Economic and Social Commission for Asia and the Pacific

Promotion of Investment in the selected Asian Highway Routes
in four countries (Bangladesh, Kyrgyzstan, Mongolia and Myanmar)

Final Report

Prefeasibility Study of Upgrading Jessore – Banpara Highway (AH41) in Bangladesh



This study was undertaken with the financial assistance of
Korea Expressway Corporation

Bangkok
November 2014

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Foreword

This prefeasibility study is based primarily on data that were readily available from various secondary sources, including concerned government departments, and previous studies and reports. The study itself did not commission any field study to complement data available from secondary sources. A field trip was however undertaken by the study team mainly to understand the project's physical and overall development contexts, and the nature of its likely social and environmental impacts in broad terms. The available data and information from secondary sources were mostly limited to physical (topographical and cross-sectional), traffic flow, standard construction costs for different road construction items and some socio-economic aspects. The study lacks any quantitative assessment of environmental and social impacts based on surveyed data. However, some initial comments based on observations during the field trip are included. Given the significance of environmental and social impacts of a road project, any future full-scale feasibility study of the project should carefully investigate these impacts and consider suitable mitigation measures through detailed field-level studies.

An attempt was made by the study team to understand the broader development contexts of the project, including future potential benefits due to improved domestic and cross-border connectivity with the neighboring countries. However, these understandings were mainly qualitative in nature (and reflected so in narrative text in the report). A full-scale feasibility study may investigate this aspect further and examine how the benefits of enhanced cross-border connectivity may be assessed and evaluated for use in a conventional economic or investment analysis.

Abbreviations and Acronyms

AADT	Annual Average Daily Traffic
AH	Asian Highway
ADB	Asian Development Bank
AHN	Asian Highway Network
B/C	Benefit/Cost Ratio
BCA	Benefit Cost Analysis
CAS	Country Assistance Strategy
COS	Country Operational Strategy
CPS	Country Partnership Strategy
CSP	Country Strategy and Program
DBST	Double Bituminous Surface Treatment
EIA	Environmental Impact Assessment
EIP	Environmental Investment Program
ESCAP	Economic and Social Commission for Asia and the Pacific
GOB	Government of Bangladesh
IA	Implementation Agency
IEE	Initial Environmental Examination
IR	Involuntary Resettlement
IRR	Internal Rate of Return
KEC	Korea Expressway Corporation
LGED	Local Government Engineering Department
MDB	Multilateral Development Bank
MOC	Ministry of Communication
MOP	Ministry of Planning
NPV	Net Present Value
O/D	Origin/Destination Survey
PCE	Passenger Car Equivalent
RHD	Roads and Highways Department
RRD	Roads and Railway Division
SYFP	Sixth Five Year Plan
SIP	Social Investment Program
TA	Technical Assistance
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
VOC	Vehicle Operating Cost
WB	World Bank

Table of Contents

Foreword…….. ii
Abbreviations and Acronyms…….. iii
Table of Contents…… iv

Section 1 Introduction 1
1.1 Background 1
1.2 Project Description 2
1.3 Methodology 4
1.4 Study Team 4
1.5 Limitation of the study (Recommendations for a formal feasibility study) 4

Section 2 Data Survey and Review of Previous Studies 6
2.1 Data Survey 6
2.2 Review of previous studies 6

Section 3 Development Plan and Socio-economic Characteristics 7
3.1 Development Plan: 6th five-year Plan (SFYP, 2011 to 2015, MOP) 7
3.2 Socio-economic Characteristics 7
3.3 Road System Inventory 11
3.4 Asian Highway Network 13

Section 4 Technical Feasibility 15
4.1 Route Assessment 15
4.2 Traffic Forecast 16
4.3 Improvement Plan 18
4.4 Cost Estimation 18

Section 5 Economic Analysis 20
5.1 Methodology 20
5.2 Benefit/Cost Analysis 21
5.3 Sensitivity Analysis 25

Section 6 Environmental and Social Impact 26
6.1 Environmental Impact 26
6.2 Social Impact 26

Section 7 Recommendation 27
7.1 Conclusion 27
7.2 Recommendation 27
7.3 Implementation Plan 27

Appendices
Appendix A. List of persons met 29
Appendix B. Implementation Agency (Roads and Highways Department, MOC) 31
Appendix C. Economic Analysis 32
Appendix D. Asian Highway Database (UNESCAP, 2010) 34
Appendix E. Asian highway Design Standard (1993) 36
Appendix F. Data Survey Request 37
Appendix G. Comments from RHD (Aug 2013) 38

Section 1 INTRODUCTION

1.1 Background

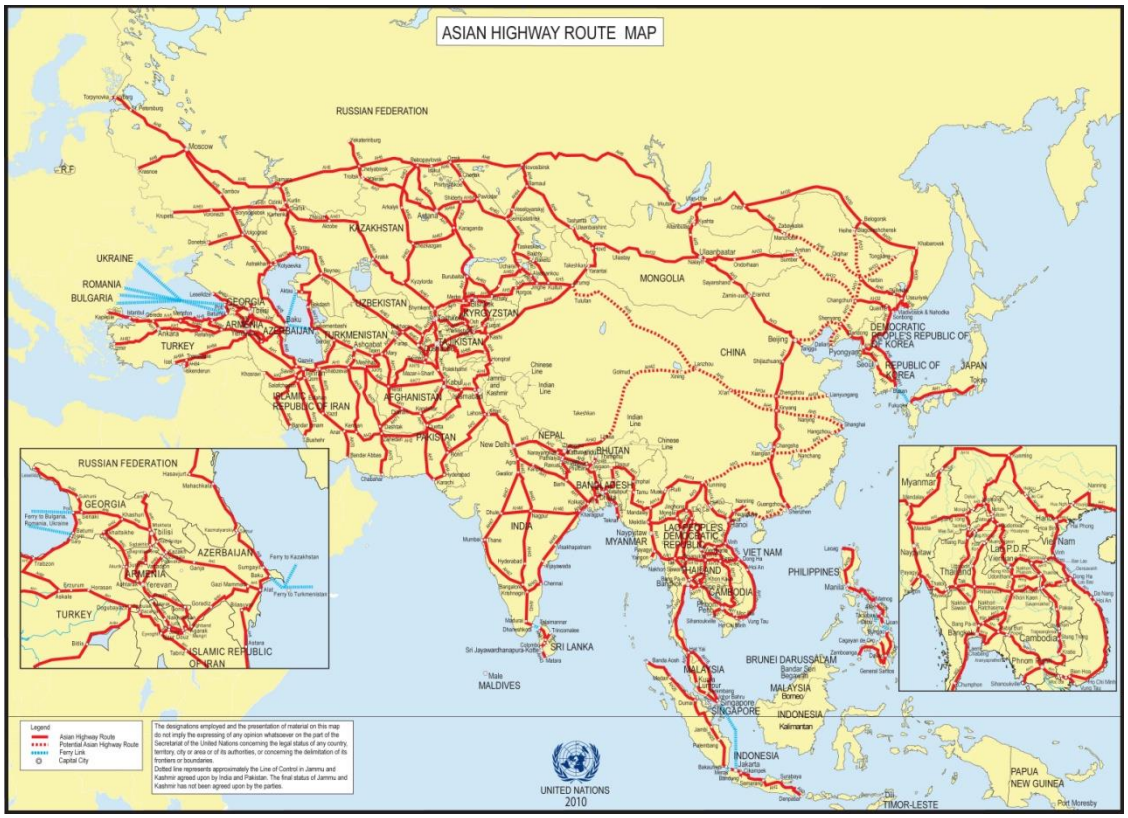
Efforts have been made in recent years to assess the current level of investment and to identify investment needs and priorities for the development, *mainly upgrade of Asian Highway (AH) to the required technical standard*, of AH Network (AHN) including:

- Priority Investment Needs for the development of the Asian Highway Network (2006, UNESCAP)
- Prefeasibility study of the selected routes (upgrading of priority routes) in Armenia, Bangladesh, Mongolia and Myanmar (2007, UNESCAP)
- Investment Forum (16 November 2007, UNESCAP)

To facilitate the promotion and development of AH investment, a second phase of prefeasibility study of selected routes in Bangladesh, Kyrgyzstan, Mongolia and Myanmar is being implemented as an ongoing effort by UNESCAP with the financial support from Korea Expressway Corporation (KEC).

ESCAP decided that study routes should be nominated by recipient countries considering a set of given criteria reflecting their needs and overall strategic development contexts.

Figure 1. Asian Highway Network



1.2 Project Description

Project Summary

The Ministry of Communication (MOC), Bangladesh, has proposed improvement of the Jessore-Banpara section (2 lane, 148km) on AH41. It is AH Class II in light of AH classification and design standards. It is noted that an ADB intervention[1] was already underway for the rehabilitation of Jessore - Jhenaidah section (45km). Considering this, Jhenaidah - Banpara section (2 lane, 103km) has been studied as the main focus of this study.

Figure 2. Jhenaidah - Banpara Section in Bangladesh



Source: Based on UN country map for Bangladesh available at
http://www.un.org/Depts/Cartographic/map/profile/banglade.pdf

[1] Procurement of TA for Subregional Road Transport Project Preparatory Facility is underway

Strategic context of the project

1. The project road is one of national and regional priorities as well as a part of the 6th five-year Plan (2010/2011 to 2014/2015). Improved Jessore-Banpara section (2 lane, 148km) on AH41 will be the principal north to south corridor in the western region in Bangladesh connecting nation's 2nd largest Mongla sea port[2] and Benapole dry port with the capital city, Dhaka, via Lalon Shan (Paksey) Bridge over Padma river.

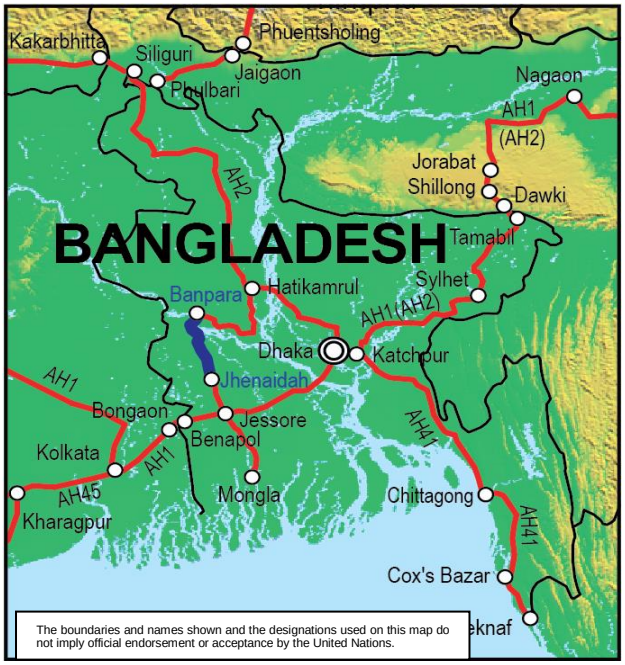
Figure 3. Mongla Sea Port



2. It was agreed that Bangladesh will allow the use of Mongla and Chittagong sea ports for the movement of goods to and from India through road and rail. Bangladesh also conveyed their intention to give Nepal and Bhutan access to Mongla and Chittagong ports. (India-Bangladesh Joint Statement, January 2010)

In this regards, improved Jessore-Banpara section can play a vital role providing access to Mongla sea port to and from India and especially land-locked Nepal and Bhutan as proposed in the above-mentioned Joint Statement.

Figure 4. Strategic location of Mongla Sea Port



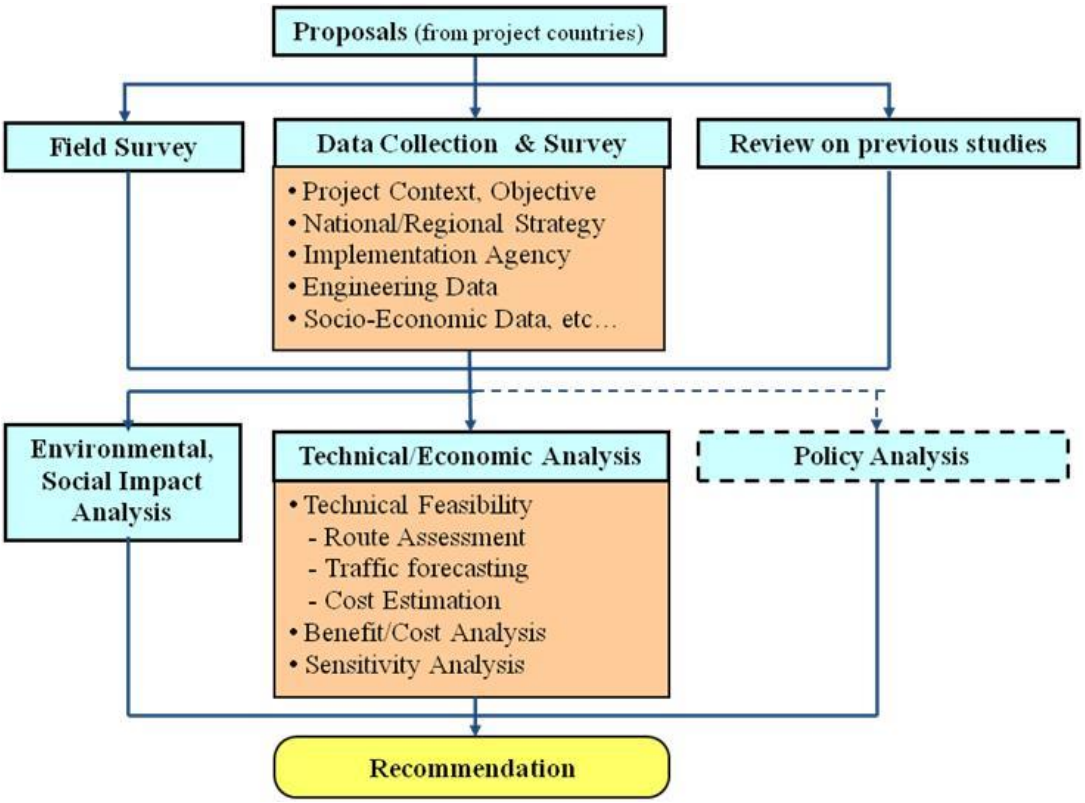
Source: Based on Asian Highway Network map (see Figure 1.)

[2] http://www.mpa.gov.bd/

1.3 Methodology

The overall approach of the prefeasibility study is represented diagrammatically in Figure 3 as below. Due to the limited availability of resources, A simple trend analysis has been used for the future traffic forecasting.

Figure 5. Prefeasibility Study Process



1.4 Study Team

This prefeasibility study report has been issued by the Transport and Tourism Division, Economic and Social Commission for Asia and the Pacific (ESCAP). The external consultant, Mr. Woohyun Kwon has prepared the report with the assistance of other consultants and ESCAP officials.

Mr. Hyunha Kwon and Mr. Byungryeol Kim from Naekyung Engineering, Korea, provided additional assistance with the technical study, traffic forecast and economic evaluation. Mr. Mohammad Nurul Amin (Deputy Secretary, Roads and Railway Division, MOC) provided relevant data and inputs as the national expert.

1.5 Limitation of the study (Recommendations for a formal feasibility study)

1. Given the limited resources including the budget, this study has been conducted with the objective of providing initial evaluation of the candidate route, which was proposed by the Government of Bangladesh (GOB), to facilitate interventions by bilateral and/or multilateral donors. In this regards, the limitations of this study and recommendations for a formal feasibility study are as follows:

- The rationale review of the candidate route, which was suggested by the recipient county, and an exploration of its alternatives have been omitted;
- The output of the report is mainly relied on the limited information and data provided by GOB. The route assessment for the 148km long project was done during a two-day site survey only while a thorough investigation of the site should be conducted for the efficient planning/design and estimation of quantities regarding the improvement plan;
- Unit cost analysis instead of estimation of BOQ has been applied. Cost estimates of the previous study and CPI, as an inflator, have been used; and
- Historical cost data and (digital) terrain map recommended to be used for accurate cost estimator..

2. In countries with a low traffic demand such as Bangladesh, traditional Benefit Cost Analysis may not capture the need of infrastructure development properly. By the nature of traffic demand, a derived secondary function of a variety of socio-economic activities and development plans, the output of the traffic forecasting and economic analysis in Bangladesh may be insignificant since the initial values of major indicators including registered vehicles is very low.

Moreover, especially for the overlay works, the output of the traffic forecasting and economic analysis may be insignificant without serious enhancement in travel speed. This is the reason why only V/C (Volume/Capacity ratio) and national priority for the overlay works are observed in many other countries.

In this regards, a holistic, instead of demand-driven, approach may be appropriate, if a higher priority is given for the project by the government.

3. The economic viability of the project could have been enhanced considerably by considering the following information:

- Socio-economic data/statistics including development plan of regions and transport facilities in the catchments;
- Per-unit data for economic analysis in the context of Bangladesh including reduction of traffic accidents and environmental benefits; and
- Traffic survey data including O/D, network, sectional volumes, and travel speed.

Section 2 DATA SURVEY AND REVIEW OF PREVIOUS STUDIES

2.1 Data Survey

The project team has provided the background materials for data collection in the form of a country Report (Appendix E). National, regional and project level survey was done by the collection of country report from project country, Internet research, document review and field mission.

Major data collection and survey items are as follows:

A. National (and Regional) Outlook
- Area, population, currency and exchange rate
- GDP/GRP, GDP per capita, economic growth rate, inflation rate, employment rate by sector
- Trade (Import, Export), major trade commodities, major trade partners (Import, Export)

B. National & Sub-national strategy and priority
- Road Master Plan, Regional & sub-regional Planning
- Development and upgrading plan of AHN
- Strategies and priorities

C. Implementation Agency (Road authority)
- Organization
- Implementation process including planning, design, construction and maintenance

D. Engineering data
- Design specification
- Road and bridge inventory
- Traffic data (volume, O/D, travel speed, number of accident)
- Unit construction cost(road, box & culvert, bridge, T/N)
- Maintenance cost (Routine maintenance, periodic overlay)
- Toll rate
- Geotechnical and hydraulic survey

E. Socio-economic data
- Social discount rate (%)
- Passenger Car Equivalent (PCE), Vehicle occupancies, Number of registered Vehicles
- Time Value, Vehicle Operating Cost (VOC)
- GRP/GDP
- Land use plan

2.2 Review of previous studies

Previous studies regarding AH were thoroughly reviewed and be incorporated as needed. Major previous studies are as follows:

Priority Investment Needs for the development of the Asian Highway (AH) Network (2006, UNESCAP)

National priorities and intermodal connectivity have been identified as follows:

- *Status of AH network*: Bangladesh has a total 1,805km long AH network, among which 868km is below class III
- *Priority investment needs*: Jhenaida-Jessore (45km, USD 8 million) and Dasuria-Paksey-Kushita (38km, USD 2.6 million) were identified as a part of five priority projects.

Section 3 DEVELOPMENT PLAN AND SOCIO-ECONOMIC CHARACTERISTICS

3.1 Development Plan: 6th five-year Plan (SFYP, 2011 to 2015, MOP)

RHD Physical Targets for the SFYP

Table 1. RHD Targets in SFYP

	Physical Activities	SFYP Targets(2011-15)
i.	Construction of new roads	4,672 km
ii.	Improvement/ Rehabilitation of roads	8,433 km
iii.	Construction of new bridges/culverts /overpass	23,777 meter
iv.	Reconstruction of bridges/culverts	10,362 meter
v.	Construction of Tunnel	5,400 meter

RHD Priorities for the SFYP regarding the project

i. Completion of ongoing projects
ii. Proper maintenance of existing road network to reduce huge road user costs
xi. Improve regional road connectivity including implementation of AHN to boost up trade and commerce.

3.2 Socio-economic Characteristics

3.2.1 General

Bangladesh is the 8th most populous country as well as the most densely populated large country in the world. It is bordered by India and Myanmar, and faces the Bay of Bengal to its south. The key Socio-economic indicators of Bangladesh (WB, 2011) are as follows:

- Surface Area: 143,998 ㎢
- Population: 150.5 million
- Population growth: 1.32%
- GDP per capita: US $735 (2011)
- GDP Growth Rate: 6.7% (2011)
- Currency unit: Taka (BDT)
- US $1=81.59 (effective as of Oct 1, 2012)

3.2.2 Socio-economic characteristics

Population

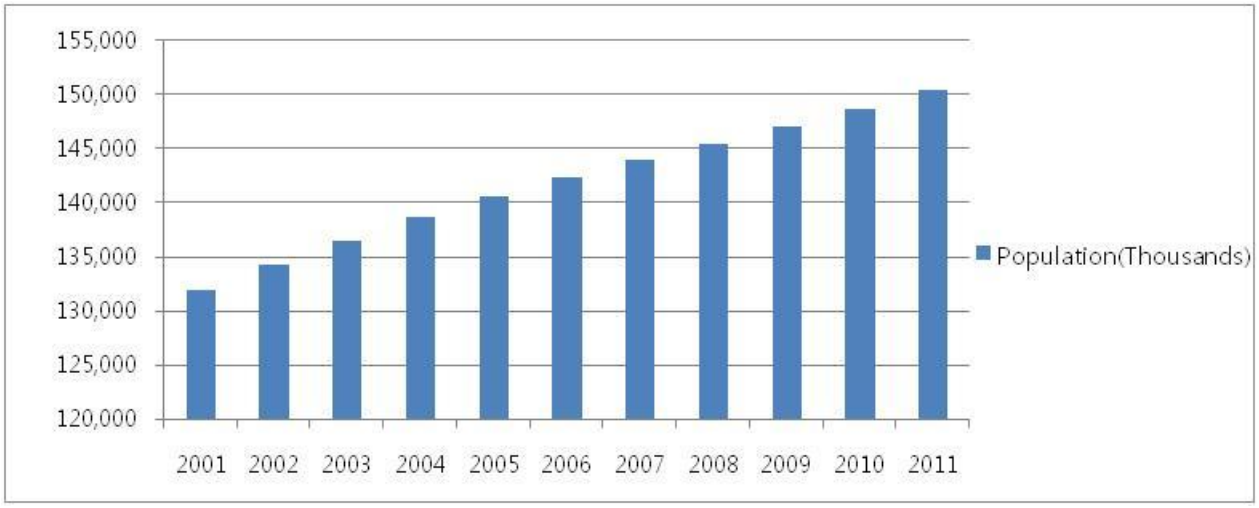
The population of People's Republic of Bangladesh is 150 million (2011) with very low annual growth rate of 1.32% since 2001.

Table 2. Population trend in Bangladesh

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Growth Rate (‘01~‘11)
Population (1000people)	131,944.6	134,266.4	136,514.8	138,633.4	140,587.9	142,353.5	143,956.8	145,478.3	147,030.1	148,692.1	150,493.7	1.32%

Source: UNESCAP Statistics Homepage, http://www.unescap.org/stat/data/statdb

Figure 6. Population trend in Bangladesh



Regional distribution of Population

Bangladesh is divided into seven divisions including, Dhaka, Barisal, Chittagong, Khulna, Rajshahi, Sylhet and Rangpur. The capital city and Dhaka division represents 46.7 million, 32.8% of the total population, while Khulna and Rajshahi divisions represent 10.8% and 12.9% of the total population respectively.

Table 3. Regional distribution of population

(unit: 1000 people)

Year / Division	Population in thousands			Average Annual Growth Rate %	
	1991	2001	2011	1991-2001	2001-2011
Bangladesh	**106,315**	**124,355**	**142,319**	**1.58**	**1.34**
Barisal	7,463	8,174	8,147	0.9	0.0
Chittagong	20,523	24,290	28,079	1.7	1.4
Dhaka	32,666	39,045	46,729	1.8	1.8
Khulna	12,688	14,705	15,563	1.5	0.6
Rajshahi	14,212	16,355	18,329	1.4	1.1
Rangpur	11,998	13,847	15,665	1.4	1.2
Sylhet	6,765	7,939	9,807	1.6	2.1

Source: "2011 Population & Housing Census: Preliminary Results". Bangladesh, Bureau of Statistics.

Number of Registered Vehicles

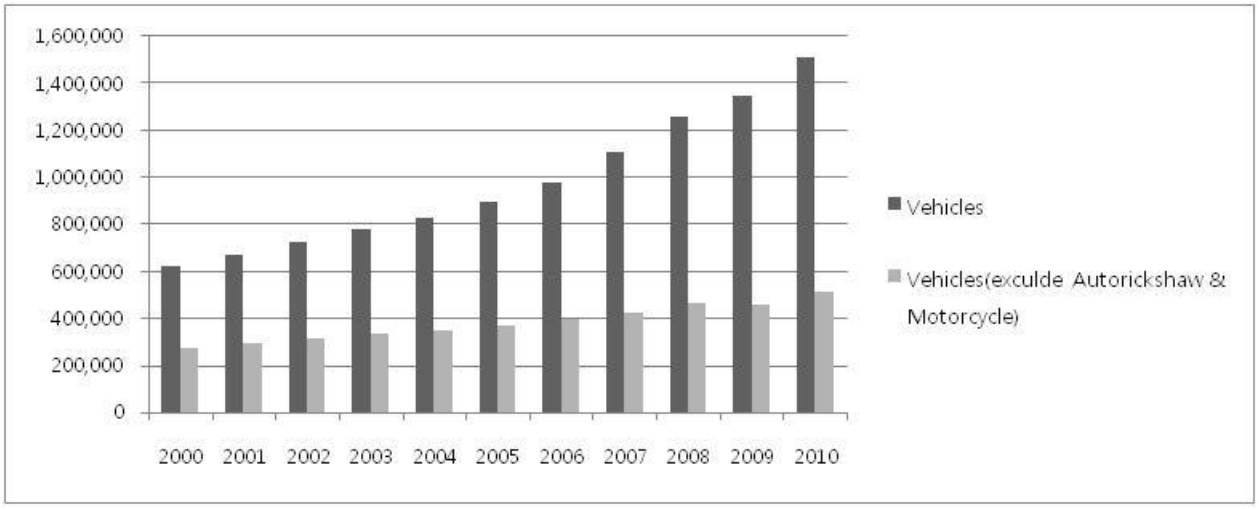
Bangladesh represents relatively small number of registered vehicles, 509,576 (2010) except Auto Rickshaw and Motorcycle with annual growth rate of 6.3% during 2000-2010. It is noted that total number of registered vehicles including Rickshaw and Motorcycle is 1.5million. It is also noted that Rickshaw and Motorcycle represent more than 60% of the total number of vehicles.

Table 4. Number of registered vehicles

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Growth Rate ('00~'10)
With Rickshaw /Motorcycles	625,318	666,834	721,450	779,295	827,513	893,086	978,790	1,105,444	1,256,450	1,347,870	1,509,028	9.2%
Without Rickshaw /Motorcycles	276,059	292,769	312,859	335,752	350,055	367,525	395,225	426,218	464,562	455,938	509,579	6.3%

Source: Bangladesh Bureau of Statistics Homepage, http://www.bbs.gov.bd/WebTestApplication/userfiles/Image/SY2010/Chapter-07.pdf

Figure 7. Number of registered vehicles



Number of vehicles by types

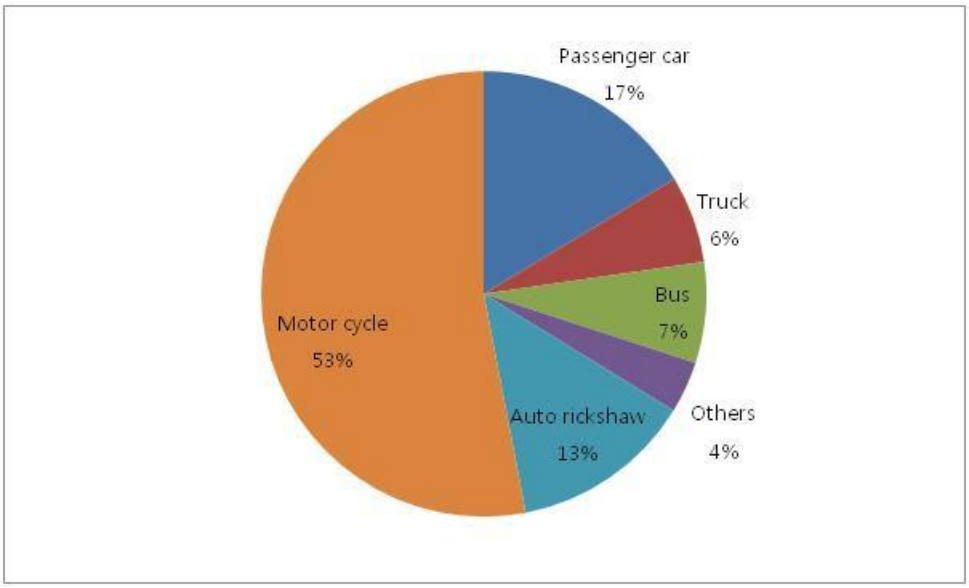
Passenger Car represents 16.4% of the total vehicles in 2010 as below.

Table 5. Number of vehicles by types and annual growth rate (2010)

Contents	Passenger car	Truck	Bus	Others	Auto rickshaw	Motor cycle	Total
No.	246,999	95,425	110,484	56,671	199,519	799,930	1,509,028
%	16.4%	6.3%	7.3%	3.8%	13.2%	53.0%	100.0%

Source: Bangladesh Bureau of Statistics Homepage, http://www.bbs.gov.bd/WebTestApplication/userfiles/Image/SY2010/Chapter-07.pdf
Source: National Statistical Office of Bangladesh Homepage, http://www.nso.mn/v3/index2.php

Figure 8. Per cent of vehicles by type



GDP

The annual growth rate of GDP represents 5.96% from 2001 to 2011.

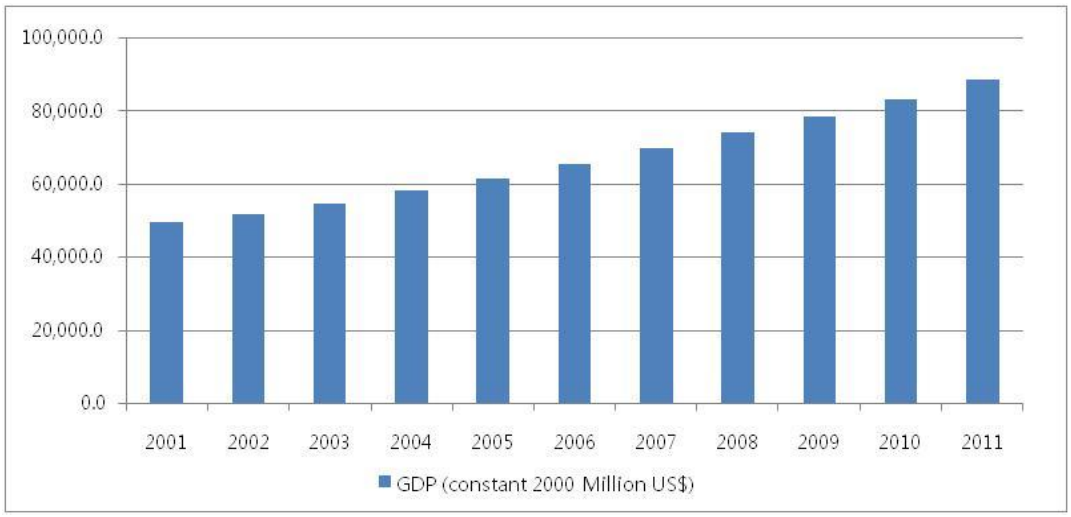
Table 6. GDP trend (2000 Nominal price)

(unit : Million 2000 US dollars)

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Growth Rate ('01~'11)
GDP	49,610.3	51,800.8	54,523.4	57,942.3	61,393.1	65,463.0	69,670.9	73,983.8	78,231.4	82,979.5	88,507.8	5.96%

Source: World Bank Data Homepage, http://data.worldbank.org

Figure 9. GDP trend



3.3 Road System Inventory

The road network in Bangladesh comprises 310,000 kilometers, of which 20,000km is managed by RHD while 290,000 km is managed by LGED (Local Government Engineering Department).

Table 7. Road Network in 2011

Road Type	Total Length(km)	Road Administrator
National Highway	3,492	RHD
Regional Highway	4,268	RHD
Zilla Road	13,280	RHD
Sub-Total	21,040	
Upazila Road	37,785	LGED
Union Road	44,780	LGED
Rural Road Type-A	106,894	LGED
Rural Road Type-B	100,565	LGED
Sub-Total	290,024	
Total	311,064	

Source: Maintenance and Rehabilitation Needs of 2010-11 for RHD Paved Roads
LGED's Annual Report 2010-11

Figure 10. RHD Road Network in Bangladesh



Note: The boundaries and names shown and designations used on this map do not imply official endorsement or acceptance by the United Nations.

Source: Roads and Highways Department, Ministry of communication, Bangledesh; http://www.rhd.gov.bd/

3.4 Asian Highway Network

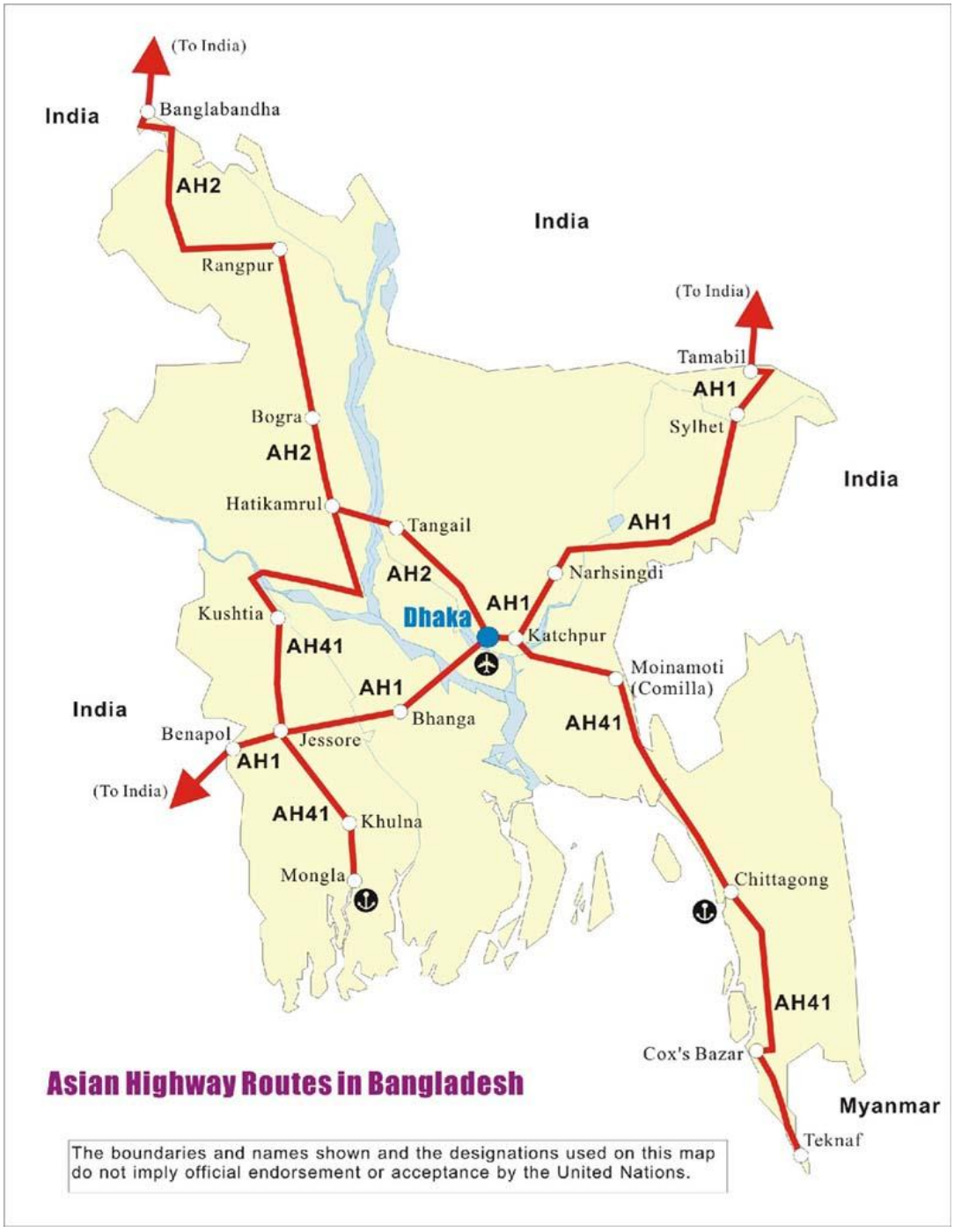
The Asian Highway network in Bangladesh consists of 3 routes as below. Out of total 1,762km long AH, 40km is below class Ⅲ standard.

Table 8. Current Status of AH network in Bangladesh (2010)

AH No.		AH1	AH7	AH41	Total
Border and major cities		Tamabil(Border of India)-Jessore-Benapole (Border of India)	Tamabil(Border of India)-Dhaka -Banglabandh (Border of India)	Teknaf-Cox's Bazar-Chittagong-Dhaka-Paksey-Jessore-Khulna-Mongla	-
Grade	Primary	-	-	-	-
	Ⅰ	-	42	26	68
	Ⅱ	432	414	728	1,574
	Ⅲ	51	44	-	95
	Below Ⅲ	8	12	-	20
	Other	5	-	-	5
Total		496	512	754	1,762

Source: Asian Highway Database 2010, United Nations ESCAP

Figure 11. Asian Highway Routes in Bangladesh



Source: United Nations ESCAP

Section 4 TECHNICAL FEASIBILITY

Technical viability of the candidate route was assessed in terms of its geometry, alignment, traffic volume, project cost and cross-border connectivity.

4.1 Route Assessment

4.1.1 Field Mission

A UNESCAP mission comprising Mr. Abdul Quium (UNESCAP), Mr. Woohyun Kwon (KEC), Mr. Hyunha Kwon and Byungryeol Kim (Naekyung Engineering) visited Bangladesh from April 22 to 26, 2012.

Meetings and Capacity Building Workshop were held with MOC, including Mr. Obaidul Quader MP (Honorable Minister), Mr. Mohammad Abdul Quadir (Joint Secretary, Bridge Division), Mr. Mohammad Nurul Amin (Deputy Secretary, Roads and Railway Division), Mr. Md. Aminur Rahman Lasker (Chief Engineer, RHD), Mr. Engr. Mahboob-ul Alam (Additional Chief Engineer, RHD), Ms. Marufa Ismat (Chief Transport Economist, RHD), Mr. Shabbir Hasan khan (Executive Engineer, RHD), Mr. ABM Sertajur Rahman (Assistant Project Director, RNIMP, RHD), Mr. Md. Liaquat Ali (Executive Engineer, BBA) and Mr. Md. Syeedul Haque (Joint Chief, Programming Division, Bangladesh Planning Commission)

The mission provided comments to MOC to assist them with formulating investment proposal including traffic forecast, economic analysis and safeguard during the meetings and one day capacity building workshop on May 8.

Due to an internal conflict during the first mission in April, Mr. Abdul Quium (UNESCAP) and Mr. Woohyun Kwon (KEC) visited Jessore-Banpara (L=148km) site again from Aug 26 to 27, 2012. Mr. Mohammad Nurul Amin (Deputy Secretary, Roads and Railway Division) and Mr. Shabbir Hasan khan (Executive Engineer, RHD) joined the mission.

The objectives of the mission were:

- To identify the strategic context of the project;
- To assess the road and traffic conditions; and
- To identify social and environmental constraints, if any

Within Jessore-Banpara section (2 lane, 148km) on AH41, which was proposed by MOC, the Jhenaidah-Banpara section (2 lane, 103km) has been studied as the main focus since an ADB intervention[3] was already underway for the rehabilitation of the Jessore - Jhenaidah section (45km).

4.1.2 Review of road and traffic conditions

General

Alignment and pavement: No significant improvement is needed except the Kushita bypass section. It is AH Class II in light of AH classification and design standards. Two-lane DBST and AC pavement sections were identified with good or fair conditions overall.

Bridges: Twelve bridges were identified with relatively good conditions.

Social and Environmental Impact: Land acquisition and resettlement is needed only for the Kushita bypass option. No significant negative impact on the environment of the catchment of the project road is expected.

[3] Procurement of TA for Sub-regional Road Transport Project Preparatory Facility is underway

Division of road sections: Considering the administrational division of RHD, two sections, Jhenaidah-Paksey section under Khulna Division and Paksey-Banpara section under Rajshahi Division were formulated and reviewed.

1. Jhenaidah - Paksey Section

The Jhenaidah –Paksey is 73km long, two-lane, section under Khulna Division. It passes flat terrain, mostly through rice fields with fair alignment. 10 bridges were identified with good conditions. The overall surface condition of DBST is fair or good. Four-lane Lalon Shah Bridge (L=1.76km, 4-Lane, Box Girder) were identified with good condition. Surface condition of the 21 km section from Kustia to Lalon Shah bridge is good due to DBST overlay in 2006.

For this section, the improvement of pavement with partial repair based on the current alignment is recommended.

Kushtia bypass has also been proposed as an alternative to reduce the traffic congestion and improved traffic safety. Provision of a frontage road and safety furniture is required in the village section due to vulnerable Non-Motorized Transport (NMT).

2. Paksey~Banpara section

The Paksey–Banpara is 32km long, two-lane, section under Rajshani Division. It passes a flat terrain, mostly rice fields with fair alignment. 2 bridges were identified with good conditions. The overall surface condition of DBST is fair or good. In this regards, the improvement of pavement with partial repair based on the current alignment is recommended.

Findings and recommendations are as follows:

- Gopapur bypass is also recommended, but not included in the project, to ease the congestion and enhance traffic safety.
- Two roundabouts were installed too closely on N6 and N705 intersections in Dasura. Integration of the two roundabouts should be further explored.
- Relocation of Bus stops from "inside" of the intersection to "after" the intersection with auxiliary lane is recommended to reduce congestion.
- Provision of a frontage road and safety furniture is required in the city section due to vulnerable Non-Motorized Transport (NMT).

4.2 Traffic Forecast

4.2.1 Current Traffic condition

Based on the internal data from RHD, traffic volume of Banpara~Paksey~ Kushtia~Jhenaidah section represents maximum of about 6,000 vehicles per day in 2013 as below.

Table 9. Current traffic volumes in AH41 Banpara~Paksey~ Kushtia~Jhenaidah~Jessore (2013)

City/Town Name at Start Point	City/Town Name at End Point	Traffic Volume by Vehicle Type						
		Passenger Car	Pick-up	Bus	Truck	Motorcycle	Others	Total
Banpara	Dasuria	244	738	770	2,860	25	379	5,016
Dasuria	Paksey	251	1,414	755	2,257	25	1,170	5,872

Paksey	Kushtia	189	489	725	2,746	34	648	4,831
Kushtia	Jhenaidah	189	489	725	2,746	34	648	4,831

Source: HDM Circle, RHD (Non-Motorized Vehicles were excluded)

4.2.2 Traffic forecast

Simple Trend Analysis

A simple trend analysis has been used for the future traffic forecasting considering the absence of comprehensive traffic database including traffic count and O/D survey and transport network data.

Traffic Projection of existing road

30 year traffic projection has been provided as below to synchronize the period of economic analysis from 2015 to 2044 considering 2-year construction periods from 2013 to 2014.

The annual growth rate of nominal GDP was used as an independent variable for the regression model of traffic forecasting considering the strong correlation between traffic growth and GDP growth.[4]

Table 10. Traffic projection in Banpara ~ Jhenaidah

Section	Year	Passenger Car	Pick-up	Bus	Truck	Motor Cycle[5]	**Total**	Annual Average Growth Rate
Banpara - Dasuria	2015	264	799	834	3,125	411	**5,433**	
	2019	305	922	962	3,605	474	**6,268**	3.6%
	2024	356	1,076	1,122	4,205	552	**7,311**	3.1%
	2029	406	1,229	1,282	4,805	631	**8,354**	2.7%
	2034	457	1,383	1,442	5,405	710	**9,397**	2.4%
	2039	508	1,536	1,603	6,005	789	**10,440**	2.1%
	2044	559	1,689	1,763	6,604	868	**11,483**	1.9%
Dasuria - Jhenaidah	2015	272	1,532	818	2,472	1,267	**6,360**	
	2019	314	1,767	943	2,851	1,462	**7,337**	3.6%
	2024	366	2,061	1,100	3,326	1,705	**8,558**	3.1%
	2029	418	2,355	1,257	3,800	1,949	**9,779**	2.7%
	2034	470	2,649	1,414	4,275	2,192	**11,000**	2.4%
	2039	522	2,943	1,571	4,750	2,435	**12,221**	2.1%
	2044	575	3,237	1,728	5,224	2,678	**13,442**	1.9%

[4] RHD suggested annual traffic growth rate of 5 to 7% based on the statistics from national highways. Further details of this statistics should be explored during a formal feasibility study.

[5] This includes Auto Rickshaw and others

4.3 Improvement Plan

Summary of Current status

Based on the given information, discussion and site survey, major findings are as follows:

- The project road represents Asian Highway Class II standard and overall alignment doesn't need to be improved.
- City bypass could be considered as an alternative to reduce congestion and improve road safety.
- Most sections run through flat terrain and rice fields.
- The part of the sections represents fair surface condition (DBST) and it may need to be improved.
- 12 bridges are found to be in good conditions.

To address these challenges, upgrading plan was proposed as follows:

- Alternative 1 (101km): Construction of two-lane bypass at Kushita (15km) and AC overlay of other sections (86km).
- Alternative 2 (105km): AC overlay for the whole section (105km)
- Alternative 3 (101km): Reconstruction of whole section with two-lane bypass at Kushita (101km)

4.4 Cost Estimation

Unit cost estimation

Cost estimates from the RHD have been used as below.

Table 11. Unit cost of major work items

Contents	Unit cost (US $)
	Cost estimated by the committee[6,7]
Construction of 1km of new road	913,593
AC Overlay	139,925

Source: Internal Data (Roads Division, Ministry of communication Roads and Highways Department)

Preliminary construction cost estimation

Based on the work items under each alternative and its unit cost, a preliminary construction cost for each alternative is estimated as below.

[6] The costs estimated by the committee are based on Schedule of Rates 2011 by adding 20% more in consideration of the present market price.

[7] The details of costs are shown in Appendix G

Table 12. Preliminary construction cost of Alternatives

Alternative	Contents	Quantities	Unit cost (US $)	Cost (US $ in thousands)
Alternative-1	a. Construction of the new road	15km	913,593	13,704
	b. Overlay of the existing road	86km	139,925	12,034
	Total	101km		25,738
Alternative-2	a. Overlay of the existing road	105km	139,925	14,692
Alternative-3	a. Reconstruction of entire section	105km	913,593	95,927

Section 5 ECONOMIC ANALYSIS

5.1 Methodology

General

Economic feasibility will be reviewed by Benefit/Cost Analysis (BCA). Benefit Cost Analysis is a calculation of the stream of both benefits and costs over the lifetime of the facility or strategy. Major indices of BCA are as follows:

- Internal Rate of Return (IRR): The ratio of the total discounted benefit to the total discounted cost

$$\sum_{t=1}^{N} \frac{Bi - Ci}{(1+r)^i} = 0 (i = 1,2,....n)$$

- Net Present Value (NPV): The discounted value of the absolute welfare gain minus discounted value of the investment over the whole life of the project

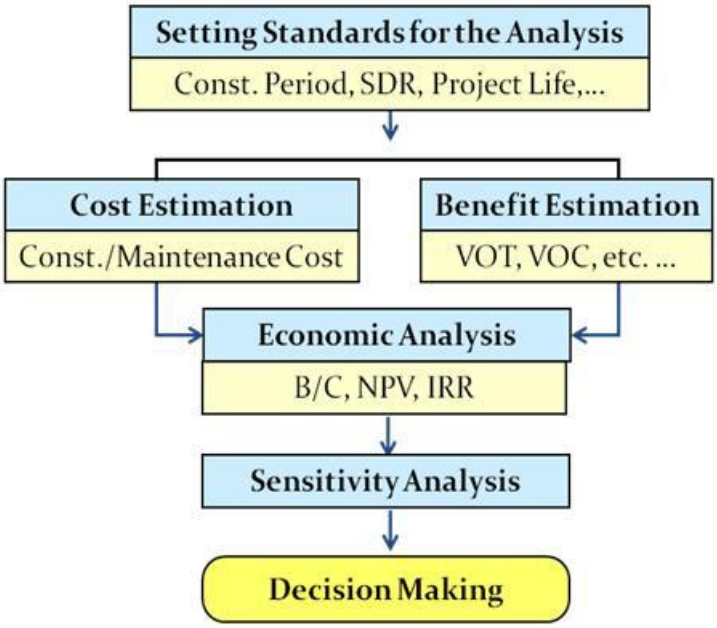
$$NPV = \sum_{t=1}^{N} \frac{Bi - Ci}{(1+d)^i} (i = 1,2,....n)$$

- Benefit Cost ratio (B/C): The discount rate that equates the present value of a future stream of benefits to the investment (Discount rate such that NPV=0)

$$B/C = \sum_{t=1}^{N} \frac{Bi}{(1+d)^i} / \sum_{t=1}^{N} \frac{Ci}{(1+d)^i} (i = 1,2,....., n)$$

Where, Ci = cost in year i, Bi= benefit in year i, i = year, N = project life, i = discount rate

Figure 12. Economic Analysis Process



Evaluation Criteria

Internal Rate of Return (IRR) > Social Discount Rate
Benefit - Cost Ratio (B/C) > 1
Net Present Value (NPV) > 0

5.2 Benefit/Cost Analysis

5.2.1 Economic Analysis Criteria

Basic assumptions for the analysis are as follows:

- Project road: Jhenaidah – Banpara (105km)
- Construction period: 2 years (2013-2014)
- Analysis period : 2015 ~ 2044 year (30 years after opening)
- Discount rate : 12.0% (proposed value by ADB)
- Basic Price: Market price in 2011
  (Economic price, converted from market price, was used for the analysis)

B/C Analysis for Alternative 3 (Reconstruction) has been omitted, considering the limited resources for the study, since it has 6.5 times higher cost than the overlay option (Alt 1, 2) while the benefit may not be significantly different.

5.2.2 Estimation of Costs

Construction and maintenance cost were estimated and used for the analysis. For the economic analysis, the shadow price was calculated by eliminating taxes and interests from the total costs.

Initial Cost

Construction cost was equally divided into 2 years of construction as below.

Table 13. Allocation of construction cost

Year	Annual Cost(US thousand dollars)	
	Alt. 1 (Including bypass)	Alt. 2
2013	12,869.0	7,346.0
2014	12,869.0	7,346.0
total	25,738.0	14,692.0

Maintenance Cost

It is assumed that the periodic maintenance will be done in every 5 years and the cost of routine maintenance is estimated as a 10% of periodic maintenance work. No additional maintenance cost for Alternative 2 (overlay) was assigned since it has the same maintenance cost with do-nothing. In this regards, only additional cost of the new bypass was estimated for Alternative 1.

Table 14. Estimated Maintenance Cost

Content	Maintenance Cost(US thousand dollars)	
	Alt. 1	Alt. 2
Periodic	2,098.9	-
Routine	209.9	-

5.2.3 Estimation of Benefits

Vehicle Operation Cost Saving (VOCS)

The costs of operation of a selection of vehicle types, when used under a range of operating conditions can be estimated by Vehicle Operating Cost models. Due to the absence of relevant data, Korean VOC model has been used[8]. Vehicle types are modified in the context of Bangladesh.

Table 15. Vehicle operating cost for vehicles under various speed (2009)

(Unit: Korean Won/km)

Speed(km/h)	Passenger car	Pick-up	Bus	Truck	Trailer
10	440.40	384.62	758.41	601.31	856.25
20	356.45	307.64	606.76	463.47	678.65
30	302.56	256.91	498.49	395.27	573.27
40	258.87	222.01	424.54	343.42	505.78
50	227.08	200.79	379.76	314.02	457.58
60	209.93	187.20	353.58	296.70	432.27
70	198.03	179.51	339.52	290.20	419.52
80	186.08	176.21	332.23	292.85	417.90
90	180.47	179.53	330.49	308.11	440.10
100	178.57	190.10	339.93	347.08	465.02
110	179.54	384.62	363.26	-	-
120	183.15	-	758.41	-	-

Source: Guidelines for Transport project evaluation, 4th edition (MLTM, 2011)

VOC model for this study was estimated by regression as below.

$$VOC = a + bV + c\frac{1}{V} + dV^2$$

Where, VOC: VOC for vehicles under ideal conditions (Won/Veh-km)
V: Speed under ideal conditions (km/hr)
a,b,c,d: parameters

The unit VOC of Motorcycle was assumed as 1/5 of Passenger car VOC due to the lack of data in Bangladesh.

[8] As a comment on the draft final report, Vehicle Operating Cost table at different IRI was given on August 2013 from RHD (see Appendix G); however, it was not incorporated in the report due to the lack of IRI data of existing highways. Korean VOC model may exaggerate the benefit part but it will compensate the benefits from the diverted traffic due to the improvements, which has not been captured in the study.

Table 16. VOC model parameters

Vehicle type	a	b	c	d	R^2
Passenger car	400.734	-4.68767	1172.673	0.024462	0.997121
Pick-up	690.8032	-9.26246	2119.066	0.05802	0.996183
Bus	366.5035	-5.04615	933.398	0.033327	0.998794
Truck	551.848	-7.98578	1653.167	0.059748	0.998844
Trailer	795.9204	-10.7247	2215.565	0.075531	0.999495

Travel speed was estimated as:

- 30km/h for through city section
- 50km/h for before improvement
- 60km/h for after improvement

Table 17. Per unit cost of VOC

(Unit: Korean Won/km)

Speed	Passenger car	Pick-up	Bus	Truck	Motorcycle[9]
60km/h	194.23	217.60	293.49	326.66	38.85
50km/h	208.76	225.01	321.84	337.03	41.75
30km/h	254.65	268.54	425.09	391.15	50.93

VOCS benefit is as follows:

Table 18. VOC saving

(Unit: US thousand dollars/yr)

Alternatives	2015	2024	2034	2044
Alt. 1	3,117.0	4,194.0	5,390.8	6,587.6
Alt. 2	3,037.4	4,087.0	5,253.2	6,419.4

Travel Time Saving

Travel time saving has been estimated from 2004 time value per passenger data (RHD) by use of CPI between 2004 and 2011.

Table 19. Travel Time Cost by Vehicle Types

Classification	Travel Time Cost		
	2004(Taka/hr)	2011(Taka/hr)	2011(USD/hr)
Passenger car	30.9	52.9	0.529
Micro Bus	24.9	42.6	0.426
Bus	17.6	30.1	0.301

[9] For a per unit cost of motorcycle, 1/5 of passenger car was used considering its fuel efficiency.

Utility	30.9	52.9	0.529
Motor Cycle	22.9	39.2	0.392

Source: Internal data (RHD, 2004)

Table 20. Time Value of Passenger by Vehicle Types

(Unit: USD/ vehicle·hour)

Classification	Passenger car	Bus		Truck	Motor-cycle
		small	large		
Passenger[10]	4	7	47	1.5	2
VOT/vehicle	2.1166	2.9848	14.1655	0.7937	0.7843
average VOT/vehicle		8.5752			

Source: Internal data (RHD)

The output of Travel time saving has been very low comparing VOCS due to the level of income in Bangladesh.

Table 21. Travel Time Saving

(Unit: US thousand dollars/yr)

Alternatives	2015	2024	2034	2044
Alt. 1	1,158.1	1,558.3	2,002.9	2,447.5
Alt. 2	1,132.5	1,523.8	1,958.6	2,393.4

Other Benefits

Given the limited availability of data, only two user benefits including Vehicle Operating Cost (VOC) and Travel Time Saving are used in this project. Other benefits can be considered are as follows:

- Change in Externality Costs: Traffic accident, Environmental costs, Regional developments
- Change in system operating costs and revenue
- Co-benefits (CO2 emission reduction)

5.2.4 Results of Economic Analysis

Alternative with low cost, Alternative 2, represented better output in economic analysis as below.

Table 22. Economic Analysis

Content	Alternative 1	Alternative 2
B/C	1.408	2.761

10 VIENTIANE 3'rd RING ROAD FEASIBILITY STUDY, December, 2008, Lao People's Democratic Republic

NPV (USD 1,000)	9,086.8	19,521.8
IRR	16.78%	28.22%

In terms of the evaluation criteria, the economic viability of the project is as follows:

Internal Rate of Return (IRR) = 28.22% > Social Discount Rate (12%)
Benefit - Cost Ratio (B/C) = 2.761 > 1
Net Present Value (NPV) = 19,521.8 > 0

5.3 Sensitivity Analysis

The sensitivity of economic analysis for Alt. 2 was done by re-running B/C, NPV and IRR calculations for:

- Total Benefits at +/- 10% and 20%
- Total Costs at +/- 10% and 20%

Table 23. Sensitivity Analysis (Alt. 2)

Cost	Indicator	Benefit		
		0%	-10%	-20%
0%	B/C	2.761	2.485	2.209
	NPV	19,521.8	14,697.4	11,964.7
	IRR	28.22%	25.91%	23.54%
10%	B/C	2.510	2.259	2.008
	NPV	16,440.4	13,707.7	10,975.0
	IRR	26.13%	23.98%	21.78%
20%	B/C	2.301	2.071	1.841
	NPV	15,450.7	12,718.0	9,985.2
	IRR	24.34%	22.33%	20.27%

Section 6 ENVIRONMENTAL AND SOCIAL IMPACT

6.1 Environmental Impact

For the project road, Environmental Safeguarding may be triggered due to the Kushita bypass option; however, no significant negative impact on the environment of the catchment of the project road is expected. Trigger of Environmental safeguard shall be decided based on the detailed site survey.

Followings are the Environmental Categorization in MDB guidelines.

Table 24. Environmental Categorization (ADB)

A	• Environmental Impact Assessment(EIA) report • Environmental Management Plan including a budget • Public consultation(at least twice) • Disclosure 120 days in advance of Board Consideration
B	• Initial Environmental Examination(IEE) report • Public consultation
C	• Review of Environmental Implications(No EIA or IEE is required)
FI	• Environmental Management System(Equity Investment) • EMS including Environmental Assessment and Review Procedures for Subprojects(Credit Lines)

6.2 Social Impact

Land acquisition and resettlement is needed only for the bypass alternative. Remedies need to be prepared accordingly.

Women's economic and social empowerment is essential in economic growth and poverty reduction. The project will provide better access to employment, child care, education, health and political processes for the women in the rural areas including Jhenaidah, Kushita, Paksey and Banpara.

Social Safeguarding including Involuntary Resettlement (IR) due to a bypass alternative and Gender Impact should be assessed in terms of National, Bilateral and Multilateral donors' guidelines during a formal study.

Section 7 RECOMMENDATION

7.1 Conclusion

1. Jhenaidah-Banpara section (AH41) will be the principal north to south corridor in the western region in Bangladesh connecting nation's 2nd largest Mongla sea port and Benapole dry port with the capital city, Dhaka. It meets AH Class II standard.

2. The improvement of surface, from DBST to AC overlay with Kushita bypass, was proposed considering its strategic role as above. The total cost is estimated as USD 25.7 million.

- AC overlay (86km, USD 13.7million)
- Construction of Kushita bypass (15 km, USD 12.0million)

It is also estimated that traffic projection in 2045 is maximum 13,442 vehicles per day at Dasuria - Paksey section.

3. Based on the given information, both the alternatives are economically feasible in light of the evaluation criteria. The output of AC pavement with bypass option is as follows:

- Internal Rate of Return (IRR) = 28.22% > Social Discount Rate (12%)
- Benefit - Cost Ratio (B/C) = 2.761 > 1
- Net Present Value (NPV) = 19,521.8 > 0

7.2 Recommendation

1. 2-lane AC overlay with (Alt 1) or without the bypass (Alt 2) is found to be economically viable while reconstruction (Alt 3) was not found feasible; however, RHD expressed their desire to reconstruct the whole section (Alternative 3) based on the thorough survey, including deflection test, considering the cross-border connectivity via Benapole dry port and Mongla seaport. A holistic, instead of demand-driven, approach may be appropriate in this case.

2. Further study in the context of enhancing cross-border connectivity and mobility may be considered in the near term with sustainable financing solutions, which will be vital for economic and social development in the western region of Bangladesh and neighboring land-locked countries including Nepal and Bhutan.

7.3 Implementation Plan

7.3.1 Preparation and Procurement

The output of this study was presented during an Investment Forum in October 2013 (Bangkok, UNESCAP) for identification of major donors. Subsequently, project preparation, project appraisal, loan/credit negotiations, loan/credit approval and signing will take minimum two years depending on the internal process of multi-lateral or bi-lateral donors, The procurement process will follow thereafter.

7.3.2 Implementation

The project area represents tropical climate with a mild winter, average 20℃(11~29℃), from October to March, a hot, humid summer from March to June. During rainy season from July to Oct, 75% of annual average precipitation is provided. Considering this, pavement works can be done for 8 months in this regards.

Table 25. Implementation Plan (Construction)

Work Item	1st Year				2nd Year			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Earth work								
Pavement work								

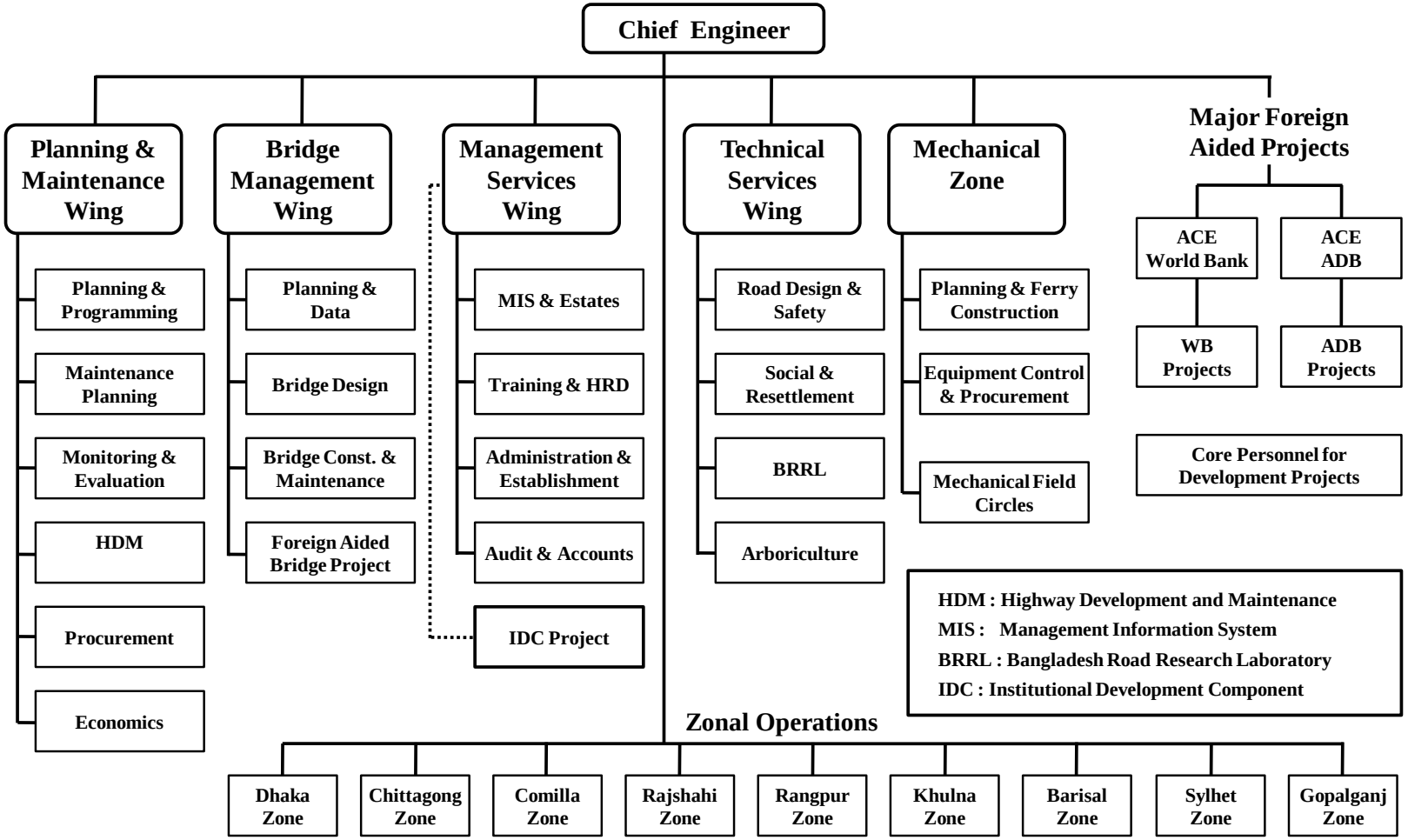
Appendices

Appendix A. List of persons met

MOC

Mr. Obaidul Quader MP (Honorable Minister, MOC)
Mr. Mohammad Abdul Quadir (Joint Secretary, Bridge Division, MOC)
Mr. Mohammad Nurul Amin (Deputy Secretary, Roads and Railway Division, MOC)
Mr. Md. Aminur Rahman Lasker (Chief Engineer, RHD, MOC)
Mr. Engr. Mahboob-ul Alam (Additional Chief Engineer, RHD, MOC)
Mr. Engr. Marufa Ismat (Chief Transport Economist, RHD, MOC)
Mr. Shabbir Hasan khan (Executive Engineer, RHD, MOC)
Mr. ABM Sertajur Rahman (Assistant Project Director, RNIMP, RHD, MOC)
Mr. Md. Liaquat Ali (Executive Engineer, BBA, MOC)
Mr. Md. Syeedul Haque (Joint Chief, Programming Division, Bangladesh Planning Commission)

Appendix B. Implementation Agency (Roads and Highways Department, MOC)



Appendix C. Economic Analysis
Alternative 1

discount rate	12.0%
Base Year	2011

B/C	**1.408**
NPV	**9,086.8**
IRR	**16.78%**

Unit:1,000US $

Year	Cost		Benefit			
	CV	PV	VOCS	Time saving	VOCS+Time saving	PV
2013	12,869.0	10,259.1				
2014	12,869.0	9,159.9				
2015	209.9	133.4	3,117.0	1,158.1	4,275.0	2,716.9
2016	209.9	119.1	3,236.6	1,202.5	4,439.2	2,518.9
2017	209.9	106.3	3,356.3	1,247.0	4,603.3	2,332.2
2018	209.9	94.9	3,476.0	1,291.5	4,767.5	2,156.6
2019	2,098.9	847.7	3,595.7	1,335.9	4,931.6	1,991.8
2020	209.9	75.7	3,715.3	1,380.4	5,095.7	1,837.6
2021	209.9	67.6	3,835.0	1,424.9	5,259.9	1,693.5
2022	209.9	60.3	3,954.7	1,469.3	5,424.0	1,559.3
2023	209.9	53.9	4,074.4	1,513.8	5,588.2	1,434.3
2024	2,098.9	481.0	4,194.0	1,558.3	5,752.3	1,318.3
2025	209.9	42.9	4,313.7	1,602.7	5,916.4	1,210.6
2026	209.9	38.3	4,433.4	1,647.2	6,080.6	1,110.9
2027	209.9	34.2	4,553.1	1,691.6	6,244.7	1,018.6
2028	209.9	30.6	4,672.7	1,736.1	6,408.9	933.4
2029	2,098.9	272.9	4,792.4	1,780.6	6,573.0	854.7
2030	209.9	24.4	4,912.1	1,825.0	6,737.1	782.2
2031	209.9	21.8	5,031.8	1,869.5	6,901.3	715.4
2032	209.9	19.4	5,151.4	1,914.0	7,065.4	654.0
2033	209.9	17.3	5,271.1	1,958.4	7,229.6	597.5
2034	2,098.9	154.9	5,390.8	2,002.9	7,393.7	545.6
2035	209.9	13.8	5,510.5	2,047.4	7,557.8	497.9
2036	209.9	12.3	5,630.1	2,091.8	7,722.0	454.2
2037	209.9	11.0	5,749.8	2,136.3	7,886.1	414.2
2038	2,098.9	98.4	5,869.5	2,180.8	8,050.3	377.5
2039	209.9	8.8	5,989.2	2,225.2	8,214.4	343.9
2040	209.9	7.8	6,108.8	2,269.7	8,378.5	313.2
2041	209.9	7.0	6,228.5	2,314.1	8,542.7	285.1
2042	209.9	6.3	6,348.2	2,358.6	8,706.8	259.5
2043	209.9	5.6	6,467.9	2,403.1	8,871.0	236.0
2044	209.9	5.0	6,587.6	2,447.5	9,035.1	214.7
Total	41,479.4	22,291.8	145,567.6	54,084.3	199,651.9	31,378.6

Alternative 2

discount rate	12.0%
Base Year	2011

B/C	**2.761**
NPV	**19,521.8**
IRR	**28.22%**

Unit:1,000US $

Year	Cost		Benefit			
	CV	PV	VOCS	Time saving	VOCS+Time saving	PV
2013	7,346.0	5,856.2				
2014	7,346.0	5,228.7				
2015	0.0	0.0	3,037.4	1,132.5	4,169.9	2,650.0
2016	0.0	0.0	3,154.0	1,175.9	4,330.0	2,456.9
2017	0.0	0.0	3,270.7	1,219.4	4,490.1	2,274.8
2018	0.0	0.0	3,387.3	1,262.9	4,650.2	2,103.5
2019	0.0	0.0	3,503.9	1,306.4	4,810.3	1,942.8
2020	0.0	0.0	3,620.5	1,349.9	4,970.4	1,792.4
2021	0.0	0.0	3,737.1	1,393.3	5,130.5	1,651.9
2022	0.0	0.0	3,853.8	1,436.8	5,290.6	1,520.9
2023	0.0	0.0	3,970.4	1,480.3	5,450.7	1,399.1
2024	0.0	0.0	4,087.0	1,523.8	5,610.8	1,285.8
2025	0.0	0.0	4,203.6	1,567.3	5,770.9	1,180.8
2026	0.0	0.0	4,320.3	1,610.7	5,931.0	1,083.6
2027	0.0	0.0	4,436.9	1,654.2	6,091.1	993.6
2028	0.0	0.0	4,553.5	1,697.7	6,251.2	910.5
2029	0.0	0.0	4,670.1	1,741.2	6,411.3	833.7
2030	0.0	0.0	4,786.7	1,784.7	6,571.4	763.0
2031	0.0	0.0	4,903.4	1,828.1	6,731.5	697.8
2032	0.0	0.0	5,020.0	1,871.6	6,891.6	637.9
2033	0.0	0.0	5,136.6	1,915.1	7,051.7	582.8
2034	0.0	0.0	5,253.2	1,958.6	7,211.8	532.1
2035	0.0	0.0	5,369.8	2,002.1	7,371.9	485.7
2036	0.0	0.0	5,486.5	2,045.6	7,532.0	443.1
2037	0.0	0.0	5,603.1	2,089.0	7,692.1	404.0
2038	0.0	0.0	5,719.7	2,132.5	7,852.2	368.2
2039	0.0	0.0	5,836.3	2,176.0	8,012.3	335.5
2040	0.0	0.0	5,953.0	2,219.5	8,172.4	305.5
2041	0.0	0.0	6,069.6	2,263.0	8,332.5	278.1
2042	0.0	0.0	6,186.2	2,306.4	8,492.6	253.1
2043	0.0	0.0	6,302.8	2,349.9	8,652.7	230.2
2044	0.0	0.0	6,419.4	2,393.4	8,812.8	209.4
Total	14,692.0	11,084.9	141,852.8	52,887.8	194,740.6	30,606.7

Appendix D. Asian Highway Database (UNESCAP, 2010)

1. Geometry and pavement type

Section		Jhenaidah-Kushtia	Kushtia-Paksey	Paksey-Dasuria	Dasuria-Banpara
Number of Lanes	2	42km	31km	9km	23km
	4				
	6				
Surface Type	Asphalt Con'c	42km	31km	9km	23km
	PM DB SB				
Surface Condition	Good				
	Bad				
Number of Major Intersections		3	3	1	2
Information of Bridges	Total No.	7	3	1	1
	Total Length	243	1,882	9	83
	Vertical Clearance<4.5m	No	No	No	No
	Design Load Below HS 20-44	No	No	No	No

Source : Asian Highway Database 2010, United Nations ESCAP

Section		Jhenaidah-Kushtia	Kushtia-Paksey	Paksey-Dasuria	Dasuria-Banpara
Row Width	50-70m	42km	31km	9km	23km
Carriageway Width	7-14m	42km	29km	9km	23km
	Unknown	-	2km	-	-
Type of Shoulder	Hard	42km	-	-	-
	Soft	-	29km	9km	23km
	No	-	2km	-	-
Shoulder Width (One Side)	≥1m	-	-	-	-
	1-2m	42km	29km	9km	23km
	Unknown	-	2km	-	-
Side Walk	With	42km	29km	9km	23km
	Without	-	2km	-	-

2. Traffic data

Section		Jhenaidah-Kushtia	Kushtia-Paksey	Paksey-Dasuria	Dasuria-Banpara
Year of Construction		1997	1960	1996	1996
Year of Rehabilitation Improvement		2000	2005	-	2004
Traffic Volume by Vehicle Type	Passenger Car	219	219	219	94
	Pick-up	130	130	130	85
	Bus	748	748	748	531
	Truck	938	938	938	1,278
	Trailer	0	0	0	0
	Motor Cycle	2,708	2,708	2,708	325
	Other	2,199	2,199	2,199	365
	Non-Motorized	5,348	5,348	5,348	856
Traffic Accident	No. of Accidents	0	0	3	0
	No. of Fatalities	0	0	4	0
Number of Rest Areas		0	0	0	0
Number of Refueling Points		4	3	2	3
Remarks		-	-	-	-

Source: Asian Highway Database 2010, United Nations ESCAP
Note: Traffic volume by Vehicle Types does not match with AADT

Appendix E. Asian highway Design Standard (1993)

Highway classification		Primary (4 or more lanes)				Class I (4 or more lanes)				Class II (2 lanes)				Class III (2 lanes)			
Terrain classification		L	R	M	S	L	R	M	S	L	R	M	S	L	R	M	S
Design seeped (km/h)		120	100	80	60	100	80	60		80	60	50	40	60	50	40	30
Width (m)	Right of way	50				40				40				30(40)			
	Lane	3.75				3.50				3.50				3.00(3.25)			
	Shoulder	3.00		2.50		3.00		2.50		2.50		2.00		1.5(2.0)		1.0(1.5)	
	Median strip	4.00		3.00		3.00		2.50		N/A		N/A		N/A		N/A	
Min. horizontal curve (m)		520	350	210	115	350	210	115		210	115	80	50	115	80	50	30
Pavement slope (%)		2				2				2				2 - 5			
Shoulder slope (%l		3 - 6				3 - 6				3- 6				3 - 6			
Type of pavement		Asphalt/cement concrete				Asphalt/cement concrete				Asphalt/cement concrete				Dbl. bituminous treatment			
Max. superelevation (%)		10				10				10				10			
Max. vertical grade (%)		4	5	6	7	4	5	6	7	4	5	6	7	4	5	6	7
Structure loading (minimum)		HS20-44				HS20-44				HS20-44				HS20-44			

Notes: Figures bracket are desirable values
Minimum horizontal curve shall be determined in conjunction with super-elevation

Appendix F. Data Survey Request

Section 1. General Information

1.1 National/Regional Outlook

- Area, Population
- Currency and exchange rate:
- GDP/GRP/GNI, GDP/GNI per capita:
- Economic growth rate, Inflation rate, Employment rate by sector
- Trade (Import, Export), Major trade commodities, Major trade partners (Import, Export)

1.2 Traffic related information

- Driving style: *Left-hand side drive*
- International border crossing points (*example*)

Name of Border	AH No.	Name of Neighbouring country	Operation hour
Muse	AH14	China	

- Maximum gross weight and axle load permissible
- Major Tourism spot

Section 2. Data Collection and Survey

2.1 Implementation Agency (Road authority)

- Organization
- Implementation process including planning, design, construction and maintenance

2.2 National & Sub-national strategy and priority, Guidelines

- Road Master Plan
- Regional & sub-regional Planning
- Development and upgrading plan of AHN
- Strategies and priorities
- Design specification

2.3 Asian Highway Database – Any update of **AHDB 2011(draft, Appendix 1)** including:

- Traffic data (volume, accident, etc.)
- Road and bridge inventory
- Toll rate

2.4 Other Engineering and Socio-economic data (**Appendix 2)** including

- Social Discount Rate
- Travel speed, Time value, Value of Time
- O/D, Number of registered Vehicles
- Land use plan
- Unit construction cost(road, box & culvert, bridge, T/N)
- Maintenance cost (Routine maintenance, periodic overlay)
- Geotechnical and hydraulic survey

Appendices

Appendix 1. AHDB 2011(draft version to UNESCAP)
Appendix 2. Engineering & Socio-economic Data (attached)

Appendix G. Comments from RHD (Aug 2013)

Government of the People's Republic of Bangladesh
Roads Division, Ministry of Communication
Roads and Highways Department

Comments
on
Prefeasibility Study of Upgrading Jessore-Banpara Highway (AH41) in Bangladesh, February 2013 Report

August 2013

Introduction

Comments 2

2.1 Socio-economic data 2

2.2 Cost estimation 2

2.3 Traffic 2

2.3.1 Updating traffic data 2

2.3.2 Cross-border traffic 2

2.4 Vehicle Operation Costs (VOCs) and Travel Time Costs (TTCs) 3

2.5 Pavement Improvement 3

2.5.1 Alternatives 3

2.5.2 Frequency of Periodic Maintenance 4

1. Introduction

The Roads Division, Ministry of Communication requested the Roads and Highways Department to provide comments on the Draft Prefeasibility Report on **Banpara-Dasuria-Pakshey-Kushtia-Jhenaidah section of Asian Highway 41 (AH41) (Annex-I)**. The comments were sought on the following issues:

i. *Review the study and provide feedback including how it may be further improved;*
ii. *As some parameter values for Bangladesh (for example, Vehicle Operating Cost) were not available, values from other studies have been used. If such parameter values are now available for Bangladesh, please provide those values;*
iii. *Any relevant additional/ new data or information that was not available earlier;*
iv. *Any point that may not have been correctly reflected. In such a case, please provide the text;*
v. *Any other point that you would like to include.*

Subsequently, the Chief Engineer of the Roads and Highways Department constituted a 4-member committee (Table 1) to review and provide comments on the draft prefeasibility report (Annex-II).

Table 1. Committee constituted by the Chief Engineer, RHD to review report

Sl	Name and designation	Position in the Committee
1.	Mr. Mahboob Ul Alam Additional Chief Engineer, RHD Technical Services Wing, Dhaka	Convener
2.	Mr. Kamrul Haque Superintending Engineer, RHD Road Design and Safety Circle, Dhaka	Member-Secretary
3.	Mr. AKM Fazlul Karim Executive Engineer, RHD Database Division, Dhaka	Member
4.	Mr. Shishir Kanti Routh Executive Engineer, RHD Subregional Road Transport Project Preparatory Facility, Dhaka	Member

Consequently, a meeting of the committee was held at the office of the Convener of the Committee on 14 August to review the draft prefeasibility report. The meeting was chaired by Mr. Mahboob Ul Alam, Additional Chief Engineer, RHD.

Mr. ABM Sertajur Rahman, Sub-Divisional Engineer, RHD and Mr. Sajjad Hossain, Transport Economist, RHD and Md. Saiful Haque, Director (Engineering), BRTA, Dhaka were also invited to the meeting for their comments. The meeting discussed all relevant issues pertaining to the draft report and made following comments for consideration of the consultants.

2. Comments

2.1 Socio-economic data

In section 3.2.1 and 3.2.2, the basic information should be drawn from latest World Bank data or Bangladesh Bureau of Statistics for updated key general information and socio-economic indicators.

2.2 Cost estimation

The estimation of cost of major work items (Draft Feasibility Report, Page 7) should be based on RHD Schedule of Rates 2011 with cost adjustment. The following Table 2 provides the suggested costs.

Table 2: Estimated costs as per RHD Schedule of Rates

Contents	Unit cost (US$)	
	Cost considered in the Study	Cost estimated by the committee
Construction of 1km of new road	866,000	913,593
AC overlay	176,000	139,925

Note:
1. The costs estimated by the committee are based on Schedule of Rates 2011 by adding 20% more in consideration of present market price.
2. The details of costs are shown in Annex III

The unit costs of the civil works need to be reflected in the subsequent cost calculations.

2.3 Traffic

2.3.1 Updating traffic data

RHD has recent traffic data **(Table-3)** that can be incorporated into the report.

Table 3: 2013 Traffic data along the AH41 stretch

City/Town Name at Start Point	City/Town Name at End Point	Traffic Volume by Vehicle Type								Total
		Passenger Car	Pick-up	Bus	Truck	Trailer	Motor-cycle	Others	Non-Motorized	
Banpara	Dasuria	244	738	770	2860	25	293	86	125	5141
Dasuria	Paksey	251	1414	755	2257	25	980	190	860	6732
Paksey	Kushtia	189	489	725	2746	34	535	113	482	5313
Kushtia	Jhenaidah	189	489	725	2746	34	535	113	482	5313

Source: HDM Circle, RHD (2013)

* Normally in Bangladesh for National Highway traffic growth rate is considered as 5% to 7.

2.3.2 Cross-border traffic

This road stretches which are part of SAARC Highway Corridor (SHC-4 and SHC-8) are also being considered for development under South Asia Subregional Economic Cooperation (SASEC). The SASEC Corridors are listed below.

Corridor 1: Kathmandu-Kakarvitta-Panirtanki-Phulbari- Banglabandha-Mongla/Chittagong, and

Corridor 2: Thimphu–Phuentsholing–Jaigaon–Chengrabandha-Burimari–Mongla/Chittagong.

The Joint Communiqué signed by the prime ministers of Bangladesh and India in New Delhi on 10 January 2010 put special emphasis on cross-border traffic. An important provision of the Joint Communiqué has opened up the opportunity of connectivity between Bangladesh, Bhutan, Nepal and India particularly the eastern part of India. It is therefore expected that this road will experience cross-border traffic once the relevant agreements with the neighboring countries are in place. SAARC Regional Multimodal Transport Study (SRMTS), 2006 sponsored by Asian Development Bank (ADB) provides a comprehensive study of transport corridors that can be put in place for enhancing connectivity among SAARC member states namely, Bangladesh, India, Pakistan, Nepal, Bhutan, Sri Lanka, the Maldives and Afghanistan. Considering the importance of this stretch in providing international connectivity, the feasibility study needs to take into consideration cross-border traffic. SRMTS provides preliminary information of cross-border traffic.

2.4 Vehicle Operation Costs (VOCs) and Travel Time Costs (TTCs)

In section 5.2.3, the report mentions about the absence of relevant data for Vehicle Cost Model. However, the Roads and Highways Department (RHD) published a Road User Cost Study in 2005 (Annex-IV) that provides values for VOCs for different categories of vehicles for different road surface condition. Similarly, Road User Cost Study, 2005 also provides values of Travel Time Costs (TTC). However, these values need to be adjusted by using appropriate factors. The growth of GDP or changes in CPIs could be used to adjust these values.

2.5 Pavement Improvement

2.5.1 Alternatives

The study evaluates following two alternatives for upgrading this section.

Alternative 1 (101km)
Construction of two-lane bypass at Kushita (15km) and AC overlay of other sections (86km).

Alternative 2 (105km)
AC overlay for the whole section (105km)

Since underlying layers of the pavement is not completely ascertained, another alternative **'reconstruction of entire 101 km' should be considered in the study by conducting Deflection test.**

2.5.2 Frequency of Periodic Maintenance

Regarding the frequency of overlay, it has been assumed in the study that the periodic maintenance shall be done in every 10 years. However, in practice periodic maintenance works are carried out roughly every 5 years in Bangladesh.

Annex-I: Letter of Roads Division, Ministry of Communication

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
যোগাযোগ মন্ত্রণালয়
সড়ক বিভাগ
ডিএফডিপি অধিশাখা

নম্বর ৩৫.০০.০০০০.০২৯.১৪.০০১.১২-৩৯৩

তারিখ : ২৫ আষাঢ় ১৪১৬ / ০৯ জুলাই ২০১৯

প্রধান প্রকৌশলী
সড়ক ও জনপথ অধিদপ্তর
সড়ক ভবন, রমনা
ঢাকা-১০০০।

বিষয় : **Asian Highway- Draft Prefeasibility study Report**

উপর্যুক্ত বিষয়ে UNESCAP হতে প্রাপ্ত এশিয়ান হাইওয়ের (AH-41) বনপাড়া-দাশুরিয়া-পাকশী-কুষ্টিয়া-ঝিনাইদহ-যশোর সেকশন এর Prefeasibility study'র খসড়া প্রতিবেদনের ছায়ালিপি এতদসঙ্গে প্রেরণপূর্বক নিম্নোক্ত বিষয়গুলোসহ খসড়া প্রতিবেদনের উপর আগামী ১০ (দশ) কার্যদিবসের মধ্যে মতামত প্রদানের জন্য নির্দেশক্রমে অনুরোধ করা হলো :

1. Review the study and provide us your feed back including how it may be further improved. Please bear in mind that the study was prepared primarily based on data that was made available to the study team and information obtained from other sources.
2. As some parameter values for your country (for example, vehicle operating cost) were not available, values from other studies have been used. If such parameter values are now available for your country, please provide us those values. We may consider revising calculations in the final report if so needed.
3. Any relevant additional/new data or information that was not available earlier.
4. Any point in the report that may not have been correctly reflected. In such a case, please provide us the text.
5. Any other point that you would like to include.

সংযুক্তি : বর্ণনামতে।

মোহাম্মদ নুরুল আমিন
উপসচিব
ফোন : ৯৫৭৫৫১৪

প্রধান প্রকৌশলী
সড়ক ও জনপথ অধিদপ্তর
সড়ক ভবন, রমনা, ঢাকা।

অনুলিপি :
সচিব মহোদয়ের একান্ত সচিব, সড়ক বিভাগ, যোগাযোগ মন্ত্রণালয়, ঢাকা

Annex-II: Committee constituted by the Chief Engineer, RHD

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
প্রধান প্রকৌশলীর কার্যালয়
সড়ক ও জনপথ অধিদপ্তর
তেজগাঁও, ঢাকা
E-mail : ce@rhd.gov.bd

স্মারক নং ৯৪.প্রা.প্র/

তারিখ ঃ ৭/৮/৯৮

"অফিস আদেশ"

বিষয় ঃ Asian Highway Draft Prefeasibility Study Report এর উপর সওজ অধিদপ্তরের মতামত প্রদানের লক্ষ্যে কমিটি গঠন প্রসংগে।

উপর্যুক্ত বিষয়ে UNESCAP হইতে প্রাপ্ত এশিয়ান হাইওয়ে (AH-41) এর বনপাড়া-দাশুরিয়া-পাকশী-কুষ্টিয়া-ঝিনাইদহ-যশোর সেকশনের Prefeasibility Study'র খসড়া প্রতিবেদনের উপর সওজ অধিদপ্তরের মতামত প্রদানের জন্য সড়ক বিভাগ, যোগাযোগ মন্ত্রণালয় হইতে অনুরোধ করা হইয়াছে (কপি সংযুক্ত)।

উক্ত খসড়া প্রতিবেদনটি পর্যালোচনাপূর্বক এর উপর মতামত প্রদানের জন্য নিম্নরূপ কমিটি গঠন করা হইল ঃ

ক্রমিক নং	নাম ও পদবী	কমিটিতে অবস্থান
১।	জনাব মাহবুব উল আলম অতিরিক্ত প্রধান প্রকৌশলী, সওজ টেকনিক্যাল সার্ভিসেস উইং, ঢাকা।	আহবায়ক
২।	জনাব কামরুল হক তত্ত্বাবধায়ক প্রকৌশলী, সওজ রোড ডিজাইন এন্ড সেফটি সার্কেল, ঢাকা।	সদস্য-সচিব
৩।	জনাব একে এম ফজলুল করিম নির্বাহী প্রকৌশলী, সওজ ডাটাবেজ বিভাগ, ঢাকা।	সদস্য
৪।	জনাব শিশির কান্তি রাউৎ প্রকল্প ব্যবস্থাপক (নিঃ প্রঃ), সওজ সাবরিজিওনাল রোড ট্রান্সপোর্ট প্রজেক্ট প্রিপারেটরী ফ্যাসিলিটি, ঢাকা।	সদস্য

উক্ত কমিটি আগামী ০৭ (সাত) দিনের মধ্যে বর্ণিত প্রতিবেদনের উপর মতামত প্রদান করিবেন।

সংযুক্তি ঃ Draft Prefeasibility Study Report.

৭/৮/৯৮

(মোঃ আমিনুর রহমান লস্কর)
পরিচিতি নং-০০৫১৮৩
প্রধান প্রকৌশলী (চঃ দাঃ)
সড়ক ও জনপথ অধিদপ্তর
তেজগাঁও, ঢাকা।
তারিখ ঃ

স্মারক নং
অনুলিপি অবগতি ও প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য প্রেরণ করা হইল ঃ
১। অতিরিক্ত প্রধান প্রকৌশলী, সওজ, পরিকল্পনা ও রক্ষণাবেক্ষণ, তেজগাঁও, ঢাকা।
২। জনাব মাহবুব উল আলম, অতিরিক্ত প্রধান প্রকৌশলী, সওজ, টেকনিক্যাল সার্ভিসেস উইং, ঢাকা। সংযুক্ত Draft Prefeasibility Study Report সহ।
৩। জনাব কামরুল হক, তত্ত্বাবধায়ক প্রকৌশলী, সওজ, রোড ডিজাইন এন্ড সেফটি সার্কেল, ঢাকা।
৪। জনাব একে এম ফজলুল করিম, নির্বাহী প্রকৌশলী, সওজ, ডাটাবেজ বিভাগ, ঢাকা।
৫। জনাব শিশির কান্তি রাউৎ, প্রকল্প ব্যবস্থাপক (নিঃ প্রঃ), সওজ, সাবরিজিওনাল রোড ট্রান্সপোর্ট প্রজেক্ট প্রিপারেটরী ফ্যাসিলিটি, ঢাকা।

৭/৮/৯৮

(মোঃ আমিনুর রহমান লস্কর)
প্রধান প্রকৌশলী (চঃ দাঃ)
সড়ক ও জনপথ অধিদপ্তর
তেজগাঁও, ঢাকা।

Annex-III: Estimation of costs for construction of 1Km New Road

Item Code	Item Description	Measurement	Unit	Quantity	Unit Price	Amount
Carriage Way						
02/02/02	Roadway Excavation in Suitable Material	1 X 1000 X 7.3 X 1.070	cum.	7811	134.00	1,046,674.00
02/07/01	Preparation of Subgrade 300mm depth	1 X 1000 X 7.3	sqm.	7300	57.00	416,100.00
02/08/01	Improved Sub-grade	1 X 1000 X 7.3 X 0.30	cum.	2190	804.00	1,760,760.00
03/02/01	Sub-Base	1 X 1000 X 7.3 X 0.25	cum.	1825	3,953.00	7,214,225.00
03/03/02	Aggregate Base Type-II	1 X 1000 X 7.3 X 0.20	cum.	1460	4,275.00	6,241,500.00
03/03/01	Aggregate Base Type-I	1 X 1000 X 7.3 X 0.20	cum.	1460	5,475.00	7,993,500.00
03/06/01a	Bituminous Primecoat (Plant Placed)	1 X 1000 X 7.3	sqm.	7300	90.00	657,000.00
03/10/01	Dense Bituminous Surfacing - Base Course (Plant Method)	1 X 1000 X 7.3 X 0.07	cum.	511	13,591.00	6,945,001.00
03/10/02	Dense Bituminous Surfacing - Wearing Course (Plant Method)	1 X 1000 X 7.3 X 0.05	cum.	365	14,267.00	5,207,455.00
06/12/01	Geotextile Filter Fabric (Drainage Layer)	2 X 68 X 2.44 X 1.10	sqm.	365.024	173.00	63,149.15
02/12/01	Sub-Grade Drains	2 X 68 X 2.44	Lin. Meter	331.84	243.00	80,637.12
	Total					***37,626,001.27***
Hard Shoulder						
02/02/02	Roadway Excavation in Suitable Material	2 X 1000 X 1.5 X 1.020	cum.	3060	134.00	410,040.00
02/07/01	Preparation of Subgrade 300mm depth	2 X 1000 X 1.5	sqm.	3000	57.00	171,000.00
02/08/01	a) Improved Sub-grade	2 X 1000 X 1.5 X 0.30	cum.	900	804.00	723,600.00
03/02/01	b) Sub-Base	2 X 1000 X 1.5 X 0.25	cum.	750	3,953.00	2,964,750.00
03/03/02	c) Aggregate Base Type-II	2 X 1000 X 1.5 X 0.20	cum.	600	4,275.00	2,565,000.00
03/03/01	d) Aggregate Base Type-I	2 X 1000 X 1.5 X 0.20	cum.	600	5,475.00	3,285,000.00
03/06/01a	e) Bituminous Primecoat (Plant Placed)	2 X 1000 X 1.5	sqm.	3000	90.00	270,000.00
03/10/01	f) Dense Bituminous Surfacing - Base Course (Plant Method)	2 X 1000 X 1.5 X 0.07	cum.	210	13,591.00	2,854,110.00
	Total					***12,662,460.00***
	Total (Pavement + Hard Shoulder) =					***50,288,461.27***
Overlay (Considering 60mm overlay is to be provided after 10 years)						
03/07/01a	Bituminous Tack Coat (Plant Work)	1 X 1000 X 10.3	sqm.	10300	27.00	278,100.00
03/10/02©	Dense Bituminous Surfacing - Wearing Course (Plant Method)	1 X 1000 X 10.3 X 0.06	cum.	618	14,267.00	8,817,006.00
	Total =					***9,095,106.00***

Grand total		59,383,567.27
	Adding 20% more considering present market price =	***71260281Tk.***
Construction Cost of 1 Km New Pavement		**913593 USD**

Overlay on 1Km Existing of Pavement		9,095,106.00
	Adding 20% more considering present market price =	***10,914,127.20***
		139925 USD

Note: 1 USD = 78 TK.

Annex-IV: Travel Time Costs and Vehicle Operating Costs

Table A1: Speed of different vehicles at different IRI (Km/hr)

IRI	Med truck	Small Truck	Large Bus	Minibus	Microbus	Utility	Car	Auto Rick	Motor Cycle
2	63	69	74	71	70	86	84	51	70
3	62	69	74	71	70	86	84	51	70
4	62	69	74	71	70	85	84	50	70
5	60	68	74	70	70	84	83	49	69
6	59	67	73	69	69	82	81	48	69
7	57	65	70	68	68	77	77	47	67
8	55	63	65	65	66	71	72	45	65
9	52	59	59	62	62	65	66	44	62
10	50	56	54	58	58	60	60	42	58
11	47	52	49	53	54	55	55	40	54
12	45	49	45	50	50	50	51	39	50
13	42	45	42	46	47	46	47	37	47
14	40	43	39	43	44	43	44	36	44
15	38	40	36	40	41	40	41	34	41

Source: RHD Road User Cost Report 2004-05

Table A2: Travel Times Costs for different modes

Vehicle Category	Financial	Economic
	TTC per passenger (Taka/hr)	TTC per passenger (Taka/hr)
All Buses	22.0	17.6
Microbus	31.2	24.9
Car/Utility	38.6	30.9
Tempo	13.6	10.9
Auto Rickshaw	20.6	16.4
Motor Cycle	28.6	22.9

Source: Road User Cost Annual Report 2004-2005

Table A3: Speed of different vehicles at different IRI (Km/hr)

IRI	Med truck	Small Truck	Large Bus	Minibus	Microbus	Utility	Car	Auto Rick	Motor Cycle
2	63	69	74	71	70	86	84	51	70
3	62	69	74	71	70	86	84	51	70
4	62	69	74	71	70	85	84	50	70
5	60	68	74	70	70	84	83	49	69
6	59	67	73	69	69	82	81	48	69
7	57	65	70	68	68	77	77	47	67
8	55	63	65	65	66	71	72	45	65
9	52	59	59	62	62	65	66	44	62
10	50	56	54	58	58	60	60	42	58
11	47	52	49	53	54	55	55	40	54
12	45	49	45	50	50	50	51	39	50
13	42	45	42	46	47	46	47	37	47
14	40	43	39	43	44	43	44	36	44
15	38	40	36	40	41	40	41	34	41

Source: RHD Road User Cost Report 2004-05

Table A4: Economic Vehicle Operating Cost Taka per KM

IRI	Medium truck	Small Truck	Large Bus	Minibus	Microbus	Utility	Car	Auto Rickshaw	Motor Cycle
2	12.25	9.08	13.04	11	10.9	8.85	9.02	2.25	1.28
3	12.4	9.18	13.16	11.11	10.96	8.93	9.06	2.26	1.28
4	12.9	9.56	13.72	11.4	11.36	9.26	9.32	2.32	1.3
5	13.43	9.95	14.32	11.7	11.79	9.62	9.59	2.38	1.32
6	13.98	10.34	14.92	12	12.27	10.05	9.88	2.44	1.34
7	14.55	10.71	15.54	12.29	12.78	10.56	10.16	2.51	1.35
8	15.13	11.07	16.23	12.58	13.35	11.18	10.44	2.58	1.36
9	15.74	11.44	17.06	12.89	14	11.92	10.76	2.66	1.36
10	16.38	11.85	18.05	13.25	14.76	12.76	11.11	2.74	1.37
11	17.06	12.3	19.15	13.68	15.6	13.68	11.49	2.83	1.38
12	17.77	12.79	20.34	14.18	16.51	14.65	11.89	2.93	1.41
13	18.5	13.33	21.58	14.74	17.48	15.66	12.32	3.03	1.45
14	19.27	13.9	22.87	15.34	18.49	16.7	12.75	3.13	1.49
15	20.05	14.5	24.18	15.98	19.52	17.76	13.2	3.25	1.54

Source: Road User Cost Annual Report 2004-2005

Table A5: Occupancy

Mode	Average Occupancy (National Average)
Large Bus	47
Minibus	35
Mircobus	7
Jeep/Pickup	7
Car/Taxi	4
Auto-rickshaw	4
Tempo	8
Motocycle	2
Bicycle	1
Passenger rickshaw	2

19/08/2013

(Shishir Kanti Routh)
Executive Engineer, RHD
Sub-regional Road Transport Project
Preparatory Facility, Dhaka
. and Member of the Committee.

(A. K. M. Fazlul Karim)
Executive Engineer, RHD
HDM Database Division, Dhaka
and Member of the Committee
and
Project Manager-1,
SASEC Road Connectivity Project.

19/8/2013.

(Md. Kamrul Haque)
Superintending Engineer, RHD
Road Design & Safety Circle,
Elenbari, Tejgaon, Dhaka
and Member Secretary of the Committee.

19.8.13

(Mahboob Ul Alam)
Additional Chief Engineer, RHD
Technical Services Wing,
Elenbari, Tejgaon, Dhaka
and Convener of the Committee.