August, 2016	22%
Bosila, Karaniganj (Private)	108	August, 2016	22%
Total	**691**		

Source: Bangladesh Power Development Board

Table 33 Ongoing Projects Based on Duel Fuel (Gas/HFO or Gas/ HSD)

Project Location	Plant Capacity (MW)	Expected Date of Completion	Completed work (in percentage)	Remark
	Public sector			
Kodda, Gazipur	150	March, 2015	60%	Gas & HFO
Khulna	75	September, 2015	10%	Up-gradation to CC (Gas & HSD)
Sirajganj	220	July, 2017	0%	Gas/HSD
Shikalbaha	225	July, 2017	0%	Gas/HSD
Sub Total	**670**			
	Private sector			
Meghna Ghat	115	March, 2015	97%	Construction of ST of CCPP (Gas &HSD)
Jamalpur	95	January, 2016	45%	Gas& HFO
Sub Total	**210**			
Total	**880**			

Source: Bangladesh Power Development Board

Table 34 List of On-going Projects in Public Sector Based on Coal

Project Location	Plant Capacity (MW)	Expected Date of Completion	Completed Work (in percentage)	Remark
	Public Sector			
Barapukuria, Dinajpur	274	March, 2018	97%	Domestic Coal
Sub Total	**274**			
	Private Sector			
Moawa, Munshiganj	522	July, 2018	0%	Imported Coal
Khulna	630	July, 2018	0%	Imported Coal
Sub Total	**1,152**			
Total	**1,426**			

Source: Bangladesh Power Development Board

Table 35 List of On-going Projects in Private Sector Based on Wind

Project Location	Plant Capacity (MW)	Expected Date of Completion	Completed Work (in percentage)	Remark
Cox's Bazar	60	December, 2015	0%	
Total	**60**			

Source: Bangladesh Power Development Board

Table 36 List of On-going Projects on Transmission and Distribution

Serial	Project Name	Expected Date of Completion
1	Two new 132/33 kV substations at Kulaura & Sherpur with interconnecting lines.	Feb' 2014
2	Aminbazar-Old Airport 230 kV Transmission Line and Associated Substations	June'2014
3	Siddhirganj-Maniknagar 230 kV Transmission Line	June'2014
4	Barisal-Bhola-Burhanuddin 230 kV Transmission Line Project	June' 2014
5	Bibiyana-Kaliakoir 400 KV and Fenchuganj-Bibiyana 230KV Transmission Line (NG2)	Dec'2014
6	Goalpara-Bagerhat 132 kV Double Circuit Transmission Line	June' 2015
7	132 kV Grid Network Development Project in Eastern Region.	June'2016
8	400/230/132 Network Development Project (Trance-2)	June'2017
9	National Power Transmission Network Development Project	June'2017
10	Enhancement of Capacity of Grid Substation and Transmission Lines for Rural Electrification.	Dec' 2017

Source: Power Grid Company Bangladesh Limited

3.8.4 Future Projects

The future projects have been approved by the planning commission of government and yet to start. The future projects in public and private sector are listed under this section. Majority of the future gas based projects will be implemented by public sector which is 1,225 MW in total. In private sector, total capacity of 580 MW will be implemented (**Table 37**).

Table 37 List of Future Projects Based on Gas

Project Location	Plant Capacity (MW)	Expected Date of Completion	Remark
	Public Sector		
Sylhet	75	January,2017	Upgradation to CCPP
Ghorashal Unit 6	206	December, 2017	Repairing
Baghabari	50	August, 2017	Upgradation to CCPP
Shahaji Bazar	35	August, 2017	upgradation to CCPP
Sub total	**366**		
	Private Sector		
Sirajganj	367	June, 2017	GAS & Diesel
Kushiara	163	June,2016	CCPP
Fenchuganj	50	March,2016	
Sub Total	**580**		
Total	**946**		

Source: Power Division, MPEMR

The coal based power plants will be the major projects in future. Capacity of all imported coal based power plants will be above 1,000 MW and will be located in the coastal areas. These Giga Watt (above 1,000 MW) scale projects will be implemented by public sector. The coal based power plants in the private sector will be located mainly in Dhaka, Cox's Bazaar and Chittagong and will depend on imported coal. Therefore the transportation of coal from the sea port to the project location will be a major concern.

Table 38 List of Future Projects based on Coal

Project Location	Plant Capacity (MW)	Expected Date of Completion	Remark
	Public sector		
Rampal, Khulna	1,320	June, 2019	Imported Coal
Maheshkhali	1,200	June, 2021	Imported coal **HDH**
Matarbari	1,200	December, 2021	Imported Coal (Funded by JICA)
Maheshkhali	1,200	June, 2022	Imported Coal
Maheshkhali	1,200	June, 2022	Imported Coal **(ECA Funding)**
Paira, Patuakhali	1,200	June, 2022	Imported Coal (**China)**
Sub total	**7,320**		
	Private Sector		
Dhaka (Orion Group)	282	June, 2019	Imported Coal
Chittagong (Orion Group)	282	June, 2019	Imported Coal
Chittagong (S Alam Group)	612	March, 2020	Imported Coal
Chittagong (S Alam Group)	612	January, 2021	Imported Coal
Dhaka (Orion Group)	635	March, 2020	Imported Coal
Sub total	**2,423**		
Total	**9,743**		

Source: Power Division, MPEMR

The HFO based power plants will be implemented by different private companies at different location close to load centres (**Table 39**).

Table 39 List of Future Project in Private Sector Based on HFO

Project Location	Plant Capacity (MW)	Expected Date of Completion
Bhairab	50	December, 2016
Madanganj	52	August, 2016
Barisal	100	July, 2016
Kamalaghat	50	December,2016
Satkhira	50	January, 2017
Total	**302**	

Source: Power Division, MPEMR

The shortage of gas supply will be mitigated by importing LNG. Along with other necessary facilities, the infrastructure of two terminals of 500 MMCFD will at least be built to receive the imported liquid. The government has a plan to construct a liquefied natural gas (LNG) based Giga Watt scale power plant and it is already approved by the planning commission. The location of the project is yet to be selected. This will be first LNG based power plant in Bangladesh (**Table 40**).

Table 40 List of Future Project in Public Sector Based on LNG

Project Location	Plant Capacity (MW)	Expected Date of Completion	Remark
Coastal Area	1,000	June, 2020	First LNG Based CCPP

Source: Power Division, MPEMR

The solar and wind based projects in public and private sector are expecting to be completed by 2016. The present status of these projects has been discussed in the renewable energy section (**Table 41** to **Table 43**).

Table 41 List of Future Projects in Public Sector (Renewable Energy)

Project Location	Plant Capacity (MW)	Source of Energy	Expected Date of Completion
Kaptai	8	Solar	December, 2016
Hatia	7	Solar	December, 2016
Total	**15**		

Source: Power Division, MPEMR

Table 42 List of Future Projects in Private Sector (Renewable Energy)

Project Location	Capacity (MW)	Source of Energy	Expected Date of Completion
Sharisha Bari	3	Solar	December, 2016
Thorola	30	Solar	December, 2016
Total	**33**		

Source: Power Division, MPEMR

Table 43 List of Future Projects Related to Transmission and Distribution System

Serial	Project Name	Expected Date of Completion
1	Ashuganj-Bhulta 400 kV Transmission line	June'2015
2	Western Grid Network Development Project	June'2017
3	Maduna ghat – Meghna ghat 400 kV Transmission line (NG4)	June'2017
4	Enhancement of Capacity of Grid Substations and Transmission Line (Phase-I)	June' 2017
5	Rural Transmission Network Development & Renovation Project	June' 2017
6	Aminbazar-Maowa-Mongla 400 KV and Mongla-Khulna(S) 230 kV Transmission line (NG3)	June'2017
7	Matarbari-Madunaghat 400kV Transmission line project	2021

Source: Power Grid Company Bangladesh Limited

3.8.5 Long Term Generation Plan (2010-2030)

Government has prepared the Power System Master Plan 2010 with the support of JICA. According to the PSMP-2010, the maximum demand in 2015, 2021 and 2030 will be 10,000, 19,000 and 34,000 MW respectively. To meet this demand with reliability, the installed capacity should be increased to 24,000 MW and 39,000 MW by the year 2021 & 2030 respectively. According to PSMP 2010, the generation capacity from different primary fuel by 2030 would be as follows:

- Domestic and imported coal based - 19,650 MW
- Nuclear power - 4,000 MW
- Gas and LNG - 8,850 MW
- Regional Grid - 3,500 MW
- Liquid fuel, Hydro, Renewable - 2,700 MW

At present, natural gas is the primary fuel (65%) of electricity generation followed by liquid fuel (26%). The current gas reserve of Bangladesh is 16.12 TCF which will be consumed within few decades and many power plants would be shut down due to the shortage of gas (52). Liquid fuel cannot be considered as alternative of natural gas. Therefore, coal could be the alternative of natural gas as a primary source of fuel although it will increase CO_2 emission. High quality bituminous coalmines are located in the north-western part of Bangladesh and the total reserve of coal is around 2,355 million MT.

Nuclear Power Plant

In March 2009, Russia made a formal proposal to build a nuclear power plant in the country and a bilateral nuclear cooperation agreement was signed. In April 2009, the government approved the Russian proposal to build a 1,000 MWe AES-92 nuclear plant at Rooppur for about $2 billion, and a year later this had become two such reactors by 2017 (55). A nuclear energy bill was introduced into parliament in May 2012, with work to begin in 2013, and setting up a Bangladesh Atomic Energy Regulatory Authority. According to the bill, 4,000 MW of nuclear capacity was envisaged by 2030, and a second plant would need to be built in the southern part of Bangladesh once Rooppur starts operation.

In May 2010 an intergovernmental agreement was signed with Russia, providing a legal basis for nuclear cooperation in areas such as design, construction and operation of power and research nuclear reactors, water desalination plants, and elementary particle accelerators. Other areas covered included fuel supply and wastes – Russia will manage wastes and decommissioning.

In February 2012, the Ministry of Science and Technology, signed an agreement with Russia's Rostechnadzor related to regulation and safety and the provision of advisory support to the Bangladesh Nuclear Regulatory Commission on regulation, licensing and supervision. Staff will be trained in Russia.

An intergovernmental agreement for provision of a $500 million Russian loan to finance engineering surveys on the site, project development and personnel training was signed in January 2013. A future loan of about $1.5 billion is expected for the nuclear build proper. In August 2012 a financing agreement was negotiated under which Bangladesh would borrow $500 million for a 2-year technical and economic study together with design, documentation and training, at not less than 4.5% interest rates. Russia will then provide a second loan of $1.5 billion for 90% of the first unit's construction. The agreement was signed in January 2013. The $500 million loan will be repaid in 12 years with 5 years grace period, and the final construction cost will be repaid in 28 years with 10 years grace period. The IAEA continues its close involvement with the project.

In June 2013, NIAEP-Atom Story Export signed a contract with BAEC to prepare documentation related to construction and environmental impact assessment for the plant, as well as providing for necessary engineering studies. This was followed by a $265 million agreement in October (both part of the $500 million loan facility) for site preparation and detailed design documentation. A $190 million agreement for major site works to prepare for first concrete was signed in June 2014, and BAEC authorized this in September, to be completed by 2016. The project management company is JSC NIAEP.

Site works started in October 2013, and construction works of the first unit is scheduled from 2015, with operation soon after 2020. In June 2014 the government and the Bangladesh Atomic Energy Commission (BAEC) invited the Japan Atomic Energy Agency (JAEA) to explore the possibility of building a second 2,000 MWe nuclear power plant in the south of the country.

The proposed location of nuclear power plant is situated at Rooppur on bank of the Padma River, 200 km north-west of Dhaka, in Ishwardi Upazila under Pabna District, in the northwest of the country. BAEC under Ministry of Science and ICT is the government agency responsible for implementing the project. The project is in the initial stage and the detail report and design documents will be prepared based ongoing feasibility evaluation, Engineering survey, Environment studies, etc by June 2017. Rooppur has been chosen primarily as plant site because of its soil type (soft soil). The construction of the reactor will be started soon and the report on the feasibility study of the site will be published by 2017 (53). The 'water-water energetic' reactor (VVER) designed by Russia will be used in Rooppur Nuclear Power Plant. Initially Russian regulations will be adopted by Bangladesh Atomic Energy Regulatory Authority.

Regional Cooperation on Cross Border Power Trade

South Asian countries have good resource potential and good scope for energy cooperation. Huge potential lies in cross-border energy trade, which can ensure reductions in required generation and transmission capacity, reduction in fuel costs and improved use of low-cost electricity sources. Some countries like Nepal, Bhutan and north-eastern part of India have enormous unexploited hydroelectric potential compared to their low peak demands.

Interconnection of regional power grids improves stability and reliability of power supply and also allows the construction of larger and more economical central power plants. At present, Bangladesh is importing 500 MW of electricity from India through grid interconnectivity, with a process underway to bring in another 600 MW. However, Bangladesh emphasized the need for new cross border interconnection in order to facilitate regional power trade with neighbouring countries for energy security and reliability.

In Power System Master Plan 2010, Bangladesh identified several inter-connection points for regional power trade with neighbouring countries. Already first regional inter-connection of capacity 1,000 MW has become operational with 500 MW power import from India. The **Table 44** below shows possible interconnection points to facillitate regional power trade (first phase) with neighbouring countries.

Table 44 Estimated Hydro Power Potential in South Asia

Country	**Estimated Hydropower Potential in South Asia (Giga Watt)**
India	149
Nepal	83
Pakistan	50
Bhutan	30
Bangladesh	0.8
Sri Lanka	2
Myanmar	39
Total	**345**

Source: Sixth Five Year Plan

South Asia's North East sub-region has very good untapped hydropower potentials as shown in table above. Currently 500 MW of electricity is imported from India through Bheramara-Bahrampur 400KV substation. Discussion is going for 100 MW power import from Tripura by January 2016 and additional 500 MW through Bheramara-Baharampur by June, 2017 as capacity of the substation is 1,000 MW. Importantly the grid connectivity with India opens up possibility for power trade with Nepal and Bhutan. Possiblie interconnection among India, Myanmar and Bangladesh is shown in **Figure 27**.

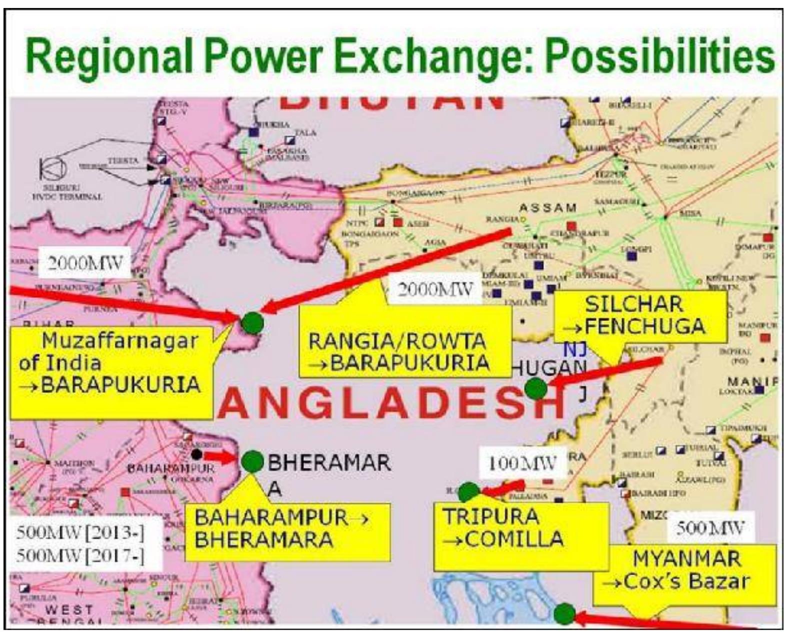


Figure 27 Future Cross Border Power Trade Corridors

Source: Bangladesh Power Development Board

Regional Co-operation with Nepal for Hydro Power Import

According to the Annual Report, forecast of domestic peak power demand of Nepal will be around 4,000 MW in 2030. Even with considering high demand growth Nepal will have sufficient capacity in future for export to its neighbouring countries. Due to enhanced economic growth, power demand in Bangladesh is increasing rapidly and hydro power from Nepal, Bhutan and North-Eastern region of India is one important option to mitigate future power demand. So Bangladesh could be a potential market of neighbouring hydro power. Possible interconnection to import Hydro Power from Nepal may be – "Duhabi (Nepal) – Purnia (India) – Barapukuria (Bangladesh) Transmission Line". Purnia (India) - Barapukuria (Bangladesh) transmission line may be developed under bilateral co-operation between Bangladesh and India. Bangladesh may also participate in the Hydro-Power development in Nepal to facilitate power trade in this region. The associate challenges and issues are listed as follow:

- Cost-effective hydro power development in Nepal for power export to Bangladesh and India
- Establishment of regional power market to facilitate power exchange to its participating member countries.
- Adoption of relevant legal and regulatory measures in respective countries to establish 'Regional Power Market'.
- Needs to identify win-win option for sustainable Regional Co-operation.
- Strong Political will is the key to move forward towards Regional Energy Co-operation to ensure energy security in this region for overall socio-economic benefit.

Development of Coal Power by 2030

According to power System master plan 2010, 19,650 MW of total generation coal will be added from coal based power plants by 2030. The coal centres will be located in Sonadia, Matarbari and Chittagong from where coal will be transported to coal based power plants by waterway and railway as shown in following figure (**Figure 28**). The location of future coal based power plants is also shown in the figure.

Figure 28 Coal Centres

Courtesy: Google Earth, information: PSMP 2010

Liquid Natural Gas (LNG)

Liquid Natural Gas (LNG) will be imported to meet the shortage of gas supply. It is included in The Sixth five year plan that along with other necessary facilities, at least the infrastructure of two terminals of 500 MMCFD will be built to receive the imported LNG.

3.9 Challenges

3.9.1 Present Challenges

In a developing economy like Bangladesh, aspiring to achieve middle income status, it is natural that the demand for and intensity of electricity use will be on the rise. In FY 2014, 60% (Grid) of the total population has access to grid electricity, and per capita electricity consumption is only 233 kWh (Grid) which is much lower than the neighbouring countries except Nepal. Based on the current income elasticity, with average economic growth of 6%t per year, and likely to grow at 7% per year over the next 2 years, the capacity for electricity generation would need to be doubled every six years. Fast tracking the generation and distribution system is also a difficult proposition as development and investment in the power sector is different from that of the other sectors due to the sector specific characteristics. Large asset accumulation and bulk procurement is required for investment in the power sector; the gestation period is usually high and the lumpiness of capital requirement makes the investment risky. This warrants a systematic and well thought-out short, medium and long term plans as well as creating level playing field to attract private investments to supplement public sector efforts. The major constraints of development of the power sector in Bangladesh are highlighted below:

Lack of Adequate Resources: (Private- Public- External)

Acute resource scarcity and insufficient allocation in the national budget is a major hindrance for implementation of the PSMP 2010 for orderly development of the sector. The PPP projects and private sector investments for the development of the power sector did not make expected headway as envisioned in the country's SFYP (estimated Tk 10 billion). Switching over from natural-gas fired generation to liquid fuel based generation system didn't attract much investment as a result of volatility of fuel price in the international market. Other sources of low-cost electricity production such as coal or renewable resource like hydropower, are not readily available, to encourage private investment. Very few donors are eager to step in due to the commercial nature of development of the sector as well as requirement of bulk financing in the backdrop of prevailing external economic environment.

Issues related to Good Governance

Absence of clear organizational goals, career planning, inadequate financial and commercial autonomy and lack of adequate incentive is seriously influencing the governance culture of and practice in administering the sector. Attempts to introduce modern practices and pre-paid meters are strongly resisted by the vested elements while unholy alliance between field levels staff and some delinquent consumers exacerbating governance situation. Further decentralization of the operations, introduction of strong regulation as well as close monitoring can improve the governance system of the sector. Improvements in governance will facilitate much needed private investment in the sector.

Lack of Adequate Co-ordination

Absence of proper demarcation of responsibilities between generation, transmission and distribution of electricity is discouraging segment specific corrective measures. All three units of operations need to be closely coordinated to improve performance of the sector. A road map to this effect needs be prepared to match the generation expansion program with transmission and distribution.

Lack of Appropriate Cost and Asset Accounting System

Lack of appropriate cost and asset accounting system by plants, absence of effective operational performance evaluation of the different areas of the system such as generation, transmission and distribution, are also considered as challenges.

Irregular and Insufficient Gas Supply to the Gas-based Plants:

Electricity production is overwhelmingly dependent on the natural gas. In FY 2014, 72 % of country's electricity is produced from gas-based plants. Use of other means of production such as diesel, furnace oil and coal is still limited and not cost-effective, particularly for domestic consumers. Pattern of consumption is undergoing structural change in the recent times; domestic consumption has outpaced industrial and service sector consumption. Further increase in cost-effective production of electricity will depend on discovery of new gas fields and diversification of primary sources away from gas to alternatives including hydro, coal, oil, solar and nuclear energies to ensure energy security in the country. One way to reduce pressure on natural gas would be to finalize coal policy.

Inadequate Maintenance of Power Plants:

Inadequate maintenance of the existing plants or lack of it is impairing the installed capacity of generation, transmission and distribution system. The tariff policy of electricity rate should take into account the maintenance aspect so that regular maintenance of the existing plants can be ensured and their economic life is maintained. At present Bangladesh Energy Regulatory Commission (BERC) passed order to create a Maintenance & Development fund from where major maintenance work will be done.

Tariff rate and Structures:

The current tariff rate and structures is discriminatory to the less privileged and requires restructuring, which will reduce fiscal burden and release resources for development. Automatic adjustments in tariff structure can be a worthwhile step to offset efficiency loss of the economy.

Delay in Implementation of Power Projects

Out of 22 ongoing projects in the current fiscal year, implementation period of 11 projects has been extended by one to four years. The remaining projects are in the initial stage so it is very likely that these projects will also be extended in future. It is very obvious that the delay in completion of projects increases the project cost unnecessarily.

Organizing Funds for Project Implementation

At present 22 projects are under implementation and there are 14 more projects waiting for approval. Organizing fund for all 36 projects is definitely a big challenge.

Lack of Prioritization

As mentioned earlier there are 14 additional projects in the pipeline waiting for approval. But there is no indication of prioritizing the projects in terms of organizing fund or in terms of national interest.

Load Shedding

Load shedding is very well known problem of power sector. In the peak hours, demand for electricity is higher than the generation therefore some loads are required forced cut-off to maintain the balance in the grid which is known as load shedding. This problem is very serious especially in the summer when demand is very high due to use like air conditioners, fans, etc. The load shedding is very common problem in the rural areas (under REB) and sometimes these areas suffer load shedding for five to eight hours at night time, especially in the summer season. Distribution network could not be expanded as per demand expansion, so the distribution network is always overloaded in some areas.

Table 45 Maximum Load shedding and Energy not served

FY	Maximum Load shedding (MW)	Energy not Served (MkWh)
1996-97	674	550
1997-98	711	516
1998-99	774	264
1999-00	536	121
2000-01	663	118
2001-02	367	70
2002-03	468	69
2003-04	694	147
2004-05	770	260
2005-06	1,312	843
2006-07	1,345	2,264
2007-08	2,087	1,107
2008-09	1,269	1,362
2009-10	1,459	1,829
2010-11	1,335	1,900
2011-12	1,058	1,647
2012-13	1,048	1,070
2013-14	932	515

Source: Bangladesh Power Development Board

It can be understood from the above table that since FY-2008-09 load shedding was unbearable, but it is decreasing day by day and now it is at a tolerable range. It is observed that under 'energy not served' it was maximum (2,264 MkWh) in FY 2006-07, but only 515 MkWh in FY 2014, which indicates that load shedding is decreasing day by day.

Lack of Maintenance Budget

In the FY 2012-13, the total amount of maintenance and development fund of BPDB was BDT 718.67 crore which is only 3.41% of the total annual cost of BPDB. In the fiscal year FY 2013-14, there are only two projects of rehabilitation of distribution systems and two projects of repowering generation unit out of 34 ongoing and pipeline projects. It is self explanatory that there is a lack of budget for maintenance of power plants, transmission and distribution system.

Failure in Routine Maintenance and Forced Shutdown of Power Plants

It is mentioned earlier that demand for electricity is higher than the generation. Therefore power plant units are needed to run continuously and cannot be shut down for routine maintenance when required. Due to this lack of routine maintenance, damage to different parts occurs as a result of continuous operation, which leads to forced shutdown for many plants.

Blackout

During recent time, the power sector faced the blackout problem. About 100 million people out of a total population of 160 million were without electricity for about 10 hours on 1 November, 2014. The interruption originated at 11.30 am at a sub-station in Bheramara in Kushtia district. Soon it knocked out the 400 KV transmission line that was bringing in 445 MW power from India. As the national grid lost about 445 MW of power, an uncontrolled chain reaction set in. All the power plants of the country were forced to shut down.

The grid is controlled from a national load dispatch centre (NLDC) which is not fully automatic and loads cannot be disconnected automatically when required. There must always be a perfect balance between the generation and the load or demand so as to maintain a constant system frequency. Whenever there is an imbalance, the frequency will automatically change. If a generator fails, the load will instantly exceed the generation capacity, resulting in a drop in frequency. If the loss of generation is within a tolerable limit, it is possible to continue the operation of the grid by increasing the generation from the hot reserve capacity of the system which is available from the operating power plants and/or by resorting to load-shedding. On the other hand, if a significant load is lost, there will be excess generation in the system that will boost the frequency. In that case, the generation capacity must be reduced to bring down the frequency to the desired level. A power grid collapses if the loss of generation or load is too large for the system to handle. This is exactly what happened on November 1. The tripping of the transmission line at Bheramara amounted to a loss of about 445 MW of power imported from India, as mentioned earlier.

3.9.2 Future Challenges

The future challenges that power sector is going to face to achieve the midterm goal of development of the sector can be classified as follows:

- **Primary Fuel Supply**
    - Enhance Gas Exploration and Production
    - Domestic Coal Development: Open field mining, Underground mining and Underground coal gasification.
    - Coal Import and Deep Sea Port Development for Coal Handling
    - Liquefied Natural Gas Import
    - Safe Nuclear Technology
- **Project Financing**
    - Ensuring Financing for Public and Private Sector Projects
    - Prioritization of Projects for Financing
- **Transportation of Fuel**
    - Railway Infrastructure Development for coal Transport
    - Dredging of River Routes to Transport Coal by Waterway
    - Capacity Building of Bangladesh Internal Water Transport Authority (BIWTA), Bangladesh Railway
- **Operation and Maintenance**
    - Safe operation of nuclear power plants and coal based power plant
    - Operation and Maintenance of LNG Landing Station
    - Development of Skilled Manpower to adapt and Operate New Technology
- **Over dependency on Imported Power**

    In future dependency on imported electricity from neighbouring countries may increase frequency of grid failure if necessary precautions are not taken
- **Reliability of National Grid**
    - In future the reliability of the national grid will be a challenge as different power sources like nuclear power plant, MW scale coal-based power plant and imported power from neighbouring countries will be integrated to the national grid.
- **Lack of cooling water due to the changing situation**

  Bangladesh is a large delta formed by the alluvial deposits of the three mighty Himalayan Rivers. There are about 405 rivers in Bangladesh of which 57 are Transboundary Rivers. Out of these 57 rivers, 54 are common with India and remaining 3 with Myanmar. The life and livelihood of the millions of people of Bangladesh have been revolving around waters of these rivers for ages. The Ganges, the Brahmaputra and the Meghna river systems drain a total catchment area of about 1.72 million sq km through Bangladesh into the Bay of Bengal. Out of this large catchment area, only 7% lies in Bangladesh. The other co-riparian countries are India, Nepal, Bhutan and China as shown in the following Basin Map (**Figure 29**).

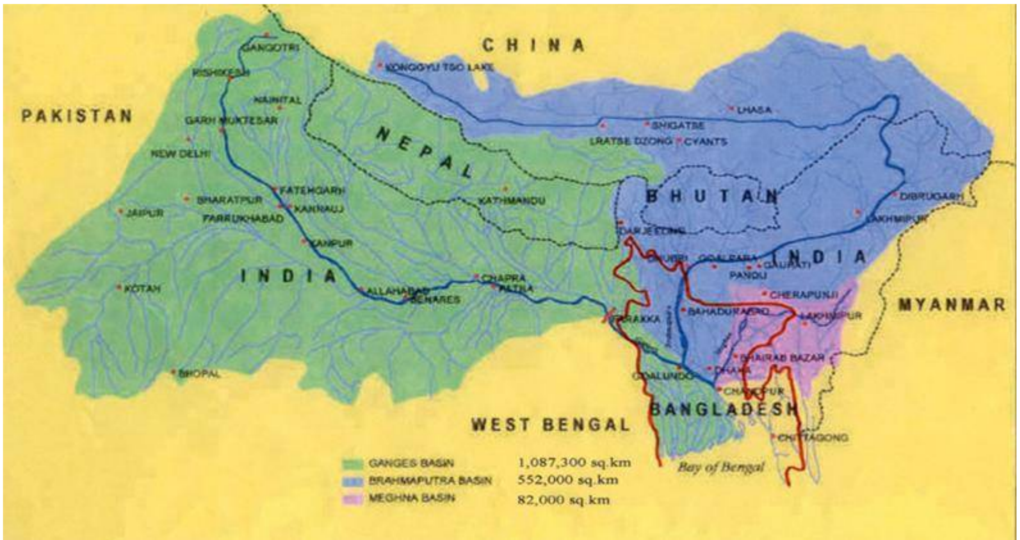


Figure 29 Basin Map of the Ganges, the Brahmaputra and the Meghna Rivers

Source: Joint River Commission, Bangladesh

China has been constructing two more dams on the upstream of the Brahmaputra River near to Zangum dam. There is another dam on the Brahmaputra River in Subansiri of Assam state in India. Because of these dams located on the upstream of the river, it is very likely that Bangladesh will face severe water crisis in the rivers, especially in the dry season and it will bring the cooling water crisis for the existing and future power plants (**Figure 29**).

Figure 30 Location of Chinese Dams on the Upstream of Brahmaputra River

Source: The Hindu Newspaper, India

India has already built dams in almost all the major common rivers between Bangladesh and India and extracting water from those rivers. The map below (**Figure 31**) shows dams that are already built by India in the upstream of the major common rivers. China is also going to build a dam in the upstream of the

Brahmaputra River. So, it is anticipated that in the near future the common rivers will not have sufficient water flow. The power plants need huge amount of cooling water and the large scale power plants depend on river water as source of cooling water. That is why it is suggested that the sourcing of cooling water for large thermal power projects should be studied critically and addressed properly. All the future thermal power plants should have cooling towers.

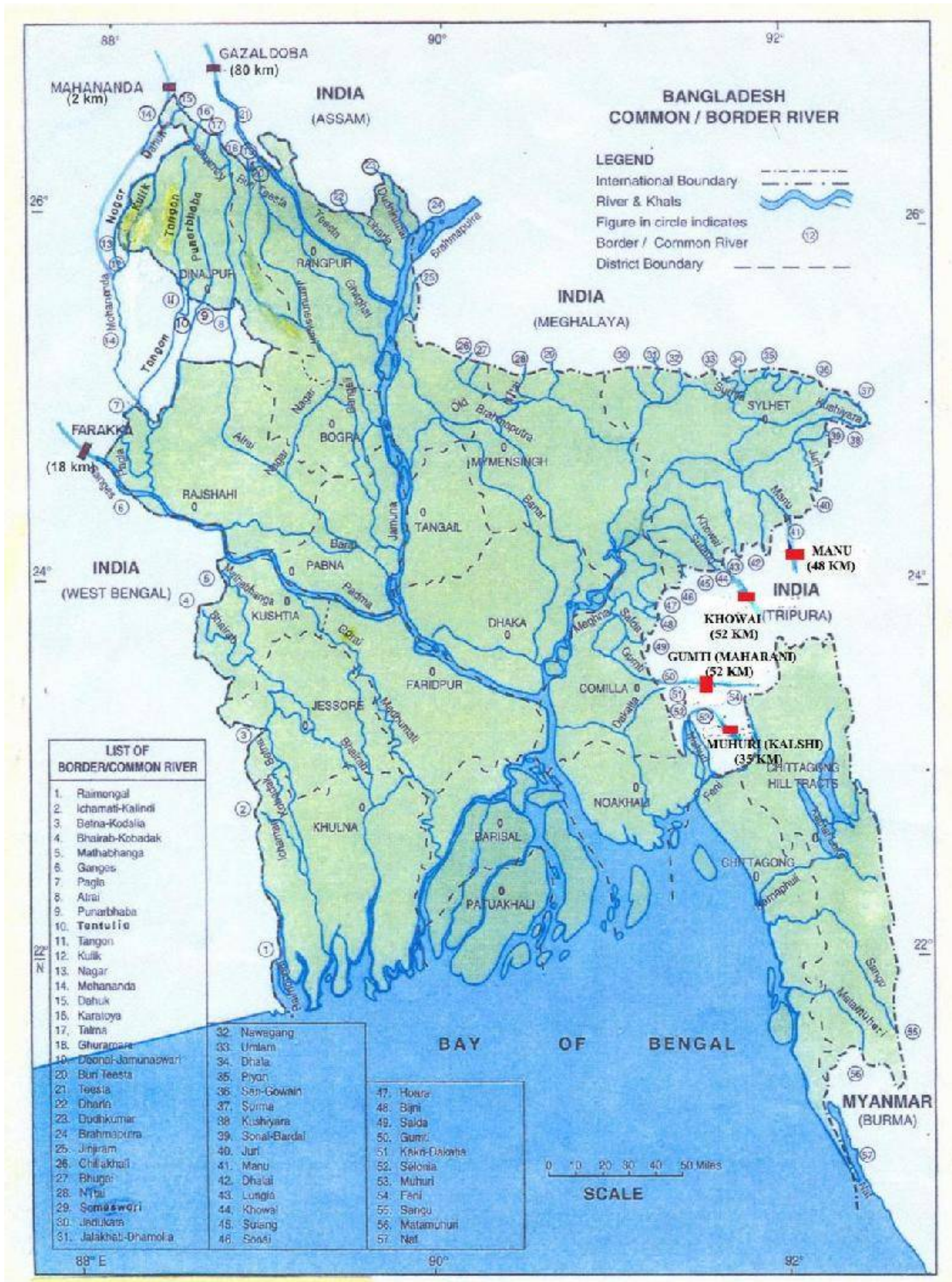


Figure 31 Existing Dams built by India on common rivers of Bangladesh and India (in red)

Source: Joint River Commission, Bangladesh

3.10 Knowledge Gaps

Knowledge gaps regarding data availability is the lack of information on system losses of power sector and load shedding. The knowledge gaps regarding technology are as follows:

- In near future Bangladesh power sector will shift from gas to coal for sourcing of primary fuel. But there is lack of knowledge, and lack of qualified and experienced professionals for planning, implementing and operating Giga watt (GW) scale coal-based power plants.
- Local coal mining knowledge is lacking and therefore will be a major challenge considering the high density of population.
- Lack of background study on social and environmental impact of coal mining and adapting proper methodology of mining keeping these factors in mind.
- Lack of knowledge on development of infrastructure for coal mining and large coal transportation.
- Lack of background study on imported coal-based power plants and CO_2 emission from those power plants.
- Shortage of local well educated experts on nuclear engineering and related safety issues.
- Lack of knowledge and trained manpower for operation, maintenance and safety of nuclear power plants.
- Lack of assessment of the impact of importing electricity from neighbouring countries on the operation and safety of the national grid
- No experience of financing and management of GW scale coal-based power plant projects, LNG terminal and Deep Sea Port.
- Institutional drawback for research & development in new technology and limited budget for research & development of new technology.

3.11 Recommendations

The recommendations to meet future challenges are listed below:

- Government is yet to decide how to explore the national coal reserve, whether should go for open mining or tunnelling method or underground coal gasification method. Government should take immediate and rational decision to extract the local coal.
- Bangladesh is aspiring to have nuclear based power generation and it is planning to have approximately 4,000 MW of electric power capacity from nuclear energy by 2030. Local qualified and experienced experts and human resources are needed to be developed for the safe operation and maintenance of nuclear power plants.
- Source of cooling water is going to be a major issue for Rooppur Nuclear Power Plant as well as for large scale thermal power plants. The natural draft cooling power technology could be a solution if adequate water cannot be arranged from the rivers.
- According to the PSMS there will be a big power generation hub in the northern part of Bangladesh. The inland waterways need to be kept navigable by regular dredging during the construction phase and also for fuel transportation like coal and LNG.
- Coal can be transported by waterways and railways. The success in setting up coal as a main source of fuel for electricity generation is greatly dependent on related infrastructure development for coal transportation.
- According to second national communication of Bangladesh submitted to UNFCCC, the power generation subsector is the main source of green house gases (GHGs) emission in Bangladesh. Among all power plants, the coal based power plants are having the highest grid emission factor. Preventive measures like pulverized coal and ultra super critical pressure technology should be taken to reduce GHGs emission from coal fired power plants.

- Development in transportation and power sectors are equally important for development. Without developing the transportation sector, the real benefit of improvement in power sector cannot harnessed as uninterrupted power supply and free movement of heavy vehicles are preconditions of economic development
- Up-gradation of protection devices and real time fault detection is essential so that the national grid would be capable to handle power feeding from different power sources like imported power from neighbouring countries, nuclear power plant and MW scale coal based power plants and the national grid should be withstand any interruption from these power plants or from anywhere else.

4 References

Annual Report 2012, Pertobangla

Annual Report 2013-14, Bangladesh Power Development Board

Bangladesh Power Development Board

Bangladesh Atomic Energy Commission

Department of Environment, Ministry of Environment and Forest.

Infrastructure Development Company Limited

Power Grid Company Bangladesh Ltd.

Power System Master Plan 2010

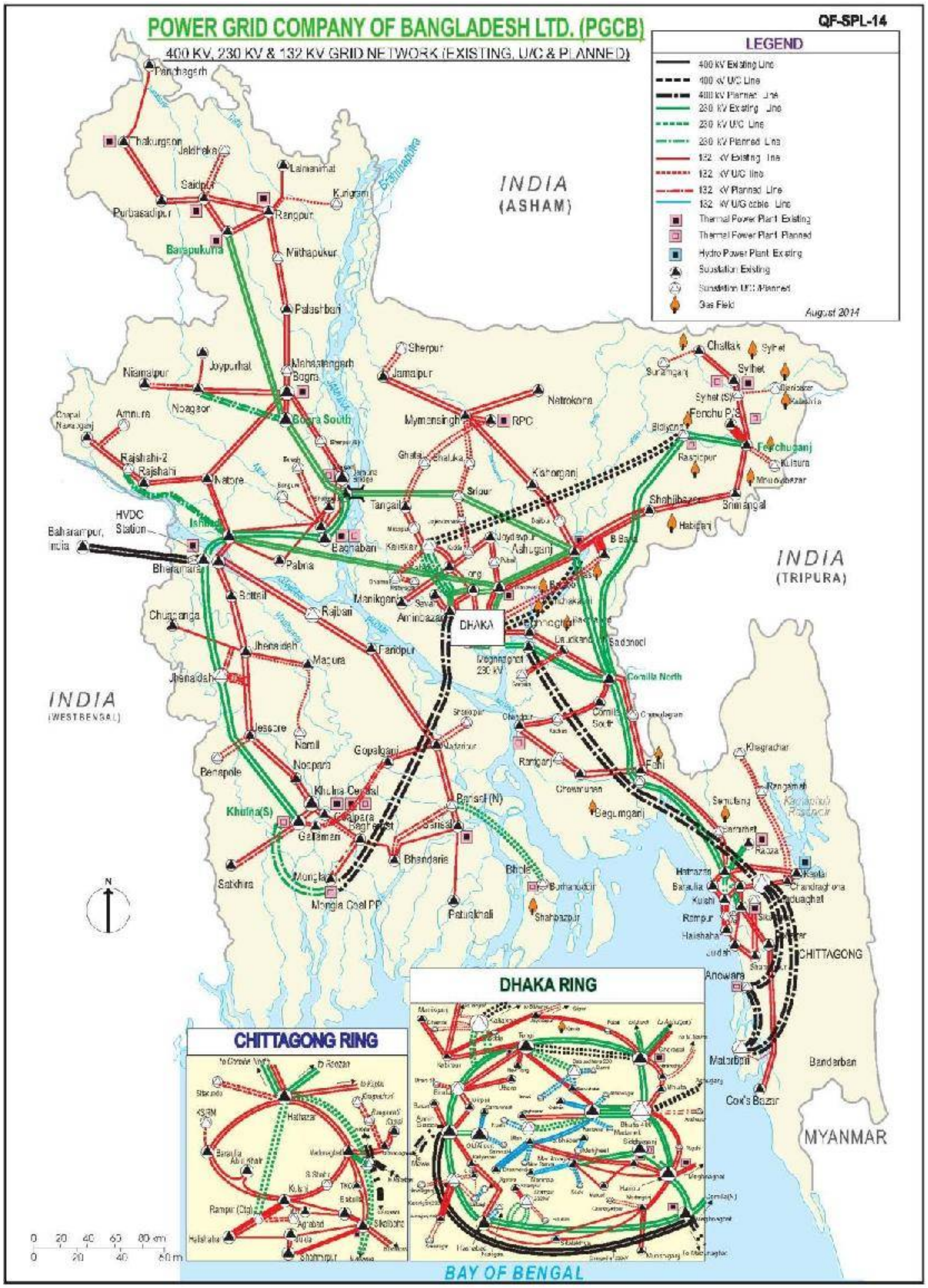
Power Division, Ministry of Power Energy and Mineral Resources

World Nuclear Association

West Zone Power Distribution Company Limited

5 Annex

A1: Map of Existing and Planned Power Plants and Transmission Network of Bangladesh as on August 2014



A2 List of Commissioned Power Plants During 2009 -11

SL	Name of Power Plant	Capacity (MW)	Fuel Type	Date of Commissioning	Ownership
1	Habiganj SIPP	11	Gas	01/10/2009	IPP(REB)
2	Shahjibazar Rental	86	Gas	02/10/2009	IPP(BPDB)
3	Feni SIPP	22	Gas	2/16/2009	IPP(BPDB)
4	Ullapara SIPP	11	Gas	03/02/2009	IPP(REB)
5	Kumargaon Rental	10	Gas	3/15/2009	IPP(BPDB)
6	Mahipal, Feni SIPP	11	Gas	4/22/2009	IPP(REB)
7	Mawona Gazipur SIPP	33	Gas	05/12/2009	IPP(REB)
8	Barobkunda SIPP	22	Gas	5/23/2009	IPP(BPDB)
9	Rupganj Narayanganj SIPP	33	Gas	06/09/2009	IPP(REB)
10	Jangalia, Comilla SIPP	33	Gas	6/25/2009	IPP(BPDB)
11	Bhola Rental	33	Gas	07/12/2009	IPP(BPDB)
12	Fenchuganj Rental	51	Gas	10/18/2009	IPP(BPDB)
13	Ashuganj Rental	55	Gas	04/07/2010	IPP(BPDB)
14	Shikalbaha Rental	55	HFO	05/06/2010	IPP(BPDB)
15	Thakurgaon Rental	50	Diesel	07/02/2010	IPP(BPDB)
16	Khulna Quick Rental (Agrico)	55	Diesel	07/10/2010	IPP(BPDB)
17	Ghorashal Quick Rental	145	Diesel/Gas	5/28/2010	IPP(BPDB)
18	Shikalbaha 150 MW Peaking	150	Gas	7/18/2010	Govt(BPDB)
19	Shiddhirganj 2x120 MW (2nd Unit)	105	Gas	10/14/2010	Govt(EGCB)
20	Pagla Quick Rental	50	Diesel	11/24/2010	IPP(BPDB)
21	Bheramara Rental	110	Diesel	12/31/2010	IPP(BPDB)
22	Shiddhirganj Quick rental	100	Diesel	2/17/2011	IPP(BPDB)
23	B-Baria Quick Rental	70	Gas	03/06/2011	IPP(BPDB)
24	Madanganj Quick Rental	102	HFO	04/10/2011	IPP(BPDB)
25	Ashuganj 50MW PP	53	Gas	04/03/2011	Govt(APSCL)
26	Meghnaghat Quick Rental	100	HFO	05/08/2011	IPP(BPDB)
27	Ghorashal Quick Rental (Max Power)	78	Gas	5/27/2011	IPP(BPDB)
28	Noapara Quick Rental	40	HFO	5/29/2011	IPP(BPDB)
29	Ashuganj Quick Rental (Agrico)	80	Gas	5/31/2011	IPP(BPDB)
30	Khulna Quick Rental (KPCL -2)	115	HFO	06/01/2011	IPP(BPDB)
31	Ashuganj quick Rental (United power)	53	Gas	6/22/2011	IPP(BPDB)
32	Shidhirganj Quick Rental	100	HFO	7/21/2011	IPP(BPDB)
33	Noapara, Jashar rental	105	HFO	8/26/2011	IPP(BPDB)
34	Baghabari 50MW Picking Power centre	52	HFO	8/29/2011	Govt (BPDB)
35	Fenchuganj 90MW CCPP	104	Gas	10/26/2011	Govt (BPDB)
36	Berha 70MW Picking Power Centre	71	HFO	10/28/2011	Govt (BPDB)
37	Daudkandi 50MW Picking power Centre	52	HFO	10/29/2011	Govt (BPDB)

SL	Name of Power Plant	Capacity (MW)	Fuel Type	Date of Commissioning	Ownership
38	Faridpur 50MW Picking Power Centre	54	HFO	01/11/2011	Govt (BPDB)
39	Gopalganj 100MW Picking Power centre	109	HFO	11/16/2011	Govt (BPDB)
40	Bogra Rental	20	Gas	11/13/2011	IPP(BPDB)
41	Shidhirganj 2X120 MW Picking power Centre	105	Gas	01/12/2011	Govt(EGCB)
42	Hathazari picking Power Centre	98	HFO	12/23/2011	Govt (BPDB)
43	Shangu, Dohajari Picking Power centre	102	HFO	12/31/2011	Govt (BPDB)
44	Amnura 5year Period Quick Rental	50	HFO	1/13/2012	IPP(BPDB)
45	Fenchuganj 50MW Rental	44	Gas	1/15/2012	IPP(BPDB)
46	Julda quick Rental	100	HFO	3/26/2012	IPP(BPDB)
47	Keraniganj Quick Rental	100	HFO	3/27/2012	IPP(BPDB)
48	Shylet 150MW Power Centre	142	Gas	3/28/2012	Govt (BPDB)
49	Katakhali Quick Rental	50	HFO	5/22/2012	IPP(BPDB)
50	Gazipur(RPCL)	52	Gas/HFO	07/07/2012	Govt (RPCL)
51	Chandpur 150MW CCPP	163	Gas	01/06/2012	Govt (BPDB)
52	Sirajganj 150MW GT (China Machinery Export Import Cor.)	150	Gas/Diesel	01/12/2012	Govt (NWPGCL)
53	Shantahar Naoga Picking Power centre	50	HFO	01/12/2012	Govt (BPDB)
54	Katakhali Picking Power Centre	50	HFO	01/12/2012	Govt (BPDB)
55	Raojan, Chittagong	25	Gas/HFO	05/03/2013	Govt (RPCL)
56	Haripur 360MW CCPP	412	Gas	01/12/2013	Govt (EGCB)
57	Khulna 150MW GT	150	Gas/Diesel	9/23/2013	Govt (NWPGCL)
58	Ashuganj 51MW Power Centre	51	Gas	12/06/2013	IPP (BPDB)
59	Shajahanulla Power Company Ltd	25	Gas	01/12/2013	IPP (REB)
60	Nator, Rajshahi 50MW Power Centre	52	HFO	1/24/2014	IPP (BPDB)
61	Baraka-Patenga, Chittagong 50MW Power Plant	50	HFO	05/03/2014	IPP (BPDB)
62	Meghnaghat-2 450MW CCPP (GT Unit)	203	Gas/Diesel	5/29/2014	IPP (BPDB)
63	Gogan Nagar 102MW Power centre	102	HFO	06/03/2014	IPP (BPDB)
64	Up-gradation Of Sirajganj 150MW Picking Power Plant to 225MWCCPP	68	Gas/Diesel	7/14/2014	IPP (BPDB)
65	Ghorasal 108MW Power Centre	108	Gas	7/15/2014	IPP (BPDB)
	Total	**5091**			

A3 List of Completed Projects by Power Grid Company of Bangladesh (PGCB) during 2005-2014

Serial	Project Name	Completion Year
1	Meghnaghat-Aminbazar 400 kV Transmission Line (NG1: At present energized in 230 kV)	June'2014
2	Construction & Extension of Grid Substations including transmission line facilities (Phase-1)	June'2014
3	Transmission Efficiency Improvement through Reactive Power Compensation at Grid Substations and Reinforcement of Goalpara Substation	June'2014
4	Grid Interconnection between Bangladesh (Bheramara) and India (Baharampur)	June'2014
5	Haripur 360 MW Combined Cycle Power Plant and Associated Substation (PGCB Part)	June'2014
6	Three Transmission Lines Project (230 kV, E-W interconnector: Ashuganj-Sirajgang, Sirajganj – Bogra, Ishwardi-Sirajganj)	2010-2011
7	Joydevpur-Kabirpur-Tangail 78 km 132 kV T/L & 3 S/s Extn. Project (Joydebpur-Kabirpur-Tangail 132 kV	1/10/2007
8	Name of Project: Ishurdi-Baghabari 54 km 230 kV T/L Construction (Ishurdi Baghabari-Serajganj-Bogra 230 kV T/L Project)	3/29/2005
9	Hasnabad & Tongi 230 kV and Kalyanpur 132 kV S/s Construction (Hasnabad-Aminbazar-Tongi & Haripur-Me	5/23/2005

List of Notable Publications By General Economics Division (GED) Bangladesh Planning Commission since 2009

1. Policy Study on Financing Growth and Poverty Reduction: Policy Challenges and Options in Bangladesh (May 2009)
2. Policy Study on Responding to the Millennium Development Challenge Through Private Sectors Involvement in Bangladesh (May 2009)
3. Policy Study on The Probable Impacts of Climate Change on Poverty and Economic Growth and the Options of Coping with Adverse Effect of Climate Change in Bangladesh (May 2009)
4. Steps Towards Change: National Strategy for Accelerated Poverty Reduction II (Revised) FY 2009-11 (December 2009)
5. Millennium Development Goals: Bangladesh Progress Report 2009 (2009)
6. Millennium Development Goals: Needs Assessment and Costing 2009-2015 Bangladesh (July 2009)
7. এমডিজি কর্ম-পরিকল্পনা (৫১টি উপজেলা) (জানুয়ারি-জুন-২০১০)
8. MDG Action Plan (51 Upazillas) (January 2011)
9. MDG Financing Strategy for Bangladesh (April 2011)
10. SAARC Development Goals: Bangladesh Progress Report 2011 (August 2011)
11. Background Papers of the Sixth Five Year Plan (Volume 1-4) (September 2011)
12. 6th Five Year Plan (FY 2011-FY 2015) (December 2011)
13. Millennium Development Goals: Bangladesh Progress Report-2011 (February 2012)
14. Perspective Plan of Bangladesh 2010-2021: Making Vision 2021 a Reality (April 2012)
15. Public Expenditure for Climate Change: Bangladesh Climate Public Expenditure and Institutional Review (October 2012)
16. Development of Results Framework for Private Sectors Development in Bangladesh (2012)
17. ষষ্ঠ পঞ্চবার্ষিক পরিকল্পনা (২০১১-১৫) [মূল ইংরেজি থেকে বাংলায় অনুদিত] (অক্টোবর ২০১২)
18. Climate Fiscal Framework (October 2012)
19. Public Expenditure for Climate Change: Bangladesh CPEIR 2012
20. First Implementation Review of the Sixth Five year Plan -2012 (January 2013)
21. বাংলাদেশের প্রথম প্রেক্ষিত পরিকল্পনা (২০১০-২০২১) রূপকল্প ২০২১ বাস্তবে রূপায়ণ (ফেব্রুয়ারি ২০১৩)
22. National Sustainable Development Strategy (2010-2021) (May 2013)
23. জাতীয় টেকসই উন্নয়ন কৌশলপত্র (২০১০-২০২১) [মূল ইংরেজি থেকে বাংলায় অনুদিত] (মে ২০১৩)
24. Millennium Development Goals: Bangladesh Progress Report 2012 (June 2013)
25. Post 2015 Development Agenda: Bangladesh Proposal to UN (June 2013)
26. National Policy Dialogue on Population Dynamics, Demographic Dividend, Ageing Population & Capacity Building of GED [UNFPA Supported GED Project Output 1] (December 2013)
27. Capacity Building Strategy for Climate Mainstreaming: A Strategy for Public Sector Planning Professionals (2013)
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29. Towards Resilient Development: Scope for Mainstreaming Poverty, Environment, Climate Change and Disaster in Development Projects (January 2014)
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31. Manual of Instructions for Preparation of Development Project Proposal/Proforma Part-1 & Part 2 (March 2014)
32. SAARC Development Goals: Bangladesh Progress Report-2013 (June 2014)
33. The Mid Term-Implementation Review of the Sixth Five Year Plan 2014 (July 2014)
34. Millennium Development Goals: Bangladesh Progress Report 2013 (August 2014)
35. Population Management Issues: Monograph-2 (March 2015)
36. GED Policy Papers and Manuals (Volume 1-4) (June 2015)

37. National Social Security Strategy (NSSS) of Bangladesh (July 2015)
38. MDGs to Sustainable Development Transforming our World: SDG Agenda for Global Action (2015-2030)- A Brief for Bangladesh Delegation UNGA 70th Session, 2015) (September 2015)
39. 7th Five Year Plan (2015/16-2019/20) (December 2015)
40. সপ্তম পঞ্চবার্ষিক পরিকল্পনা ২০১৫/১৬-২০১৯/২০ [মূল ইংরেজি থেকে বাংলা অনূদিত] (অক্টোবর ২০১৬)
41. জাতীয় সামাজিক নিরাপত্তা কৌশলপত্র [মূল ইংরেজি থেকে বাংলা অনূদিত] (অক্টোবর ২০১৬)
42. Population Management Issues: Monograph-3 (March 2016)
43. Bangladesh ICPD 1994-2014 Country Report (March 2016)
44. Policy Coherence: Mainstreaming SDGs into National Plan and Implementation (Prepared for Bangladesh Delegation to 71st UNGA session, 2016) (September 2016)
45. Millennium Development Goals: End- period Stocktaking and Final Evaluation Report (2000-2015) (September 2016)
46. A Handbook on Mapping of Ministries by Targets in the implementation of SDGs aligning with 7th Five Year Plan (2016-20) (September 2016)
47. Data Gap Analysis for Sustainable Development Goals (SDGs): Bangladesh Perspective (January 2017)
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49. Integration of Sustainable Development Goals into the 7th Five Year Plan (February 2017)
50. Banking ATLAS (February 2017)
51. টেকসই উন্নয়ন অভীষ্ট, লক্ষ্যমাত্রা ও সূচকসমূহ [মূল ইংরেজি থেকে বাংলায় অনুদিত] (এপ্রিল ২০১৭)।
52. Exploring the Evidence: Background Research Papers for Preparing the National Social Security Strategy of Bangladesh (June 2017)
53. Bangladesh Voluntary National Review (VNR) 2017: Eradicating poverty and promoting prosperity in a changing world, (June 2017)
54. SDGs Financing Strategy: Bangladesh Perspective (June 2017)
55. A Training Handbook on Implementation of the 7th Five Year Plan (June 2017)
56. 7th Five Year Plan (FY 2015/16-FY 2019/20): Background Papers Volume 01: Macro Economic Management & Poverty Issues (June 2017)
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60. 7th Five Year Plan (FY 2015/16-FY 2019/20): Background Papers Volume 05: Governance, Gender & Urban Development (June 2017)
61. Education Sector Strategy and Actions for Implementation of the 7th Five Year Plan (FY2016-20)
62. GED Policy Study: Effective Use of Human Resources for Inclusive Economic Growth and Income Distribution-An Application of National Transfer Accounts (February 2018)
63. Monitoring and Evaluation Framework of Sustainable Development Goals (SDGs): Bangladesh Perspective (March 2018)
64. National Action Plan of Ministries/Divisions by Targets for the Implementation of Sustainable Development Goals (June 2018)
65. Bangladesh Delta Plan 2100: Baseline Studies: Volume 1: Water Resources Management (June 2018)
66. Bangladesh Delta Plan 2100: Baseline Studies: Volume 2: Disaster and Environmental Management (June 2018)
67. Bangladesh Delta Plan 2100: Baseline Studies: Volume 3: Land Use and Infrastructure Development (June 2018)

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