CHAPTER 12: TRANSPORT DEMAND FORECAST

12.1 Outline of the Study Approach

12.1.1 Presumptions

(1) Coverage Area for Transport Demand Forecast

The coverage area of the transport demand forecast covers the city of Dhaka and the Dhaka Metropolitan Area (DMA), which comprises the city of Dhaka and its extended suburbs. As for traffic demand projection the coverage area should be the RAJUK area, which includes the further outer suburbs surrounding DMA. This is because the traffic demand pattern in DMA will be changed due to urban development in RAJUK area which mentioned in Chapter 11.

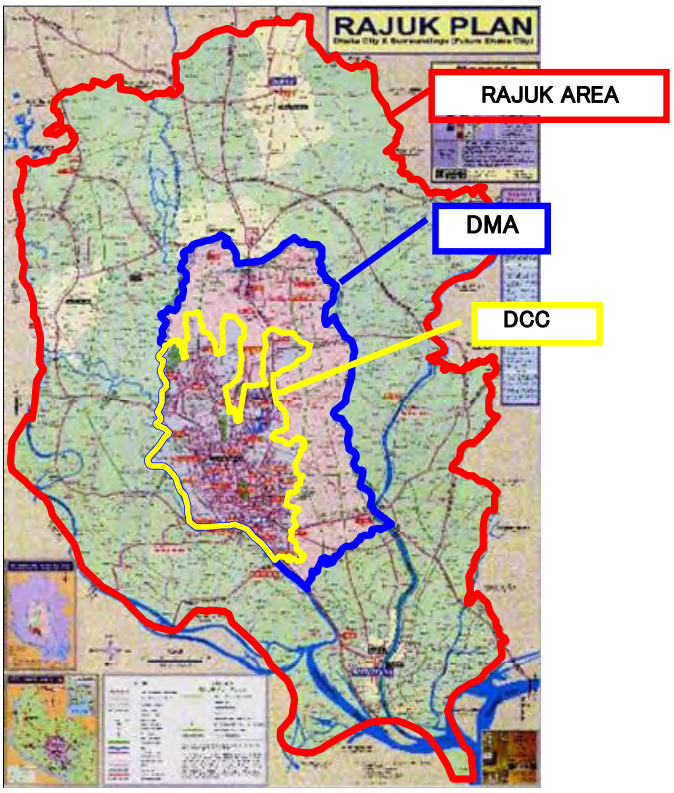


Figure 12.1-1 Coverage Area of Traffic Demand Projection

(2) Zoning

For the zoning of coverage area, the city of Dhaka was divided into 90 zones using each Ward as a zone unit, the DMA area outside the city of Dhaka into 7 zones and the outer suburbs surrounding DMA into 11 zones as the “outer zones.”

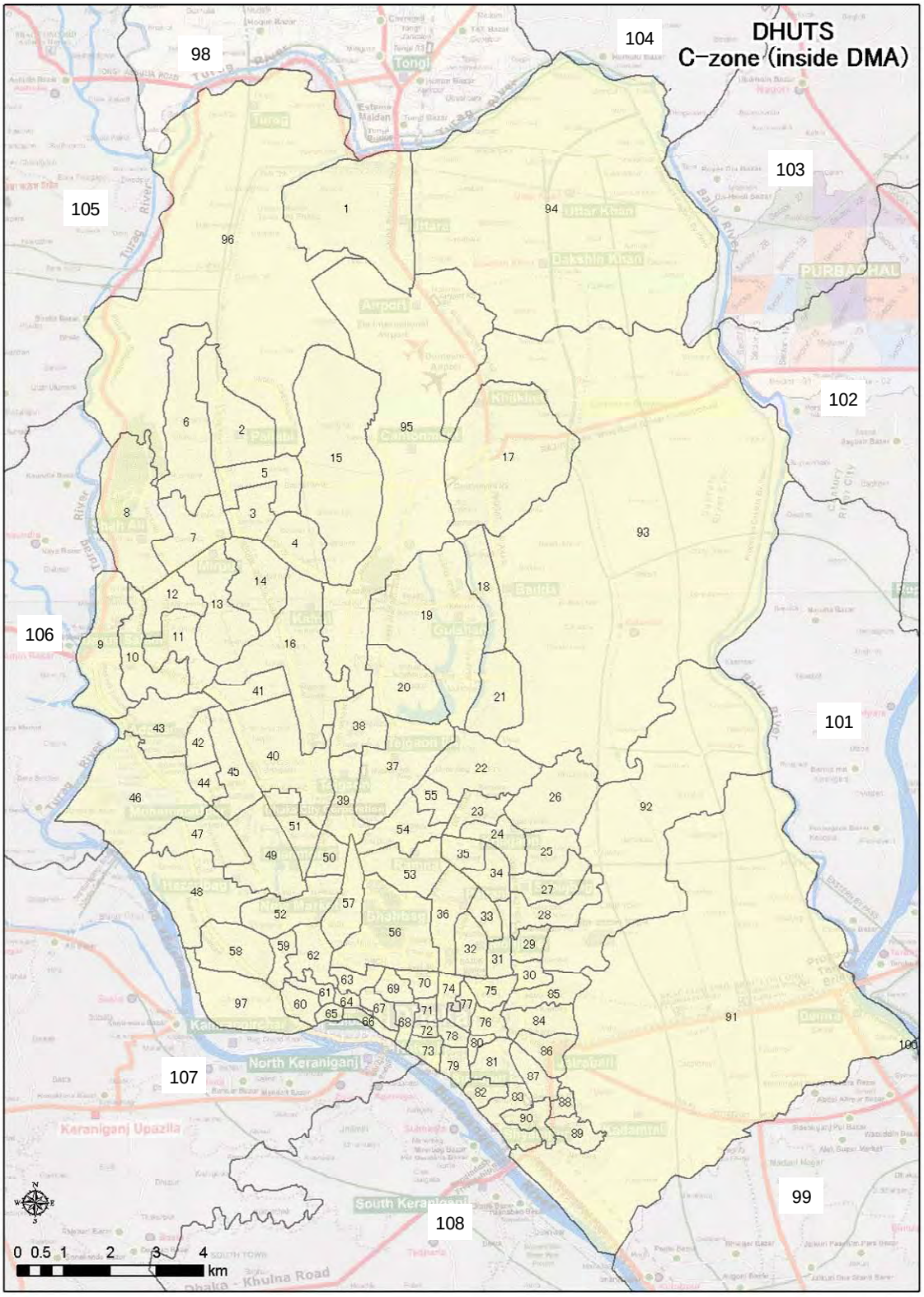


Figure 12.1-2 Zoning of Coverage Area

Source; JICA Study Team

(3) Project Year

The Project Year of the traffic demand forecast is set up as follows:

	2009	2015	2020	2025
Trip Production	○	○	○	○
Trip Generation and Attraction	○	○	○	○
OD Distribution	○	―	―	○
Modal Split	○	―	―	○
Traffic Assignment to Transport Network	○	―	―	○

Modal split by each mode and traffic assignment to transport network will be charged by the transport network scenario. However, under 'Do Nothing' scenario, it is not charged transport network.

(4) Trip Purpose and Vehicle Type

a) Trip Purpose

Trip production is a step in the modeling process that utilizes the socio-economic data to calculate the trip making characteristics (person trips) of each zone that will eventually be modeled on the road network. In this process, person trips are classified into five (5) main trip purposes as follows:

i. To Work
ii. To School
iii. NHBB (Non-Home Based Business)
iv. Private
v. To Home

b) Mode Classification

There are extremely many modes of transport running on the roads inside the city of Dhaka. In the household interview survey (HIS), 20 categories of vehicle type was prepared, and about every vehicle type surveyed its actual usage as transport means for better understanding of interviewees. In the demand projection, it was categorized those 20 transport modes into 8 aggregated categories of modes. This is because transport modes Raving Similar characteristics are aggregated and traffic demand forecast is comparatively easy and accurate.

Table 12.1-1 Mode Category

Aggregated Mode Category for Traffic Demand Forecast		Mode Category in the HIS
Non-Motorized Transport		
1	Walk	Walk
		Bicycle
2	Rickshaw	School Van
		Rickshaw
Motorized Transport		
3	Passenger Car	Car
		taxi
4.1	Private Bus	Microbus/Jeep
		Staff Bus
		School/College Bus
4.2	Public Bus	Auto-Tempo
		Minibus/Bus(private)
		AC Bus
		BRTC Bus
		Non-BRTC Bus
5	Auto Rickshaw	Motor Cycle
		CNG
		Auto (private)(＝Auto Rickshaw)
6	Railway	Rail
7	Waterway	Water
8	Truck	Truck

With the transport modes listed above as 9 aggregated modes except Walk, Railway, Waterway, the analysis was conducted for car-path assignment by applying the passenger car unit (PCU) shown in the table below that has been employed in the STP study.

Table 12.1-2 PCU of Each Mode

Aggregated Mode Category for Traffic Demand Forecast		PCU
1	Walk	—
2	Rickshaw	0.4
3	Passenger Car	1.0
4.1	Private Bus	1.8
4.2	Public Bus	2.0
5	Auto Rickshaw	0.7
6	Railway	—
7	Waterway	—
8	Truck	2.0

12.1.2 Transport Model Methodology

For the forecast of transport demand, it is employed the conventional four step methodology shown as follows. In the all steps, the JICA's STRADA as a tool is employed. As for the

traffic assignment to road network, the method of user equilibrium assignment is used.

The JICA System for Traffic Demand Analysis (JICA STRADA) is employed as a tool. This STRADA is a package of traffic demand analysis system which assists twenty three programs. The conception of the JICA STRADA package is shown in Appendix 2.

Taking into consideration of the timing for development of transport system, traffic demand forecast for 2025 is conducted.

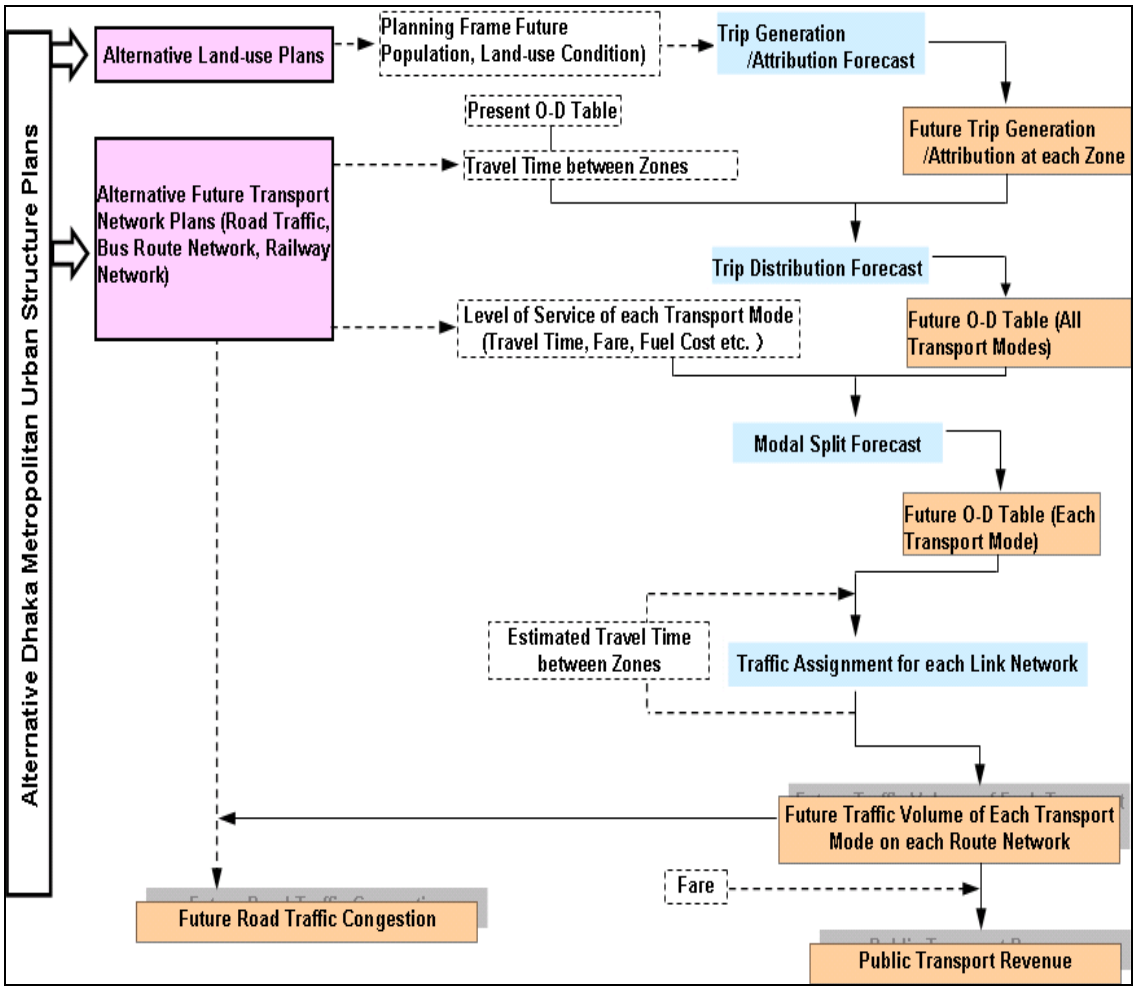


Figure 12.1-3 Transport Model Structure

12.1.3 Future Framework

As a future frame, the study team adopt the indices such as the future populations in each zone (population, employed populations counted on a home address basis and a workplace address basis, school enrollment populations counted on a home address basis and a school address basis) and the future percentage shares of each income groups in the whole coverage area.

(1) Future Population

a) Residential Population

The population in DMA has a remarkable increasing trend, the main reason being an

increase in the population inflow from the outside of DMA. With this situation, the estimation of future population density may require some caution. The population densities in the areas like the Old city of Dhaka are already of high level. Therefore, if it simply employed the same increasing ratio in the past for the estimation of their future states, the result values would reach an unrealistically high level. Taking into account those matters, future population forecasts are discussed in Chapter 11.

b) Employed Population and School Enrollment (*on the Bases of Home Address and Workplace or School Address*)

In addition to population, the analysis projected the future employed populations and school enrollment populations each on a home address basis and a workplace or school address basis. The projection methods are as follow.

[Zonal employed population on a home basis／Zonal school enrollment on a home basis]＝[Zonal population] × [Zonal rate of employment／school enrollment on a home basis]

Population projected in above (1)

Estimated as "（Rate of employment （school enrollment） on a home basis）=（Zonal employment （school enrollment） population on a home basis）／（Zonal population covered in the study）," using samples acquired in the HIS

[Zonal employed population on a workplace basis／Zonal school enrollment on a school basis]＝[Total employment （school enrollment） population in DMA on a home basis] × [Distributed rate indicating the zone’s share among all zones in DMA of employment （school enrollment） population on a workplace （school） basis]

Total number of employment （school enrollment） population in DMA projected above on a home basis

Estimated each zone’s share among all zones in DMA as the zonal distributed rate for employment (school enrollment) population on a workplace (school) basis, using samples acquired in the HIS

Zonal future populations above are set as the explanatory variable for the trip generation and attraction.

(2) Income Strata Classification

a) Classification of Income Stratum

The hypothesis which was made for the study that the trip characteristics in DMA would differ greatly depending on the income level. Following that assumption, the study decided to generate each of the traffic demand projections on the income level basis. The study devised three income strata so that they reveal clear differences in their travel behaviors. The Figure 12.1-4 shows the classification of income stratum.

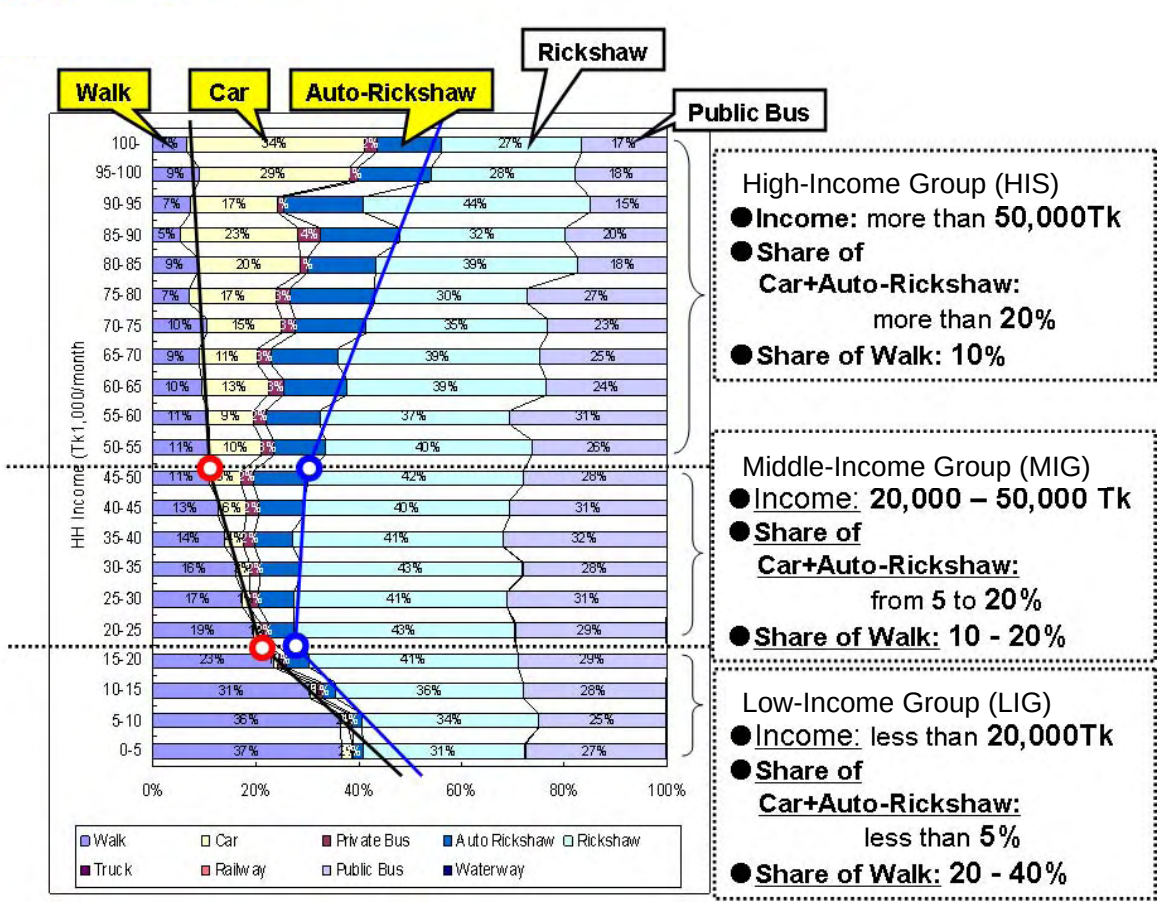


Figure 12.1-4 Projections of the Future Percentage Shares of Each Income Strata in Total

Source; JICA Study Team

b) Projection of Future Percentage Shares of Each Income Stratum's Population

On total population in DMA, the projections were produced the future percentage shares of low-, middle-, and high-income strata populations in a following manner.

i. Recent Trend in the Growing Rates of Population and GDP

Since 2002, particularly in the latest years, the growing rate of GDP reaches 6.0%～6.6% on a U.S. dollar basis. As for the growing rate of population, it is 1.59% from 1991 to 2001 and 1.41% from 2001 to 2008. Given these figures, the recent growing rate of GDP per capita in Bangladesh is 4.0～5.0%, and possible to observe a rising trend in the income level on a nationwide basis. This assumed that recently the weight volume in the percentage shares of income strata must have been shifting to the middle- and high-income strata.

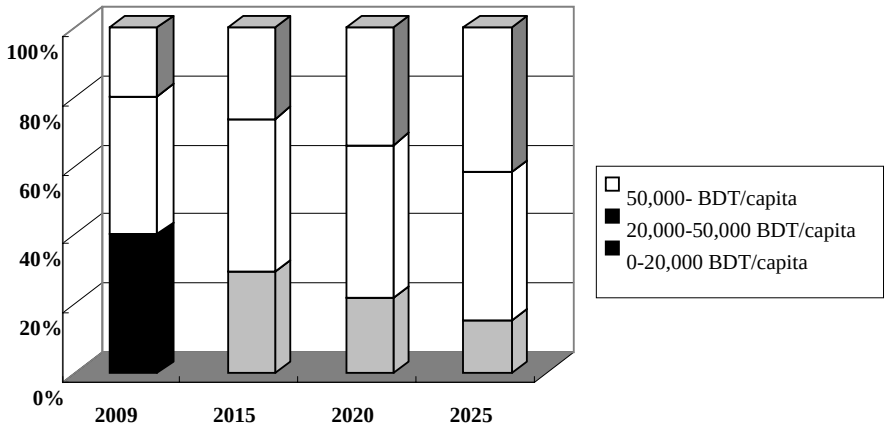
ii. Projections Based on Three Different Future Scenarios

For the study, it referred to the IMF's "IMF Report for the 2008n Article 4 Consultation" that publishes GDP projections until 2014. Produced the study GDP projections with reference to IMF report, and based on them produced the projections of the future percentage shares of each income strata. It can consider that the IMF

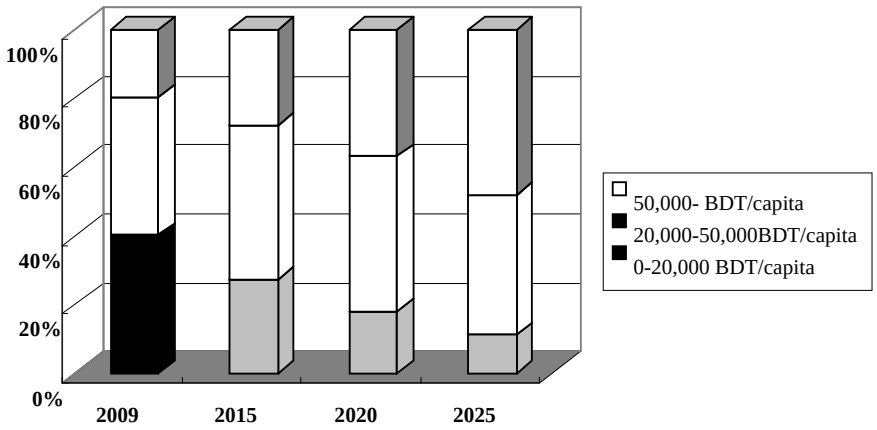
projection of GDP, which estimates the annual growing rate of 7% after 2013, is somewhat overestimating. Therefore the study examined following three scenarios for the projection.

- Scenario 1：Low Growth Scenario (GDP growing rate of 5%)
- Scenario 2：Medium Growth Scenario (GDP growing rate of 6%)
- Scenario 3：IMF Projection（GDP growing rate of 7%）

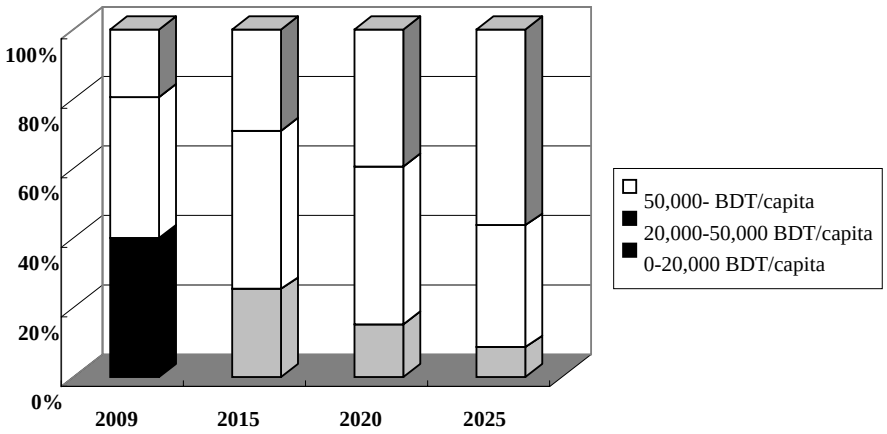
Following above, the projections of the future percentage shares of each income stratum on the bases of three different scenarios were produced. Among them, Scenario 2, Medium Growth Scenario was adopted for the study.



Scenario-1: Low Growth Scenario (GDP growing rate of 5%)



Scenario-2: Medium Growth Scenario (GDP growing rate of 6%)



Scenario-3: High Growth Scenario (GDP growing rate of 7%)

Figure 12.1-5 Projections of the Future Percentage Shares of Each Income Strata in Total Population in DMA (Following Three Scenarios)

Source; JICA Study Team

12.2 Forecasting Trip Production

12.2.1 Modeling Trip Production

The trip production in this study means the volume of trip production in the entire RAJUK area, which includes DMA. For the projection, the study first analyzed the trip generation unit per resident population in RAJUK in 2009 and then multiplied it by future population.

Referring to the total population in RAJUK in 2009, the trip generation units based on the differentials of age stratum, gender, income stratum, and purpose were calculated.

It is noted that the study does not include factor like a change in the car ownership rate here. This is because the income strata is considered in this study.

According to the trip production unit shown in Figure 12.2-1, it is pointed out that private trip production unit of high income group (HIG) persons over 50 years old is higher than that of the other ages. This is because those persons have higher mobility based on higher income and higher free time.

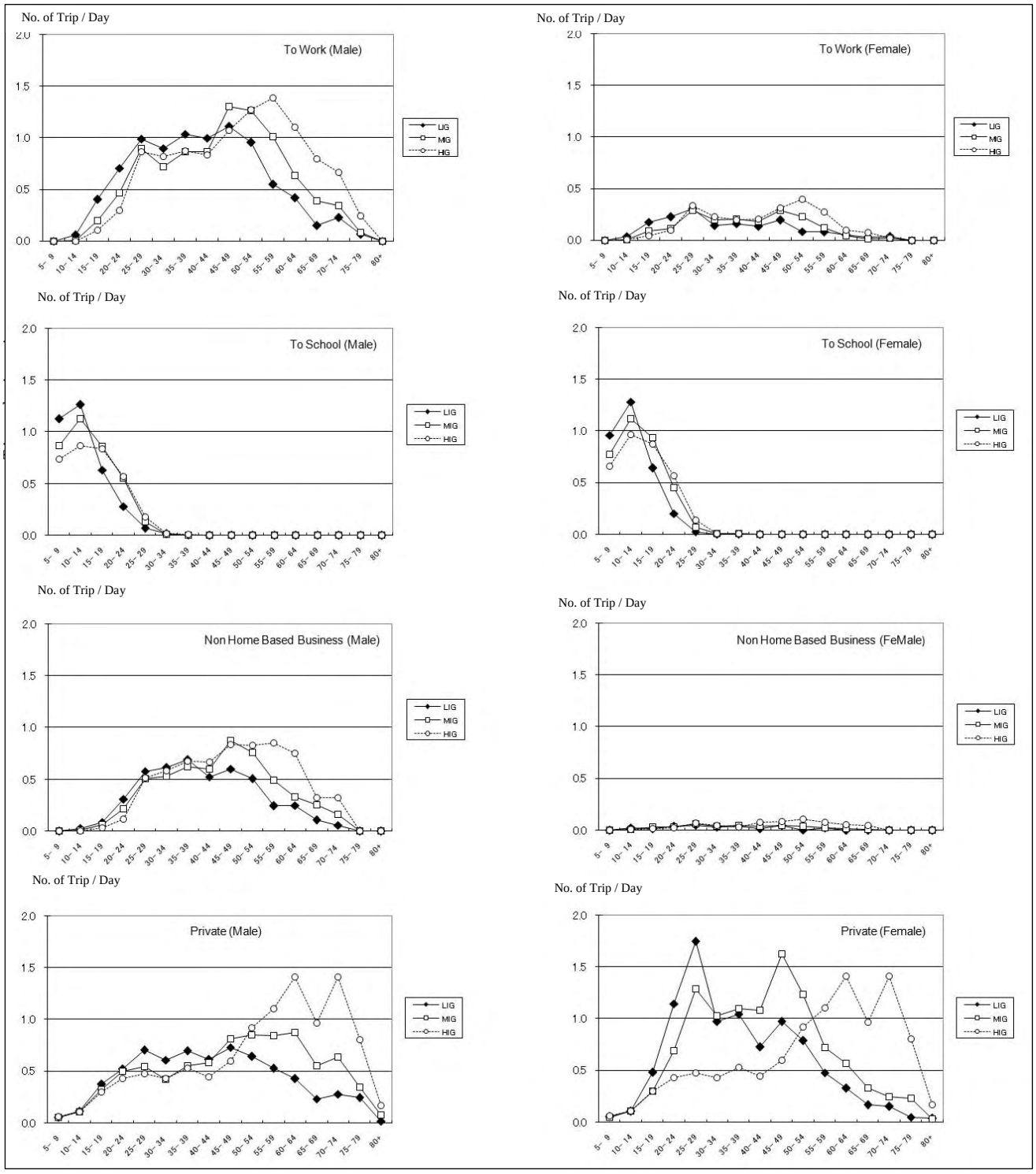


Figure 12.2-1 Trip Production Unit

12.2.2 Forecasting Trip Production

(1) Trip Production by Income Group

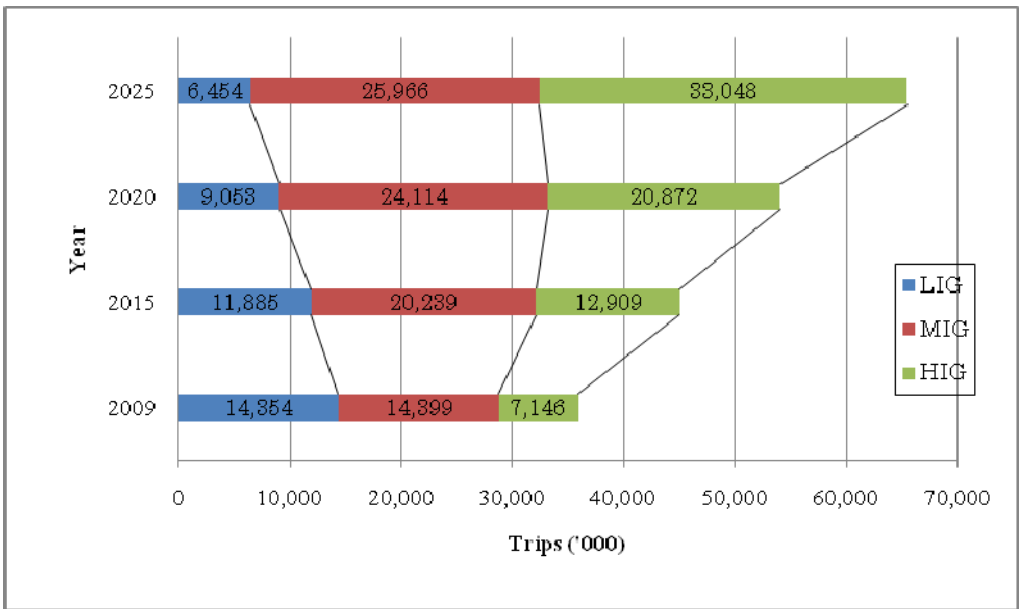
Trip production was forecasted in RAJUK area. Trip production was estimated through adoption of unit value of trip production rate by each income group, trip purpose, gender and ages.

The following table and figure shows the results of forecasts i.e. as much as 65.5 million trips per day is to be produced in 2025, which is almost 2 times of the trips in 2009. According to trip production forecasted by each income group, high income group's value was estimated as significantly increasing number while low income group's value was estimated to be decreased. Such future trends reflect the population forecasted by each income group in RAJUK.

Table 12.2-1 Forecasted Trip Production by Trip Purpose in RAJUK Area ('000 trips)

Year	Income Group	To Work	To School	To Home	NHBB	Private	Total
2009	LIG	2,372	1,446	6,011	1,199	3,327	14,354
	MIG	2,248	1,577	6,024	1,268	3,282	14,399
	HIG	1,140	725	2,952	689	1,641	7,146
	Total	**5,760**	**3,748**	**14,987**	**3,156**	**8,249**	**35,900**
2015	LIG	1,975	1,167	4,980	995	2,769	11,885
	MIG	3,211	2,024	8,442	1,811	4,751	20,239
	HIG	2,083	1,165	5,317	1,266	3,078	12,909
	Total	**7,269**	**4,355**	**18,739**	**4,071**	**10,598**	**45,033**
2020	LIG	1,491	923	3,811	742	2,086	9,053
	MIG	3,807	2,374	10,082	2,134	5,717	24,114
	HIG	3,347	1,794	8,615	2,023	5,093	20,872
	Total	**8,644**	**5,091**	**22,507**	**4,899**	**12,897**	**54,038**
2025	LIG	1,052	661	2,728	514	1,500	6,454
	MIG	4,085	2,522	10,890	2,252	6,217	25,966
	HIG	5,253	2,731	13,689	3,132	8,244	33,048
	Total	**10,390**	**5,913**	**27,306**	**5,898**	**15,961**	**65,469**

Source; JICA Study Team

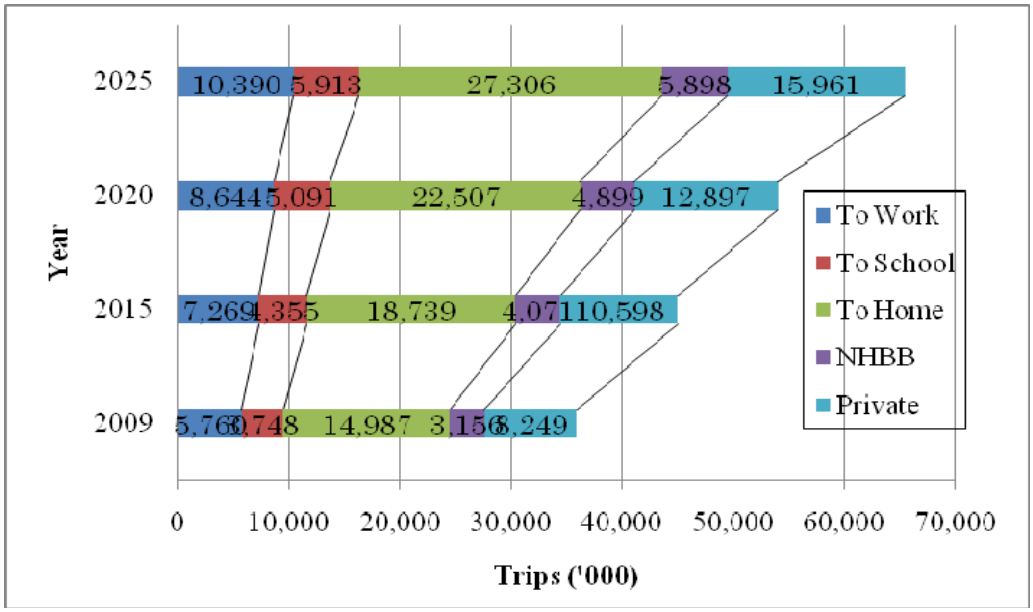


Source: JICA Study Team

Figure 12.2-2 Trip Production by Income Group in RAJUK Area (2009 - 2025)

(2) Trip Production by Trip Purpose

The values in the following table shows trip production by each trip purpose. In 2009, the share of "To Work", "To School", "NHBB" and "Private" are 16.0%, 10.4%, 8.8% and 23.0% respectively. In 2025, the share of trip purpose are 16.0%, 9.0%, 9.0% and 24.4% respectively. Overall share of trip purpose has little differences between 2009 and 2025 though, the volume of trip production by each trip purpose is estimated to be significant.



Source; JICA Study Team

Figure 12.2-3 Trip Production by Trip Purpose in RAJUK Area (2009 - 2025)

12.3 Trip Generation and Attraction

12.3.1 Prediction Model of Trip Generation and Attraction

The study produced the projection of trip generation and attraction on the basis of each purpose by constructing a simple linear regression equation whose explanatory variables are each corresponding population (no constant term). Also the prediction models for each low-, medium-, high-income strata were constructed.

a) Trip Generation and its Explanatory Variable

Purpose of Traffic Volime	Population as Explanatory Variable
To Work	Worker at Home Base
To School	Student at Home Base
Non-Home Based Business	Worker at Office Base
Private	Population, Worker at Office Base
To Home	Worker at Office Base, Student at Enrollment Base

b) Trip Attraction and its Explanatory Variable

Purpose of Traffic Volime	Population as Explanatory Variable
To Work	Worker at Office Base
To School	Student at Enrollment Base
Non-Home Based Business	Worker at Office Base
Private	Worker at Office Base
To Home	Population

The following three tables present the estimated values of the parameters of prediction models, which are constructed in response to three different income strata.

Table 12.3-1 Estimated Model Parameters for Low-Income Stratum

Model Type	Trip Purpose	Parameter (t-score)					R-square
		Population 5&Above	Worker at Home Base	Worker at Office Base	Student at Home Base	Student at Enrolment Base	
Trip Generation	Home to Work	-	0.964370	-	-	-	0.995
			(132.82)				
	Home to School	-	-	-	0.978091	-	0.998
					(210.60)		
	To Home	-	-	1.497398	-	1.412623	0.949
				(14.09)		(7.40)	
	NHBB	-	-	0.455214	-	-	0.837
				(22.36)			
	Private	0.408706	-	0.401705	-	-	0.937
		(15.82)		(7.68)			
Trip Attraction	Home to Work	-	-	0.937579	-	-	0.974
				(60.33)			
	Home to School	-	-	-	-	0.949102	0.989
						(94.99)	
	To Home	1.090259	-	-	-	-	0.980
		(68.66)					
	NHBB	-	-	0.459821	-	-	0.851
				(23.54)			
	Private	-	-	1.205846	-	-	0.824
				(21.33)			

Source; JICA Study Team

Table 12.3-2 Estimated Model Parameters for Medium-Income Stratum

Model Type	Trip Purpose	Parameter (t-score)					R-square
		Population 5&Above	Worker at Home Base	Worker at Office Base	Student at Home Base	Student at Enrolment Base	
Trip Generation	Home to Work	-	0.961851	-	-	-	0.995
			(143.25)				
	Home to School	-	-	-	0.951818	-	0.995
					(139.39)		
	To Home	-	-	1.339577	-	1.685580	0.935
				(13.12)		(12.59)	
	NHBB	-	-	0.551149	-	-	0.903
				(29.97)			
	Private	0.427679	-	0.382494	-	-	0.958
		(25.64)		(11.42)			
Trip Attraction	Home to Work	-	-	0.997288	-	-	0.982
				(72.70)			
	Home to School	-	-	-	-	0.892861	0.989
						(93.25)	
	To Home	1.080133	-	-	-	-	0.990
		(99.50)					
	NHBB	-	-	0.562886	-	-	0.910
				(31.35)			
	Private	-	-	0.628786	-	0.980719	0.779
				(5.81)		(6.92)	

Source; JICA Study Team

Table 12.3-3 Estimated Model Parameters for High-Income Stratum

Model Type	Trip Purpose	Parameter (t-score)					R-square
		Population 5&Above	Worker at Home Base	Worker at Office Base	Student at Home Base	Student at Enrolment Base	
Trip Generation	Home to Work	-	0.931489	-	-	-	0.991
			(106.30)				
	Home to School	-	-	-	0.947311	-	0.986
					(81.52)		
	To Home	-	-	1.150670	-	1.985357	0.946
				(12.75)		(17.84)	
	NHBB	-	-	0.603348	-	-	0.955
				(45.31)			
	Private	0.454563	-	0.381793	-	-	0.935
		(22.01)		(10.64)			
Trip Attraction	Home to Work	-	-	1.058169	-	-	0.974
				(60.52)			
	Home to School	-	-	-	-	0.878171	0.988
						(89.34)	
	To Home	1.096771	-	-	-	-	0.992
		(111.35)					
	NHBB	-	-	0.611910	-	-	0.938
				(38.39)			
	Private	-	-	0.445393	-	1.230054	0.805
				(4.56)		(10.22)	

Source; JICA Study Team

Note; Sample size of Table 12.3-1to 12.3-3 is shown in Appendix Table 2.1-9.

12.3.2 Results of Trip Generation and Attraction

(1) Outline of the Results

Trip production in RAJUK was set as a control total of the amount of trips all over RAJUK. Based on the trip production and future population distribution by each traffic analysis zone, trip generation/attraction was forecasted. According to the results of forecasts in all trip purpose, all income group, trip generation/attraction will significantly increase in eastern fringe area located in the border area of DCC and DMA

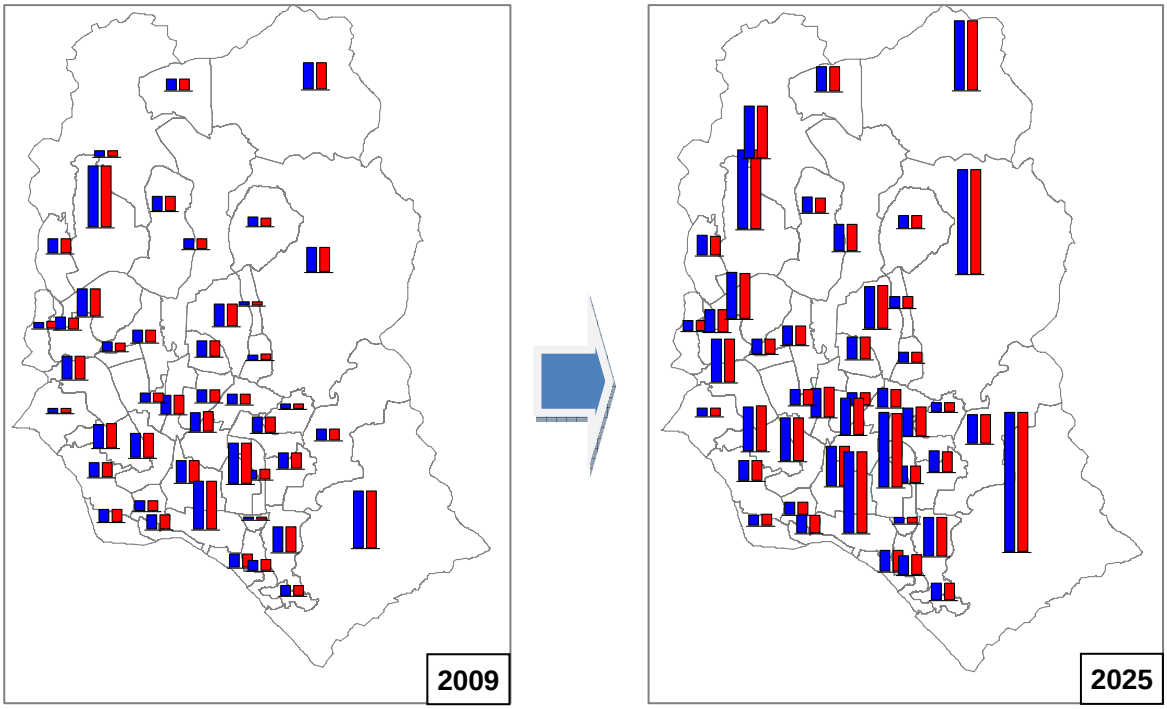


Figure 12.3-1 Trip Generation/Attraction in DMA
(all purpose/all modes/all income group: 2009 - 2025)

(2) Trip Generation/Attraction by each Income Group

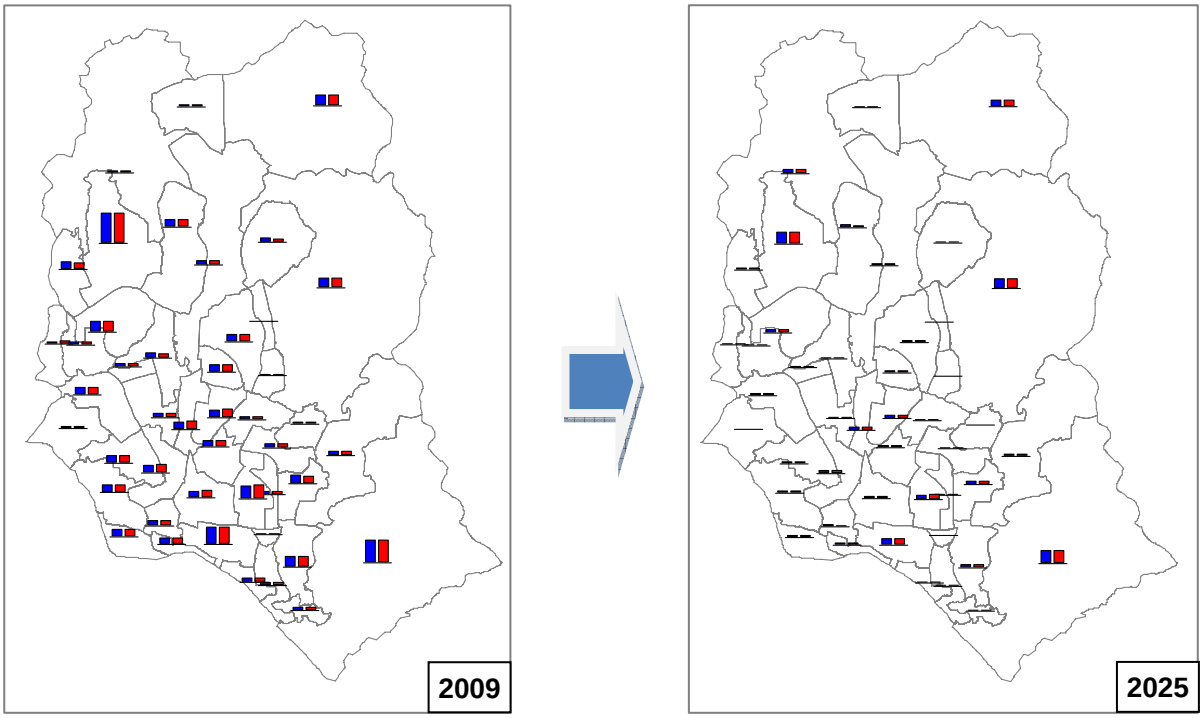


Figure 12.3-2 Trip Generation/Attraction in DMA
(Low income group, all purpose/all modes: 2009 - 2025)

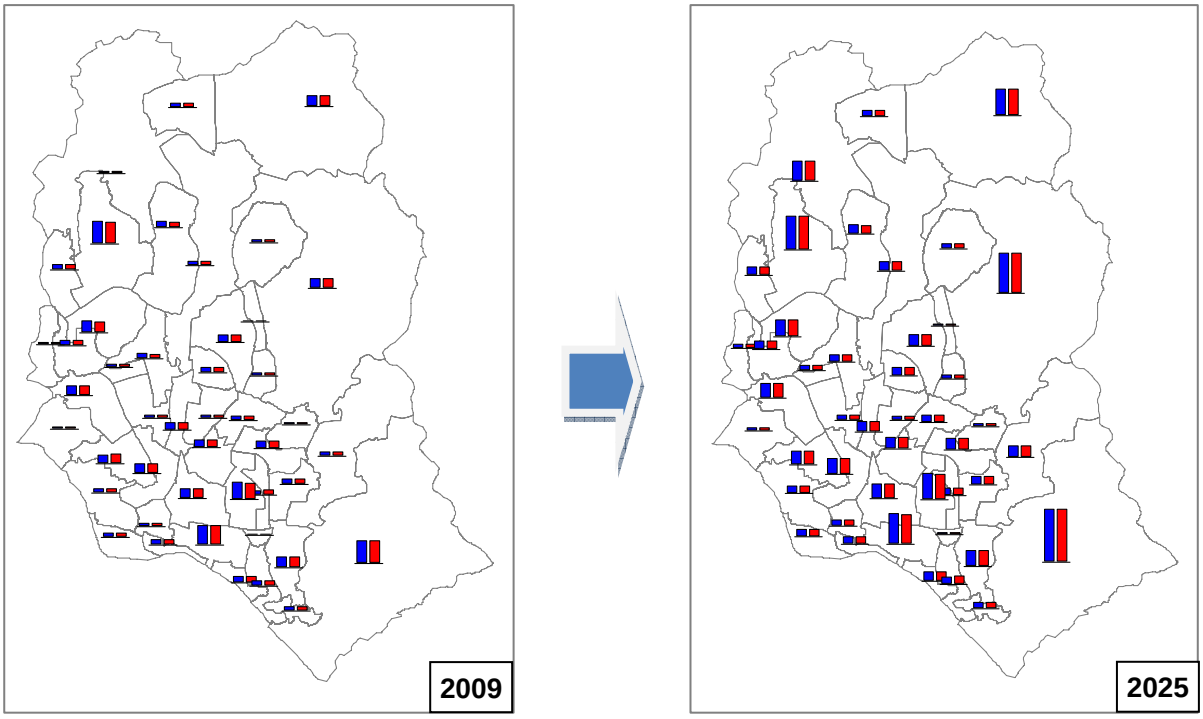


Figure 12.3-3 Trip Generation/Attraction in DMA
(Medium income group, all purpose/all modes: 2009 - 2025)

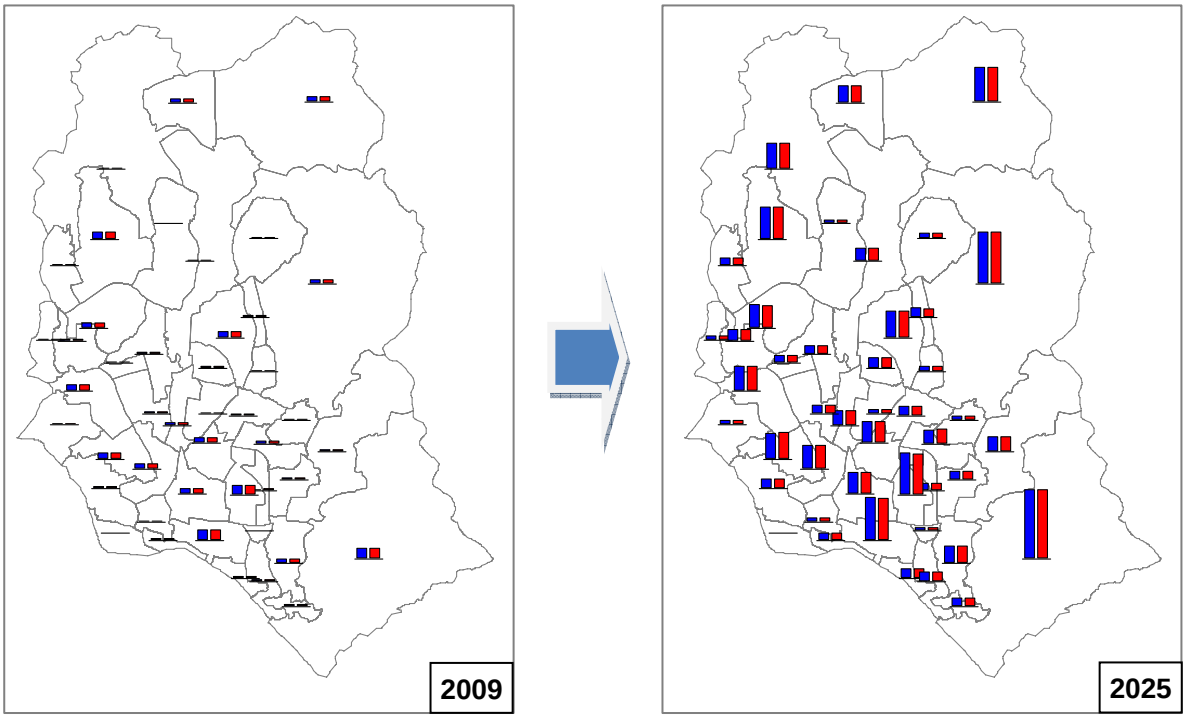


Figure 12.3-4 Trip Generation/Attraction in DMA
(High income group, all purpose/all modes: 2009 - 2025)

12.4 Forecast of Trip Distribution

12.4.1 Trip Distribution Estimate Procedure

As the methodology of trip distribution projection, first attempted to apply the gravity model whose explanatory variables are the distance between zones and the origin and destination (OD) pair population. However, in doing so it appeared that the sensitivity of traffic volume between origin and destination to the distance between zones was extremely low and therefore it was hard to secure the statistical significant of the model. Therefore, a future OD table by Frator method on the basis of current pattern was formulated. As for some areas in outer zones which do not have current OD tables, their trip distributions separately by applying the latest OD pattern in the zone inside the city of Dhaka was set up.

Trip distribution was forecasted in the form of Origin Destination table by each transport mode and trip purpose.

12.4.2 Trip Length

Average trip length forecasts were examined comparing to actual trip length (within RAJUK) by such segmentations as income levels and trip purposes shown in the following figures. Based on the examination, the model parameters were properly calibrated shown as follows.

Trip length forecasts were examined comparing to actual trip length (within RAJUK) by such segmentations as income levels and trip purposes shown in the following figures. Based on the examination, the model parameters were properly calibrated shown as follows.

Table 12.4-1 Average Trip Length by Trip Purpose (2009 & 2025)

	Work	School	Home	NHBB	Private	Total
2009	7.7	7.6	7.7	7.7	7.4	7.6
2025	8.3	7.9	8.0	8.2	7.7	8.0
2025/2009	1.08	1.04	1.04	1.06	1.04	1.05

Source: JICA Study Team

Table 12.4-2 Average Trip Length by Income Group (2009 & 2025)

	LIG	MIG	HIG	Average
2009	7.3	7.8	8.4	7.7
2025	7.5	8.1	8.6	8.3
2025/2009	1.03	1.04	1.02	1.08

Source: JICA Study Team

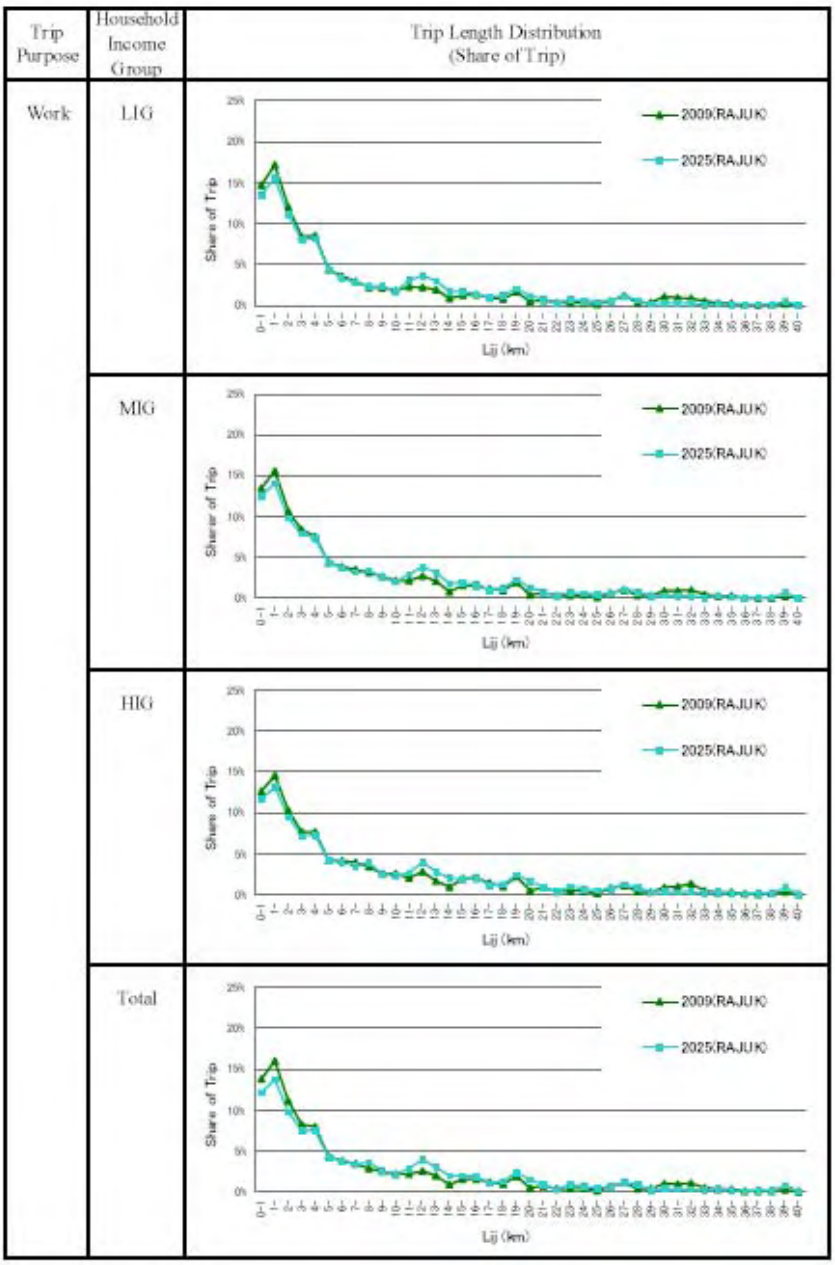


Figure 12.4-1 Trip Length Distribution by each Income Group in 2009 and 2025 in RAJUK Area (Work Trip)

Source: JICA Study Team

12.4.3 Desired Lines

(1) Desired Lines by each Income Group

The following figures show desired line by trip purpose. According to these desired lines, the thick line (red and blue color) can be observed in the area along the corridor connected between south-east and north-west areas in DCC, especially for high and medium income groups. Along this corridor, mass transit system should be introduced to solve future traffic congestion.

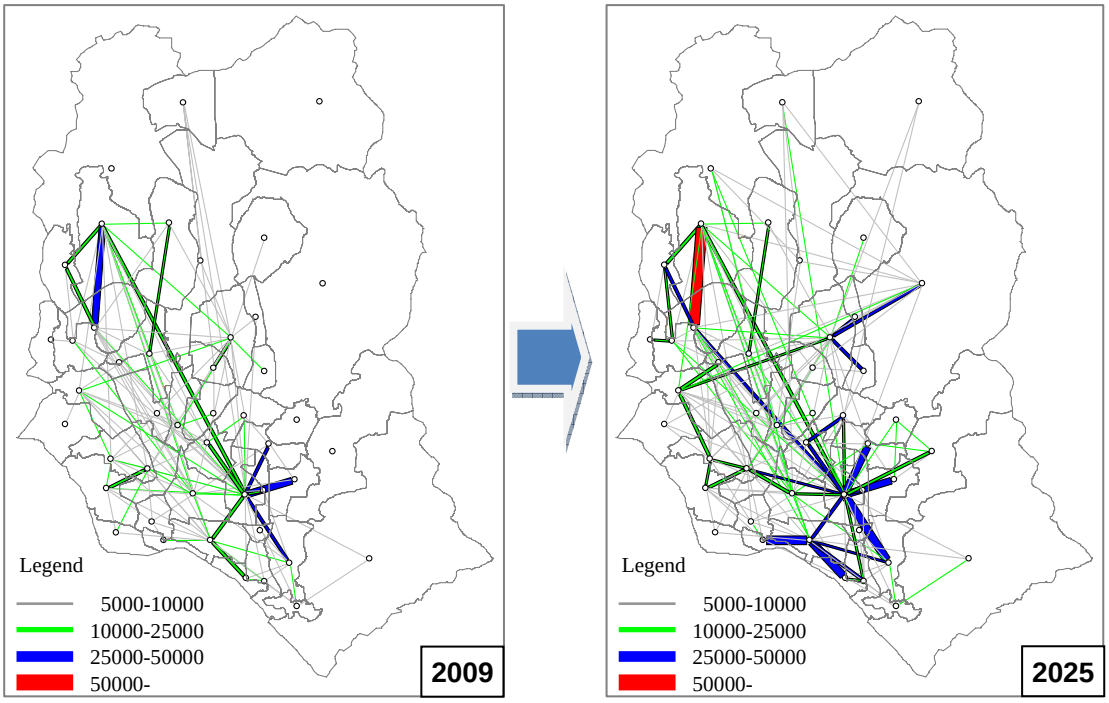


Figure 12.4-2 Desired Lines (To Work: 2009 - 2025)

Footnote: trips which is less than 5,000 are not displayed

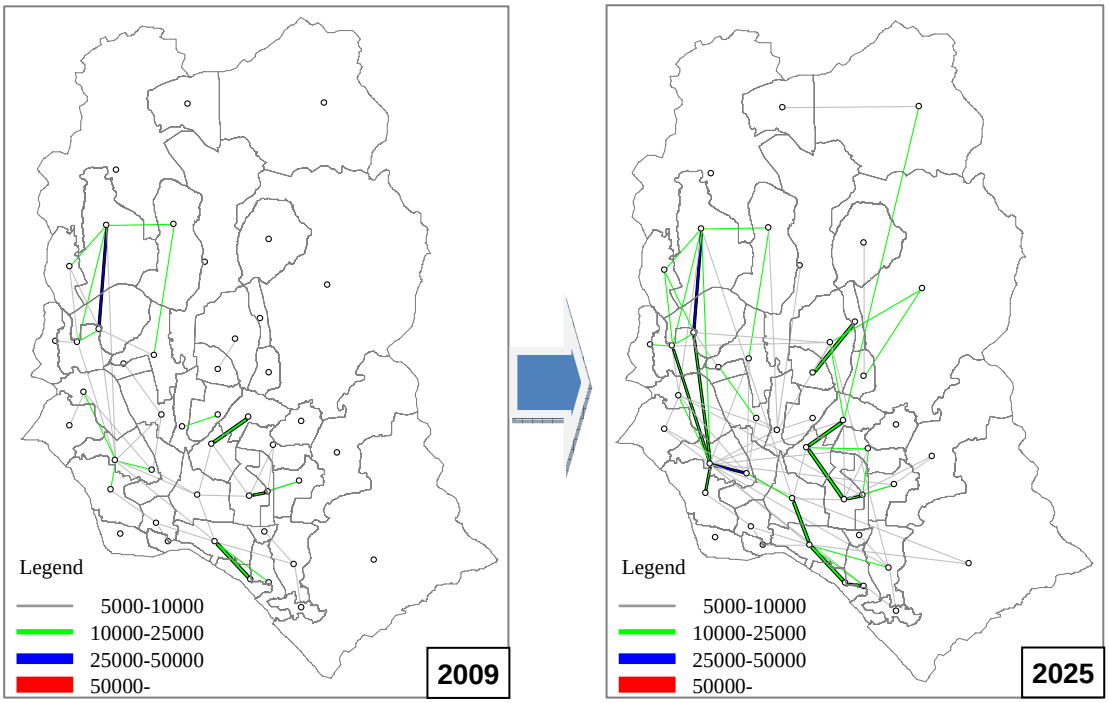


Figure 12.4-3 Desired Lines (To School: 2009 - 2025)

Footnote: trips which is less than 5,000 are not displayed

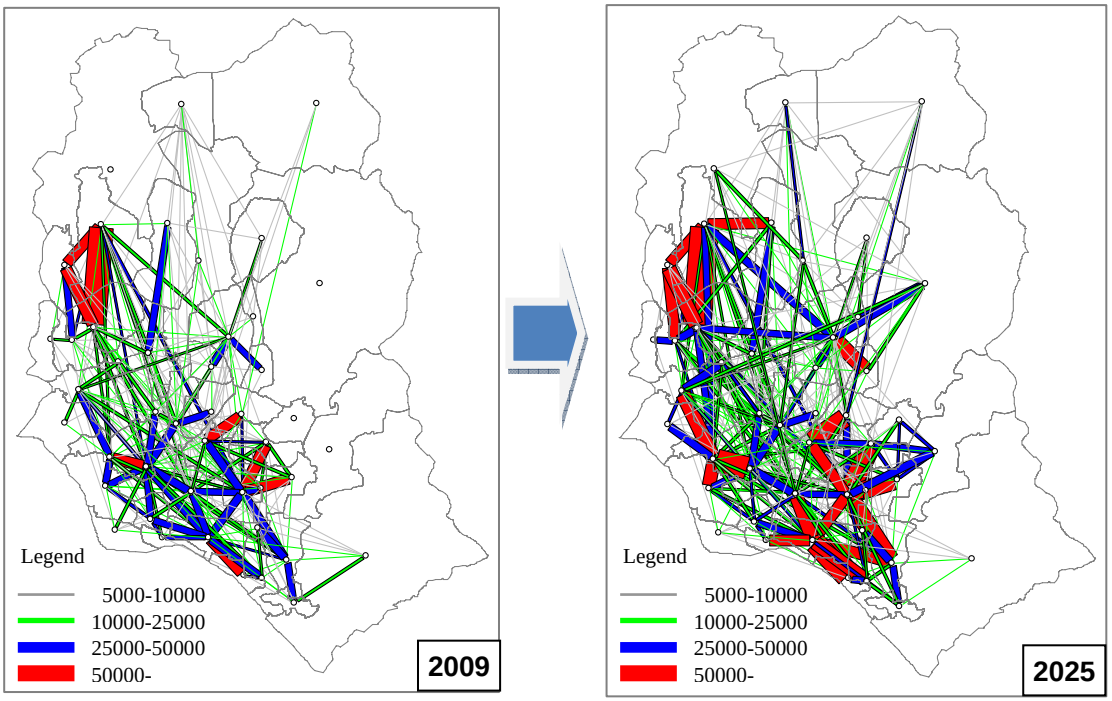


Figure 12.4-4 Desired Lines (To Home: 2009 - 2025)

Footnote: trips which is less than 5,000 are not displayed

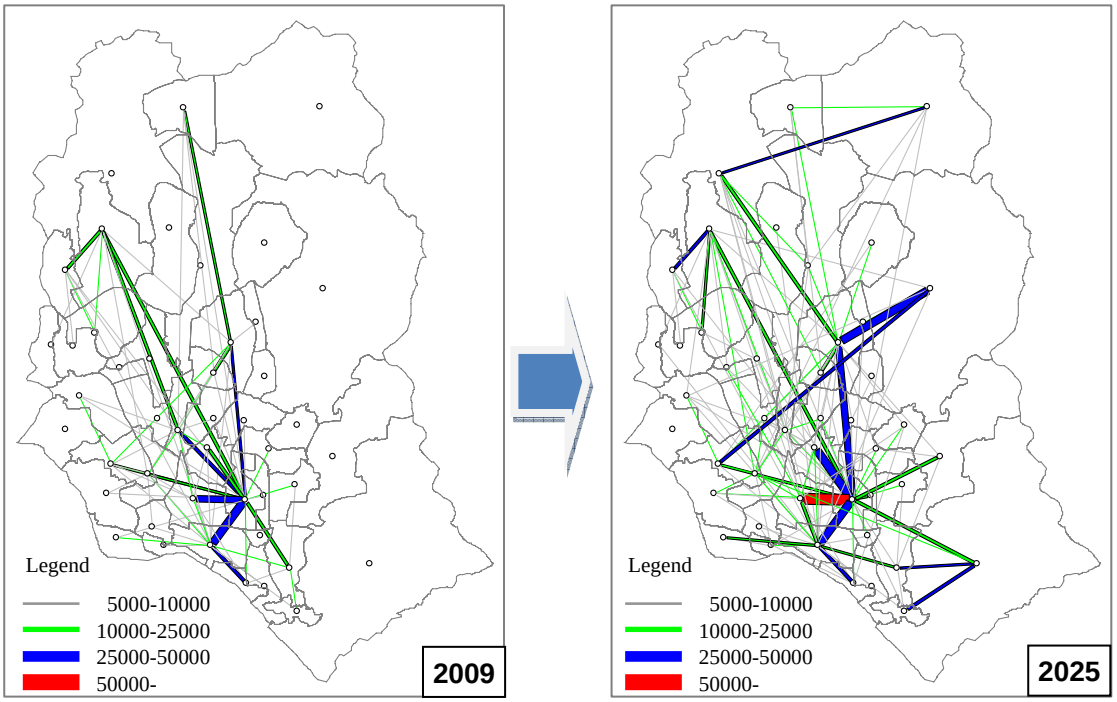


Figure 12.4-5 Desired Lines (NHBB: 2009 - 2025)

Footnote: trips which is less than 5,000 are not displayed

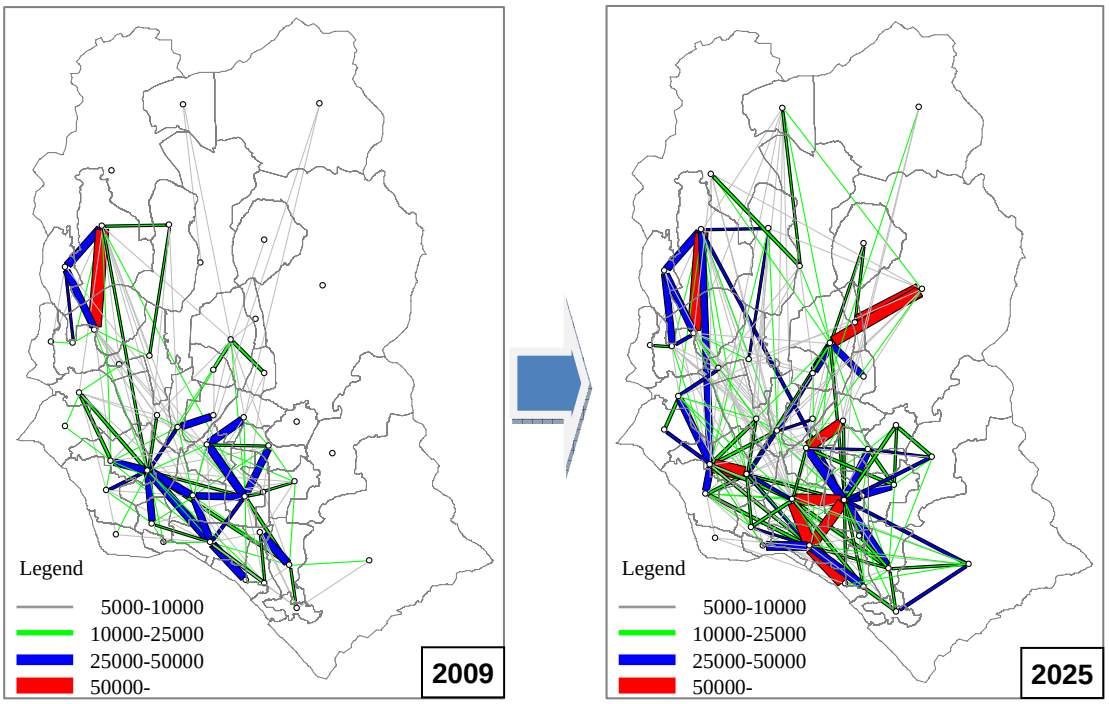


Figure 12.4-6 Desired Lines (Private: 2009 - 2025)

Footnote: trips which is less than 5,000 are not displayed

12.5 Modal Split and Traffic Assignment

12.5.1 Presumptions

(1) Information for Zones, Links and nodes

Basic presumptions such as number of zones, number of links and number of nodes, which were adopted in the transport demand forecast, are shown in the following table.

Table 12.5-1 Zones, Links and Nodes for Transport Demand Forecast

Items	Number
Number of Zones	112
Number of Links *)	
Do Nothing Scenario	1,596
Number of Nodes *)	
Do Nothing Scenario	1,144

Notes: 1) Number of links and nodes correspond to some different type of transport network scenario.
2) No. of zones is based on C zone that is the smallest zones in the study. However, the presentation in the report is used for amalgamated zones. (19 zones)

(2) Outline of Networks adopted

Transport network being developed here are shown as follows. Each transport network corresponds to some different type of alternative transport scenarios, which will be discussed in more detail in Chapter 20.

(3) Future Transport Network (in Year 2025)

a) "Do Nothing Scenario"

The network consists of existing road network, planned highways and urban express ways.

Number of Links	1,596
Number of Nodes	1,144

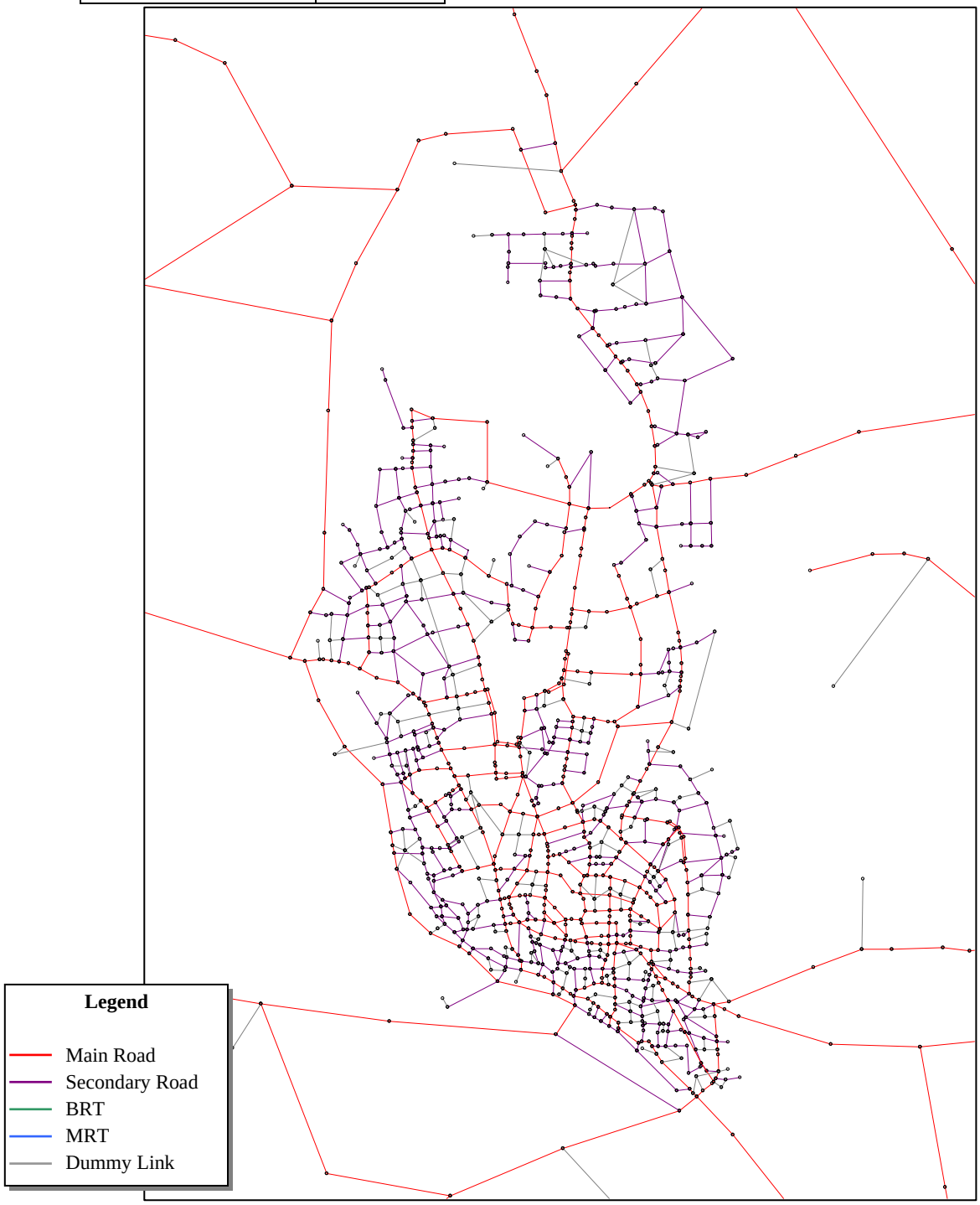


Figure 12.5-1 Transport Network Plan under Do Nothing

12.5.2 Forecast of Modal Choice

12.5.2.1 Modeling Modal Choice

(1) Model Structure

The study estimated the ratios of modal choice for each income stratum using the multivariate logic models for each income stratum. The transport means included in agenda items are as follows.

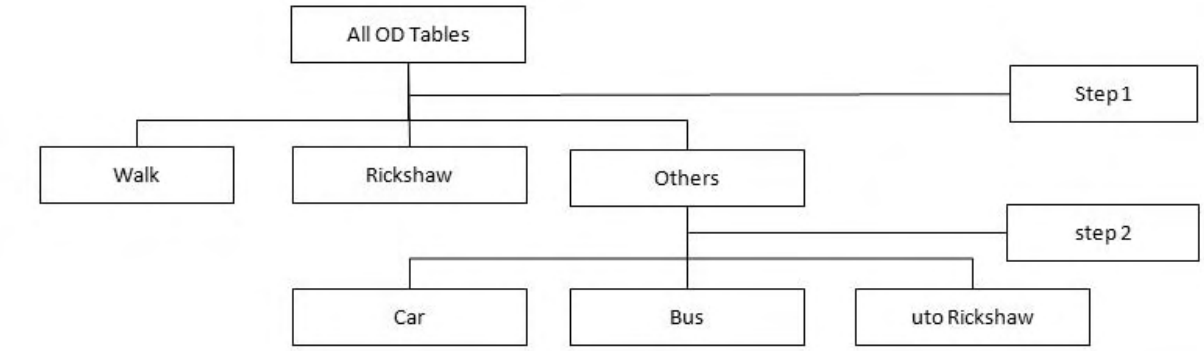


Figure 12.5-2 Basic Structure of Modal Split Model

Private car／Bus／Auto Rickshaw／Rickshaw／Walk

The following two-step method in projecting the modal choice was adopted.

a) Step 1

The parameter estimation with the two explanatory variables that are the target OD distance (the shortest distance by shortest path search) and the constant term were conducted for Walk, Rickshaw, and Others.

$$P_i = exp\ (\alpha_i \cdot L + \beta_i) \ / \ \Sigma[exp\ (\alpha_j \cdot L + \beta_j)\ ]$$

Where:

P_i : Rate of the choice of transport means I (Walk, Rickshaw, Others)

α_i、 β_i : Parameter concerning transport means i

L : Shortest distance of target OD

b) Step 2

Among the transport means of others estimated in Step 1, for the models which indicate the rate of the choice of Private Car, Bus, Auto Rickshaw, the parameter estimation with the two explanatory variables that are the generalized costs of each transport means and the constant term was conducted. The generalized cost is calculated as the following formula:

$$GC = T_t + F/tV + A_t$$

Where:

GC : Generalized Cost

T_t : Travel Time (Using network assignment result)

F/tV : Public Transport Fare/Time Value and/or Vehicle Operating Cost/Time Value
Time value computed is shown in Table 18.2-1

A_t : Access Travel Time

The model formula is same with "a) Step 1". For the parameters of the rates of MRT and BRT choices, which will be the future public transport, the study applied the parameter of Bus which has the most similar fare structure to them.

Table 12.5-2 Parameters of BPR Function

		α	β
Type 1	Roads in DCC	5.0	4.0
Type 2	Roads in Outside Area and Express way	1.0	4.0

Source; JICA Study Team

Notes: BPR (Bureau of Public Roads in US)

Table 12.5-3 Parameters of Modal Shift Model (Step 1)

		WALK	Rickshaw	Other
LIG	Parameter Lij	-0.29	0.15	0.39
	t-value	-201.76 **	48.57 **	16.58 **
MIG	Parameter Lij	-0.47	0.23	0.46
	t-value	-289.60 **	32.92 **	11.76 **
HIG	Parameter Lij	-0.64	0.30	0.56
	t-value	-304.53 **	20.75 **	6.47 **

Source; JICA Study Team

*Notes: 1) ** significant level of 1 %, * Significant level of 5%*

2) Sample size of the analysis is shown in Appendix Table2.1-10

Table 12.5-4 Parameters of Modal Shift Model (Step 2)

			Car	Bus	Significant level
LIG	Parameter	Ge-Cost	-0.12	-0.19	-0.18
	t-value		-0.10	-0.20	-0.29
	Parameter	Const.	-1.01	2.27	
	t-value		-1.21	7.09 **	
MIG	Parameter	Ge-Cost	-0.39	-0.10	-0.19
	t-value		-0.27	-0.14	-0.27
	Parameter	Const.	-0.99	1.43	
	t-value		-2.28 *	8.20 **	
HIG	Parameter	Ge-Cost	-3.42	-2.04	-2.39
	t-value		-2.15 *	-1.90 +	-2.16 *
	Parameter	Const.	-0.37	0.19	
	t-value		-2.07 *	1.25	

Source; JICA Study Team

*Notes: 1) ** significant level of 1 %, * Significant level of 5%*

2) Sample size of the analysis is shown in Appendix Table2.1-10

(2) Fare Levels of MRT and BRT

As working hypotheses, the following fare levels of MRT and BRT were established. MRT fare: Fixed fare of 10tk up to first 3 km. assumed the fixed rate fare of 2.5tk/km for the distance beyond it. BRT fare: Fixed fare of 5tk up to first 3 km. Assumed the fixed rate fare of 1.25tk/km for the distance beyond it.

12.5.2.2 Results of Modal Split

The modal choice of the future OD table under 'Do-Nothing' case is calculated and shown in Figure 12.5-3 and Table 12.5-5. Compared with person trips by mode in 2009, the modal choice under 'Do Nothing' case can be observed as follows;

a) share of car users in 2025 becomes significant larger than that in 2009
b) share of walk and rickshaw trips in 2025 becomes smaller than that in 2009
c) Share of bus trips in 2025 is slightly deceased compared with that in 2009

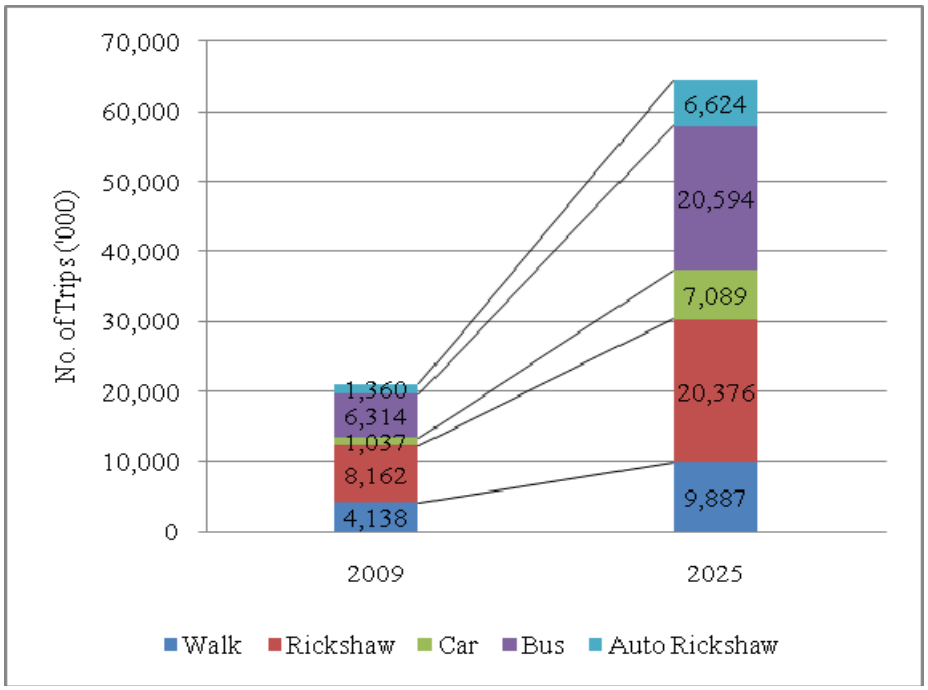


Figure 12.5-3 Present and Future Person Trips by Mode

Source: JICA Study Team

Table 12.5-5 Present and Future Person Trips by Mode

		Walk	Rickshaw	Car	Bus	CNG	Total
2009	Trips	4,138	8,162	1,037	6,314	1,360	21,011
	%	19.7%	38.8%	4.9%	30.1%	6.5%	100.0%
2025	Trips	9,887	20,376	7,089	20,594	6,624	64,570
	%	15.3%	31.6%	11.0%	31.9%	10.3%	100.0%

Source: JICA Study Team

Figure 12.5-4 shows modal share by income group and by year.

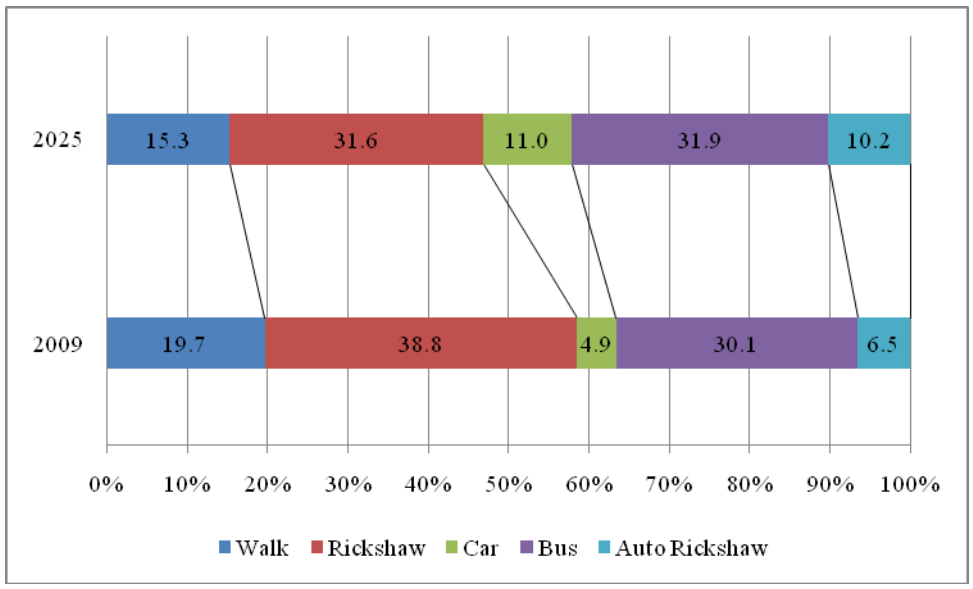


Figure 12.5-4 Present and Future Modal Split

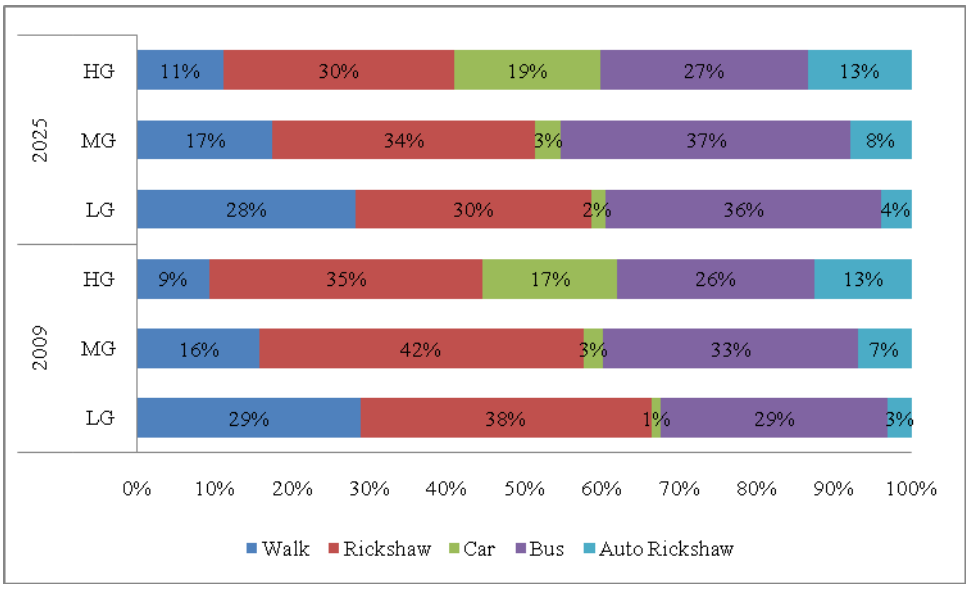


Figure 12.5-5 Present and Future Modal Split by Income Group

12.5.3 Forecast of Traffic Assignment under 'Do Nothing' Scenario

Traffic assignment to road network under 'Do Nothing' case is made in this section. Table 12.5-6 and Figure 12.5-6 shows the traffic assignment results of years 2009 and 2025. According to the results, share of road length over congestion degree of 1.0 will be extended from 12 % in 2009 to 57 % in 2025. This means that traffic situation in DMA will not be completely functioned at all. It is necessary to make actions to solve such situation.

Table 12.5-6 Traffic Assignment to Road Network Under Do Nothing Case (2009 & 2025)

Year	Item	Total (km)	Distance by VCR Rank in Alteranatives						Average V/C
			0.00~0.50	0.50~0.75	0.75~1.00	1.00~1.25	1.25~1.50	1.50~	
2009	Road Length	679.6	335.2	174.1	92.1	59.5	11.7	7.0	0.51
	%	100%	49.3%	25.6%	13.6%	8.8%	1.7%	1.0%	
2025	Road Length	747.1	143.1	46.5	130.0	134.7	115.0	177.8	1.09
	%	100%	19.2%	6.2%	17.4%	18.0%	15.4%	23.8%	

Source: JICA Study Team

Note: VCR: Congestion degree (Volume / Capacity)

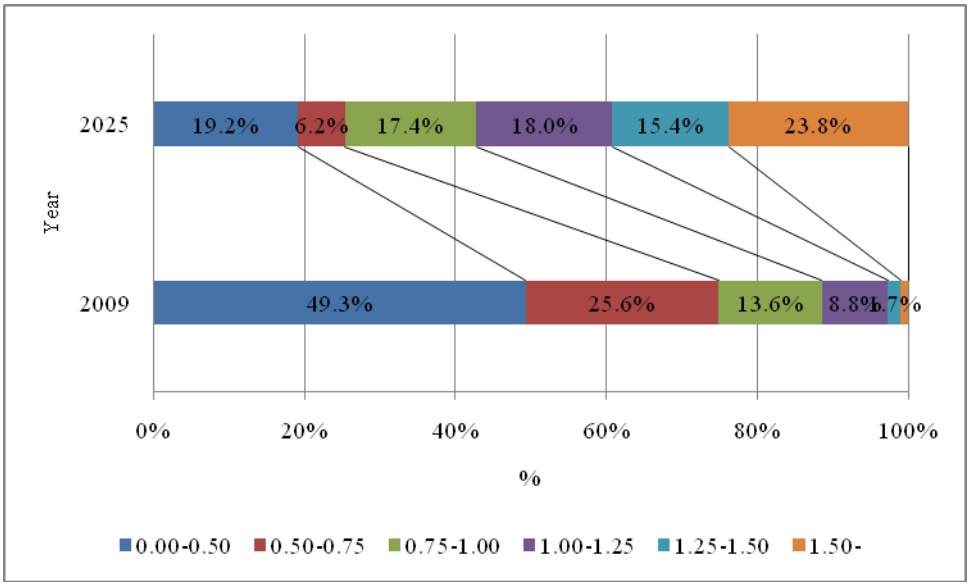


Figure 12.5-6 Share of Road Length by VCR Rank

Source: JICA Study Team

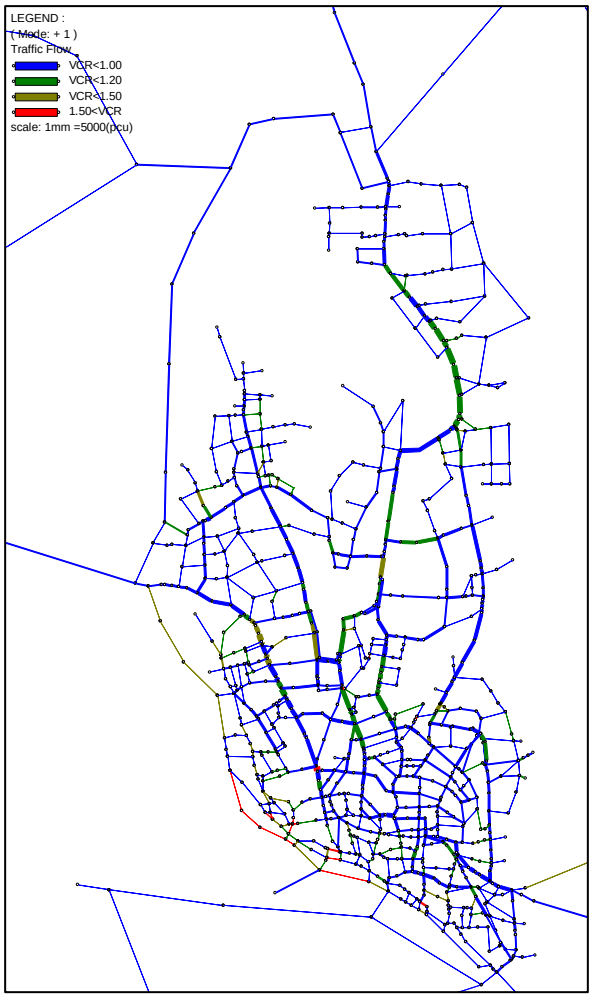


Figure 12.5-7 Current road traffic Condition (Year of 2009)

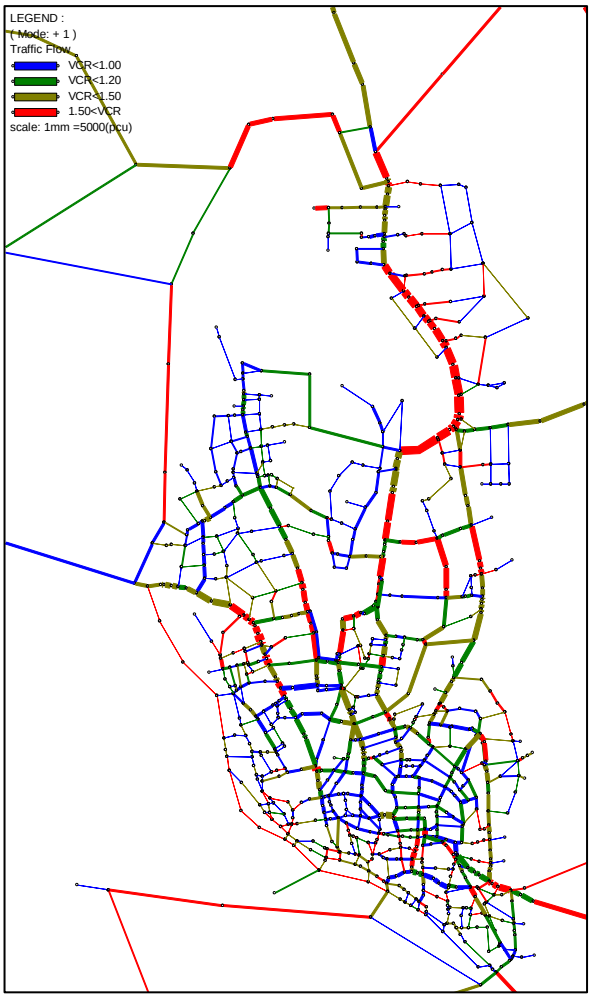


Figure 12.5-8 "Do Nothing Scenario" Condition (Year of 2025)

12.6 Major Findings of Traffic Demand Forecast under 'Do Nothing' Case

It can be observed the following findings based on the results of the traffic demand forecast:

a) If the government will not invest for any transport infrastructure projects, traffic congestion on road network becomes worst as not-experienced before. Such traffic situation is expected to be bad affected to the socio-economic development in Dhaka. It is necessary to develop transport development.

b) Traffic generation and attraction are expected to increase at fringe areas of the existing urbanized area and new community areas. It is necessary to strengthen transport network between new fringe areas and new community areas and the existing urbanized areas.

CHAPTER 13: TRANSPORT NETWORK DEVELOPMENT SCENARIOS IN 2025

13.1 Introduction

In this chapter, first of all, we will discuss the overall issues with respect to urban transport network. Based on the recognition of the extracted issues, we will draw up the vision and propose the overall policy interventions and strategies to realize the vision. As for those policies and strategies, we will focus on the rail based mass transit and examine the specific routes in order to prioritize the route so that more detailed discussion can be done on such prioritized railway routes in terms of technical and economic perspectives. Such technical and economic feasibility of the rail based mass transit will be discussed in Chapter 17 and Chapter 18 respectively.

The traffic condition in 2009 and 2025 in case of do –nothing scenario is discussed in Chapter 12.

13.2 Issues of Urban Transport Development

There are various urban transport problems and issues in Dhaka. These are summarized as follows;

(1) STP Proposal

a) Proposed public transport plans on Airport Road are duplicated i.e., BRT line 1, BRT line 3 and MRT line 4
b) Necessity of the loop line network of MRT system may be subject to reconsider. Such loop line network may not be expected to attract potential users
c) It seems that proposed MRT /BRT network may not take account of any large scale new settlement development areas such as Purbachal,
d) A little attention was paid to any possibility of upgrade of the Bangladesh Railway from the view point of making most of existing transport infrastructures, although it is doubtful whether or not Bangladesh Railway can be converted to new MRT

(2) Urban Development

a) A little attention was paid to access transport system, which includes mass transit system, to/from the newly developing areas
b) Expected environmental impact in urban areas, which is possibly caused by future population increase, may not be properly examined

(3) Public Transport

a) The existing road –based public transport is difficult to meet the future traffic demand.
b) In the bus industrial field, there exist too many small sized bus operators. Most of the bus owners are fragmented.
c) Rickshaw traffic is not properly managed

(4) Urban Road System

a) So far no hierarchy system of road network, especially in CBD and Old Dhaka Area.
b) There exist still many missing links in rban area
c) Many residential area development projects are being expanded in the eastern and northern areas.

(5) Intermodal Transport

a) Passenger Transport

i. Lack of efficient intermodal terminal facilities
ii. Fragmented bus operators never pay attention to necessity of inter-modal transport
iii. Conflict between NMTs and MTs is harsh

b) Freight Transport

i. Truck is a major transport means for freight. It is difficult to expect the realization of proper modal mix in the freight transport system in the future
ii. So far there exist no well managed freight transport terminal related facilities.

(6) Traffic Management

a) P roper traffic discipline has not been clearly stipulated
b) Safe and comfortable pedestrian facilities are not sufficiently provided
c) Operation guidelines and facilities are not properly provided by traffic police
d) Traffic management facilities including traffic signal are not provided and managed sufficiently
e) Training and education program for drivers are needed to be developed

13.3 Vision, Strategy and Transport Measures

(1) Vision of Urban Transport Development

The DHUTS proposed a set of visions of urban transport development. They are;

a) Vision 1: To achieve a sustainable social and economic growth

Dhaka should be a strong engine to drive the Bangladesh economy towards continuous growth position as socio-economic center.

b) Vision 2: To ensure social equity

Benefits of urban transport development should not be concentrated on the selected groups, but should be equitable for all people.

c) Vision 3: To ensure a healthy and secure urban environment

Urban transport should contribute to ensuring a healthy and secure environment for all of its residents.

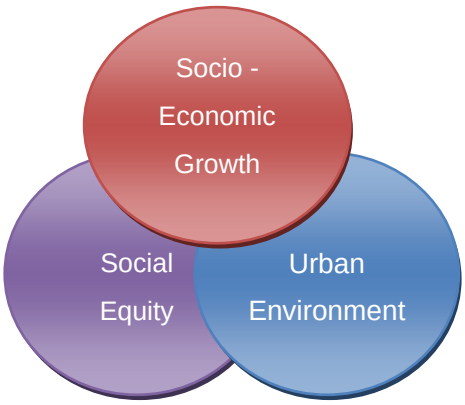


Figure 13.3-1 A Set of Visions of Urban Transport Development

(2) Missions of DHUTS Transportation System:

Mission of DHUTS transport system is identified the following three (3);

a) Mission 1: Efficient, and Effective Transport Systems

Since Dhaka people has been paid diseconomies against the economic efficiency, the transport cost needs to be minimized to realize a sustainable and economic growth in Dhaka. An effective urban transport system shall be established that the transport costs shall be minimized and the capital investments for construction of the infrastructure and maintenance and operation costs can be economically feasible.

b) Mission 2: Equitable of peoples mobility

The transport sector is generally responsive for assuring social equity, providing all people with equitable accessibility to places for their employments, school, commercial activities, social services, medical care, etc.

c) Mission 3: Safe and Environment-friendly Transport System

Any motorized transport modes generate more or less environmental pollutions as far as fossil fuels are used for energy source; and it is likely to encounter risks of accidents. Make best use of appropriate technologies, a safe and environmental – friendly transport system shall be realized to improve urban environment.

(3) Key Strategies and Transport Measures

a) Strategy 1: Improvement of People's Mobility

i. User-oriented public transport system
ii. Introduction of Traffic Demand Management (TDM)
iii. Restructuring of Public Transport System

b) Strategy 2: Establishment of Optimal Transport Infrastructure Development

i. Effective Integrated Transport System with Urban Development
ii. Public Transport System Development
iii. Road Network Development
iv. Efficient Traffic Management

c) Strategy 3: Safe and Secure Transport

i. Priority to Pedestrian Traffic
ii. Traffic safety Campaign

d) Strategy 4: Accessible Transport for All People

i. Accessible transport for all the poor
ii. Accessibility to new satellite community

e) Strategy 5; Establishment of Sustainable Institution and Organization

i. Strong leadership and owner for appropriate and timely decision making for promotion of MTS projects,
ii. Capacity development of DTCB (Dhaka Mass Transit Authority (DMTA) and Dhaka Mass Transit Corporation (DMTC)

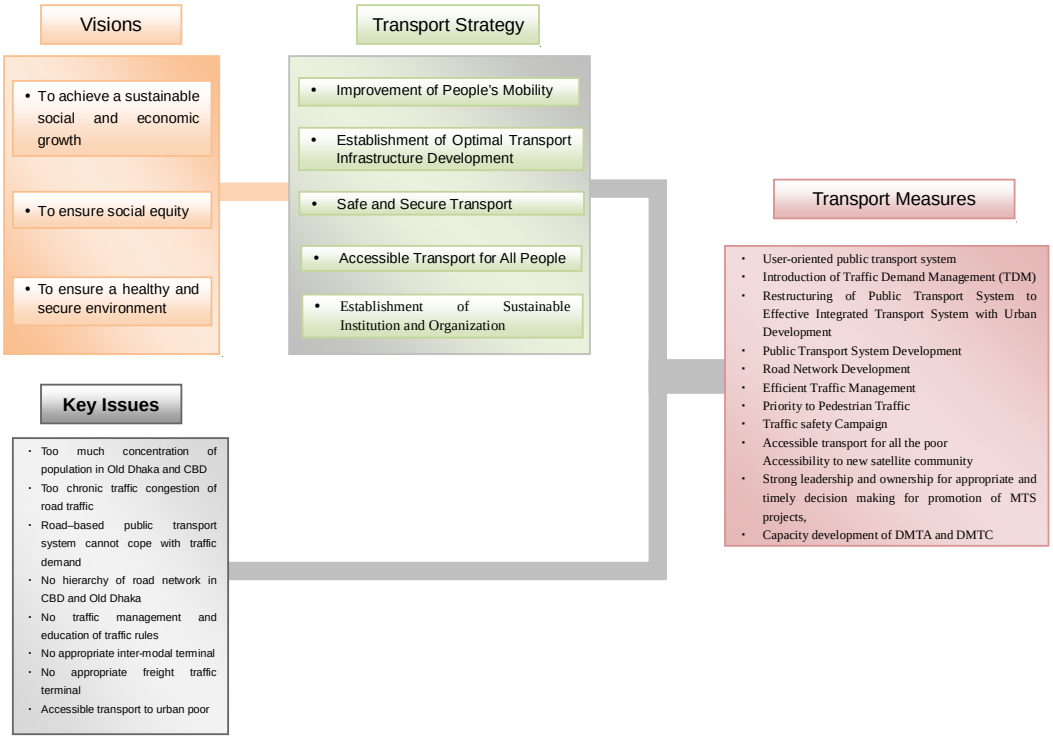


Figure 13.3-2 Vision, Strategy and Transport Measures

13.4 Selection of Optimal Transport Network Scenarios

13.4.1 Procedure of Selection of Optimal Scenario

In order to select the optimal transport network scenarios, two (2)-step selection approach is employed in this study;

a) Selection of priority MRT Line proposed by STP
b) Selection of optimal transport network scenario

Figure 13.4-1 demonstrates the procedural flow of optimal transport scenario formulation.

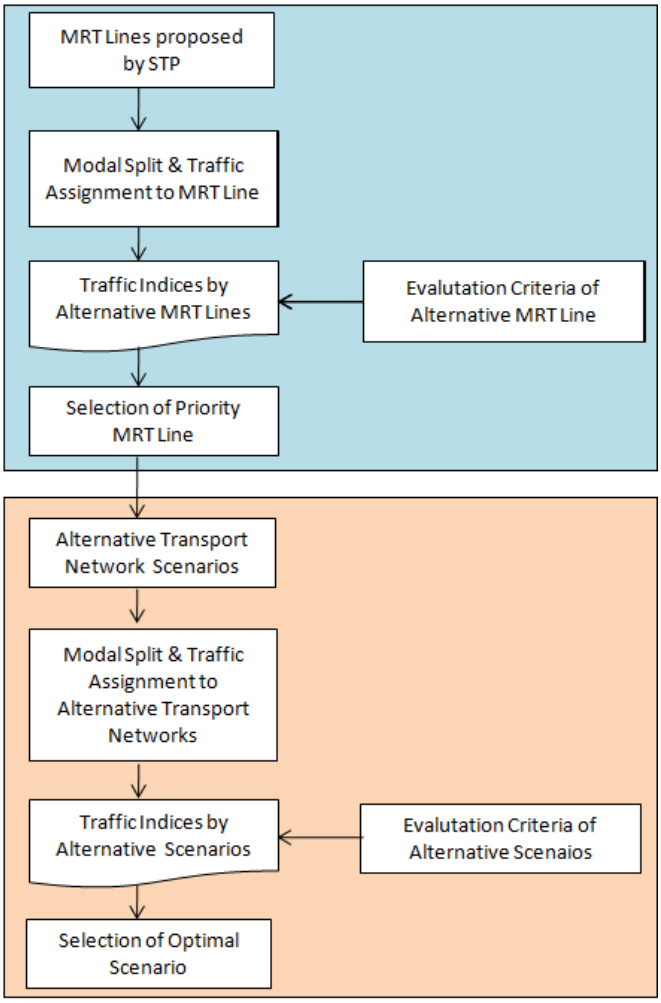


Figure 13.4-1 Procedure of Selection of Optimal Scenario

13.4.2 Selection of MRT 3 Lines proposed by STP

(1) STP Proposal

STP proposed a set of Mass Transit System (MTS) Plan. This plan contains three (3) BRT lines and three (3) MRT Lines. They are shown in Figure 13.4-2.

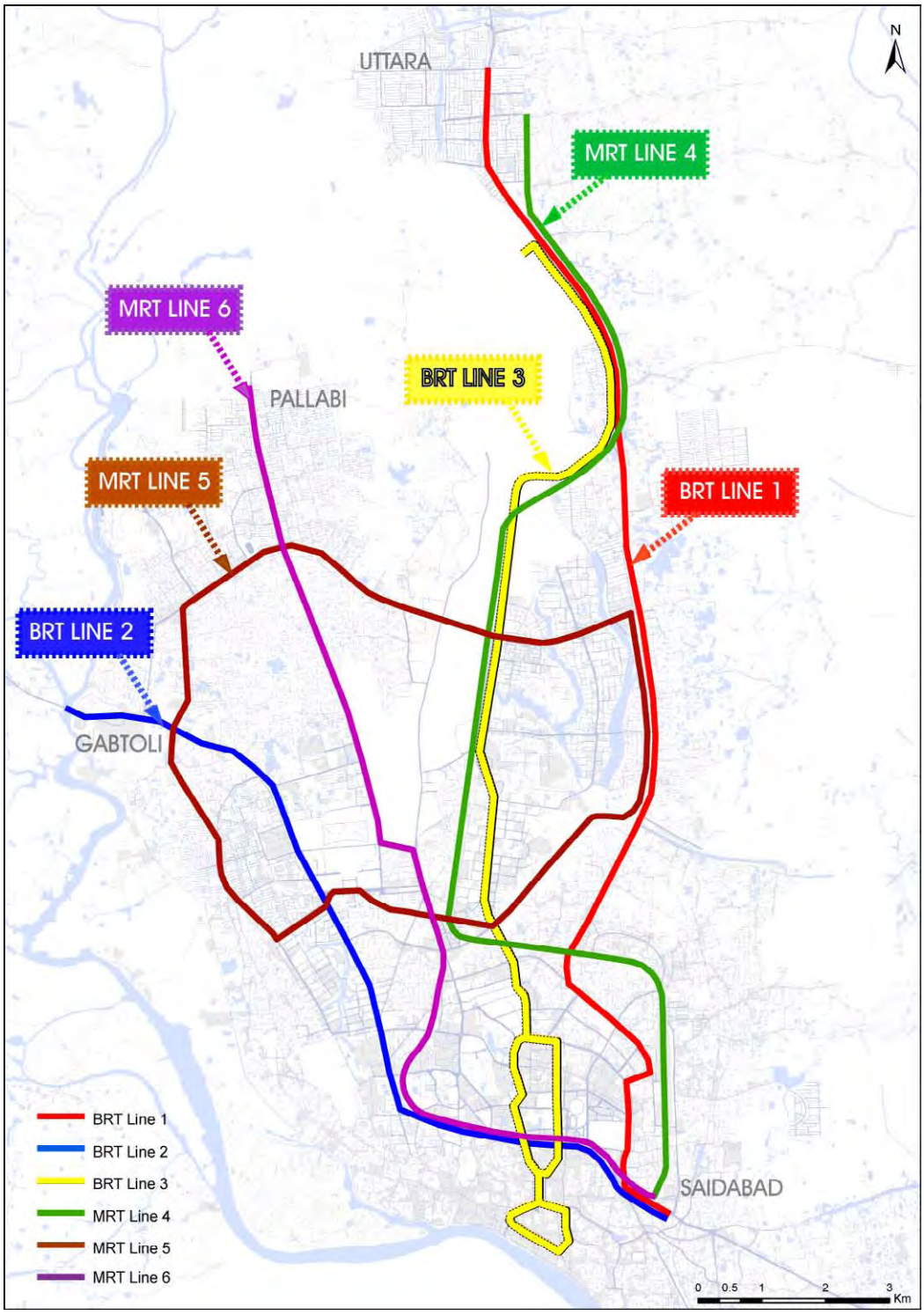
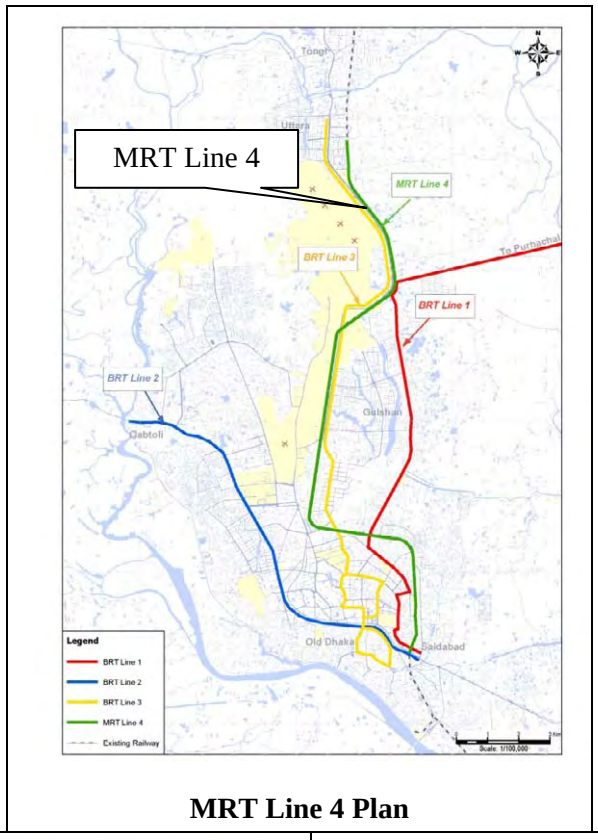


Figure 13.4-2 Mass Transit System (MTS) Plan Proposed by STP

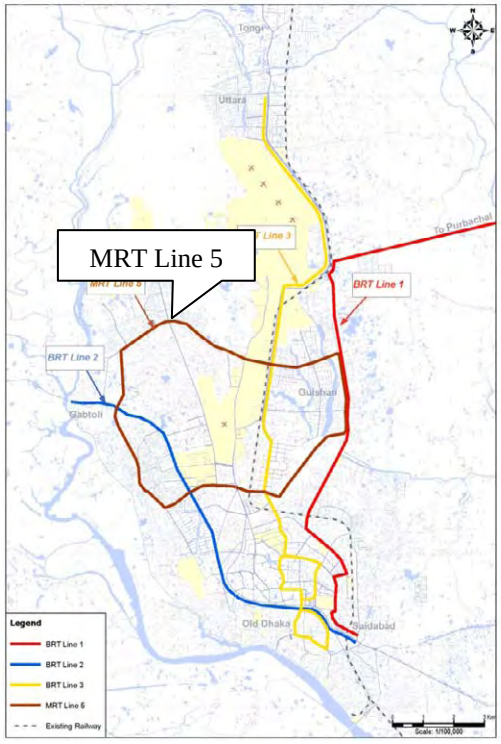
Source: STP

(2) Setting up Three (3) MRT Plans

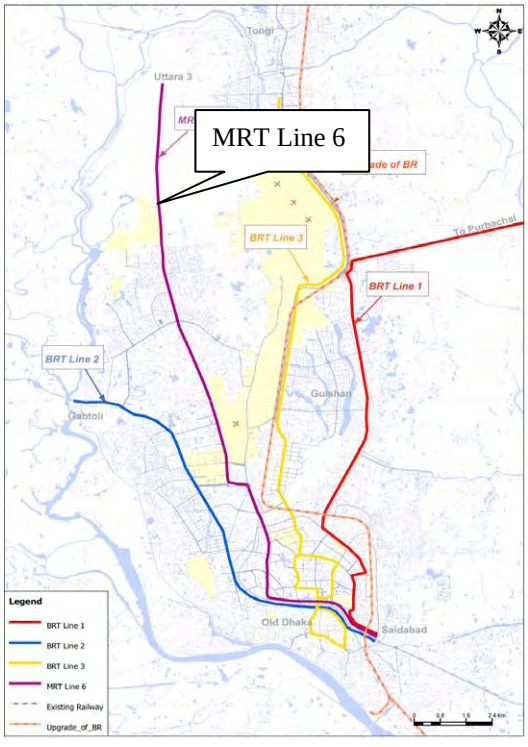
As mentioned above, it is comparatively easy to construction BRT lines if the consensus of introduction of BRT system is made. In this comparative study, it is assumed that all BRT Lines will be completed in the year 2025. Figure 13.4-3 shows the MTS network plan.



MRT Line 4 Plan



MRT Line 5 Plan



MRT Line 6 Plan

Figure 13.4-3 Three (3) - MRT Line Plan

(3) Evaluation Criteria

Evaluation of each scenario was done for the purpose of selection of specific MRT route from among three routes proposed by STP. Selected MRT route was scrutinized in more detailed form the viewpoint of economic and financial feasibility. Such more detailed examination will be discussed in following chapters.

The evaluation here was done in terms of amount of potential users for MRT and impact on alleviation of road traffic congestion. Indices adopted in the evaluation are shown in the following table. Those indices were measured in two cases, the one is "WITH" MRT case and the other is "WITHOUT" MRT case, which is "Do Nothing" scenario in 2025. The evaluation was done on the basis of the differentiation between the indices of the cases of "WITH" and "WITHOUT".

Table 13.4-1 Evaluation Indices

Specific Indices	Remarks
Index for MRT	
Number of potential users	Potential Passengers for each of three alternative MRTs.
Indices for impacts on Road Traffic	
Average degree of congestion	Degree of congestion averaged over whole DMA. The index stands for degree of alleviation of road traffic congestion.
Total vehicle kilometer	Total traffic volume summed up in whole DMA. The index stands for degree of reduction of road traffic volume and running distance.
Total time consuming	Total time consumed summed up in whole DMA. The index stands for degree of time savings due to introduction of MRTs.

(4) Selection of MRT Lines

Based on the transport demand forecasts and some outputs relevant to the scenario assessment, one MRT network was selected from among three MRT lines proposed by STP. The assessment was done along assessment indices which were discussed previously in this chapter.

a) Demand forecast of each MRT line

MRT line 4, 5 and 6 were forecasted. MRT Line 6 shows the biggest number in terms of both number of passengers and passenger-kilometer.

Table 13.4-2 Passenger Traffic Volume by Mode in 2025

Unit: Trips/Day

		Walk	Rickshaw	Car	Bus	CNG	BRT or MRT	Total
2009		4,139,000	8,162,000	1,037,000	6,314,000	1,360,000	0	21,011,000
2025	Do Nothing	9,887,000	20,376,000	8,589,000	19,094,000	6,624,000	0	64,570,000
	With MRT Route 4	9,889,000	20,441,000	7,948,000	17,954,000	6,228,000	2,111,000	64,570,000
	With MRT Route 5	9,889,000	20,441,000	7,856,000	17,755,000	6,143,000	2,486,000	64,570,000
	With MRT Route 6	9,889,000	20,441,000	7,819,000	17,678,000	6,114,000	2,629,000	64,570,000

Source JICA Study Team

Table 13.4-3 Traffic Indicators of Road Users and Public Transport Users in 2025

	Passenger Demand for MRT('000)	Passenger-Km ('000)	Average Trip Length (km)	Reduction of Road Trffic Volume ('000 veh/km)	Congestion Ratio (Veh. Km/cap.)	Reduction of Passenget Hours ('000 Pass-km)
With MRT Line 4	489	3,863	7.9	1,345	0.66	790
With MRT Line 5	396	1,224	3.1	302	0.68	397
With MRT Line 6	639	4,674	7.3	1,788	0.65	785

Source JICA Study Team

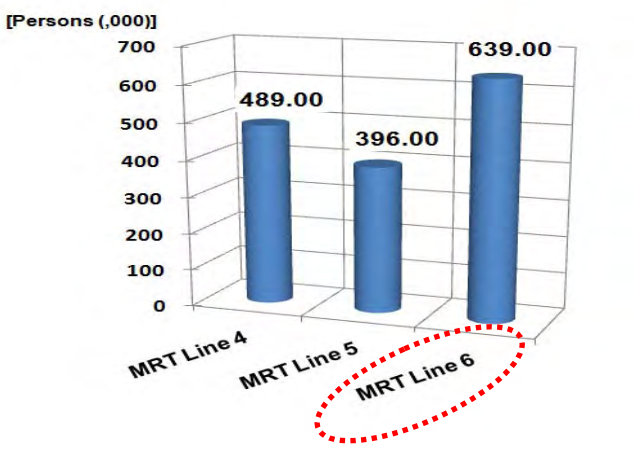


Figure 13.4-4 Demand Forecast for Each MRT Line (Number of Daily Passengers)

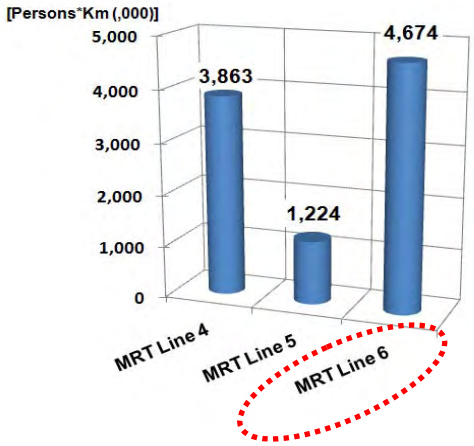


Figure 13.4-5 Demand Forecast for Each MRT Line (Passenger-Kilometer on Daily Basis)

(5) Impact of introduction of MRT on alleviation of road traffic congestion

As clearly indicated, introduction of MRT Line 6 shows significant impact in terms of alleviation of road traffic congestion shown as below.

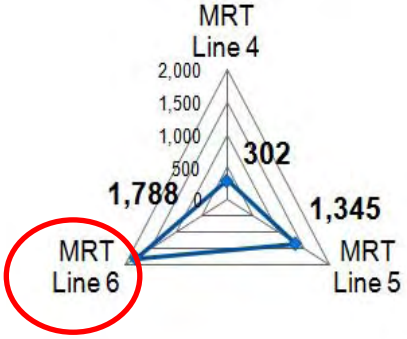


Figure 13.4-6 Reduction of the Road Traffic Volume [Veh.*km ('000)]

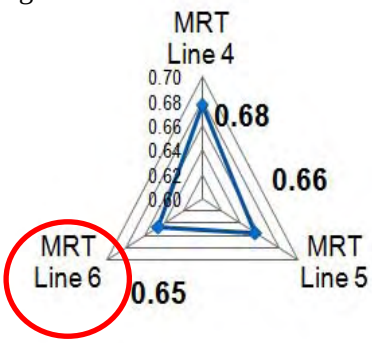


Figure 13.4-7 Degree of Road Traffic Congestion

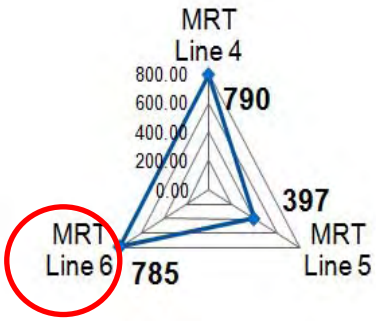


Figure 13.4-8 Time Savings [Veh.*hour ('000)]

(6) Conclusion

As the results of the examinations, it is recommend that MRT Line 6 can be the most prioritized railway line from the view point of the amount of expected demand and impact of alleviation of road traffic congestion.

In the following chapter, evaluation in terms of financial, economic and engineering viewpoints, which were done focusing on MRT Line 6, will be discussed.

13.4.3 Alternatives of Urban Transport Development Scenario in 2025

13.4.3.1 Transport Network Components

Alternatives of urban transport development scenario include the following transport networks as the component.

(1) Public surface transport network

a) MRT
b) BRT
c) Bangladesh Railway
d) Inner-city bus system

(2) Road Network

a) Urban expressway
b) Urban trunk road network

(3) Inter-modal transport network

a) Surface transport

b) Inland-waterway transport

13.4.3.2 Alternatives of Transport Network Scenarios

We considered 5 alternative transport network scenarios. They are: a) Do Nothing Scenario, b) Do STP Scenario c) Do Minimum Scenario, d) Do Medium Scenario and e) Do Maximum Scenario. The alternatives of transport network scenarios are shown in Table 13.4-1.

The main features of each scenario can be described as follows;

(1) "Do Nothing" Scenario

"Do-Nothing" Scenario is based on the existing condition that new road and mass transit (BRT and MRT) will not developed in 2025 except on-going projects committed by the Government. This scenario is used for as bench mark to evaluate alternative transport development scenarios.

(2) "Do Minimum Scenario"

Taking into limited government financial capability for investment to MRT systems, "Do Minimum" Scenario contains three (3) BRT lines and one (1) MRT Line with expansion of commuter services of BR from among three lines being proposed by STP.

(3) "Do Medium Scenario"

"Do Medium Scenario" is assumed principally based on the STP proposal although some minor amended proposals are made. This Scenario contains three (3) BRT lines and three (3) MRT lines. The scenario assumed to be medium development of transport network.

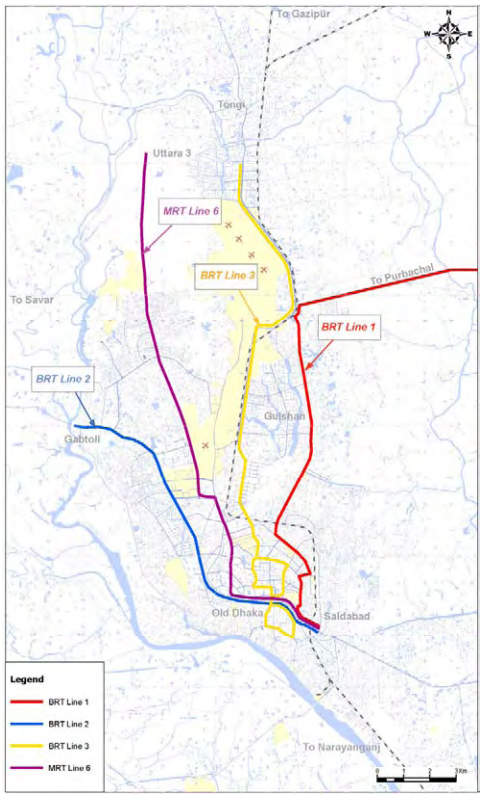
(4) "Do Maximum DHUTS Scenario"

Taking into consideration future urban development in RAJUK area, it would be necessary to develop extensive MRT system as mentioned in Chapter 12. This scenario is so called as "Do Maximum" Scenario. This contains three (3) BRT lines and five (5) MRT lines as follows. This scenario corresponds to the long term (beyond 2025) development scenario.

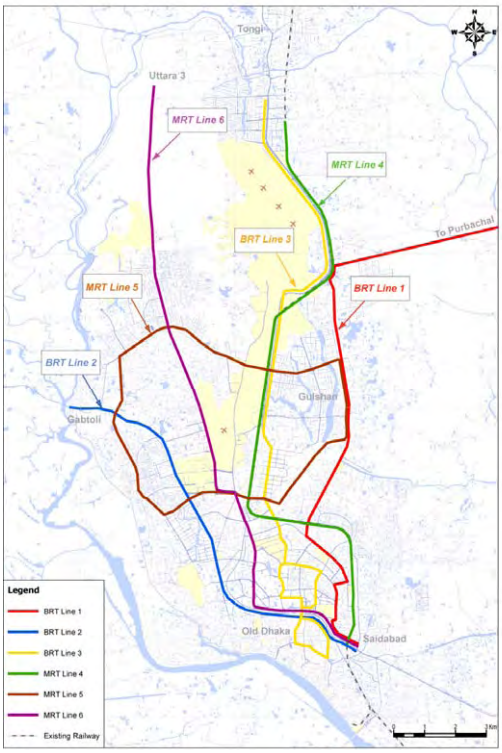
Table 13.4-4 Summary of the Alternative Scenarios

		Do Nothing	Do Minimum Plan	Do Medium Plan	Do Maximum Plan
Public Transport					
0.0	Without MRT & BRT	●			
MRT Plan					
1.0	MRT Line 4 (Minor Improvement of BR)		●		
1.1	MRT Line 4 (Minor Improvement BR w/ Extension)			●	
1.2	MRT Line 4 (Metro Level Development w/ Extension)				●
2.0	MRT Line 5			●	●
3.0	MRT Line 6 (Pallabi – Siadabad)		●	●	●
3.1	MRT Line 6 Extension (Uttara 3- Pallabi)		●	●	●
3.2	MRT Line 6 Extension (Saidabad- Tarabo)				●
4.0	Eastern Fringe Line				●
5.0	East-West Line				●
BRT Plan					
4.0	BRT Line 1 (Uttara – Saidabad)				
4.1	BRT Line 1 (Purbachar – Saidabad)			●	●
5.0	BRT Line 2 (Gabtori – Saidabad)			●	●
6.0	BRT Line 3 (Uttara – Old Dhaka)		●	●	●
6.1	BRT Line 3 Extension (Old Dhaka – Jheelmel)				●
Road Network Plan					
0.0	Without Road Improvement	●			
1.0	Urban Expressway		●	●	●
2.0	Ladder Pattern Development		●	●	●
3.0	R/C Road Network in Rajuk		●	●	●

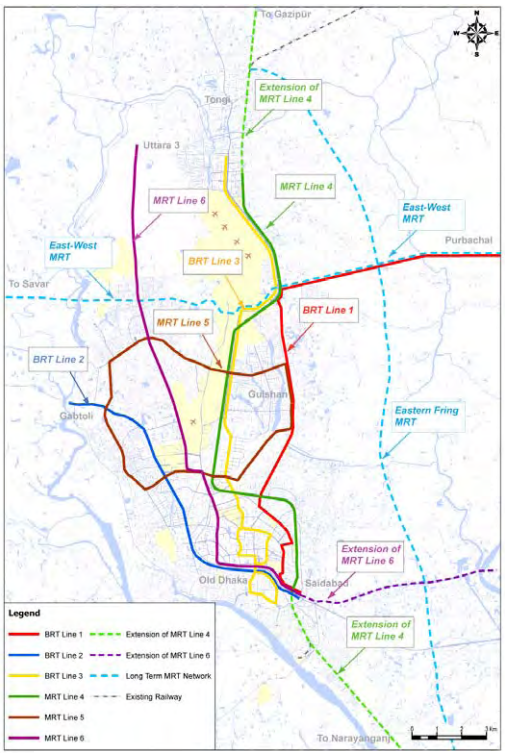
Note: Ra/C: Radial and Ring Road Network



"Do Minimum" Scenario



"Do Medium" Scenario



"Do Maximum" Scenario

Figure 13.4-9 Alternative Transport Development Scenarios

Source; JICA Study Team

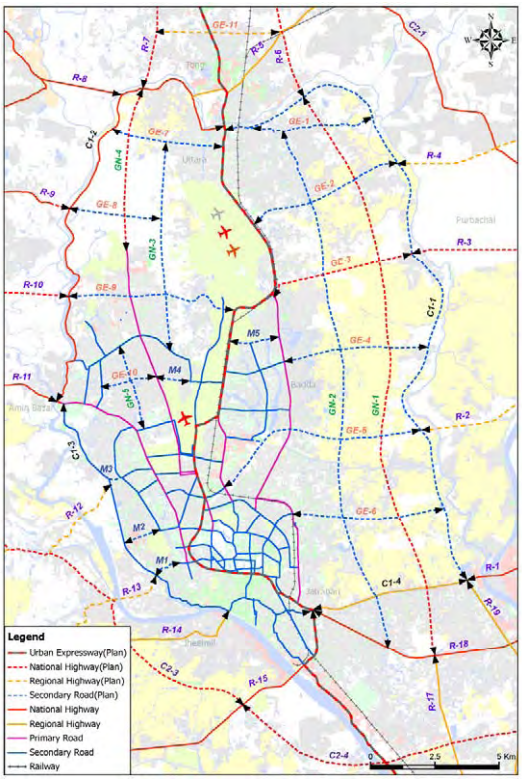


Figure 13.4-10 Alternative Transport Development (Road Plan)

Source; JICA Study Team

13.4.3.3 Comparative Evaluation of Alternative Transport Development Scenarios

(1) Evaluation Criteria

The alternative scenarios are comparatively evaluated on the basis of the following three (3) factors;

1) Traffic Aspects

- Average travel speed

  This indicator should be higher than the others.

- Average V/C ratio

  This should be smaller than the volume capacity ratio (V/C ratio =1.0),

2) System efficiency

- Travel length

  As for evaluation of the travel length of alternative scenarios, the shorter travel length is better than the others.

- Travel time

  As for evaluation of the travel time of alternative scenarios, the shorter travel time is better than the others.

- Travel cost

  As for evaluation of the travel cost of alternative scenarios, the smaller travel cost is better than the others.

3) Economic / Financial Aspects

- Average fare revenue per km

  Regarding to the average fare revenue per km, larger fare revenue per kilometer is better than the others.

- Fare revenue per investment cost

  Regarding to the fare revenue per investment cost, higher fare revenue per investment cost is superior to the others.

13.4.3.4 Selection of Transport Network Development Scenarios

(1) Traffic Assignment Analysis

The traffic assignment analysis of four (4) alternative scenarios is made on the proposed transport network scenarios in year 2025 using transport models developed in this study.

(2) Comparative Analysis of Traffic Indicators

Tables 13.4-5 and 13.4-6 summarize the comparison of traffic indicators of each transport scenarios.

Table 13.4-5 Number of Trips by Modes and by Alternative Scenarios

	Walk	Rickshaw	Car	Bus	CNG	BRT or MRT	Total
2009	4,139,000	8,162,000	1,037,000	6,314,000	1,360,000	0	21,011,000
2025							
Do Nothing	9,887,000	20,376,000	8,589,000	19,094,000	6,624,000	0	64,570,000
Do Minimum	9,889,000	20,441,000	7,819,000	17,678,000	6,114,000	2,629,000	64,570,000
Do Medium	9,889,000	20,441,000	7,727,000	17,598,000	6,067,000	2,849,000	64,570,000
Do Maximum	9,889,000	20,441,000	7,716,000	17,570,000	6,056,000	2,898,000	64,570,000

Source; JICA Study Team

Table 13.4-6 Traffic Indicators by Alternative Scenarios

	No. of Trips (trips/day)	Road Traffic				MRT/BRT			
		Vehicle-Hours ('000 PCU.hr)	Vehicle-Km (1,000 PCU.km)	Ave. Travel Speed (km/h)	Ave. V/C Ratio	Passenger-Hours (1,000 pass..Hrs)	Passenger-Km (1,000 pass.km)	Travel Length (km)	Travel Time (Min)
2009	8,710,000	920	13,851	15.1	0.51	–	–	–	–
2025									
Do Nothing	34,240,000	8,044	33,605	4.2	1.09	–	–	–	–
Do Minimum	34,240,000	2,769	35,223	12.8	0.65	19,259	580	7.33	13.24
Do Medium	34,240,000	2,375	34,182	14.5	0.63	22,102	616	7.76	12.97
Do Maximum	34,240,000	2,302	34,009	14.9	0.63	25,132	677	8.67	14.02

Source; JICA Study Team

Note: V/C Ratio: Average Congest in Rate

Table 13.4-7 Comparison Analysis of Traffic Congestion on Road Network

Scenario Scenario	Total Length Distance	Distance by VCR Rank in Alternatives						Average V/C Ratio
		0.00 -0.50	0.50 – 0.75	0.75 - 1.00	1.00 – 1.25	1.25 – 1.50	1.50 -	
2009	679.6	335.2	174.1	92.1	59.5	11.7	7.0	0.51
Do Nothing	747.1	143.1	46.5	130.0	134.7	115.0	177.8	1.09
Do Minimum	1,034.4	359.8	274.1	208.7	117.7	41.7	32.4	0.65
Do Medium	1,034.4	390.2	262.1	204.8	115.2	30.5	31.5	0.63
Do Maximum	1,034.4	388.5	266.9	203.0	113.0	32.1	30.9	0.63

Source; JICA Study Team

Note: V/C Ratio: Average Congest in Rate

(3) Comparative Analysis of Financial Points

Table 13.4-8 summarizes the comparison of financial aspect of each transport scenario. The economic and financial indicator of each scenario is evaluated from fare revenue per km and fare revenue per investment cost. From view of economic and financial points, Do Minimum scenario is superior to the others.

Table 13.4-8 Comparison Analysis of Each Transport Scenario from Economic and Financial Points

		Unit	2025			
			Do Nothing	Do Minimum	Do Medium	Do Maximum
Avrage Fare Revenue	MRT	Tk/Km	-	551,990	548,370	383,076
	BRT	Tk/Km	-	234,741	183,290	140,019
	Average	Tk/Km	-	378,338	377,880	312,070
Avrage Fare Revenue per Construction Cost	Average	Tk/Km		15,413	11,270	7,755

Source; JICA Study Team

(4) Overall Evaluation

Table 13.4-9 presents the overall evaluation of four (4) alternative scenarios. Overall evaluation is made from the view of traffic aspect, system efficiency, and economic and financial points. As the results of the evaluation, the following findings can be made;

- Do nothing scenario is considered beyond acceptable due to the not solving any traffic congestion faced in Dhaka.
- Do maximum scenario shows a scarcely acceptable level. This is due that a huge amount of investment costs for mass transit system projects will be required.
- Do minimum scenario or Do medium scenario is superior to the other scenarios. However taking into consideration financial situation of the government, it is recommended to employ the Do Minimum Scenario as master plan for DMA in 2025.

Table 13.4-9 Comparison Analysis of Alternative Transport Scenario

Scenario	Traffic Efficiency	System Efficiency	Economic / Financial Aspects	Overall Evaluation
Do Nothing ・No Special Projects	・Average Travel Speed=4.2 km/h ・Average VCR = 1.09 ・Proposed network in 2025 is not acceptable [XX]	・Passenger load = 0 pass/km ・Trip length = 16.5 km ・Travel Time =49 min [XX]	・Due to no investment cost required, no financial burdon is necessary but bad affects to Dhaka economy [XX]	As transport network in 2025, it is not recommended due to high traffic congestion [XX]
Do Minimum ・MRT Line 6 ・Upgrading BR ・3 BRT Lines ・Urban Expressway	・Average Travel Speed = 14.1 km/h ・Average VCR = 0.65 ・Proposed transport network in 2025 is acceptable from view point of traffic aspect [○]	・Passenger load = 196,000 pass/km ・Trip length = 16.5 km ・Travel Time = 15 min [○]	・Average fare revenue = 552,000 Tk/km ・Efficiency of investment cost= 15,400 Tk [◎]	As transport network in 2025, it is recommended due to minimum investment while effects being more or less same [◎]
Do Medium ・MRT Line 4,5 and 6 ・3 BRT Lines ・Urban Expressway	・Average Travel Speed=14.5 km/h ・Average VCR=0.63 ・Proposed transport network in 2025 is acceptable from view point of traffic aspect [○]	・Passenger load = 183,000 pass/km ・Trip length = 14.9 km ・Travel Time = 14 min [○]	・Average fare revenue = 548,000 Tk/km ・Efficiency of investment cost= 11,300 Tk [△]	As transport network in 2025, it is recommended as second best plan [○]
Do Maximum ・MRT Line 4,5 and 6 ・MRT Line 7 & 8 ・3 BRT Lines ・Urban Expressway	・Average Travel Speed=14.9 km/h ・Average VCR =0.63 ・Proposed transport network in 2025 is acceptable from view point of traffic aspect [○]	・Passenger load = 139,000 pass/km ・Trip length = 15.4 km ・Travel Time = 14 min [△]	・Average fare revenue = 383,000 Tk/km ・Efficiency of investment cost= 7,750 Tk [X]	As transport network in 2025, it is not recommended due to high investment cost [X]

Source; JICA Study Team

13.5 Master Plan Components

The 'Do Minimum' scenario is recommended based on the evaluation on traffic aspect, system efficiency, and economic and financial points.

Do Minimum Scenario is composed of as follows;

- Construction of Mass Rapid Transit Railway (MRT) Line.6
- Upgrading of existing Bangladesh Railway (BR)
- Bus Rapid Transit (BRT) Line 1 to 3

The recommended Transport Network Development Plan is illustrated in Figure 13.5-1.

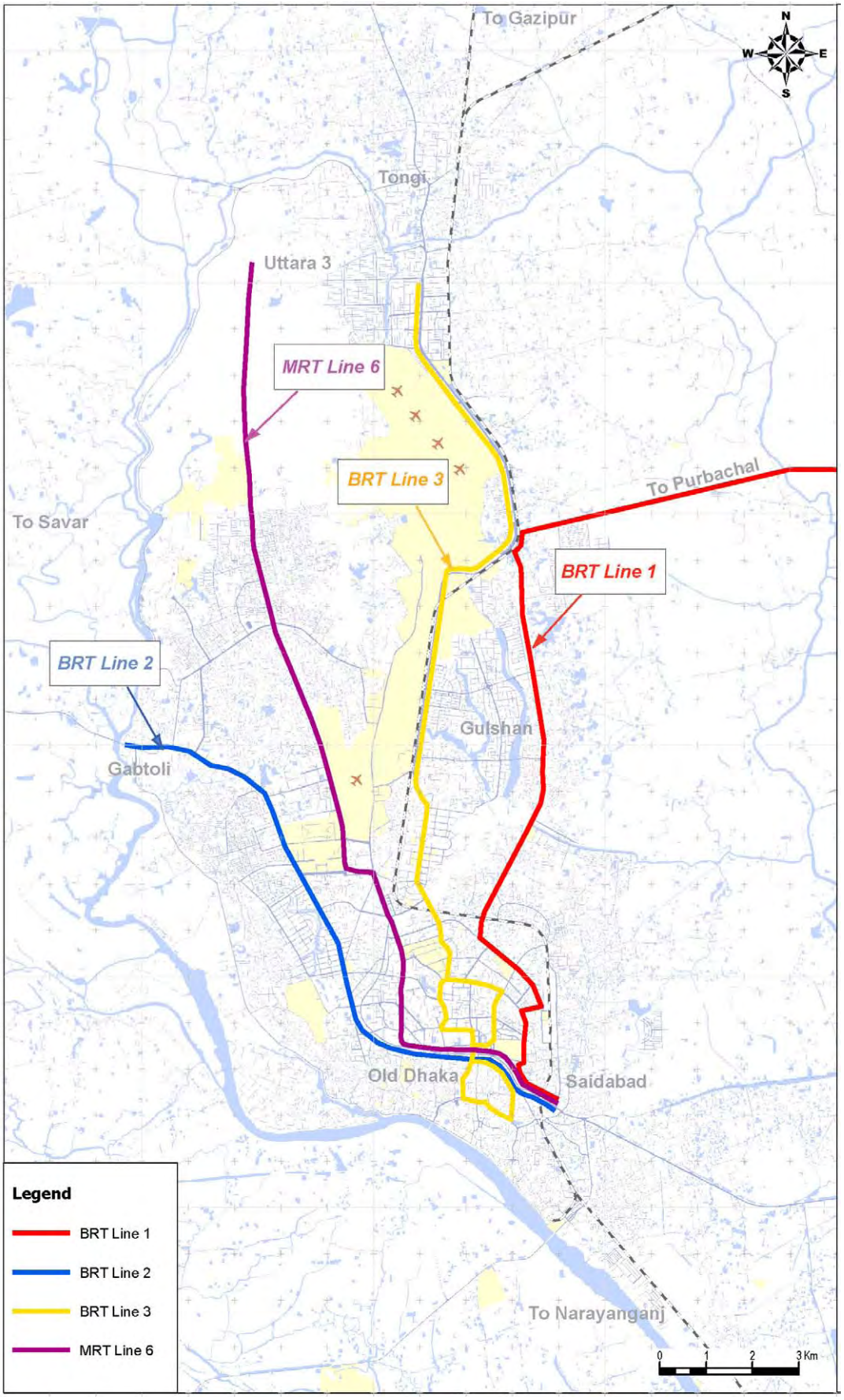


Figure 13.5-1 Proposed Mass Transit Network in 2025