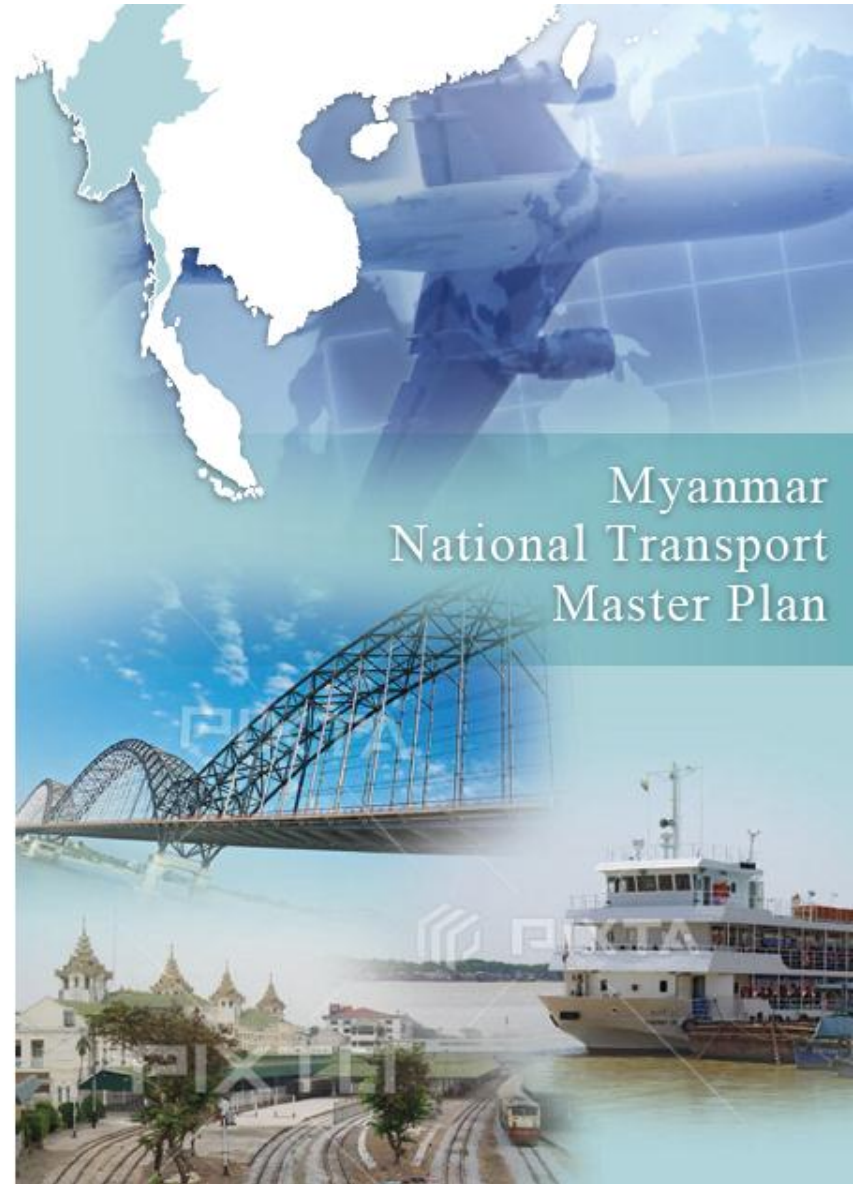




Myanmar National Transport Master Plan



**Ministry of Transport  
The Republic of the Union of Myanmar**

**The Survey Program for  
the National Transport Development Plan  
in the Republic of the Union of Myanmar**

**Final Report**

**September 2014**

**JAPAN INTERNATIONAL COOPERATION AGENCY**

**Oriental Consultants Co., Ltd.  
International Development Center of Japan  
ALMEC Corporation**

Exchange rate used in this Report

USD	1.00 = JPY	99.2
USD	1.00 = MMK	970.9
MMK	1.00 = JPY	0.102

(As of October, 2013)



### Project Location Map

Source: Road, Railway (MIMU, Revised by MYT-PLAN), Sea port, River port (MYT-PLAN),  
River, Cities, Administrative Boundary (MIMU)

**MYT-PLAN**

0 50 100 200 300 Km





**The Survey Program for  
the National Transport Development Plan  
in the Republic of the Union of Myanmar**

*A grand design for the transport sector at the dawn of new  
and modern era of transport development in Myanmar*

**Final Report**

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## Abbreviations

AADT	Annual Average Daily Traffic	GMIAL	GMR Male International Airport Pvt. Ltd.
ABC	ASEAN Broadband Corridor	GMS	Greater Mekong Sub-region
ACMECS	Ayeyarwaddy-Chao Praya-Mekong Economic Cooperation Strategy	GOM	Government of Myanmar
ADB	Asian Development Bank	GRDP	Gross Regional Domestic Product
AEC	ASEAN Economic Community	HIA	Hanthawaddy International Airport
AFAFGIT	ASEAN Framework Agreement on the Facilitation of Goods in Transit	IBRD	International Bank for Reconstruction and Development
AFAFIST	ASEAN Framework Agreement on the Facilitation of Inter-State Transport	ICAO	International Civil Aviation Organization
AFAMT	ASEAN Framework Agreement on the Multimodal Transport	ICOR	Incremental Capital-Output Ratio
AFTA	ASEAN Free Trade Agreement	IDP	Internally Displaced Population
AHN	ASEAN Highway Network	IEE	Initial Environmental Examination
ASAM	ASEAN Single Aviation Market	ILS	Instrument Landing System
ASEAN	Association of South East Asian Nations	IMF	International Monetary Fund
BIMSTEC	Bay of Bengal Initiative for Multi-Sectorial Technical and Economic Cooperation	IMO	International Maritime Organization
BOO	Build-Own-Operate	IRR	Internal Rate of Return
BOOT	Build-Own-Operate-and-Transfer	ISV	Inland Steam-vessels Act
BOT	Build-Operate-and-Transfer	ITS	Intelligent Transport System
BTO	Build-Transfer-Operate	IWT	Inland Waterway Transport, Myanmar
B/C	Benefit - Cost Ratio	JICA	Japan International Cooperation Agency
CBD	Central Business District	KBA	Key Biodiversity Area
CBTA	Cross-Border Trade Agreement	KLMR	Kuala Lumpur Metropolitan Region
CDC	Community Development Committee	LAGS	Liquids, Aerosols and Gels
CDZ	Central Dry Zone	LSPs	Logistics Service Providers
CEPT	Common Effective Preferential Tariff Scheme	MACL	Maldives Airport Company Ltd.
CIQ	Custom Immigration and Quarantine	MAFLAFS	ASEAN Multilateral Agreement on the Full Liberalization of Air Freight Service
CSO	Central Statistical Office	MAFLPAS	ASEAN Multilateral Agreement on the Full Liberalization on Passenger Air Services
CWR	Child to Women Ratio	MCDC	Mandalay City Development Committee
DCA	Department of Civil Aviation, MOT	MCDV	Myanmar Comprehensive Development Vision
DHSHD	Department of Human Settlements and Housing Development, MOC	MDGs	Millennium Development Goals
DMA	Department of Marine Administration, MOT	MES	Myanmar Engineering Society
DME	Distance Measuring Equipment	MEZ	National Myanmar Economic Zone
DPW	Department of Public Works, MOC	MHA	Malaysia Highway Authority
DWIR	Directorate of Water Resources and Improvement of River Systems, MOT	MIA	Mandalay International Airport
ECD	Environmental Conservation Department	MIC	Myanmar Investment Commission
EIA	Environmental Impact Assessment	MICT	Manila International Container Terminal
EIRR	Economic Internal Rate of Return	MNPED	Ministry of National Planning and Economic Development, Myanmar
EPA	Economic Partnership Agreement	MOC	Ministry of Construction, Myanmar
EPU	Economic Planning Unit, Malaysia	MOECAF	Ministry of Environmental Conservation and Forestry, Myanmar
ERIA	Economic Research Institute of ASEAN and East Asia	MOT	Ministry of Transport, Myanmar
EU	European Union	MPA	Myanma Port Authority, MOT
FCF	Fixed Capital Formation	MPAC	Master Plan on ASEAN Connectivity
FDI	Foreign Direct Investment	MPPA	Million Passenger Per Annum
FESR	Framework for Economic and Social Reform	MR	Myanma Railways, MRT
FIL	Foreign Investment Law	MRT	Ministry of Rail Transportation, Myanmar
FIRR	Financial Internal Rate of Return	MSSR	Mono-pulse Secondary Surveillance Radar
FTA	Free Trade Agreement	NCDP	National Comprehensive Development Plan
FTZ	Free Trade Zone	NDC	Nay Pyi Taw Development Committee
GAD	General Administration Department	NIA	Nay Pyi Taw International Airport
GDP	Gross Domestic Product	NPV	Net Present Value
GFCF	Gross Fixed Capital Formation	NSDF	National Spatial Development Framework
GIS	Geographic Information System	ODA	Official Development Assistance
		PPP	Public-Private Partnership
		PSP	Private Sector Participation
		ROMT	Rehabilitate-Operate-Maintain-Transfer



***Final Report***

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RTAD	Road Transport Administration Department
SAR	Special Autonomous Region
SAR	Search and Rescue
SCA	Societe Concessionaire de l'Aeroport
SESAR	Single European Sky Air Traffic Management Research Program
SEZ	Special Economic Zone
SIZ	Special Industrial Zones
SKRL	Singapore-Kunming Rail Link
SOE	State Owned Enterprise
SPC	Special Purpose Company
TAZ	Traffic Analysis Zone
TFR	Total Fertility Ratio
TOD	Transit Oriented Development
TPD	Transport Planning Department, MOT
TTR	Transit Transport Routes
UNESCAP	United Nations Economic and Social Commission for Asia and Pacific
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Vehicle Operating Cost
VOR	VHF Omni directional Radio-Range
VTs	Vessel traffic service
YCDC	Yangon City Development Committee
YIA	Yangon International Airport

## Chapter 1 Introduction

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### 1.1 MYT-Plan Goals and Objectives

Under the capable leadership of His Excellency President U Thein Sein, Myanmar is strengthening its economic policies to take advantage of the social and economic growth potential of an open market economy. While the transport sector has a key role in fostering this economic growth, advancing social development, especially in terms of the infrastructure, will also be needed to capitalize on regional trade opportunities. These policy reforms are important to realizing this growth potential, but success will also require the coordinated and sustained upgrading of the country's transport infrastructure, facilities, and skilled human resources.

To support domestic reforms in the transport sector, Myanmar is leveraging its role as host nation for the ASEAN Summit in 2014 and is looking forward to 2015, when the ASEAN Community will be economically integrated. Myanmar is eager to seize upon the growth opportunities provided by integration. The scale of growth in the region and the increase of foreign investment possibilities and infrastructure financing are helping in this regard. Myanmar's strategic location in the ASEAN region, its proximity to Bangladesh, China, India, Laos and Thailand, leave no doubt that Myanmar will play an important role in generating significant levels of regional GDP in the future. However, the possibilities for such growth mean that development of the country's transport sector should be an infrastructure priority, that will require investment in international airports, deep sea ports, inland waterways, strategic rail and highway networks and improvements in cross-border infrastructure and regional connectivity.

Against this backdrop, the Myanmar National Transport Master Plan (MYT-Plan) is designed to provide guidance for a long-term investment program that will help the Government achieve its economic growth targets by 2030. In addition, this Master Plan will provide guidelines that are adaptable to other industrial sectors and to private investment, to assist with investment planning and decision making for a variety of transport sector projects.

In this way, the Master Plan will influence the transport sector's development, by presenting a set of comprehensive policies relevant to all modes of transport, as well as development strategies for specific modes like road/road transport, rail, air, maritime and inland waterway, as well as the associated projects and activities that can help these modes achieve the Vision and its Objectives.

The Master Plan is designed to be read in conjunction with Myanmar's National Comprehensive Development Plan (NCDP), which describes the country's development vision and strategic goals. This transport Master Plan has been prepared with the NCDP in mind and will be updated in conjunction with the achievement of national development objectives, guided by the NCDP.

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## 1.2 Structure of the Transport Master Plan

The Myanmar National Transport Master Plan includes both policy and infrastructure components, which include planning elements designed to work within the National Comprehensive Development Plan's existing planning frameworks. These components include:

- Reference to related international frameworks (e.g. Brunei Action Plan, etc.)
- Demographic analysis and a demographic framework, including population projections
- Economic growth scenarios to forecast economic performance and prerequisites
- A National Spatial Development Framework
- A financial framework, indicating the levels of investment required as well as sector constraints
- An environmental framework to maintain and preserve Myanmar's natural and environmental assets for future generations
- A traffic demand forecast

These infrastructure and policy components recommend corridor-based infrastructure to overcome issues that hamper growth in the transport sector, such as a lack of coordination between the three transport agencies when projects are planned and implemented and weak investor commitment to spatial planning guidelines. To address these and other issues, the Master Plan recommends a set of transport infrastructure projects for development corridors, which will require a coordinated effort, by the relevant ministries for implementation.

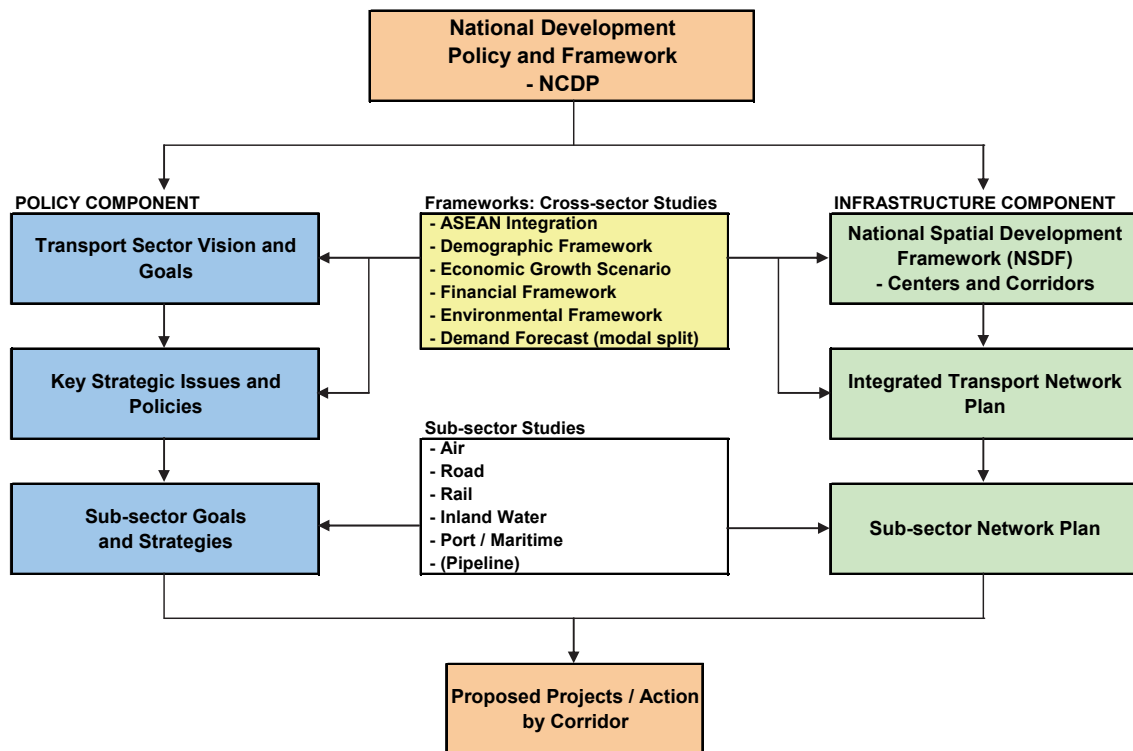


Figure 1.1 Structure of the Master Plan

### **1.3 Structure of the Report**

This Master Plan Report's 11 Chapters contain the elements needed to develop an Action Plan to implement the transport sector's vision to 2030. The Report begins with an Introduction that notes the opportunity and growth potential in Myanmar, if the transport sector is reformed and strengthened with legislative support. The balance of the Report, Chapters 2 through 11, include analysis, findings and recommendations that describe a path that can secure a positive future for Myanmar's transport sector.

Chapter 2 is a critical first step in realizing this future as it establishes the Socio-Economic Framework, used to supply analysis for the transport demand forecast and other elements of the MYT-Plan. This analysis is also needed to support the demand forecasts and policy strategies in later Chapters. The Socio-Economic Framework uses a cohort change methodology to analyze current demographic trends and future population estimates, both nationally and at state/region levels.

The Socio-Economic Framework also includes analysis of Myanmar's Gross Domestic Product (GDP) trends at the national and state/region levels, including forecasts through to 2040. These future GDP and Gross Regional Domestic Product (GRDP) forecasts consider a number of important factors, including future population growth, necessary levels of investment to achieve certain levels of GDP growth (e.g. fixed capital formation), and the transportation experiences of Myanmar's peer countries in the ASEAN region, including Japan.

A Macro Economic Framework in Chapter 2 includes analysis of Public Private Partnerships in Myanmar's transport sector. These agreements, between government and the private sector, are critical to achieving the necessary investment levels for Myanmar's transport sector. This Chapter provides an overview of PPPs, description of the regulations that facilitate private investment in Myanmar, a comparative overview of PPP projects in peer countries, as well as a way forward in applying PPP principles to MYT-Plan recommended investments.

Chapter 3 presents an Environmental Framework, including the environmental legal system that is currently under development in Myanmar. The Environmental Conservation Law, which is the core law for protecting and enhancing Myanmar's environmental sustainability, was issued in March 2012.

The Ministry of Environmental Conservation and Forestry (MOECAF) is currently preparing Environmental Conservation Rules, Environmental Impact Assessment (EIA) Procedures and environmental quality standards, with assistance from the Asian Development Bank (ADB). As of May 2013, Environmental Conservation Rules had been submitted to the President's Office and are expected to be enacted shortly, however, Conservation Rules and EIA Procedures will require longer implementation periods.

Chapter 4 describes the scope of the National Spatial Development Framework (NSDF) and includes an overview of Government Ministries and Agencies involved in spatial planning and related legislation. The Chapter also summarizes the key objectives and policies of relevant Ministries and Agencies with an interest in land development, based on employment, economic activity, agriculture and agro-industries, industry and industrial zones, Special Economic Zones (SEZ), tourism and the environment. The Chapter also analyses aspects of urbanization, via the proposed distribution of future populations at the state/region and Traffic Analysis Zone (TAZ) levels.

This analysis provides the basis for a NSDF in Myanmar. The NSDF will include a spatial development framework to support the MYT-PLAN, which will guide future transport investment at the national and state/regional levels. The NSDF will also inform key transport



sector stakeholders about linkages and connectivity among their own plans, policies and programs so these stakeholders can improve coherence and efficiently in implementing their plans, policies and programs.

Chapter 5 summarizes the current institutional framework, including the role of each Ministry and Agency related to the transport sector. This Chapter forms the base for the possible future re-organization or re-arrangement of the transport sector's authorities responsible for planning and administration.

Chapter 6 describes the role of the ASEAN Transport Agreement and sector-wide Transport Action Plan and explores strategies and actions for all transport sectors listed in the Brunei Action Plan, including priority actions for the Myanmar Government to take by 2015.

Chapter 7 provides an overview of the Myanmar transportation sector, including roads and road transport, railway, inland waterways and maritime facilities, and aviation. Each of these transport sub-sectors includes a Technical Note with analysis of sector funding and private sector participation, planning and coordination, resources and policies needed to implement and maintain, and safety and environmental considerations.

Chapter 8 explains the MYT-Plan's demand forecast for the transport sector, developed from demand and transport analysis and the socio-economic framework. This analysis is also used for numerical calculations and the projects recommended in Chapter 10.

Chapter 9 provides an overview of the key transport sector issues in Myanmar's transport policies, citing analysis by the Asia Development Bank, and conducts a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) for the sector nationwide. This analysis identifies key areas for consideration in terms of planning, operations, institutions and regulatory environment, pricing and resource allocation, and human and environmental considerations. The Chapter also describes proposals for a comprehensive Transport Sector Vision.

Chapter 10 recommends transport component projects, based on the proposed corridor cluster development approach. These proposals are designed to achieve the planned transport sector Vision and Objectives.

Finally, Chapter 11 of the Report summarizes financing requirements over the next fifteen years (until 2030) and includes recommended actions for the actual implementation of the MYT-Plan.

The Myanmar National Transport Master Plan is a timely and important initiative that will support Myanmar's economic growth, through reform and improvement of its transport sector. However, it is not a static document and is designed to be adapted to Myanmar's changing transport conditions. The Ministry of Transport will be responsible for updated and maintaining the accuracy of data contained in the Report, thus allowing the MYT-Plan to be a strategic and important tool for the transport sector for years to come.

## Chapter 2 Socio-Economic and Financial Framework

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This Chapter describes a Socio-Economic Framework that was developed for use throughout the Master Plan. It includes analysis for the transport demand forecast, which is needed to support the policy strategies in later Chapters.

Future population and employment growth in Myanmar will require additional transport services. As Myanmar's population and employment grows, there will be an increasing need to effectively manage the demand for transportation services and conduct advanced planning to ensure residents and employers can easily adapt to the enhanced services, before the expected population growth is in place.

This Socio-Economic Framework consists of two primary sections. The first is a comprehensive discussion of current trends and future population estimates. It uses the cohort change methodology to analyze current demographic, both nationally and at the state/region levels. The second section is a discussion of Gross Domestic Product (GDP) trends at these same levels, including forecasts through to 2040. This analysis includes influential factors like population growth, investment levels required to achieve certain levels of GDP growth (e.g. fixed capital formation), and the experiences of Myanmar's peer countries in the ASEAN region, including Japan.

The analysis includes possible alternative Fixed Capital Formation (FCF) scenarios in the transport sector relative to Myanmar's ASEAN peers, in order to identify the public investment capacity of the transport sector. The alternative FCF scenarios are compared to the total Fixed Capital Formation and government capital formation expenditure to determine the most appropriate alternative investment scenario for the transport sector. This Chapter also includes a section on the possible application of Public-Private Partnerships (PPP), needed to diversify transport investment in Myanmar.

The second section of this Chapter provides an overview of PPPs, existing regulations that facilitate private investment in Myanmar, a comparative overview of PPP projects in peer countries relative to possible projects in Myanmar, as well as a possible way forward in terms of how to apply PPP principles to investments recommended by the MYT-Plan.

Note that regional population and GDP forecasts are based on an assumed regional economic development scenario, which will be elaborated later in this section.

### **2.1 Demographic Framework**

#### **2.1.1 Analysis of Population Growth between 1990 and 2010**

Population growth projections, based on available Government of Myanmar data beginning in 1990, were used to develop demand forecasts for transport services, the 16-year planning period

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of the Master Plan, and the 10-year plan to 2040.

This Report makes estimates of Myanmar's demographic changes, at five-year intervals, between 1990 and 2010. Table 2.1 disaggregates this data by gender and age group and uses the results to develop Table 2.2, which illustrates the survival rates by gender and age group. For example, the survival rate of 5 to 9 year old males in 1990-95 (94.3%) is calculated by dividing the population difference between 5-9 year males in 1995 (2,501,000 persons) and 0-4 year old males in 1990 (2,652,000 persons) into the 0-4 year old population.

**Table 2.1 Population by Gender and Age Bracket (Thousand Persons)**

Age group	1990	1995	2000	2005	2010
<b>Male</b>					
0-4	2,652	2,769	3,050	3,278	2,933
5-9	2,398	2,501	2,759	3,020	3,044
10-14	2,317	2,428	2,531	2,768	3,001
15-19	2,233	2,296	2,456	2,538	2,881
20-24	2,017	2,102	2,312	2,449	2,749
25-29	1,737	1,894	2,110	2,299	2,557
30-34	1,464	1,667	1,900	2,097	2,331
35-39	1,188	1,411	1,669	1,886	2,091
40-44	932	1,192	1,408	1,652	1,832
45-49	759	965	1,181	1,384	1,573
50-54	671	801	945	1,149	1,299
55-59	593	664	772	905	1,060
60-64	478	538	623	721	822
65&+	776	999	1,191	1,394	1,550
Total of male	20,215	22,227	24,907	27,540	29,400
<b>Female</b>					
0-4	2,586	2,736	3,016	3,235	2,851
5-9	2,401	2,304	2,735	2,993	2,922
10-14	2,347	2,287	2,336	2,747	2,847
15-19	2,272	2,224	2,319	2,346	2,742
20-24	2,060	2,089	2,249	2,324	2,644
25-29	1,776	1,942	2,108	2,248	2,497
30-34	1,496	1,733	1,957	2,105	2,340
35-39	1,213	1,477	1,743	1,951	2,145
40-44	955	1,257	1,479	1,731	1,924
45-49	784	1,023	1,254	1,464	1,684
50-54	698	865	1,012	1,230	1,415
55-59	624	741	845	981	1,176
60-64	509	615	709	803	934
65-	850	1,224	1,456	1,698	1,936
Total of female	20,571	22,517	25,218	27,856	29,730
Total population	40,786	44,744	50,125	55,396	59,130

Source: Myanmar Statistical Yearbook 2011, Central Statistical Organization

Both Tables 2.1 and 2.2 highlight important features of Myanmar's population growth, including:

- The male and female populations under 4 years of age, gradually increased between 1990 and 2005; since then, this cohort has been in decline.
- Population estimates for all age groups, except those under 4 years old, grew continuously throughout the entire period, suggesting that survival rates have

exceeded 100% in some age groups, at different times. Normally, these outcomes cannot occur without in-migration from other countries and these data inconsistencies are likely attributable to inaccurate population estimates by census takers. As such, it was necessary to adjust survival rates to accurately estimate population forecasts.

- The survival rates for males and females are 99.8% (10-14 year olds) and 99.0% (35-39 year olds). Survival rates for both genders decline between 40 and 44 years but still remain relatively high (between 98.0 and 99.3%).

Myanmar's elderly population, those over the age of 65, has been steadily increasing over time, however the actual population growth rate has been in decline with both genders, as is described in Table 2.3.

**Table 2.2 Survival Rate by Gender and Age Bracket (Unit: %)**

Age group	1990-95	1995-00	2000-05	2005-10	Adjustment for population projection
<b>Male</b>					
5-9	98.8	99.9	99.8	98.2	98.2
10-14	100.2	100.2	100.1	99.8	99.8
15-19	99.8	100.2	100.1	101.0	99.8
20-24	98.8	100.1	99.9	102.0	99.9
25-29	98.7	100.1	99.9	101.1	99.9
30-34	99.2	100.1	99.9	100.3	99.9
35-39	99.3	100.0	99.9	99.9	99.9
40-44	100.1	100.0	99.8	99.3	99.3
45-49	100.7	99.8	99.7	98.8	98.8
50-54	101.1	99.6	99.5	98.4	98.4
55-59	99.8	99.3	99.1	98.0	98.0
60-64	98.1	98.7	98.6	97.6	97.6
<b>Female</b>					
5-9	97.7	100.0	99.8	97.5	97.5
10-14	99.0	100.3	100.1	98.8	98.8
15-19	98.9	100.3	100.1	100.0	99.8
20-24	98.3	100.2	100.0	103.0	99.9
25-29	98.8	100.2	100.0	101.8	99.9
30-34	99.5	100.2	100.0	101.0	99.9
35-39	99.7	100.1	99.9	100.5	99.9
40-44	100.7	100.0	99.9	99.7	99.7
45-49	101.4	100.0	99.8	99.3	99.3
50-54	102.0	99.8	99.6	99.2	99.2
55-59	101.2	99.5	99.4	98.9	98.9
60-64	99.7	99.1	99.0	98.8	98.8

Source: JICA Study Team

**Table 2.3 Population Growth Rates for the Over-65 Age Bracket (Unit: %)**

(Unit: %)

Gender	1990-95	1995-00	2000-05	2005-10
Male	5.2	3.6	3.2	2.1
Female	7.6	3.5	3.1	2.7

Source: JICA Study Team

Notably, the growth rates among Myanmar's elderly population have fallen by as much as two to three times over the last 20 years.

Table 2.4 illustrates changes in Myanmar's Child to Women Ratio (CWR) and Total Fertility Ratio (TFR) since 1990. This analysis is used as a measure of the 'demographic health' of Myanmar and hence, demand for future transport services. The ratios reflect fertility and morbidity rates and the likelihood that children born will reach adulthood, as well as family size. The CWR is the ratio of the number of children under 5 years to the number of women between the ages of 15 and 44 years of age. For 1990, the CWR (0.536) was calculated by dividing the number of males and females under the age of five (5,238,000 persons) by the number of females between the ages of 15 to 44 years of age (9,772,000 persons) during that same year. The TFR is the total average number of children a woman will bear during her lifetime. For the purposes of this Study, the TFR is calculated by multiplying the CWR by a factor of six, which represents the number of five-year age brackets between the ages of 15 and 44.

**Table 2.4 Changes of Child Woman Ratio and Total Fertility Ratio since 1990**

	1990	1995	2000	2005	2010
CWR	0.536	0.513	0.512	0.513	0.405
TFR	3.22	3.08	3.07	3.08	2.43

Source: JICA Study Team

Since 1990, both the CWR and TFR have been in continuous decline. In 1990, the CWR was at 0.536 and by 2010, the rate had dropped to 0.405, a decline of more than 32%. Since the CWR serves as the basis for the TFR, the TFR has also declined at the same rate. As a result, economic and long-range forecasts and growth estimates project slower growth for transport services.

### 2.1.2 Population Projections through 2040

Before carrying out the population projection, the following considerations are important to note:

1. For people between the ages of 5 and 64, the survival rate in 2010 is used to forecast each five-year age bracket. However, as some survival rates exceeded 100% in as described in the section 2.1.1, these survival rates have been adjusted as indicated in the right-most column in Table 2.2.
2. For people 65 years of age and above, the forecast assumes that the population growth rates in this age bracket will continue to decline, as described in Table 2.5.

**Table 2.5: Forecast Population Growth Rates for the Over-65 Age Bracket, 2010-2040**

(Unit: %)						
Gender	2010-15	2015-20	2020-25	2025-30	2030-35	2035-40
Male	1.9	1.7	1.5	1.3	1.1	0.9
Female	2.5	2.3	2.1	1.9	1.7	1.5

Source: JICA Study Team

The most important factor in forecasting future population is the change in the number of births, which is expressed as a change in the CWR for purpose of this Study. The following three scenarios have been analyzed regarding the possible future changes in the CWR.

- **High Growth Scenario:** The CWR will maintain the 2010 level (0.405) through 2040 with an equivalent TFR of 2.43 for the duration of the forecast period.

- Middle Growth Scenario: The CWR will decrease by 0.02 every five years, declining from 0.385 in 2015 to 0.285 in 2040. Under this scenario, the TFR will decrease from 2.31 in 2015 to 1.71 in 2040.
- Low Growth Scenario: The CWR will decrease by 0.03 every five years, declining from 0.375 in 2015 to 0.225 in 2040. Under this scenario, the TFR will decrease from 2.25 in 2015 to 1.35 in 2040.

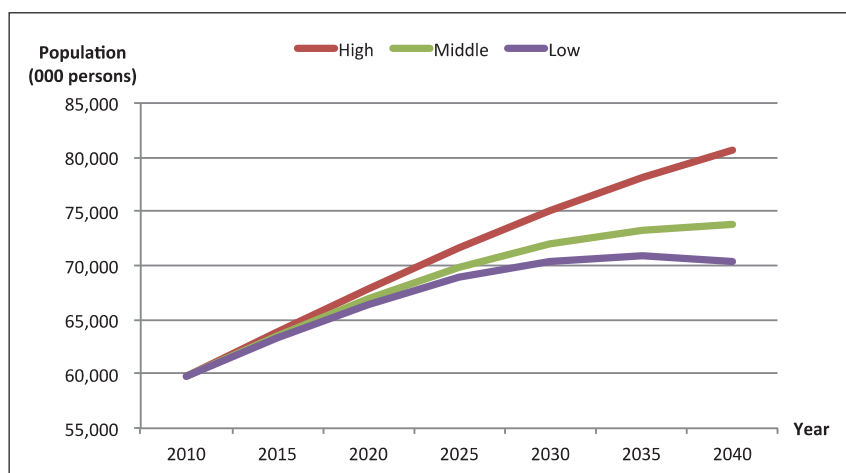
**Table 2.6 Changes of Child Woman Ratio and Total Fertility Ratio in the future**

Scenarios		Projection					
		2015	2020	2025	2030	2035	2040
High Growth	CWR	0.405	0.405	0.405	0.405	0.405	0.405
	TFR	2.43	2.43	2.43	2.43	2.43	2.43
Middle Growth	CWR	0.385	0.365	0.345	0.325	0.305	0.285
	TFR	2.31	2.19	2.07	1.95	1.83	1.71
Low Growth	CWR	0.375	0.345	0.315	0.285	0.255	0.225
	TFR	2.25	2.07	1.89	1.71	1.53	1.35

Source: JICA Study Team

Figure 2.1 illustrates the three alternative population growth scenarios based on the above parameters. In the High Growth scenario, Myanmar's population will grow at an average annual rate of 1.0% and number about 81 million people by 2040. In the Low Growth scenario, the population is expected to be 70 million, growing by about 0.5% annually. Notably, this scenario estimates that the population will peak at 71 million in 2035, and then begin to decline to 70 million by 2040.

The High Growth scenario assumes a constant CWR (and thus TFR) for a 30-year period, which will be very difficult to maintain owing to changing socio-economic conditions experienced in the face of expected rapid economic growth. At the same time, the Low Growth scenario assumes that the TFR will drop to extremely low levels, more commonly found in advanced nations like Japan. As such, and despite rapid economic development, it is unlikely that Myanmar will achieve a similar socio-economic profile to Japan. Given the identified weaknesses of these two scenarios, the Middle Growth scenario has been selected as the most likely option to serve as the baseline for the downstream planning work. Table 2.7 indicates the population projections by gender and age group for the Middle Growth scenario from 2015 to 2040.



Source: JICA Study Team

**Figure 2.1 Alternative Population Growth Scenarios**

**Table 2.7 Population Projection by Gender and Age Group (Middle Scenario)**

	2015	2020	2025	2030	2035	2040
<b>Male</b>						
0-4	2,788	2,809	2,782	2,685	2,535	2,365
5-9	2,879	2,737	2,758	2,731	2,635	2,488
10-14	3,039	2,875	2,733	2,753	2,726	2,631
15-19	2,995	3,033	2,869	2,727	2,748	2,721
20-24	2,879	2,993	3,031	2,867	2,725	2,746
25-29	2,746	2,875	2,989	3,027	2,863	2,722
30-34	2,556	2,744	2,874	2,988	3,026	2,862
35-39	2,329	2,554	2,742	2,872	2,985	3,023
40-44	2,076	2,312	2,535	2,723	2,851	2,964
45-49	1,810	2,051	2,284	2,504	2,689	2,816
50-54	1,548	1,781	2,018	2,248	2,465	2,647
55-59	1,273	1,517	1,746	1,978	2,204	2,416
60-64	1,035	1,243	1,481	1,704	1,931	2,151
65 +	1,703	1,853	1,996	2,129	2,249	2,363
Total Male Population	31,656	33,378	34,838	35,936	36,633	36,916
<b>Female</b>						
0-4	2,710	2,731	2,704	2,610	2,464	2,299
5-9	2,779	2,642	2,662	2,636	2,544	2,402
10-14	2,886	2,745	2,609	2,629	2,603	2,512
15-19	2,840	2,879	2,738	2,603	2,623	2,597
20-24	2,740	2,838	2,877	2,736	2,601	2,621
25-29	2,642	2,738	2,836	2,874	2,734	2,599
30-34	2,495	2,639	2,735	2,833	2,872	2,731
35-39	2,337	2,491	2,636	2,732	2,829	2,868
40-44	2,138	2,329	2,483	2,627	2,722	2,820
45-49	1,911	2,123	2,313	2,466	2,609	2,704
50-54	1,670	1,895	2,105	2,293	2,445	2,587
55-59	1,399	1,651	1,873	2,081	2,268	2,418
60-64	1,162	1,382	1,631	1,851	2,056	2,240
65 +	2,190	2,454	2,723	2,992	3,255	3,506
Total Female Population	31,898	33,537	34,925	35,962	36,624	36,902
Total Population	63,554	66,914	69,763	71,898	73,257	73,818
Annual population growth rate	1.5%	1.0%	0.8%	0.6%	0.4%	0.2%

Source: JICA Study Team

### 2.1.3 Population Forecast by Regions and States

In order to forecast future population distributions in line with the Middle Growth scenario outlined above, a series of key assumptions were established, largely pertaining to regional economic development prospects that consider when and why people migrate between Regions and States.

In the short term, between 2015 and 2025, major investments in infrastructure and industry in Yangon and southern Bago (and the ensuing economic growth) will be incentives that can attract large numbers of migrants from surrounding areas.

In the medium term (i.e. after 2025) it is expected that new investments will shift most rapid economic growth away from Yangon and accelerate migration to the Mandalay metropolitan area (including Sagaing City), as well as to designated Special Economic Zones (SEZ) such as Kyaukphyu (Rakhine State) and Dawei (Tanintharyi Region), where the bulk of these investments are expected to be made. Table 2.8 identifies the changes to region/state-wise populations, from 2012 to 2030.

**Table 2.8 Population Forecast by Regions and States from 2012 to 2040**

Regions/States	2012	2015	2020	2030	2040
Kachin State	1,616	1,721	1,820	1,935	1,973
Kayah State	365	391	424	450	460
Kayin State	1,855	1,986	2,151	2,401	2,496
Chin State	571	597	630	656	666
Sagaing Region	6,654	6,864	7,029	7,179	7,236
Tanintharyi Region	1,755	1,886	2,051	2,301	2,396
Bago Region	6,125	6,361	6,691	7,261	7,507
Magway Region	5,730	5,914	6,013	6,113	6,151
Mandalay Region	7,423	7,685	7,949	8,370	8,617
Mon State	3,193	3,324	3,489	3,846	3,998
Rakhine State	3,370	3,501	3,666	4,016	4,130
Yangon Region	7,170	7,617	8,739	10,445	11,015
Shan State	5,779	5,963	6,128	6,378	6,473
Ayeyarwaddy Region	8,205	8,520	8,685	8,864	8,902
Naypyitaw Council Territory	1,164	1,269	1,434	1,684	1,779
Total	60,976	63,600	66,900	71,900	73,800

Source: Population Department, Ministry of Immigration and Population (2012) and JICA Study Team

## 2.2 Macro-Economic Framework

### 2.2.1 Economic Context within ASEAN and the GMS

Myanmar is a member of two important organizations that encourage regional coordination and cooperation in a wide variety of social and economic fields. The Association for Southeast Asian Nations (ASEAN) was established in 1967 to advance economic growth, social progress, cultural development, and the protection of peace and stability in the region. There are currently ten member countries in ASEAN including Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

Early in the development of ASEAN, a Common Effective Preferential Tariff Scheme (CEPT) was adopted to promote the free flow of goods between member nations. In 1992, a more comprehensive scheme was adopted, known as the ASEAN Free Trade Agreement (AFTA). As



the number of members grew and the needs of member countries changed, the organization developed an ASEAN Economic Community (AEC), which is scheduled to be implemented in 2015. The primary objectives of the AEC are to create:

- A single market and production base
- A highly competitive economic region
- A region of equitable economic development
- A region fully integrated into the global economy

Table 2.9 indicates economic integration among four regional trade regimes: ASEAN Economic Community, the European Union (EU), an Economic Partnership Agreement (EPA), and a regional Free Trade Agreement (FTA). The AEC promotes deeper economic integration, further than the FTA but not as much as the EU's economic regime. The AEC includes no common external tariff system and its liberalization of services, trades, investment, free movement of labor and competitive environment are lower than those of the EU. The depth of economic integration under AEC could be called "FTA plus", or close to the common form of the EPA. Even so, it is expected that the production network of the ASEAN Economic Community would be strengthened and deepened, with the freer movement of goods and investment.

**Table 2.9 Comparison of Coverage Area Among AEC, EU, EPA and FTA**

Items	AEC	EU	EPA	FTA
Elimination of tariff	A	A	A	A
Common external tariff	C	A	C	C
Elimination of non-tariff barrier	A	A	B	B
Liberalization of service trade	B	A	B	C
Standardization and cross certification	B	A	B	C
Free flow of labor	B	A	B	C
Trade facilitation	A	A	A	B
Free flow of investment	A	A	B	C
Government procurement	C	A	B	C
Intellectual property rights	A	A	A	C
Competition policy	B	A	B	C
Harmonization of tariff system	C	B	C	C
Regional cooperation	A	A	A	C
Common currency	C	A	C	C
Limitation of sovereignty	C	B	C	C

Note: A: Covered, B: Partly covered, C: Not covered

Source: "What is ASEAN Economic Community –reading AEC blueprint-"  
International Trade and Investment, No. 72 Summer 2008

ASEAN has established an "AEC Blueprint" that outlines the necessary steps and actions that each member nation must take to prepare for AEC implementation in 2015. While the Myanmar government is working to prepare for this implementation, a "Mid-term Review of the Implementation of AEC blueprint" was prepared by the Economic Research Institute of ASEAN and East Asia (ERIA) in October 2012 and advises that the government still faces major challenges in the lead up to implementation. The Review identified challenges that include the need for a range of efficiencies, include in: institutions that handle financial services, trade facilitation, investment promotion and facilitation, standards and conformance systems, mutual recognition arrangements, intellectual property rights legislation, agricultural development, small and medium enterprise promotion, etc.

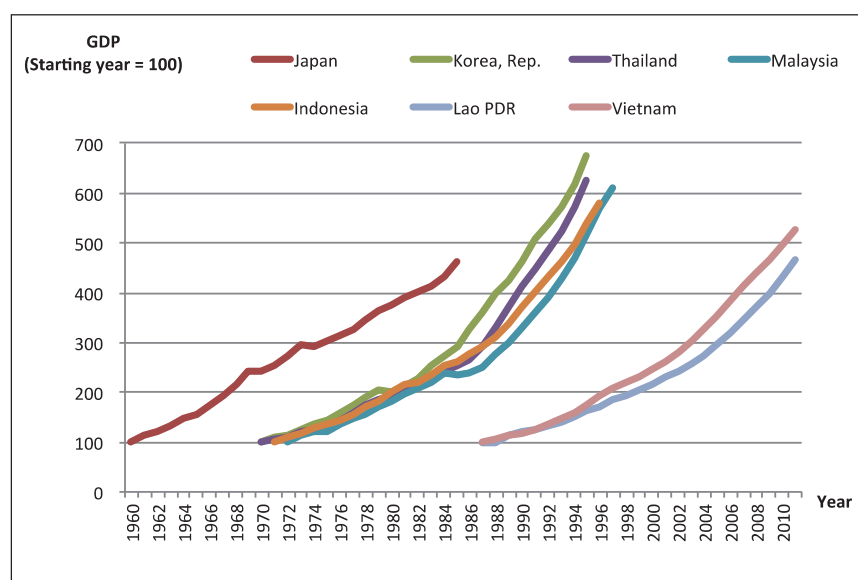
ASEAN member countries are supportive of initiatives that bring people, goods, services and capital closer together to create more competitive and resilient regions. As such, and in order to support the AEC, member countries drafted a “Master Plan on ASEAN Connectivity (MPAC)” in 2010. The Master Plan aims to increase economic growth by promoting investment in key infrastructure projects in the ASEAN region, including completion of the ASEAN Highway Network (AHN) and the creation of an ASEAN Broadband Corridor (ABC), both of which will be very important to Myanmar’s economic growth success in the future.

A second regional coordination initiative, the Greater Mekong Subregion (GMS), exists within ASEAN. Established in 1992 by the Asian Development Bank (ADB), the GMS consists of Cambodia, Laos, Myanmar, Thailand, and Vietnam as well as Yunnan Province and the Guangxi Special Autonomous Region (SAR) in southern China. The ADB has continuously supported a wide range of policies and investments that encourage social and economic development within the region. With respect to Myanmar, the most important GMS initiative to date is the Cross-Border Trade Agreement (CBTA), which promotes the integration of production and supply chain processes in the region and is designed to facilitate intra-regional flows of goods and the designation of key Economic Corridors that connect major cities and economic centers within the GMS, four of which are partially (or wholly) located in Myanmar.

## **2.2.2 Economic Growth Scenarios**

In 2011, Myanmar’s Government began enacting a wide range of political and economic reforms, which have helped Myanmar position itself as the last frontier in Asia for important foreign investment, owing to the country’s large population and vast natural resources. As the Government’s reformation process continues, most Western nations, including the United States and European Union, have been lifting, and in some cases completely removing economic sanctions, which are generating robust economic activity in the country. As more reforms are undertaken, Myanmar will become an even more attractive investment destination leading to strong and rapid economic development. Supporting this notion is a recent ADB report entitled “Myanmar in Transition” that describes how “Myanmar could grow at 7%–8% per year for a decade or more and raise its per capita income to \$2,000–\$3,000 by 2030.” In addition to the ADB report, Myanmar’s President H.E. U Thein Sein has set a target of annual GDP growth rate at 7.7% per year, for the current five-year development plan.

In order to determine whether such rapid, long-term growth is feasible, this Report includes analysis of economic growth in peer Asian countries, including the Republic of Korea, Thailand, Malaysia and Indonesia and Vietnam. By observing 25-year cycles of rapid growth, the analysis suggests that these peer countries experienced GDP growth rates of between five and seven times (relative to the base year); this is described in Figure 2.2. Based on this analysis, it is highly probable that Myanmar has the potential to achieve such rapid economic development over the next three decades.



Source: JICA Study Team

**Figure 2.2 25-Year Economic Growth Trends in Peer Asian Countries**

In order to estimate Myanmar's future Gross Domestic Product, the following three alternative economic growth scenarios have been considered, which are also described in Table 2.10 and Figure 2.3.

- **Scenario 1 - High Growth**

This scenario is based on the GDP growth target identified by H.E. President U Thein Sein, which seeks to achieve long-term annual GDP growth of at least 7.7% per year. The scenario assumes that annual growth will reach 7.7% by 2015 and continue growing at the same rate through 2035. It is expected that new and ongoing Foreign Direct Investment (FDI), public and private investment in infrastructure and additional future private investment will help sustain this growth. In this scenario, Myanmar's GDP will increase by about six times by 2035.

- **Scenario 2 - Medium Growth**

In this scenario, the GDP growth rate will increase to 7.2% by 2015, 0.5% lower than in the High Growth scenario and sustained at this level from 2014 to 2035. At this rate of growth, GDP will double every ten years, but fall slightly behind the six-fold growth experienced in some peer countries.

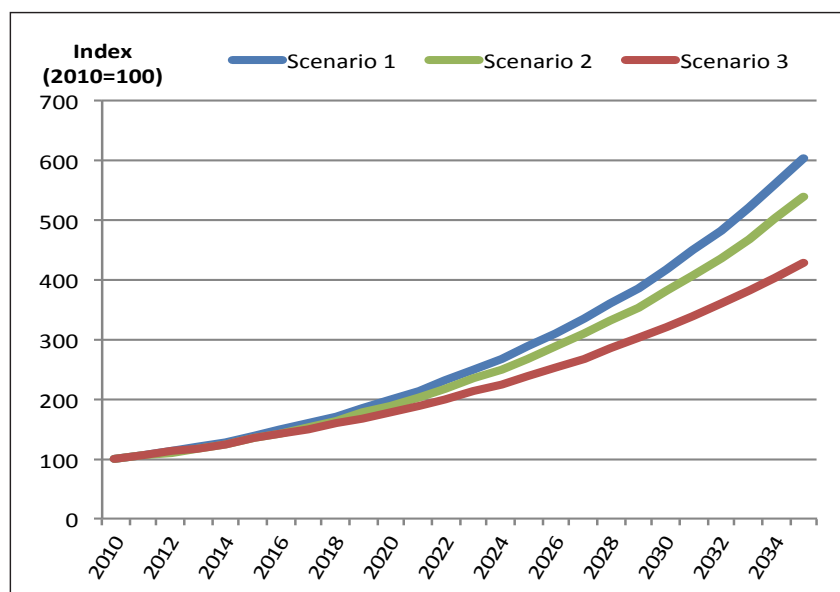
- **Scenario 3 - Low Growth**

This scenario is based on the IMF's debt sustainability analysis of Myanmar in 2011. In the IMF analysis, annual GDP growth rates from 2014 to 2031 were set at 6.0%. The Report's analysis assumes this level of growth will be maintained through 2035. As 6.0% future annual growth is similar to economic growth since 2010, this scenario can also be considered the "trend line" scenario.

**Table 2.10 Annual GDP Growth Scenarios (Unit: %)**

Scenarios	2010	2011	2012	2013	2014	2015-35	Annual average growth rate 2011-35
1) High	5.3	5.3	6.3	5.9	6.5	7.7	7.5
2) Medium	5.3	5.3	6.3	5.9	6.5	7.2	7.0
3) Low	5.3	5.3	6.3	5.9	6.0	6.0	6.0

Source: figures from 2010 to 2013 come from the IMF 2011 Article IV Consultation Report (IMF Country Report No.12/104), and figures from 2014 and 2015-35 are calculated by JICA Study Team



Source: JICA Study Team

**Figure 2.3 Economic Growth Scenarios**

In order to find a practical GDP growth scenario, the analysis calculated the necessary amount of Gross Fixed Capital Formation (GFCF)<sup>1</sup> required to achieve the GDP growth targeted in each scenario. This analysis uses an Incremental Capital-Output Ratio (ICOR), calculated using the following formula:

$$\begin{aligned}
 ICOR &= \frac{\text{increase in capital}}{\text{increase in GDP}} = \frac{\text{investment/GDP}}{\text{increase in GDP/GDP}} \\
 &= \frac{\text{percentage of investment to GDP}}{\text{GDP growth rate}}
 \end{aligned}$$

The calculations suggest that Myanmar's ICOR is 3.1 during the period between 2008 and 2010, as indicated in Table 2.11 below.

<sup>1</sup> Gross Fixed Capital Formation is the total investment consisting of both private sector and public sectors. It includes public investment, investment in plant and equipment, housing investment, etc.

**Table 2.11 Annual Myanmar's ICOR from 2008 to 2010 (Unit: %)**

Year	GDP Growth Rate	Share of Fixed Capital Formation
2008	5.5	12.9
2009	3.6	14.7
2010	5.1	16.8
Average of 2008-10	4.7	14.8
Myanmar's ICOR	-	3.1

Source: GDP growth rate is extracted from IMF World Economic Outlook Database October 2012, Share of fixed capital formation is extracted from ADB Key Indicators 2012

As indicated in Table 2.12, the ICOR levels tend to gradually increase over time. This increase is inversely related to slowing GDP growth rates. For example, Thailand's ICOR increased from 2.4 in 1961-65 to 7.2 in 2006-10, while Malaysia's ICOR increased from 2.4 in 1961-65 to 4.9 in 2006-10. Both countries experienced rapid economic growth in the early and middle part of the period, but as time passed, GDP growth started to slow down (in real terms) and this has led to increasing ICOR levels.

Based on regional experience, it is expected that Myanmar's ICOR will gradually increase over time. For the purpose of this Report, the analysis assumes that Myanmar's ICOR will increase from 3.1 in 2010 to 5.0 in 2035.

Figure 2.4 illustrates the necessary amount of GFCF for each scenario, for the period 2011 to 2035. Table 2.13 indicates the share of GFCF to GDP in 2010, 2020 and 2030, and the cumulative amounts from the period between 2014 and 2030. At present, the ratio of GFCF to GDP in Myanmar is the lowest among its East and Southeast Asian peer countries, standing at only 16.8% in 2010. In order to reach the growth target, the following levels of GFCF are required:

- Scenario 1 - High Growth  
It is necessary to increase the GFCF to GDP ratio to 28.9% in 2020 and 35.0% by 2030.
- Scenario 2 - Medium Growth  
It is necessary to increase the GFCF to GDP ratio to 27.0% in 2020 and to 32.7% by 2030.
- Scenario 3 - Low Growth  
It is necessary to increase the GFCF to GDP ratio to 22.5% by 2020 and to 27.3% by 2030.

One of the major challenges facing Myanmar is how to rapidly increase GFCF, in the short term.

**Table 2.12 Changes in GDP Growth Rate and ICOR in Selected Asian Countries (Unit: %)**

	Japan		Korea, Rep.		Thailand		Malaysia		Indonesia		Cambodia		Lao PDR		Vietnam	
	GDPGR	ICOR	GDPGR	ICOR	GDPGR	ICOR	GDPGR	ICOR	GDPGR	ICOR	GDPGR	ICOR	GDPGR	ICOR	GDPGR	ICOR
1961–65	9.4	3.4	5.9	2.3	7.2	2.4	6.9	2.4								
1966–70	9.2	3.6	10.6	2.3	9.2	2.5	6.1	2.7								
1971–75	4.6	7.5	7.6	3.2	5.8	4.0	7.2	3.3								
1976–80	4.4	7.1	7.0	4.3	8.0	3.2	8.6	2.9								
1981–85	4.3	6.7	7.8	3.7	5.4	5.1	5.2	6.4	5.7	4.2						
1986–90	5.0	6.0	9.7	3.3	10.3	3.1	6.9	3.9	7.1	3.7						
1991–95	1.4	20.7	7.8	4.8	8.6	4.7	9.5	4.1	7.9	3.4						
1996–00	0.9	31.0	4.6	7.2	0.6	43.5	5.0	6.4	1.0	25.0	7.3	2.0			7.0	3.8
2001–05	1.2	19.1	4.5	6.4	5.1	4.9	4.8	4.8	4.7	4.4	9.4	1.9	6.2	3.1	7.5	4.3
2006–10	0.4	62.0	3.8	7.5	3.6	7.2	4.5	4.9	5.7	4.9	6.7	2.7	8.0	3.7	7.0	5.0

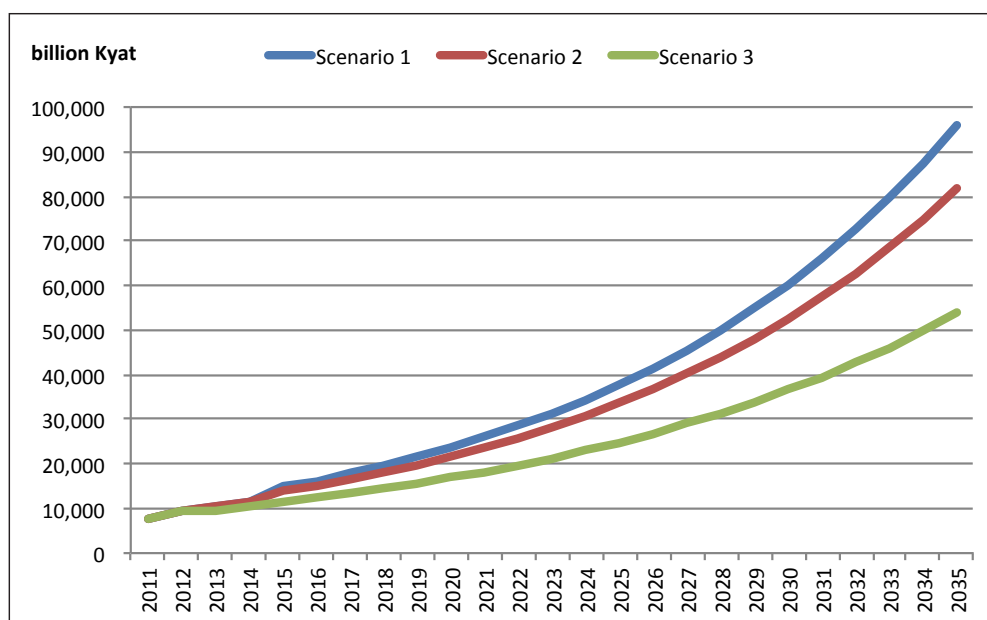
Note: Figures of Japanese ICOR after 1991 and Thai and Indonesian ICOR between 1996–00 are extremely high due to extreme economic slowdowns. The reason for the economic slowdown in Thailand and Indonesia was the Asian Financial Crisis, in Japan the cause was the collapse of the bubble economy and subsequent deflation.

Source: JICA Study Team

**Table 2.13 Required Ratio of GFCF to GDP and Accumulated GFCF Amounts**

Scenarios	2010	2020	2030	Accumulated amount 2014-2030 (trillion Kyat)
Scenario 1	16.8%	28.9%	35.0%	536
Scenario 2	16.8%	27.0%	32.7%	481
Scenario 3	16.8%	22.5%	27.3%	359

Source: figure in 2010 is from World Economic Outlook database; other figures are prepared by JICA Study Team.



Source: JICA Study Team

**Figure 2.4 Required Amount of Gross Fixed Capital Formation to Achieve GDP Growth Targets**

To encourage growth, the MYT-Plan selected the most practical and preferred GDP growth scenario from a combined assessment of GFCF and future population projections, which are the two most important inputs for economic growth. The 4th column of Table 2.13 shows how the required 2030 GFCF in Scenarios 1 and 2 are approximately double the ratio for 2010. This required rapid GFCF increase will be a major challenge for Myanmar, however other Asian countries that have experienced rapid economic growth have also recorded such high percentages.

Future population growth however, is strongly related to labor inputs and can have an impact on future economic growth. As indicated in the last row of Table 2.7, it is expected that the annual population growth rate will be less than 1.0% after 2020. In the short and medium term, it is expected that the labor population will increase, due to the mobilization of redundant workers in rural areas. However, the long-term effects of absorbing the redundant laborers into the workforce are expected to be small.

Considering the above, the Report estimates that Scenario 2, which targets more moderate economic growth with 7.0% of annual average growth rate from 2011 to 2035, is the most appropriate scenario for subsequent planning work.

### 2.2.3 Gross Regional Domestic Product by Regions and States

Myanmar's Gross Regional Domestic Product (GRDP) was last calculated in 2010 by the Department of Planning, within in the Ministry of National Planning and Economic Development (MNPED). Using these data in conjunction with regional economic development scenarios and the aforementioned population and macroeconomic growth forecasts, the MTY-Plan estimated the distribution of GDP by Region and/or State through 2030, which is described in Table 2.14.

**Table 2.14 Distribution of GRDP by Regions / States (Billion Kyat)**

Region/State	2012	2015	2020	2030
Kachin State	1,097	1,317	1,858	3,467
Kayah State	172	227	345	667
Kayin State	829	1,033	1,503	3,583
Chin State	154	182	253	542
Sagaing Region	5,508	6,320	7,731	12,320
Tanintharyi Region	1,679	2,084	3,260	7,280
Bago Region	4,027	4,700	6,581	14,124
Magway Region	4,631	5,171	6,582	9,660
Mandalay Region	5,186	6,245	9,302	21,364
Mon State	2,063	2,502	3,560	7,580
Rakhine State	1,856	2,244	3,420	7,676
Yangon Region	10,294	13,710	21,705	47,162
Shan State	3,373	3,753	4,929	9,185
Ayeyarwaddy Region	5,465	6,267	7,772	12,597
Naypyitaw Council Territory	581	810	1,280	3,290
Total	46,915	56,565	80,081	160,497

Source: JICA Study Team

### 2.2.4 Projection of Fixed Capital Formation in the Transport Sector

This Report identifies future investment needs in the transport sector by comparing the level of GFCF to total national investment capacity (total GFCF) in Asian countries. Table 2.15

describes the proportion of GFCF in the transport sector to GDP and to the total GFCF in selected Asian countries in 2003. The proportion to GDP figures have been extracted from a report entitled “Enhancing Regional Cooperation in Infrastructure Development Including that Related to Disaster Management” published by UNESCAP in 2006. The proportion of total GFCF has been calculated by JICA using GDP and GFCF data from the IMF’s “World Economic Outlook Database.”

**Table 2.15 Proportion of GFCF in the Transport Sector to GDP and to Total GFCF**

(Unit: %)

Country	Proportion to GDP	Proportion to total GFCF
Bangladesh	1.1	4.6
Cambodia	1.0	4.5
China	4.0	9.7
India	2.3	8.8
Indonesia	1.3	5.1
Mongolia	2.1	7.1
Thailand	3.9	15.6
Vietnam	6.0	16.9

Source: Figures of proportion of the FCF in the transport sector to GDP are extracted from “Enhancing Regional Cooperation In Infrastructure Development including that Related to Disaster Management,” by UNESCAP, and proportion to the total FCF is calculated by JICA Study Team

Table 2.15 lists ASEAN countries and proportion of GFCF. These countries can be classified in three distinct groups, based on the proportion of transport sector GFCF to total national GFCF; these are:

- Group 1 – Low Investment (around 5%): Cambodia (4.5%), Bangladesh (4.6%) and Indonesia (5.1%).
- Group 2 – Medium Investment (around 10%): Mongolia (7.1%), India (8.8%) and China (9.7%).
- Group 3 – High Investment (around 15%): Thailand (15.6%) and Vietnam (16.9%).

Table 2.16 describes recent changes in a wide range of economic indicators, including GFCF in the Transport Sector (Column 5) and total national GFCF (Column 6). Column (6) describes the proportion of Transport GFCF to Total GFCF indicates a steady decline in transport investment is evident. For example, in FY2004-05 and FY2005-06, while Nay Pyi Taw was under construction, the Transport GFCF to Total GFCF ratio reached 12.8% and 14.4% respectively. However, since most of the work in Nay Pyi Taw is now finished, this ratio has been declining and has held steady around 5% in recent years. Based on the lack of major transport investments in the last five years, this Report places Myanmar in Group 1 (Low Investment countries).

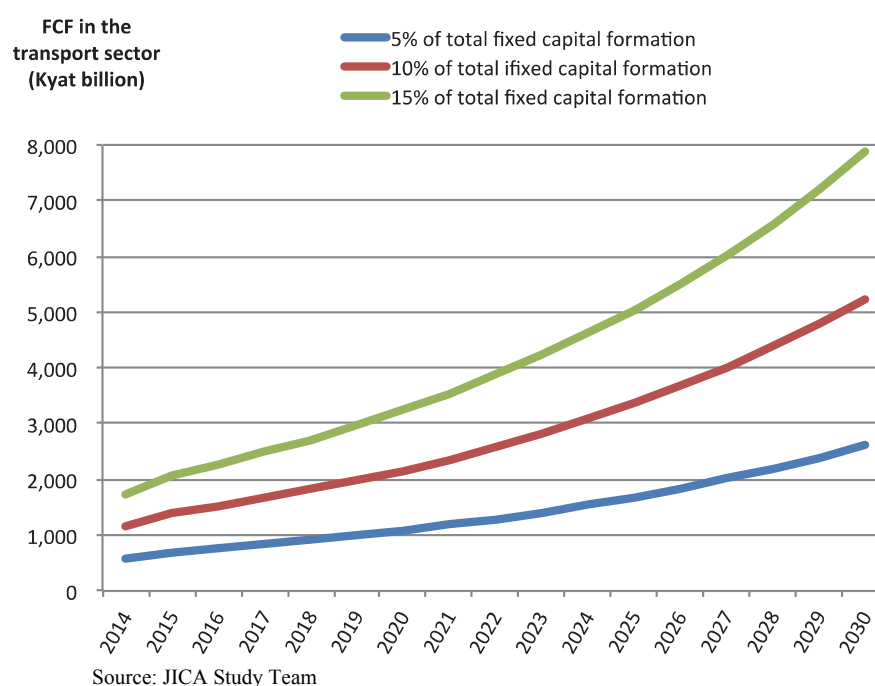
Figure 2.5 illustrates three possible transport sector investment scenarios, based on the aforementioned three peer country groups between 2014 and 2030. The Low Investment Scenario assumes that the ratio of Transport Sector GFCF (investment) will be 5% of total national GFCF under the GDP growth scenario 2. The second scenario assumes that this ratio will be 10% of national GFCF, in line with the Medium Investment country group. The third scenario assumes a ratio of 15%, in line with the High Investment countries like Thailand and Vietnam.



**Table 2.16 Proportion of GFCF in the Transport Sector to Total GFCF and to GCE in Myanmar (Billion Kyat)**

Fiscal Year	Nominal GDP	Total Fixed Capital Formation	Government Expenditure	Government Capital Expenditure	Fixed Capital Formation in the Transport Sector	Transport to Total GFCF (5)/(2) (%)
(0)	(1)	(2)	(3)	(4)	(5)	(6)
2004-05	9,078.9	1,207.5	1,693.0	733.5	154.3	12.8
2005-06	12,286.8	1,867.6	2,353.9	906.5	269.3	14.4
2006-07	16,852.8	2,359.4	3,693.5	1,274.0	177.7	7.5
2007-08	23,336.1	3,710.4	4,901.5	1,890.0	255.9	6.9
2008-09	29,233.3	5,057.4	5,314.9	2,033.6	244.3	4.8
2009-10	33,894.0	7,151.6	6,260.6	2,840.8	381.7	5.3
2010-11	39,846.7	10,081.2	7,506.9	3,575.3	352.3	3.5

Source: Myanmar Statistical Yearbooks 2010 and 2011, Central Statistical Organization



**Figure 2.5 Alternative Transport Sector Investment (GFCF) Scenarios**

In order for Myanmar to maintain a 5% share of Transport GFCF to total GFCF, the amount of investment required in 2014 would be 576 billion Kyat, which then rises to approximately 2.6 trillion Kyat by 2030. In the Medium investment scenario (10% ratio), the levels of required investment will increase to 1.2 trillion Kyat in 2014 and 5.3 trillion Kyat in 2030. If Myanmar targets the High investment scenario (15% ratio), the investment requirement will increase to 1.7 trillion Kyat in 2014 and 7.9 trillion Kyat in 2030. Table 2.17 shows the cumulative amount of required investment (GFCF) in the transport sector between 2014 and 2030.

**Table 2.17 Cumulative Required Transport Investment (GFCF) by Scenario from 2014 to 2030**

Ratio of Transport GFCF to total GFCF	Cumulative Required Investment (billion Kyat)
5%	24,034
10%	48,068
15%	72,103

Source: JICA Study Team

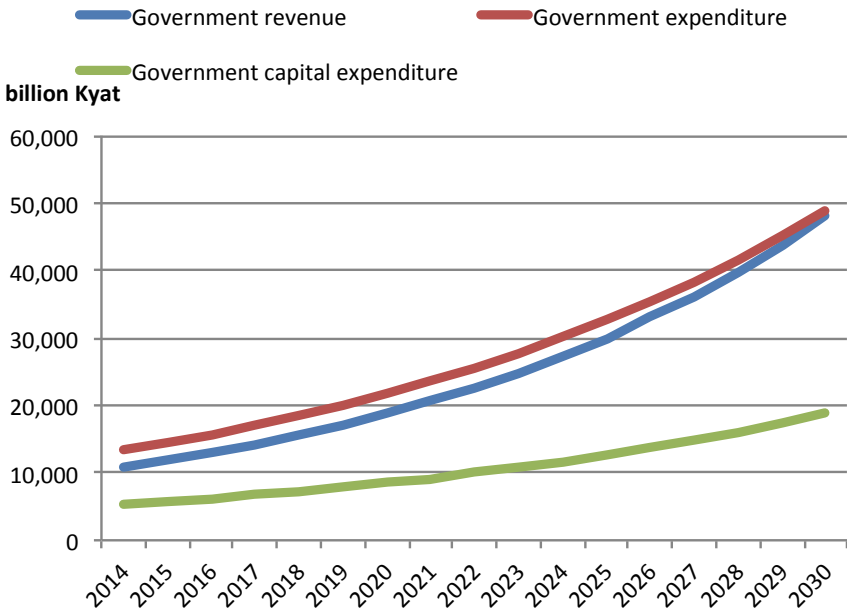
### 2.2.5 Funding Capacity of the Public Sector

In order to determine the appropriate amount of GFCF required in the transport sector, it is important to analyze and understand the impact of such investment on government expenditure and government capital expenditure.

Figure 2.6 illustrates government revenue, government expenditure and capital expenditure projections for the period between 2014 and 2030. These figures have been calculated using Table 2 of the IMF's "Myanmar Staff-monitored program" which was published in January 2013. According to the projections, Myanmar's budget deficit will amount to 5.0% of GDP in 2014 and decrease to 0.6% of GDP in 2030. During this same period, the proportion of government capital expenditure to total government expenditure will decrease from 39.5% in 2014 to 38.4% in 2030.

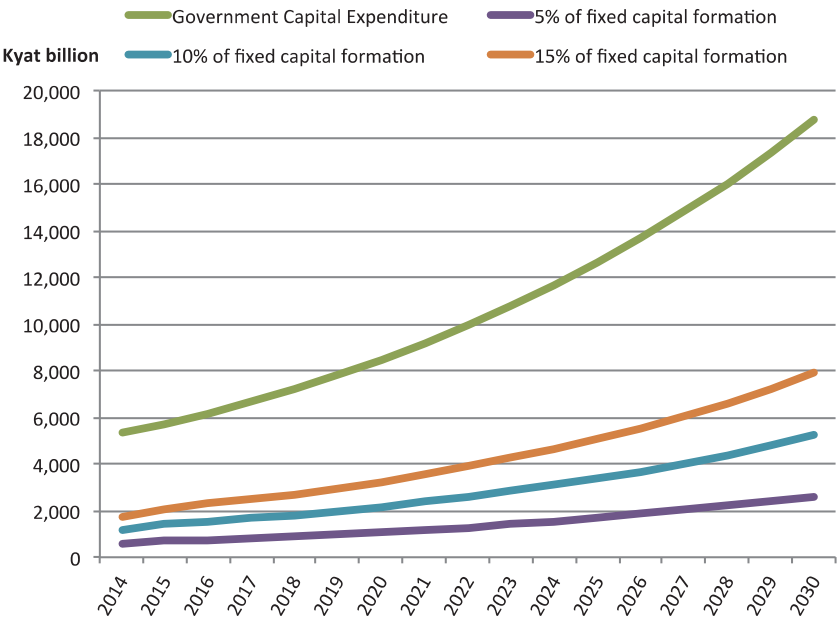
Figure 2.7 plots the government capital expenditure projections through to 2030, against the three transport investment scenarios under the GDP growth scenario 2 to illustrate the relationship of GCE to required levels of GFCF. If Myanmar continues to allocate 5% of total GFCF to the transport sector, the proportion of transport GFCF to GCE will be 10.9% in 2014, and gradually increase to 14.0% in 2030. To maintain the 10% ratio outlined in the Medium investment scenario, the level of required investment (GFCF) will amount to 21.8% of GCE in 2014, increasing to 27.9% by 2030. To maintain the 15% ratio required in the High investment scenario, the figures grow to 32.6% in 2014, which in turn increases to 41.9% in 2030.

In addition to the transport sector, Myanmar's Government must also invest in other infrastructure sectors, including power generation, transmission, and distribution, water supply and sanitation, telecommunications, etc. This Report has determined that these critical sector investments will require that the ratio of transport sector GFCF to total GCE be limited to around 30%. As a result, this analysis recommends that the Government increase the transport GFCF ratio from its current level of 4-5% to 10% as soon as possible and to make every effort to maintain this level through 2030. If the Government is successful, the cumulative investment required between 2014 and 2030 will be about 48 trillion Kyat, as noted in Table 2.17.



Source: Calculated by JICA Study Team from parameter of  
IMF’s “Myanmar Staff-Monitored Program (IMF Country Report No. 13/13)”

Figure 2.6 Government Revenue, Expenditure and Capital Expenditure Projections



Source: JICA Study Team

Figure 2.7 Projection of GCE and Alternative Transport GFCF Scenarios

### **2.2.6 Addressing the Need for External and Private Capital Investment in Transport**

According to the IMF's report entitled "Myanmar Staff-Monitored Program", Myanmar's national deficit is set at 5% of GDP. The report suggests that half of this deficit, which is expected to be 1.3 trillion Kyat (1.6 billion USD) in 2014, will be financed by foreign sources, including soft loans from international donors. These loans are a viable option for the Government to secure some of the needed financing for transport sector projects.

To achieve these required levels of investment, it will also be necessary to encourage investment from private sources, both foreign and domestic. One way to achieve this is to permit private investors to hold a 100% investment in certain projects or to arrange new investments through PPP agreements. Another option for financing is via domestic and foreign private financial resources. There is evidence to suggest that both private investments and PPP's are already underway in Myanmar's transport sector. However, implementing new PPP projects, especially large-scale transport projects, could be hampered with no existing legislation or regulations to govern PPP arrangements. Section 2.3 describes the current status and future potential of PPP projects in Myanmar.

## **2.3 Public-Private Partnerships in Myanmar's Transport Sector Development**

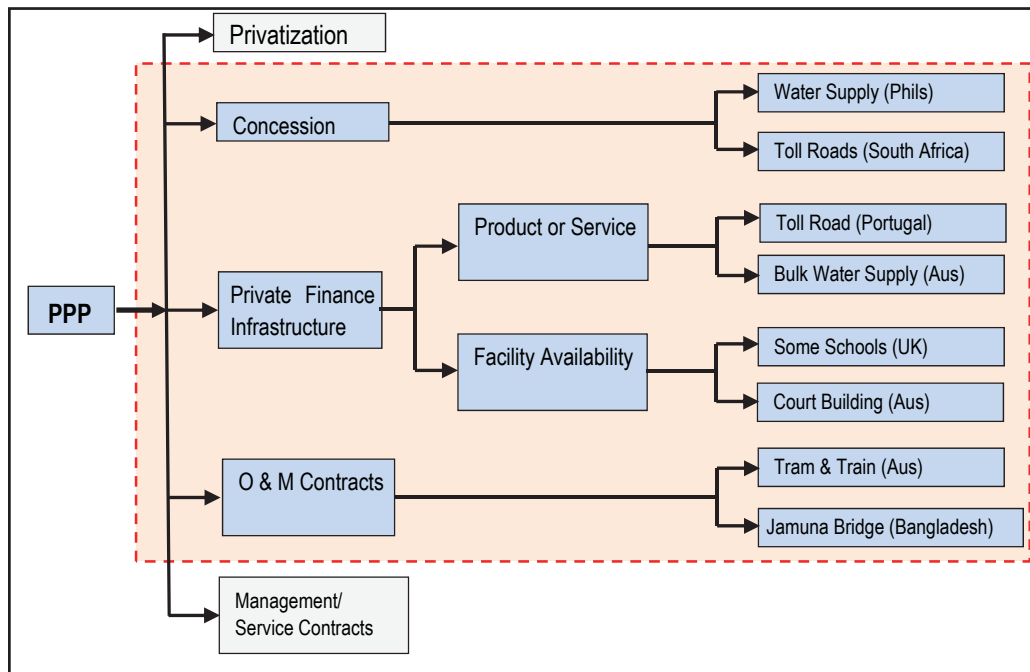
This section outlines the issues related to Public-Private Partnerships (PPP) as instruments to develop the transport sector in Myanmar, despite the country not actively encouraging PPP agreements, but instead viewing the involvement of the private sector as foreign investment. This Chapter includes a short definition of PPPs and an explanation of the several PPP variants. The Chapter concludes with a proposed direction for Myanmar and the PPP, after examining its potential in the five transport sub-sectors.

### **2.3.1 Different Forms of PPP**

#### **(1) PPPs defined**

A Public-Private Partnership (PPP) is defined as "a mutually-beneficial collaboration between public and private sectors, built on the expertise of each, in developing a country's (public goods) infrastructure, through the appropriate allocation of resources, risks, and rewards." A related description of the PPP is that it "involves a contract between a public-sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risks in the project. The cost of using the service is born by the users of the service, in full or in part. Government contributions to a PPP may be in kind, cash, tax break, or revenue subsidies for a fixed period."

As shown in Figure 2.8 below, Private Sector Participation (PSP) includes a broader scope, as compared to the PPP, although the two terms are often used interchangeably. Privatization, as well as service contracts, are legitimate forms of private sector participation, but generally considered beyond the PPP field.



Source: PPIAF/World Bank, “Public-Private Partnerships Units: Lessons for their Design and Use in Infrastructure”, (Oct 2007)

**Figure 2.8 Typical PPP Approaches**

## (2) PPP Modalities

There are a number of PPP modalities, depending on an agreement’s allocation of responsibility between the private and public sector; this is shown in Table 2.18 below. In the Build-Own-Operate (BOO) and Build-Operate-and-Transfer (BOT) privatization models, the private sector assumes the commercial or market risk (i.e. traffic volume or usage may differ from original expectations). However, in the Design-Build model, the private party assumes no commercial risk and is compensated, regardless of traffic. The service contract modality requires the least amount of responsibility and investment from the private party, because the asset or facility is built and financed by the government. The private sector operates and maintains the facility for a fee, which can be fixed or variable, depending on performance.

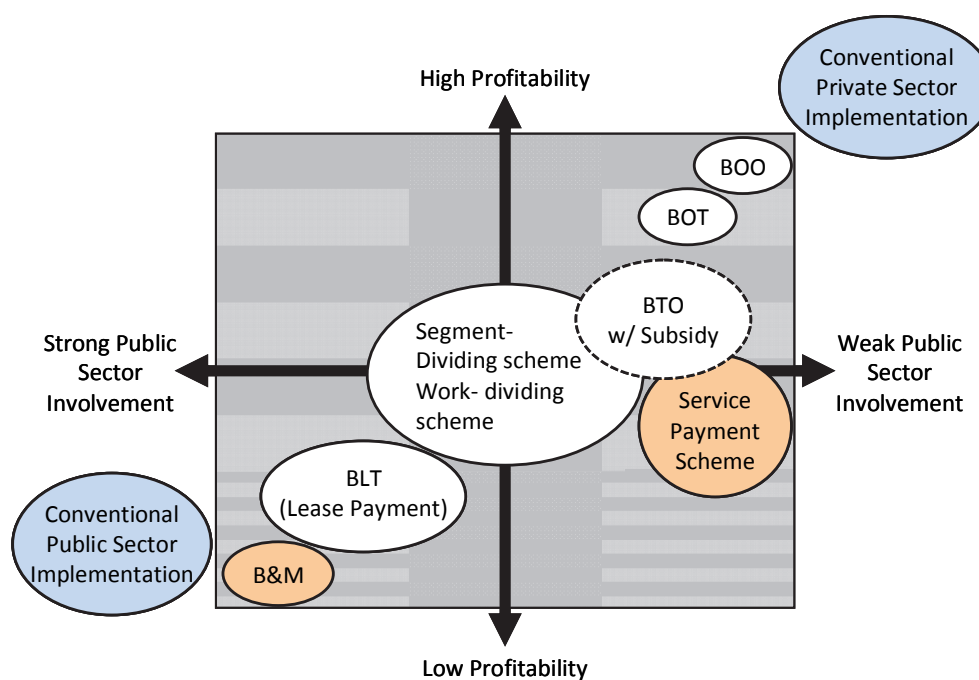
In the case of transport facility operation, such as railways and toll roads, financial viability is not always assured, especially when tariffs are set too low and traffic is also very low. In many developing countries, fares charged to passengers are often not sufficient to cover operating costs. Private sector investors tend not to risk capital on long-term BOO or BOT contracts, when their ability to adjust the fares is uncertain. The choice of PPP modality therefore, hinges on the specific circumstances surrounding the project.

Figure 2.9 illustrates when a particular modality is appropriate. A project that shows high profitability is suitable for a BOT or BOO modality and the risk exposure to the public sector partner is reduced considerably, provided it is long term (e.g. 25 years). Conversely, when the profit margins are very low or recorded as losses, the appropriate modalities are of the maintenance type or service contracts of short terms (e.g. 1-3 years), where the majority of risk remains with the government; this is very close to a conventional public sector implementation.

**Table 2.18 PPP Modalities and Risk Allocation**

Modalities	Operation & Maintenance	Commercial Risk	Capital Investment	Asset Ownership	Typical Duration
Build-Own-Operate	▲	▲	▲	▲	20-30 years
Build-Operate-Transfer	▲	▲	▲	▲ ■	20-30 years
Build-Transfer	■	■	▲	■	10-25 years
Build-Lease-Transfer	▲ ■	■	▲	▲	15-25 years
Design-Build	■	■	■	■	1-3 years
Design-Build-Maintain	▲ ■	■	■	■	1-5 years
Management Contract	▲ ■	▲ ■	■	■	3-5 years
Typical Concession	▲	▲	▲ ■	■	20-30 years
Divestiture/Privatization	▲	▲	▲	▲	Indefinite
Service Contract	▲ ■	■	■	■	1 year
<b>LEGEND</b> ▲ Private Sector ■ Public Sector					

Source: CTI / JICA, "Preparatory Survey for PPP Infrastructure Development Projects in RP", November 2010



**Figure 2.9 PPP Modality, Risk Sharing, and Profitability**

### **2.3.2 PPP Possibilities in Myanmar**

#### **(1) Indicative PPP Targets for Myanmar**

The Government of Myanmar has embraced the PPP as a strategy to expand and modernize its transport sector and one that can help promote the ambitious target of 7.7% annual growth in GDP for the next 5 years. To achieve this growth target and lift itself out of poverty and least developed status, Myanmar must make its own investment equivalent to 30% or more of its GDP. This will not be an easy task, given its low starting base of about 16% of GDP. The country is also hampered by a low tax effort (estimated at 4.1%, the lowest among ASEAN countries) and a domestic savings rate of less than 13% of GDP. Thus, the investment deficit is wide, in both the public and private sectors. As a result, the country must turn to foreign capital to cover the investment gap, which may come in the form of Foreign Direct Investment (FDI) and Official Development Assistance (ODA) from multilateral and bilateral institutions such as JICA, ADB and the World Bank.

In terms of the transport sector, the Government aims to increase investment to approximately 9% of GDP, which may be high given historic Government expenditures on transport have averaged 1% of GDP in the last five years. In comparison, peer Asian countries have averaged 2%-8% over the same period.

#### **(2) Legal framework and ongoing exercise**

Myanmar has no current laws specifically relating to PPP/PSPs for the infrastructure sector. The various Ministries involved in PPPs are using the Foreign Investment Law (FIL) of January 2013 as legal basis, which replaced previous regulations drafted in 1988. Ministries' use of the FIL is reasonable, as there is a shortage of local capital and skills. However, this also locks out foreign investors from PPP projects. As a result, this Report cannot determine which law applies to past contracts labeled as PPPs that involve local companies, such as those for the Nay Pyi Taw International Airport and the Mandalay-Lashio-Muse Highway.

The FIL permits foreign investment up to 100 percent, through joint ventures, or pursuant to a contract, with the latter applying to a PPP contract between a private company and a public agency. Similar to other businesses, the law requires infrastructure investment to be conducted through companies formed under the existing Myanmar law on companies. This also requires approval and the granting of an investment permit from the Myanmar Investment Commission (MIC), which includes the following features:

- Basic "guarantees" against nationalization
- Repatriation of invested capital and profits, may be remitted in the same currency upon expiry of the term of the investment contract
- Long-term leases of up to 50 years, extendable twice for further 10-year periods (i.e. to a maximum of 70 years)
- Enforcement of the "dispute settlement mechanism" in joint venture and investment agreements
- Tax holidays of five years, extendable to ten years as well as exemption from certain customs duties

The FIL also includes a list of areas where investment is prohibited or restricted. In terms of the transport sector, the Law limits foreign investment to a maximum of 80 percent of a joint-venture for infrastructure development and construction as well as air transportation

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services, which may also apply to companies involved in an infrastructure project. These regulations include explicit provisions for air transport services, such as prior governmental approval and a recommendation required from the Ministry of Transport in the selling and marketing of air transportation services. This may affect the planned privatization of Myanmar Airways.

The issuance of an investment permit includes a commitment to complete construction of new infrastructure project within an approved timetable, subject to a reasonable extension. If the time limits are exceeded for reasons other than force majeure, the Commission can cancel the investor's permit, without compensation. Transfer of interests in projects is also permitted, subject to approval, which can also be withheld.

A general overview of the sub-sectors is shown in Table 2.19, however, this analysis does not include consideration of the economic regulator or which government entity has authority to approve tariffs involved in concessionaire charges.



**Table 2.19 Summary of Situation by Transport Sub-Sector**

	AIR TRANSPORT	INLAND WATER	ROAD	RAILWAY	SEAPORT
OWNERSHIP					
Ministry	Min. of Transport (MOT)	Min. of Transport (MOT)	Min. of Construction (MOC)	Min. of Rail Transport (MORT)	Min. of Transport (MOT)
Infrastructure	Dept of Civil Aviation	Directorate of Water Resources & Improvement of River Systems	Department of Public Works	Myanma Railways (MR)	Myanma Port Authority (MPA)
Services	Myanma Airways (airline)	Inland Water Transport (IWT)	Road Transport Enterprise	Myanma Railways (MR)	Myanma Five Star Line
DEMAND					
Passengers	3.6 million domestic pax in 2012; 2.0m international pax	22 million pax in 2011	No information. Traffic on expressway is nil	67.6 million pax in 2011; using 248 pax-trains/day	No Data
Freight	No Data, Likely to be negligible	4.7m tons of cargo in 2011	Traffic survey is on-going at key corridors	3.3m tons in 2011; using 21 freight trains/day	No Data
SUPPLY	30 Domestic Airport	6,650 km of navigable rivers; 5 river network	142,395 km of roads; of which 18,740 are national	About 5,865 km route length	9 ports under MPA
	3 International Airport	More than 400 rivercrafts owned by IWT	39,241 km under the MOC	386 locomotives	No data on number of vessels
		Two jetties: Yangon & Patheingyi. No fixed structure in other river ports	432,504 vehicles + 1.9m MCs in 2011	1,252 pax coaches	
			Buses of various sizes, mostly private operated	3,311 freight wagons	
REGULATION	In all the transport sub-sectors, it is unclear which government body approves or decides the tariff or rates to be charged by users. This issue is critical in PPP contracts.				
PRIVATE SECTOR PARTICIPATION					
Plans	Corporatization of Myanma Airways with subsequent privatization	Private company interested in developing Patheingyi port to handle rice	Privatization of 82 roads (~4,590kms) is in the pipeline	To offer development of the Yangon suburban & circular lines to private sector	Development of deep seaport on the Andaman Coast. 4 candidate sites (Thilawa, Dawei, Sittwe, Kyaukphyu)
Current activities	Tendering is on-going for the development of 3 int'l airports (Yangon, Hanthawaddy, Mandalay) under PPP	No information	On-going privatization of road construction and maintenance; probably maintenance service contract		No information
Past & Present	Pioneer Aerodrome Services Ltd has 30-year O&M contract for Yangon Airport terminal, plus 60-year contract on Naypyidaw Export cargo terminal under Mingaladon Cargo Services Co. Ltd	Private operators are reportedly active in barging, leasing some of the river crafts from the government	It was claimed that the Mandalay-Lacio-Muse Highway was built on BOT basis at 30 year concession  60 roads (5,655kms) said to be contracted to 28 private companies	Sleeper factory is private	No information

Source: JICA Study Team

### **(3) Possibilities for PPPs in Myanmar Transport**

This Report identified the following assessments from the transport sector summary in Table 2.19.

**Toll Roads** – There will be limited opportunity for PPPs in the road sector, despite reports that several BOT projects are ongoing or completed. Available information suggests that these agreements are primarily service contracts or out-sourced construction works, fully financed by the government, as opposed to user fees from motorists to defray costs. Essentially, Myanmar has a very low motorization rate, about 7.5 vehicles per 1,000 people, which is lowest among ASEAN countries and less than one-half that of Laos, as well as low household incomes. These two indicators point to the limited-viability of toll roads via a PPP. The country's average GDP per capita, expressed in purchasing power parity, is only 47% that of Laos, 40% of Vietnam and 14% of Thailand.

**Railways** – The poor condition of the existing track infrastructure, even on the most-travelled segments (Yangon-Mandalay), plus the apparent lack of reforms from traditional railway stakeholders may be inhibiting PPPs in the sector, a situation that can be difficult to overcome in the near term. International experience indicates that a nation's railway sector can include PPPs if measures are taken to restructure, split or reform services and operations. This may also be the case for Myanmar Railways. A detailed study should be completed regarding the operations and businesses of Myanmar Railways, in order to identify services (such as freight) and sections (such as Yangon-Mandalay and Yangon Circular Rail) that can be unbundled and privatized, if this approach is deemed viable.

**Inland Waterways** – The prospect for PPPs in the development of river ports is less viable than with railways or roads, due to the fact that users are able to bypass ports and load/unload on landing points along the riverbanks, thereby avoiding port charges. Moving bulk cargo on waterways is more economical if it originates and is destined for points along the river. Such advantages do not exist for break bulk commodities. Traffic is dependent on the navigability of waterways, which in turn, is also subject to changes in climate and the ability of government to train and maintain the waterway infrastructure. Alternatively, private entities may engage in ferry and barging services.

**Seaport** – Based on international experience, PPP agreements and foreign investment are possible in the development and operation of container terminal ports, provided the port functions as the main gateway and the country is open to international trade flows. At the time PPP agreements are negotiated, companies may require sole provider assurances, until a certain threshold volume is reached. For a PPP to succeed, however, a prior feasibility study will be required. In addition, agreement would also be needed to define the obligations (such as roads, land, and civil works) for the Government.

**Airport** – Myanmar's airport industry may be the first industry to make use of the PPP approach due, in part, to the Government's eagerness to pursue simultaneous tenders for three international airports, each with a concession period of 30 years. The three projects, however, have significant differences in their risk profiles and investment scales. Yangon International Airport (YIA) is a brown-field project, therefore less risky, with existing traffic patronage and substantial asset base already in place. Its success will depend on an arrangement by the Department of Civil Aviation (DCA) with regard to the market to ensure YIA does not lose its international traffic when the new Hanthawaddy Airport (HIA) is built. YIA may also infringe on the existing 30-year contract with Pioneer Aerodrome Services Ltd. HIA is a green-field project with no history of demand and having a very small asset base. In addition, HIA suffers from lack of road access and is 77 kilometers from the city. Among the three projects up for

tender, Mandalay International Airport (MIA) appears to have the least risk. Demand forecasts for MIA show the airport has unused runway and terminal capacities. As a result, the concessionaire will not require large upfront investments. However, MIA's market is not as significant as that of the other airports.

### **2.3.3 PPP Processes in Myanmar**

If Myanmar is to achieve its desired social and economic growth and development targets, the transport infrastructure must improve and expand. In addition, the Government must encourage investment diversification to include other sectors such as health, education, rural development, etc. This, however, could leave the Government short of investment funds for transport infrastructure, due to competing demands on its budget.

If gaps continue to exist between the scale of required investment in the transport sector and the capacity of Government to mobilize funds from existing domestic sources, four options are available for the Government to bridge this gap:

- Raise taxes and/or improve tax collection efforts
- Secure more funds from ODA sources (e.g. JICA, ADB, IBRD, and other bilateral funders)
- Develop innovative financing schemes
- Attract private sector investments via Public-Private Partnerships (PPP)

The remainder of this Chapter focuses on the PPP option, with some analysis of innovative financing schemes as well. The Chapter reviews the projects that have already been contracted, as well as those on the current PPP agenda, and suggests measures about how to build from these earlier efforts and sustain PPP initiatives.

#### **(1) The Challenge**

As discussed earlier in this Chapter, the total required investment for transport infrastructure is estimated at 48 trillion Kyat from 2014-2030. This amount represents an increase from 1,155 billion Kyat in 2014 to 5,251 billion Kyat in 2030 in terms of government capital expenditure in the transport sector. Against these required investments is the current Government investment in the sector, which was 381.7 billion Kyat in 2009/10 and 352.3 billion Kyat in 2010/11. This demonstrates how addressing the gap between the need/demand for efficient transport infrastructure and the available financial resources is one of the major issues for Myanmar, now and in the future.

For many countries, one of the most common alternative financial resources possible is private investment. As indicated in Table 2.20, Myanmar's neighboring countries are already inviting private investment to partner on transport infrastructure. These investments can be grouped into three levels of private financing, in terms of % of private financing: 20 to 30% (Cambodia and Malaysia), 3 to 5% (China and Indonesia) and 1 to 2% (Thailand and Vietnam).

In Myanmar, there are currently very few projects in the PPP pipeline, except for the major projects planned for three airports, noted above. As mentioned, Myanmar does not yet have specific legislation regarding PPPs, and is using the existing Foreign Investment Law for these partnerships, despite the law being only generally applicable and not ideal for infrastructure. As well, Myanmar does not yet have basic principles for demarcation between public sector and private sector in law. Finally, Myanmar does not yet have a rating from international credit rating agencies, due to its long years of economic insularity. Domestic sources of long-term

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capital appear also to be in short supply. Myanmar will need time to develop appropriate legislation and institutional capacity to attract and capitalize on possibilities with PPPs. In addition, private investment alone is not sufficient to fill the gap between transport infrastructure demand and available government financial resource. Other financing will be needed to develop transport infrastructure, such as external financial supports (both grants and soft loans) from development partners.

**Table 2.20 Investment Targets in the Transport Sector**

	Cambodia	China	India	Indonesia	Thailand	Vietnam
(1) Percentage of transport investment in total investment (average of 2003-05)	5.0%	9.5%	7.6%	5.2%	14.2%	16.9%
(2) Percentage of private investment in transport sector in total investment (average of 2000-2012)	1.5%	0.3%	1.4%	0.2%	0.1%	0.3%
(3) Percentage of private investment in transport investment (2)/(1)	30.0%	3.2%	18.4%	3.8%	0.7%	1.8%

Source: JICA Study Team

According to investment projections provided by the Socio-Economic Framework (Chapter 2), the percentage of government budget deficit to GDP will decrease from 5.0% in 2014 to 0.6% in 2030. The annual average budget deficit amount will increase from 2.656 trillion Kyat in 2014 to 2.951 trillion in 2020, and then decrease to 947 billion Kyat in 2030. The financial resources of development partners could likely finance most of Myanmar's financial deficit until 2020. After 2020, the government financial deficit will be financed by both of the development partners and private investors.

## **(2) Positive Starts but not without Risk**

PPPs are not new to Myanmar. In fact, the government has tried the scheme in port development, road improvements, and airport transport infrastructure, despite not having appropriate legislation to support this type of investment.

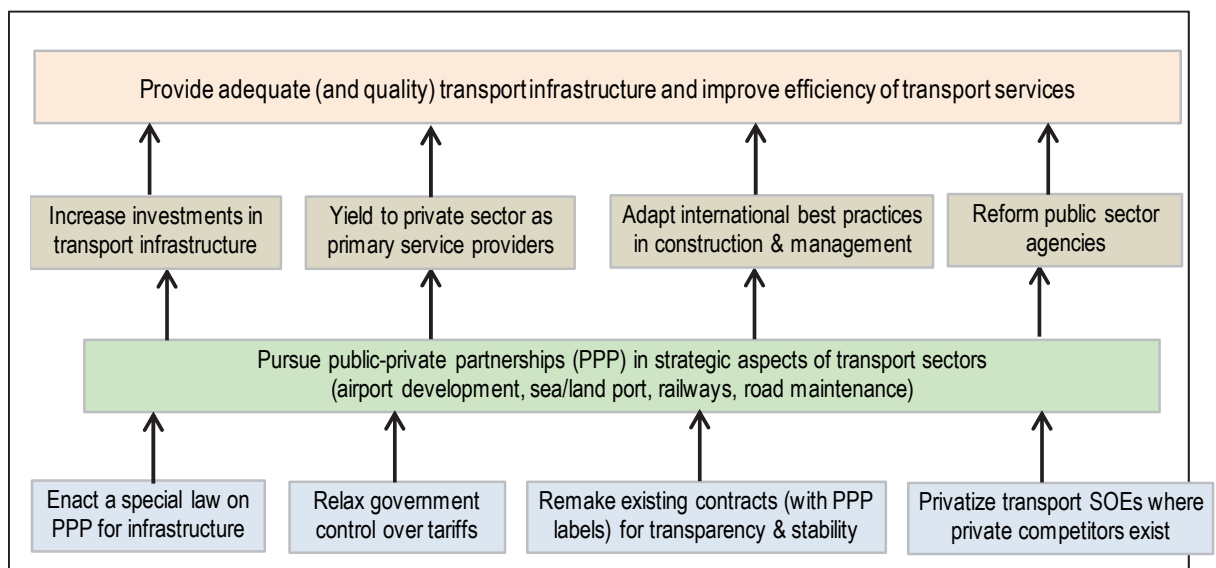
In the past, the Government has stated that it embraces a policy that encourages private sector participation in the development of transportation linkages under international cooperation frameworks such as ASEAN, GMS, ACMECS and BIMSTEC.<sup>2</sup> This position is echoed in official reports from the Department of Public Works on 61 road projects implemented under BOT schemes since 1996. The development of Thilawa port by Hutchison Port Holdings also involved private sector, although details are not available. The new international airport at Nay Pyi Taw was built with a combination of bilateral loans and a PPP. The most recent demonstration of the PPP policy, its most ambitious to date, was the tendering for the three international airports of Yangon, Hanthawaddy and Mandalay.

<sup>2</sup> Statement of Deputy Minister of MOC of the Union of Myanmar at the Ministerial Conference on Public-Private Participation for Infrastructure Development in Asia and the Pacific, October 2007, Seoul, Korea.

### (3) An Enabling Environment for PPPs

The possibility of the PPP to contribute to the achievement of transport development objectives may be illustrated by way of a means-ends tree (Figure 2.10). In addition to PPPs being a means to increase investment, they can also provide Myanmar with a means to acquire necessary technologies and management skills, which normally take time and training to develop in-house.

Governments may achieve skills and technological advantage more rapidly by outsourcing, something the PPP may also facilitate. The Department of Civil Aviation used this approach when they issued the Request for Proposal for the three airports. A key objective of this process allowed for the private sector to be engaged on operation and maintenance of the airport, achieving a higher standard of quality than what was possible under Government operation.



Source: JICA Study Team

**Figure 2.10 Means-Ends Tree for PPP in Myanmar Transport Sector**

As demonstrated in the above Figure, successful PPPs require an enabling environment to succeed. This Report recommends the following strategies to the Government to sustain PPPs in Myanmar:

- Enact a special law to support PPPs – The Foreign Investment Law (FIL) that is currently being used is not adequate for this purpose. Infrastructures are long-term physical assets that cannot be withdrawn once built, and therefore require a legal foundation for stable and long-term service. These assets include activities traditionally provided by government and classified as public utilities in most countries, whereas the FIL is focused on economic activities, generally outside the domain of the public sector.
- Liberalize government control over transport tariffs – The Government of Myanmar has historically held firm on tariffs of various transport enterprises, potentially set artificially low so as to be cost-effective for the people. The government control over tariffs stems from the interests to view infrastructure as public goods. But in addition to supporting public goods, PPPs place infrastructure under commercial regimes that must be managed efficiently in order to recoup investment. In this case, the market often determines price. The shortage of road-based public transport would likely

reduce significantly if fare-setting becomes more flexible. Investors in infrastructure are reassured when they see opportunities to adjust tariffs, in accordance with market conditions and the changing cost of operations. While the Government has the responsibility to monitor if tariff charges are reasonable, concessionaires may not find this acceptable as there is currently no mechanism to contest Government decisions. Private investors may worry if the regulatory environment is uncertain, as regulators could force unreasonable or unprofitable rate changes. To mitigate against this, an objective formula for future adjustments should be included in the service contract. Alternatively, or in addition, the Concession Agreement could specify a neutral arbitrator, to which an appeal can be made.

- Review existing contracts with BOT labels – This would primarily affect the 61 road contracts of the Department of Public Works (DPW) which are essentially road maintenance contracts with some features of BOT. Because they involve private sector participation, these BOT privatization models can be considered for Myanmar, though the existing service contract terms and conditions would need to be clarified. This is needed because at this early stage, when vehicle traffic is low, the private contractor has little incentive to oppose changes or amendments to the existing contract. In later years, when traffic increases and toll collections become substantial, the contractor may resist changes more strongly, which could prove costly.
- Privatization of State-Owned-Enterprises (SOEs), where private competitors exist – The Government of Myanmar has many agencies (and state-owned enterprises) that are engaged in various transport services, the most notable example is Myanmar Airways. With several private operators already in the airline market, the Government may not need to provide services. If a service is required for reasons other than economics, the Government could contract to have that service provided by a private carrier, at a potentially lower cost. In the past, some governments' involvement in a marketplace has stifled innovation and competitiveness. Opening the market up to private sector engagement can encourage private and foreign investment. A similar approach may be appropriate for the inland waterway and road-based public transport sectors. Myanmar has experience with this in the past, when it privatized more than 90 state-owned businesses in 2008, about 300 SOEs in 2009, 100 in 2010, and 76 more in 2011. Under the Ministry of Transport, 4 enterprises, including Inland Water Transport, Myanmar Port Authority, Shipyards, and Myanmar Airways are said to be under consideration.

#### **(4) Review of Road Projects**

Where Myanmar is active in PPPs, the Government sees most success in the road sector. There, the private sector has stimulated road development and supplemented government investment. They have been involved in the construction and rehabilitation of selected roads since 1996; these PPPs are best described as Build, Operate and Transfer (BOT) concessions. As of March 2013, a total of 61 40-year contracts with 29 private companies were in place, covering approximately 5,585 km of roads.

This Report reviewed a number of these contracts, which showed that the contracts covered existing national highways in need of rehabilitation, widening, repair and/or improvements with a maintenance component included. The legal basis for these contracts is the Citizens Investment Law, and thus limited to domestic entities. These contracts are most similar to a simple Rehabilitate-Operate-Maintain-Transfer (ROMT) model, with the following features:

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- Historically, all of Myanmar's roads were built with government funding. These typically included sections of major highways with predictably high traffic volumes and therefore can be considered as 'brown fields' projects, with a lower market risk.
- Nearly all road projects were launched through an unsolicited proposal process, with the initiative proposed by a private sector proponent, rather than being requested by the Government. In a few cases, alternatives to the private sector proposals were sought by the DPW before approval by the Minister of Construction. However in all cases, endorsement by the Regional and State Ministers remained mandatory.
- The proponent prepared the cost estimate and assembled the necessary funding for the rehabilitation and improvement works; this is considered private risk capital.
- There is no viability assessment on the part of the Government as to future traffic, revenues or expenses. These viability assessments are considered business decisions by the proponent.
- The contracts contain a wide range of provisions during the initial stage of construction/repair works, but the contractor has little responsibility for maintenance during the 40-year life of the contract.
- For a Rehabilitate-Operate-Maintain-Transfer (ROMT) scheme with little investment, a 40-year term is somewhat long, especially with a provision for up to three 5-year extensions, for a total of 55 years. The difficulty with the ROMT scheme is compounded by the absence of provisions on impact of future changes in the locality and on the network.
- Revisiting or revising the terms of a contract during the 40-year period has not been considered, despite the fact that many changes are possible during that period (e.g. construction of an alternate road that could alter traffic, emergence of traffic generators after the tollgate and therefore avoiding tolls, government installation of an intersecting road that might inadvertently create an exit/entry point, and collection leakages). These are just a few of the many possible scenarios that could change financial viability upward or downward.
- Toll collection for these contracts is essentially an open system as the highway cannot be enclosed. It requires the installation of weighing machines able to apply the tariff calculated on vehicle-weight miles. Cars are deemed to fall below the threshold weight and charge the minimum. Residents in the catchment area are permitted to access the road free-of-charge, on the assumption that local traffic does not pass the tollgate anyway. The exemption from toll payment is wide (e.g. national heroes, local residents, high government officials), thus making toll collection porous.
- There is no force majeure clause after road completion and the assumption is that the contractor will absorb all costs such as damage caused by floods or earthquakes and other factors during the 40-year operating life.
- Termination requires that certain conditions be satisfied, which generally reference events that happen during construction. Denial or withdrawal of consent by the Regional and State Chief Minister is noted in the BOT regulations of the DPW and may apply throughout the entire life of the contract. Contracts are therefore vulnerable to changes at the local level.
- The Ministry of Construction (MOC) posts monthly audits of toll collections, as well as reports on visual inspections of road quality. This is supplemented by monthly

status reports, submitted by the contractor. The MOC audits are used to determine tax liability and as basis for adjustments in toll tariffs.

- Tariffs are decided by the Cabinet and may be influenced by a number of special interests, as opposed to market conditions.
- Taxes are paid by the contractor, ranging from 0% during the first 3 years and 5% up to the 10th year, rising to 20% on the 34th year onwards. This is relatively high, if applied on gross toll, and is likely to be passed on to motorists.
- Performance Bonds during the operating period are not mentioned in the contracts.

### Procurement Methods

This Report's analysis found that Myanmar's road contracts assign risk to the private contractor, while a lack of pre-defined standards on what constitutes maintenance allows the contractor a great deal of flexibility in this regard. Also, the long contract period (between 40 and 55 years) provides the contractor multiple opportunities to recover their small investment, especially when traffic volumes have grown. Procurement models vary, and several of the most common are described here:

- 1) In-house construction and maintenance – In this, the oldest procurement model, the government plans, designs, finances, builds, and maintains the road with its own workforce and equipment. There is no private sector involvement, except for the supply of some materials.
- 2) Conventional procurement with privatized construction – This is the most common model, in which government plans, designs, and finances the road development, then hires and pays a private entity to construct and maintain the road.
- 3) Road maintenance by contract – This type of maintenance contract enhances the efficacy of the preceding model, with a private company engaged to perform the maintenance works. This saves the government from employing a large workforce and investing in maintenance equipment. The contract period is short, between 5 years and 10 years, because there is little investment or risk capital on the part of the contractor. There are two variations to this contract:
  - a) Contract terms are tailored to the amount of work being measured and paid for on agreed rates for different work items. Payments are based on the amount of works and services executed.
  - b) Performance-based Road Management and Maintenance Contracts, which define a minimum set of conditions for road, bridge, and traffic assets that must be met by the contractor, as well as other services such as the collection and management of asset inventory data, call-out and attendance to emergencies, and response to public requests, complaints and feedback. Payments are based on how well the contractor manages to comply with the performance standards defined in the contract.
- 4) Turnkey Contract – This expands the role of the private contractor, to include design and financing. The completed facility is turned over to the road agency, which then undertakes to pay the contractor in lump sum or in agreed instalments over several years. This model can also be classified as a PPP of the Build-Transfer variety. A variation is the BTO where the contractor assumes maintenance obligation on the assets built. Ownership of the road asset is transferred to the government immediately upon



completion of construction. Traffic or commercial risk is minimal, if it is not assumed by the government.

- 5) BOT – This contract model is used when the private concessionaire plans, designs, finances, builds, operates and maintains the road (typically with limited access, to ensure full capture of traffic) over a long term period (20-30 years). At the end of the concession, the concessionaire transfers everything to the Government. In this case, traffic or commercial risk is assumed by the private sector. From the toll collections, the contractor hopes to recover its investments in the project, which leads to long contract periods and the freedom of the concessionaire to adjust tariffs.

### Toward Better Roads

To achieve well-maintained roads, there are two options for the DPW-MOC:

1. Revise the existing contracts to make them conform to ROMT models
2. Transform existing contracts into performance-based maintenance contracts (i.e. model 3b in preceding section)

The first option would address the deficiencies mentioned above, such as a mechanism for recovery of the initial project cost, with a life of 20 years or less. Depending on the annual revenues collected against investment and the agreed rate of return on invested capital, this option would also address other deficiencies including: toll adjustment formula, treatment of unforeseen changes in the catchment area during operation, performance bonds after construction, and force majeure. However, a threshold volume of Annual Average Daily Traffic (AADT) should be met, before such an arrangement is made to avoid the premature imposition of high tolls that could depress traffic and lead to economic losses.

This option can be made more appealing to contractors, through such means as granting revenue opportunities in addition to tolls or grants for exclusive right to re-fuelling stations along the highway or by setting up of a roadside stations similar to the famous “Michi no eki” of Japan.

The second option would restrict these agreements to road maintenance, rather than network expansion. Performance standards, response times and penalties for non-compliance would be defined for pavements, shoulders and drainage systems. Tolls could still be collected, but should be simplified into fixed amounts by vehicle class (e.g. light, medium, heavy) rather than predicated on weighing scales. Should the total toll collections fall short of standard cost by agreed work item, the Government could commit to bridge the gap in exchange for a larger share in case of excess. At present, the terms are such that the private contractor collects all the monies with only a general commitment to maintenance.

For new roads, the Government can include a 5-year maintenance contract for the contractor who first builds the road. This is similar to a warranty on the completed works and would ensure construction quality, without the need to set up a Quality Inspection/Audit Team in the Government. As the contractor is aware that it must maintain the road (at its expense during the first 5 years after completion), the contractor has an incentive to build the infrastructure to a high standard, in order to minimize subsequent maintenance expenses.

Under the procurement models 1 and 2, the road agency typically deploys a Quality Audit Team that inspects works during construction and ensures compliance with design specifications. This procedure may be compromised either by corruption (e.g. the Audit Team is bribed to ignore defects) or by the contractor avoiding responsibility (e.g. blaming failures or defects on faulty design or the Audit Team).

Performance-based contracts would be most appropriate for new and old roads. These contracts could yield the following benefits:

- Broaden the range of private sector participation (PPP) in the road sector
- Reduce maintenance costs through the application of more effective and efficient technologies and work procedures
- Provide transparency for road users, road administrations and contractors with regard to the conditions roads have to be maintained
- Improve control and enforcement of quality standards
- Improve overall road conditions and road user satisfaction
- Creating a performance culture, the government also establishes an environment for a world-class and competitive construction industry

Myanmar can learn from many countries that have adopted Performance Contracts in road maintenance<sup>3</sup>. Cost reductions have been seen in Australia, the United States and New Zealand. In Latin America, road conditions have notably improved on roads that are being maintained under the new contracting scheme.

#### **(5) PPPs at Myanmar's Airports**

The Yangon International Airport was the first of Myanmar's airports to be managed by a private company, a consortium headed by Pioneer Aerodrome Services Ltd. As part of the management agreement, the company was required to improve the existing international terminal building. Although the 30-year concession period was not up for renewal, a new bidding process for the airport's expansion and redevelopment was launched in February 2013. Subsequently, tenders for management services at Myanmar's Mandalay and Hanthawaddy airports were also issued.

##### Nay Pyi Taw International Airport (NIA)

Myanmar's newest airport opened in 2011 and involved the private sector from its inception, making it Myanmar's first airport built on the PPP module. The significant feature of this PPP is the extent to which the Government provided viability gap funding. As a 'green field' project with unreliable traffic volumes, the NIA will require government support to ensure the cost-effective operation.

This Government support was financed from the national budget and covered the cost of the land development, runway, air navigation facilities (e.g. ILS, VOR/DME) and runway lighting (e.g. edge, approach light, PAPI). The balance (approximately 80%) of the project cost was to be financed and built by the private concessionaire. The Government secured a loan from a China Exim Bank to fund a private company to construct the taxiway, apron, terminal building, control tower, fuel farm, car park and other facilities. Servicing of the loan was transferred to the Special Purpose Company (SPC) and therefore carries with it a sovereign guarantee.

The term of this concession is 30 years but it includes an option for renewal and an additional 30-year period. If renewed, the SPC could then apply up to 2 times for 10-year extensions, effectively extending the concession for a maximum of 50 years. The BOT concession was

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<sup>3</sup> One source is <http://www.performance-based-road-contracts.com/>.

signed on 28 May 2011 and could theoretically expire in 2086.

The concession permits the SPC to impose and collect all fees and charges, on the airport's landside as well as the airside. However, the SPC is required to pay a pre-set land rent.

#### Airport tenders for three major airports

Building on the perceived PPP success of the NIA, the DCA sought to tender management and servicing of the 3 remaining airports in Myanmar, Yangon (YIA), Mandalay (MIA), and Hanthawaddy (HIA). While the scale of these investments and their commercial risks vary greatly between airports (Table 2.21) their term sheets share the following features:

- There is no government subsidy or funding support<sup>4</sup>, inclusive of loan guarantee, other than the land which is valued and provided as government equity in the respective airport SPC
- The SPC enjoys full assumption and control over revenues from landside and airside activities, including cargo-handling
- The concession period runs for 30 years, with options to extend for 10 years plus a final 10 years (ie. maximum 50 years)
- The DCA and Government retain responsibility for operation of the air traffic control, CIQ, airport security, meteorological service, emergency and rescue service – firefighting services, however, rest with the SPC
- Land rentals are paid to the government
- The DCA holds a seat in the board of directors and has a minority share in the respective SPCs, corresponding to the value of their land contribution

**Table 2.21 – Selected Features of the 3 Airports**

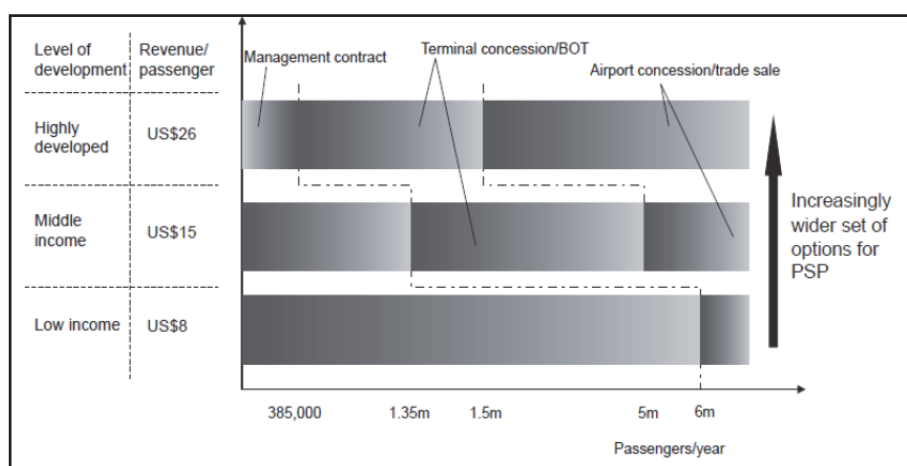
Airport	Investment Scale	Add-on Facilities	Current Traffic	Demand in 2030	Distance from City
Yangon	Medium, incremental	Domestic Terminal	3,069	6,000	18 km, N
Hanthawaddy	High & Lumpy	Runway, Terminal, etc	0	17,214	77km, NE
Mandalay	Low, incremental	Rehab w/expansion	574	3,752	30km, SW

Certain features of both the HIA and NIA illustrate their important similarities. Both were largely purpose built at scale, although some civil works were already on-site as a result of discontinued earlier works; these works are appraised at US\$102 million. The other two airports, MIA and YIA are building on already established traffic and functional facilities, hence, their investment is incremental. The analysis finds that HIA may have difficulty to be cost-effective, especially with competition from YIA. HIA may seek concession terms similar to those of the NIA, where the Korean ExIm Bank provides the loan facility on a government-to-government basis. Mandalay has sufficient capacity at present, and therefore expansion can be deferred until demand becomes critical.

<sup>4</sup> Incheon won the tender in August 2013, with three other consortia led by Singapore's Changi Airport Planners, France's Vinci Airport and Japan's Taisei Airport selected as backups. However, negotiations with Incheon never materialized and now all four consortia are being asked to resubmit their financial proposals. ODA Loan can be applied in the re-tender proposal.

### Local Airport Improvements

The DCA plans to invite private investors to upgrade 30 (of 69) domestic airports to improve safety, capacity and operational efficiency. It is likely that this policy change is as a result of recent budget constraints in the central government. Additionally, it may be difficult to administer private investor participation for all of the 30 airports, as opposed to selecting a few airports in areas having development potential, such as a tourism industry.



Source: Investment in ATI: Guidance for Developing Private Participation, World Bank (2010)

Figure 2.11 – Diagnostic Tool for Air Transport Infrastructure

### Negotiating Capacity and Risk

In the simultaneous PPP concession tendering of Myanmar's 3 international airports, the Government has demonstrated its assertiveness for the PPP as a means to realize strategic objectives in the transport sector. This move has attracted international attention to Myanmar's potential, which extends beyond infrastructure. Though this move is bold, it is not without significant risk, especially for a low-income country with passenger traffic of less than 5 million a year. Additionally, this move reveals a weakness that should be addressed to improve its chances for success.

The concession tenders require proponents to draft the concession agreements. This effectively leaves important concession issues to be negotiated behind closed doors, clouding transparency and leaving critical issues at the discretion of the negotiators. Experience from other sectors in other parts of the world suggests that the concession tendering process in Myanmar is potentially unbalanced, with the private sector better resourced to advocate its position and the Government, often with less ability to access negotiating expertise, assuming a disproportionate level of risk.

### Policy Context

Yangon metropolitan area's projected demand, as prepared by DCA, is vulnerable to changes in government economic policy, on aviation rights (e.g. freedoms of the air), and on adoption of less restrictive "open skies" agreements with other countries. The DCA is aware of these potential vulnerabilities and is responding by splitting air traffic between YIA and HIA. YIA will operate as a domestic airport with some regional (ASEAN, and short-haul) flights for the national airline, with a cap on capacity of 6 million passengers per annum (mppa). All international flights, beyond this threshold will be diverted to HIA, which shall handle

long-haul flights. Free-market environment, such as “open skies”, would be welcome to HIA, MIA, and NIA. However, Myanmar’s government has barred this type of liberalization in the aviation industry.

## **(6) Institutional Changes**

As indicated in Figure 2.11, institutional reforms made before PPP implementation are preferred. Though in Myanmar’s case, the typical sequence of reforms may have to be reversed, beginning with institutional changes after a PPP is implemented. PPPs effectively change the role of government, from service deliverer to that of regulator and policy implementer. By converting the DCA into the Myanmar Airport Authority (e.g. the Thai model) the Government is using the success of the PPP while changing DCA responsibilities under the concession.

Myanmar is continuing with its strong pursuit of PPPs by drafting changes to aviation sector legislation, which will be submitted to the Attorney General’s Office before it is approved by the Cabinet and sent to Parliament for enactment into law. This Report recommends that the DCA exercise care that the provisions of this planned law continue to encourage a stable PPP platform in the country, especially in terms of economic regulations. While this is immediately relevant to air transport, institutional reforms for road, rail, IWT, and maritime industries should also be considered to ensure these industries are hospitable to PPP concessions.

This Report finds that Myanmar should draft special PPP laws that can establish a common framework for economic regulation and regulatory governance. This law would be vital to strengthen the use of PPPs in other transport sectors and critical to enlarging the share of PPP in the total transport investments of the country. While there is no draft of such a law as yet, it is recommended that a common set of rules and procedures or guidelines on PPP (within the ambit of the Foreign Investment Law and Citizens Investment Law) be issued. The DCA is now experienced with the PPP model and can share lessons with other agencies. The DPW may be one priority department for this experience, having the most numerous BOT projects but having weaker concession contracting.

In other industries, Myanmar can also seek to incorporate PPPs. Concessions and other PPP instruments may be viable in the following projects or sectors: (a) deep sea port for ocean shipping; (b) dry or land ports inland on the Asian Highway and Myanma Railways; (c) selected features in the railway sector, which would require the re-structuring or unbundling of Myanma Railways; or (d) IWT port with property development. Due to Myanmar’s current low level of motorization, PPPs for expressways may not be viable for some time, due to low traffic volumes on the Yangon-Nay Pyi Taw-Mandalay Expressway. The installation and operation of weighing-stations (to enforce axle load limits on trucks) may also be suitable candidate for PPP execution.

## **(7) Other Non-Traditional Financing**

While PPPs offer many important positive effects, they are also unpredictable in terms of assured levels of regular funding to supplement capital budgets. Variations from year to year may be very high and, unlike funding from the Treasury and ODA where annual flows can be forecast accurately and variations are low from year to year, the PPP is less certain. As well, success with these arrangements involves the efforts of two parties (public and private) to convert a planned project into an actual investment.

As a result, this Report recommends that the Government explore additional financial options in developing its infrastructure, including PPP models. One innovative and emerging form of

financing are “Diaspora Bonds”<sup>5</sup> targeted at the potentially large number of overseas workers that Myanmar may have and leveraging the remittances already flowing to the country. For example, India has raised US\$11 billion from this source and African countries are also tapping this important source of funding. A side benefit for Myanmar is that, along with the access to steady new funding, Diaspora Bonds may help improve ratings on the country’s sovereign debt.

Another source, which is non-recurring but could be substantial given the high land prices in Yangon, is the opportunity afforded by the transfer of the capital from Yangon to Nay Pyi Taw. If not yet committed, those lands and properties that have become vacant or under-utilized could be sold or securitized to generate funds for infrastructure.

Lastly, for the road sector, the Government could ensure efficient and stable payments to private road contractors via a “road user fund”, dedicated to road maintenance.

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<sup>5</sup> Seliatou Kayode-Anglade and Nana Spio-Garbrah, “Diaspora Bonds: Some Lessons for African Countries”, African Development Bank (Dec 2012).

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## Chapter 3 Environmental Framework

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### 3.1 Institutional Framework

#### 3.1.1 Environmental Policy, Strategy and Legal Framework

In Myanmar, environmental legal systems are still in development. The Environmental Conservation Law, the core law for protecting and enhancing environmental sustainability in Myanmar, was issued in March 2012 after significant consultation. The Ministry of Environmental Conservation and Forestry (MOECF) then prepared Environmental Conservation Rules, Environmental Impact Assessment (EIA) Procedures and environmental quality standards with the assistance of the Asian Development Bank (ADB). In June 2013, the Cabinet approved the Environmental Conservation Rules. These new environmental laws and rules are important for Myanmar, but they will require a significant amount of time to implement successfully. The Government is now planning EIA procedures and capacity building for officials to implement the EIA.

#### 3.1.2 Overarching Framework

In brief, the following three initiatives are the major policy frameworks for environmental management in Myanmar:

- a) The National Environmental Policy regulates the environment “wealth of the nation” and places environmental protection as the highest priority.
- b) Myanmar Agenda 21 was developed in 1997 to steer a process of sustainable land use management and recognizes the important role of the Environmental Impact Assessment (EIA). It calls for public participation with a particular focus on “those most affected by (the) decisions.”
- c) The National Sustainable Development Strategy (NSDS) sets out strategies and areas for development with an aim to achieving sustainable natural resource management, integrated economic development and sustainable social development.

#### 3.1.3 Environmental Management Legislation

##### Environmental Conservation Law

The principal law governing environmental management in Myanmar is the Environmental Conservation Law, which was issued in March 2012 (The Pyidaungsu Hluttaw Law No. 9/20/2130rh). This law stipulates which government bodies are responsible for environmental conservation, as well as their roles and responsibilities. The law affects environmental and social impact assessments as well as water, air, land, noise, vibration and solid waste qualities, though the law does not provide specific standards to be met. In the context of project development, it is important to note that the law adopts the stance of a polluter/beneficiary pays principle, as it requires that project promoters be responsible for covering all environmental and

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social costs generated by the project. The law serves as the basis for establishing the Environmental Conservation Department (ECD) under MOECAF, both of which will be explained later in this Chapter. Supporting the Environmental Conservation Law are two legal arrangements, the Environmental Conservation Rules and EIA Procedures.

#### Environmental Conservation Rules

Environmental Conservation Rules are designed to provide a platform for the Environmental Conservation Law, with more specific and practical rules and guidelines, including EIA procedures and environmental quality standards. However, only limited data is available with regard to the content of the Rules.

#### EIA Procedures and Environmental Quality Standards

The EIA Procedures describe the conditions under which an EIA is required and the steps to be followed in conducting and assessing the EIA. Under the Procedures, the Ministry, as the Executing Agency, strikes an EIA Review Committee to provide recommendations from an environmental point of view, and whether to approve EIA reports or not. Membership in the EIA Review Committee is determined by the Minister of MOECAF but must include experts from industry, academia, and civil society, as well as government officials. The EIA includes an environmental management plan and a social impact assessment report.

The EIA Procedures may also if the Ministry determines this is required. The Procedures may also require the application of the “precautionary principle” and address climate change; however, the Procedures will not include a Strategic Environmental Assessment.

The EIA Procedures require that EIAs follow a specific process and while it is yet to be enacted, draft document and results of interviews with ECD staff members indicate that the EIA process in Myanmar will generally include these elements:

- a) All development projects in Myanmar will be subject to an environmental screening process through which projects will be assessed to determine if they require an environmental review and, if so, at which level (i.e. IEE or EIA).
- b) An EIA will include an environmental management plan and a social impact assessment report.
- c) Public participation will be required, when deemed necessary, for the Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA), and preparation of an Environmental Management Plan (EMP).
- d) The project’s executing agency will form an EIA Review Committee, which will supply recommendations to the Ministry of Environmental Conservation and Forestry (MOECAF) from an environmental standpoint and whether to approve the EIA reports. The MOECAF Minister is empowered to make the final decision based on this recommendation. The review period is 50 days for an IEE and 90 days for an EIA.
- e) Members of the EIA Review Committee will be selected by the Minister of MOECAF and will include experts from industry, academia, and civil society, as well as government officials.
- f) Involuntary resettlement is managed by respective regional governments and will not be included in the EIA Procedures.
- g) Costs involved in conducting EIA are to be covered by the project proponent.

- h) The EIA can be carried out in Myanmar only by firms that are registered under ECD/MOECAF.

### 3.1.4 Other Laws Concerned with the Natural and Social Environment

Myanmar's other environment-related laws and regulations are described in Table 3.1.

**Table 3.1 Environmental Laws and Regulations**

Name of the Legislation (year issued)	Features
Environmental Conservation Law	<ul style="list-style-type: none"> <li>The principal law governing environmental management in Myanmar issued in March 2012</li> </ul>
Environmental Conservation Rules	<ul style="list-style-type: none"> <li>A platform to bridge the Environmental Conservation Law with more specific and practical rules and guidelines, including EIA Procedures and environmental quality standards. The Environmental Conservation Rules was approved by the Cabinet in June 2013.</li> </ul>
EIA procedures	<ul style="list-style-type: none"> <li>MOECAF has prepared a draft EIA guideline with support from ADB in late 2013, which is under review by the Presidential Office as of May 2014.</li> </ul>
Other Laws Concerned	
(Natural Environment)	
The Protection of Wildlife and Conservation of Natural Areas Law (1994)	<ul style="list-style-type: none"> <li>Designates national parks and other protected areas to be: Scientific Reserve; National Park Marine National Park; Nature Reserve; Wildlife Sanctuary; Geo-physically Significant Reserve; or Other Nature Reserve as designated by the Minister</li> <li>Specifies those acts that are prohibited and subject to fines</li> </ul>
Myanmar Forest Policy (1995)	<ul style="list-style-type: none"> <li>Shows the general orientation of the government in terms of sustainable management of forest resources and their responsible development for socio-economic purposes</li> </ul>
The Forest Law (1992)	<ul style="list-style-type: none"> <li>Concerns itself with implementing Forest and Environmental Conservation Policy</li> </ul>
(Social Environment)	
Land Acquisition Act	<ul style="list-style-type: none"> <li>Stipulates that the government holds the right to expropriate land, provided that compensation is provided to the original land owner</li> <li>States that no private ownership of land is permitted and that all land must be leased from the Union State</li> </ul>
The Land Nationalization Act (1953)	<ul style="list-style-type: none"> <li>With some exceptions, stipulates that all types of agricultural land are owned by the President</li> <li>Indicates that, in the case of a breach of regulations, even land exempted from government confiscation may be forfeited to the country without compensation</li> <li>States that the President reserves the right to decide the crops to be grown on agricultural lands</li> </ul>
Farmland Bill (2011)	<ul style="list-style-type: none"> <li>Calls for suitable compensation and indemnity in the case of repossession of farmland, in the interest of the Union State</li> </ul>
Farmland Rules (2012)	<ul style="list-style-type: none"> <li>Stipulates farmers' right to work on farmland</li> <li>States that when farmlands are converted to different land uses, based on the interest of the State or Public, the State or Public must provide compensation to farmers, without delay</li> </ul>

Source: JICA Study Team

### **3.1.5 Government Bodies Responsible for Environmental Management**

The government body with primary responsibility to ensure and promote the soundness of the environment in Myanmar is MOECAP, although other Ministries (e.g. Ministry of Agriculture and Irrigation, Ministry of Livestock and Fisheries) also share a certain level of responsibility. MOECAP was reformed in September 2011 from the Ministry of Forestry to be the focal point and coordinating agency for environmental management. While Myanmar law does not specify the full scope of MOECAP's role regarding environmental governance, responsibility of its predecessor (i.e. Ministry of Forestry) is stipulated in the Forest Policy (1995) as forestland management, environmental protection, timber extraction and forest policy in Myanmar. Since then, there has been only one modification to the structure of the Ministry, which is the notable addition of ECD established in October 2012 and based on Environmental Conservation Law. ECD is the department responsible for managing the EIA process in Myanmar. The role of MOECAP in environmental conservation can therefore be considered greater than before.

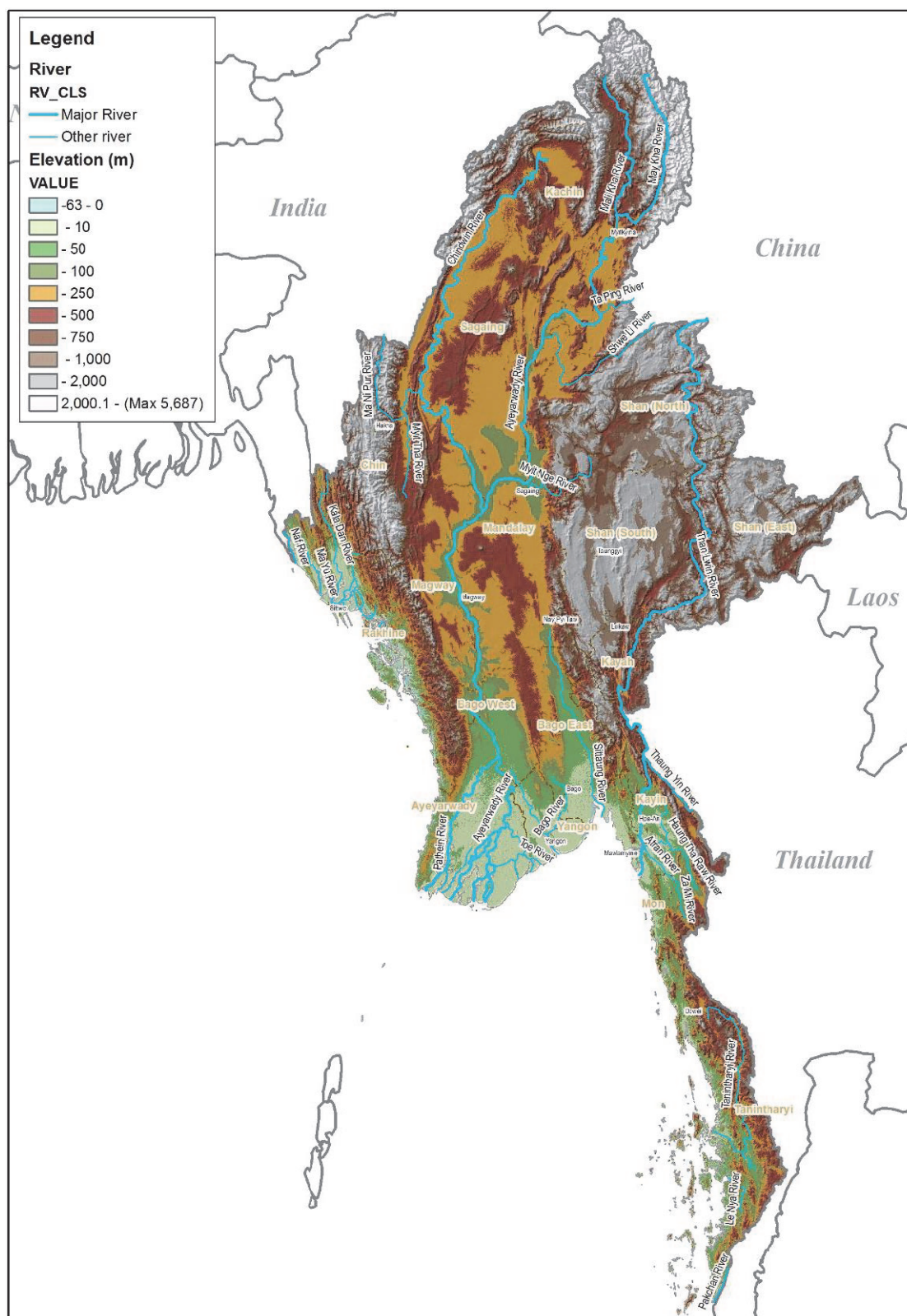
## **3.2 Existing Status of the Environment in Myanmar**

### **3.2.1 Natural Environment**

#### Topography, Geography and Hydrology

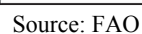
Myanmar is characterized by a variety of topographic features including mountain ranges in the north, east and west, and a long coastal strip in the south, as shown in Figure 3.1. Steep mountainous ranges traverse the entire western border of Myanmar with India and Bangladesh. Their average elevation is approximately 1,800 meters and the highest point is the top of Mt. Hkakaborazi, reaching 5,881 meters above sea level.

Myanmar has five main rivers: Ayeyarwaddy, Chindwin, Salween, Sittaung and Tenasserim, the longest of which is the 2,170 kilometer long Ayeyarwaddy River, which runs through the country into the Gulf of Martaban.



Source: SRTM (left) and Agricultural Atlas

**Figure 3.1 Topographic and Hydrological Features**

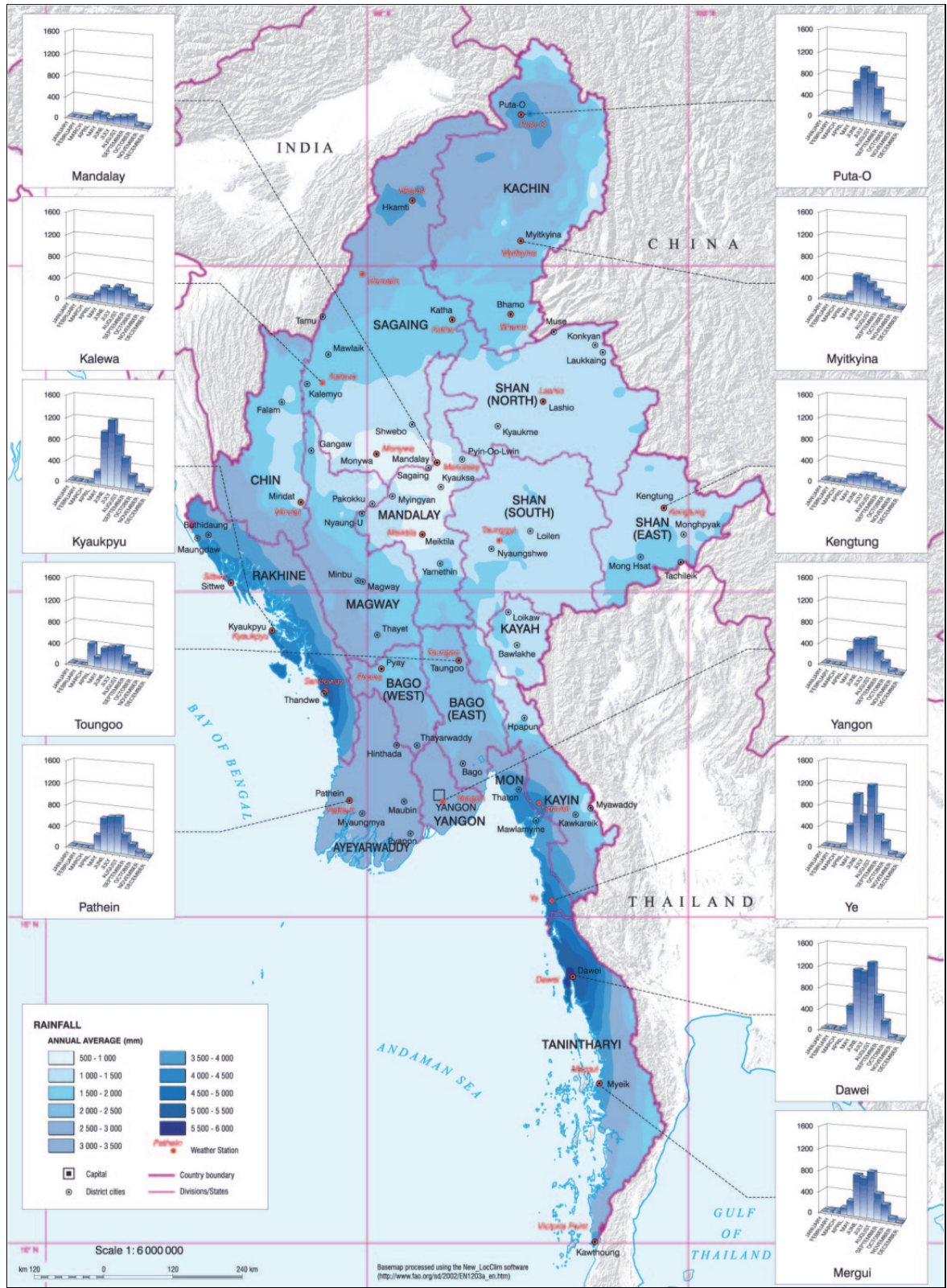


### Figure 3.2 Geographical Condition

### Climate

Myanmar has a tropical monsoon climate, which is characterized by a rainy season (May to September) and a dry season (October to April). There are significant variations in precipitation between the central region, where annual rainfall is less than 800 millimeters in the Tanintharyi Region to more than 5,000 millimeters in northern Rakhine State. The country has average temperature ranges from 38°C to 42°C in summer (March and April) and 10°C to 16°C in winter (November to February). Figure 3.3 describes average precipitation levels in Myanmar.





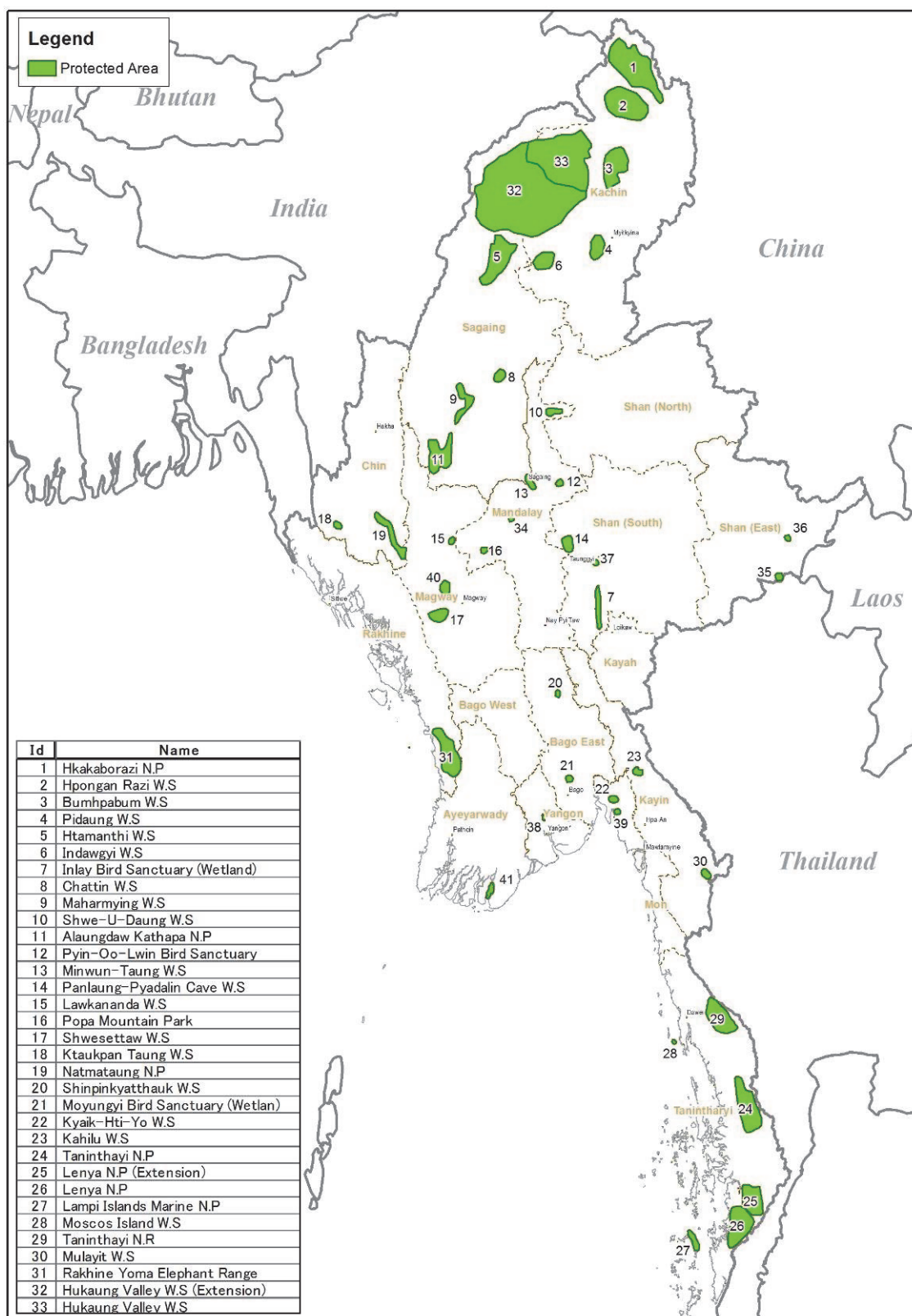
Source: Agricultural Atlas, FAO

Figure 3.3 Average Precipitation in Myanmar

### Ecosystem - Biodiversity

Sometimes referred to as the “last frontier of biodiversity in Asia” (BEWG 2011), Myanmar is endowed with rich plant life and numerous animal species. Many critically endangered wildlife species have been found in Myanmar, including over 300 identified mammal species, 7,000 plant, 425 reptile and amphibian species, 310 fish species and 1,027 bird species. However, a recent increase in the illegal trade of animal and plant life along with uncontrolled development is beginning to seriously degrade much of Myanmar’s rich biodiversity, prompting the Government to designate certain areas as protected, in order to safeguard natural resources (Figure 3.4).





Source: MOECAP

**Figure 3.4 Protected Areas in Myanmar, Existing and Proposed**

### Ecosystem - Forests

According to MOECF, nearly 50% of Myanmar is covered by forest, of which 27% is closed canopy forest (see Figure 3.5). The majority of these large, densely forested areas are found in the boarder areas of Kachin State in the north, along the national border with India and Bangladesh in the west (particularly south towards the Bay of Bengal) and in Tanintharyi Region in the south.

According to Khin Htun of FAO (2009), the annual rate of Myanmar's deforestation was 6.9% between 1990 and 2000, 3.7% between 2000 and 2005 and 10.3% between 1990 and 2005. Timber is one of the major export commodities for Myanmar in last two decades. In the lowlands of the central and southern areas, on the other hand, the main drivers of deforestation include forest conversion, charcoal production and fuel wood collection. Deforestation also has a significantly negative impact on local communities' living conditions, as people are dependent on forest resources, directly in terms of charcoal and wood fuel and indirectly by their reliance on the ecosystem and wildlife.

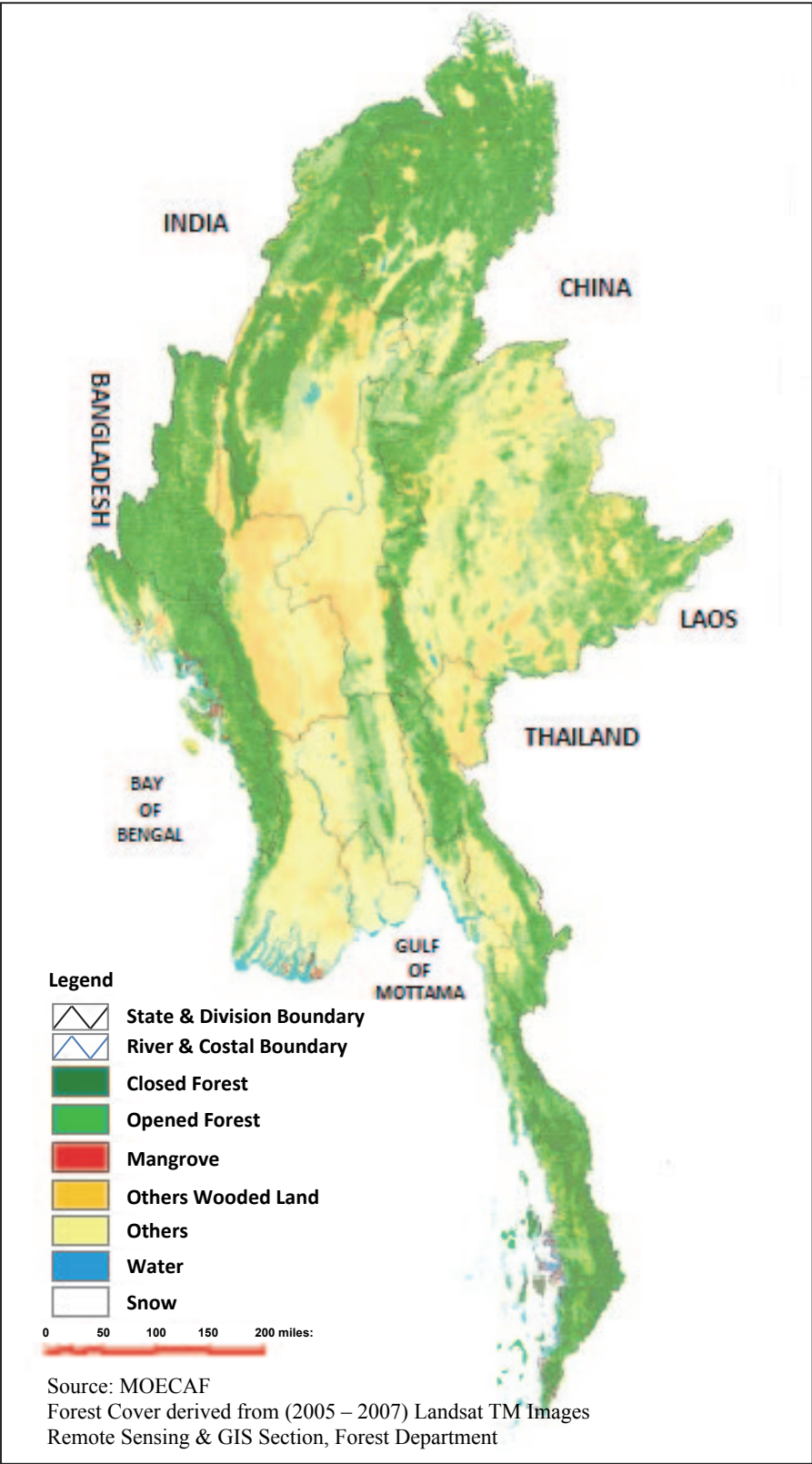


Figure 3.5 Forest Cover in Myanmar

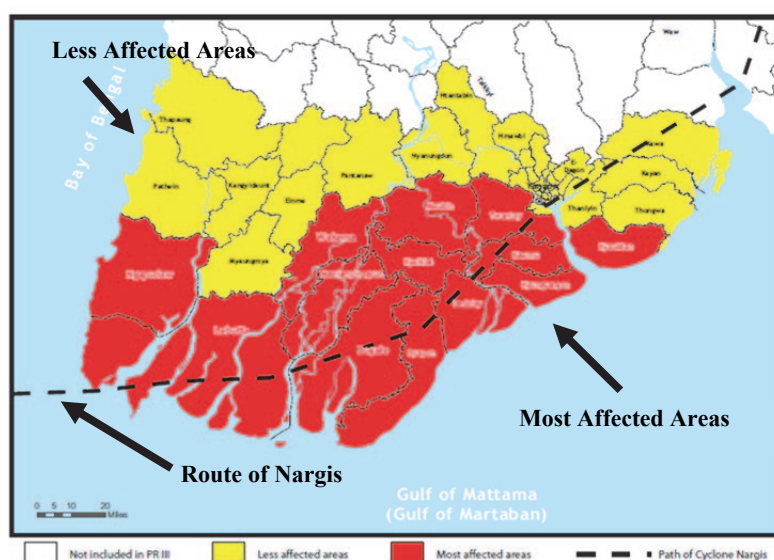
### Ecosystem – Coastal Areas

Myanmar's 2,276 kilometer coastline extends from the Bengal Bay to the Andaman Sea, which has a large inter-tidal mud flat with mangrove forests and shrubs. The coastal area provides habitat for large numbers of animals, and has wide mangrove forests. It is reported that over 20% of the mangrove forests have been lost between 1990 and 2000.<sup>1</sup>

### Natural Disasters

Myanmar experiences four types of recurring natural disasters that are relevant to existing and future transport infrastructure development, including: cyclones, flooding, earthquakes and landslides.

Cyclones: Measured in terms of their magnitude of damage, including loss of life, cyclones are considered the most significant natural disaster occurring in Myanmar and generally follow a southwest-to-northeast trajectory. The most significant cyclone in Myanmar was Cyclone Nargis, which passed the southern delta area in 2008 and caused the widespread destruction of built structures and farmland and caused more than 100,000 deaths. Cyclone Nargis was the single most destructive natural disaster in Myanmar's history and, in addition to tragic loss of life, also resulted in dramatic economic losses. The number of missing and dead had been reported to reach 140,000 in Ayeyarwaddy Delta region alone, with an additional estimated 2.4 million people losing homes and livelihoods. Figure 3.6 describes the areas most affected by Cyclone Nargis. Similarly, in 2010, Cyclone Giri passed the middle of Myanmar causing considerable destruction. More than 260,000 people were affected and at least 45 died. At least 17,500 acres of agricultural land and nearly 50,000 acres of aquaculture ponds were also damaged.



Source: Post Nargis Periodic Review III

**Figure 3.6 Areas Affected by Cyclone Nargis**

<sup>1</sup> Leimgruber *et al.* 2004 cited in Birdlife International 2005



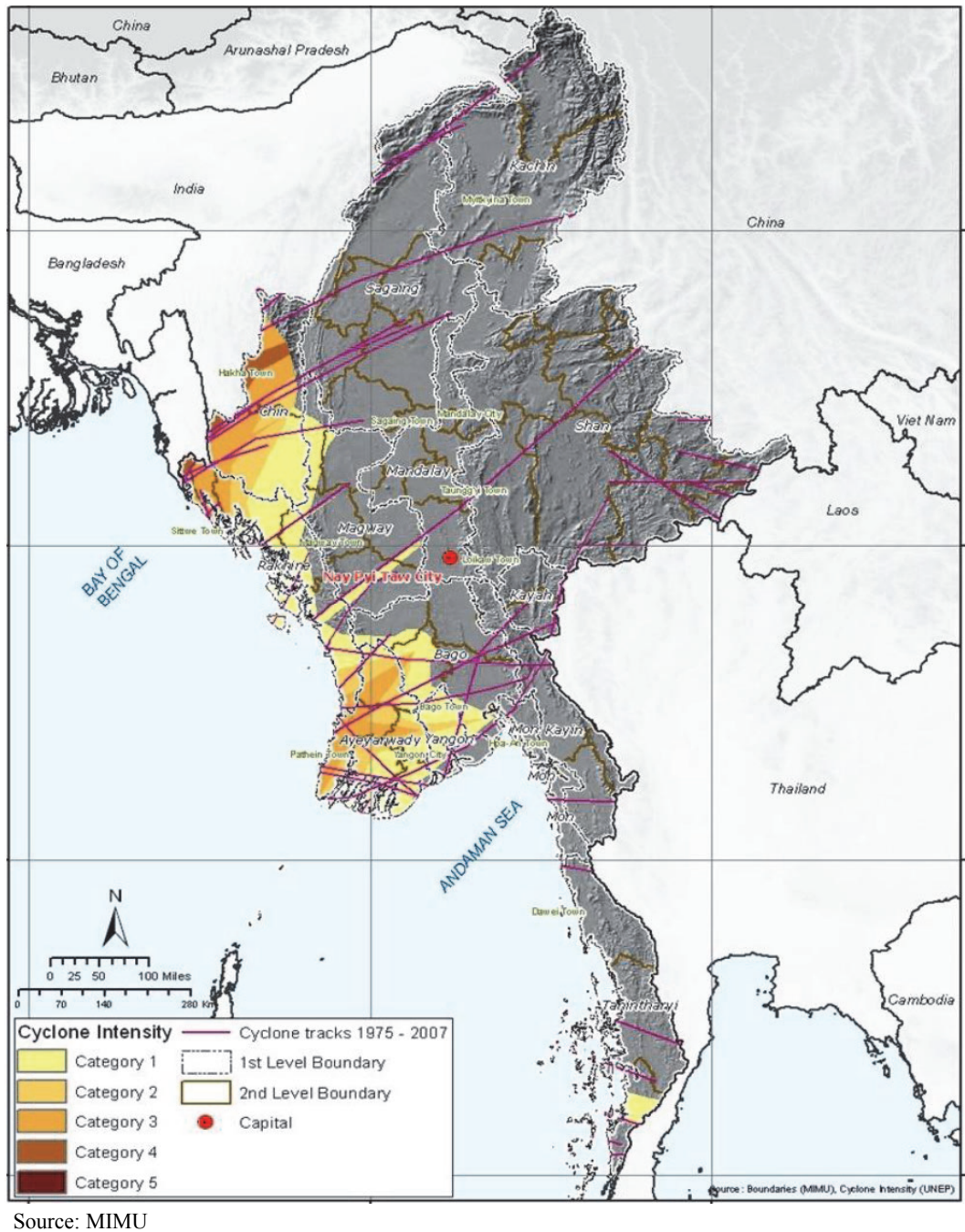
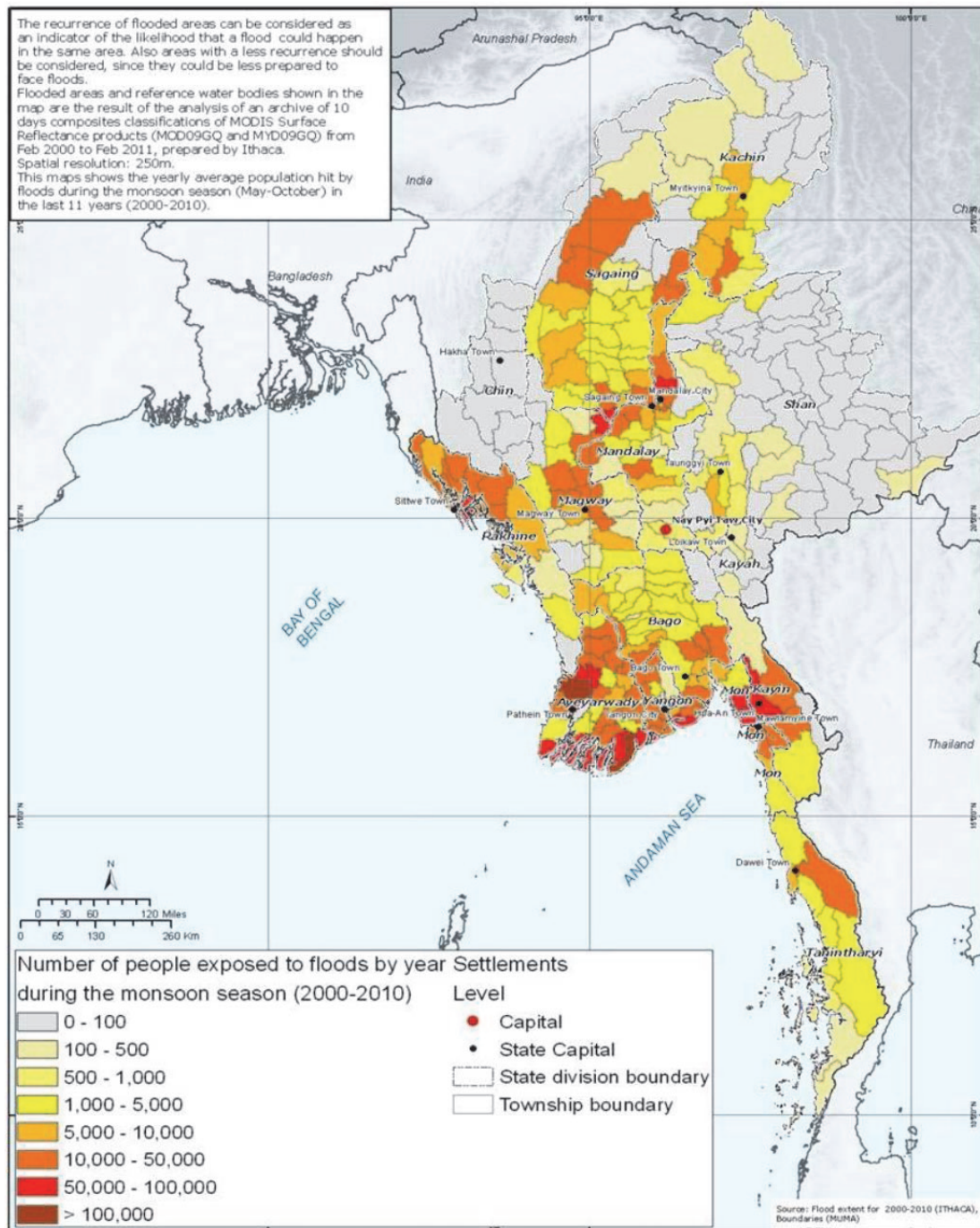


Figure 3.7 Cyclone Intensity

Flooding is another major natural disaster that takes place frequently in Myanmar, predominantly during the rainy/monsoon season. Figure 3.7 illustrates the intensity of past cyclones (one of the major causes of flooding) in each geographical area and Figure 3.8 indicates those populations most exposed to floods. In 2012, Myanmar's southern delta area was severely flooded with Ayeyarwaddy Region most affected where approximately 50,000 people were displaced and more than 100,000 acres of agricultural land, houses and road infrastructure were damaged.

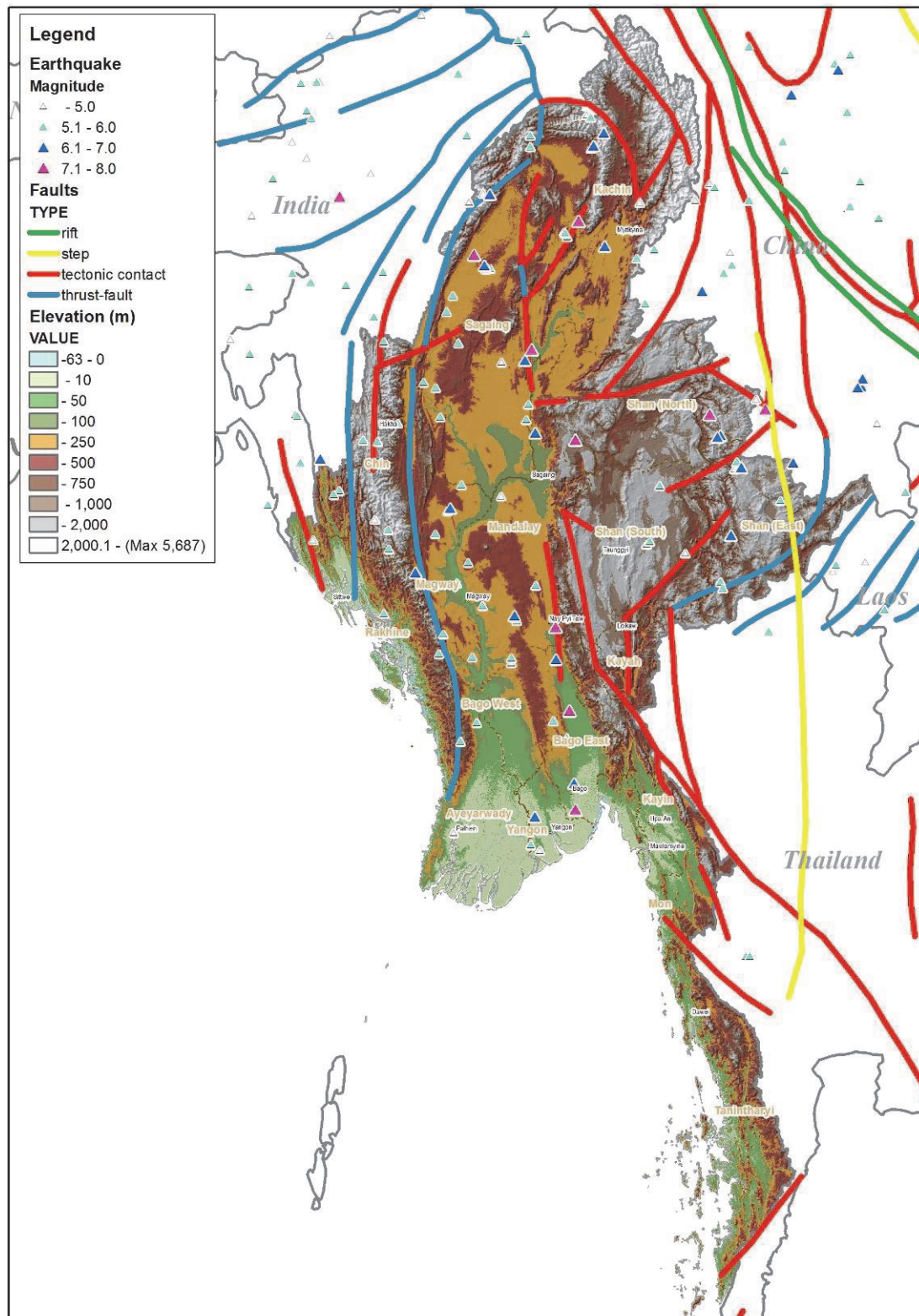


Source: MIMU

**Figure 3.8 Populations exposed to floods**

Earthquakes occur with some frequency as Myanmar is relatively more prone to earthquakes than other Indochina countries. In November 2012, a magnitude 6.8 earthquake struck the north part of the country. The most affected areas were Mandalay and Sagaing Regions where at least 16 people were killed, 52 injured and over 400 houses, 65 schools and around 100 religious buildings were damaged. As shown in Figure 3.9, active faults run from north to south in the western mountainous area with some passing through the center of Myanmar.





Source: MIMU

**Figure 3.9 Active Faults and Seismic Centers in Myanmar**



Landslides occur in Myanmar, particularly during the rainy season in the Western Ranges and the Eastern Highlands and on the banks of Ayeyarwaddy River and its tributaries in the central lowlands. A combination of steep slopes, heavy rain and unstable soil conditions are the main causes of landslides but they can also be triggered by earthquakes. Transportation infrastructure, and roads in particular, are often affected by landslides. In September 2004, a large-scale landslide took place along the Kale-Kalewa road near Kale-City, Sagaing Region, destroying the road and bridges for 30 kilometers (Kyaw Hhun 2010). Damage to residential areas, on the other hand, is generally limited because of low population densities in the areas susceptible to landslides. Nevertheless, there have been incidences such as in Tanintharyi Region where houses and primary schools were buried by soil in 1999 (Kyaw Hhun 2010). Table 3.2 describes major landslides in Myanmar over the last century.

**Table 3.2 Major Landslides in Myanmar**

Year	Location	Name and Type	Triggering Process	Impact
1912	North of Taunggyi	Maymyo Landslide	Earthquake	Serious Landslides and Ground Cracks
1946	Tagaung	Landslides	Earthquake	380 acres of Crop Damage
1991	Tagaung	Landslides	Earthquake	Buildings Destroyed
1999	Western Slope of Tanintharyi Range	Landslides	Torrential Rain	Buried Villages
2001	Nansang	Subsidence	Heavy Rain	Two Circular Graven 50-feet in Diameter Appeared
2003	Taungdwingyi	Landslides	Earthquake	Some Slopes and Railroads along the Western Bago Yoma Failed
2004	Kalewa-Kale Road	Chaungkyin Landslides	Heavy Rain	Bridges and 30 km of the Main Road Destroyed
2008	Mogoke	Mogoke Landslides	Heavy Rain / Excavation	11 People Killed
2009	Kyauktaw-Ann Road	Kyauktaw Landslides	Heavy Rain	120 km of Main Road Destroyed

Source: Kyaw Hhun (2010)

### 3.2.2 Social Environment and Development

In Myanmar, nearly 75% of the population lives in rural areas and approximately the same number of people rely on agriculture for their livelihoods. In areas where the Myanmar maintains records, 40 to 60 % of the famers are dependent on small farm cultivation, holding land of less than five acres (BEWG 2011).

### Development and Land Ownership

Both statutory and customary land ownership laws exist in many rural areas. In general, customary laws are practiced in the uplands where the majority of ethnic groups reside, while statutory laws are followed more in the lowlands (BEWG 2011). Since most natural resources such as forests, minerals, and oil and gas exist in upland areas, social tensions and conflicts are frequently reported between local farmers and Government authorities, as customary rights over resources on occupied lands are not yet recognized by statute.

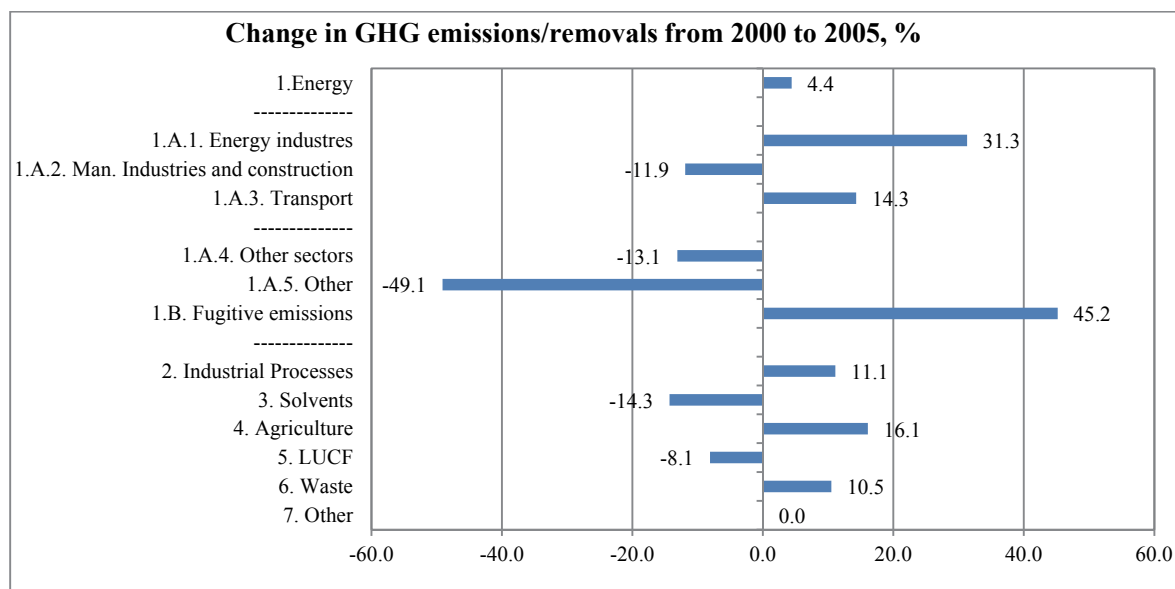
### Development and Ethnic Conflicts

Myanmar is one of the most ethnically diverse countries in Asia. Most of the foreign direct investment is located in peripheral areas, where ethnic groups are prevalent. During the past decade, much of this investment relates to natural resources and the oil and gas, hydropower, and mining sectors specifically. A number of conflicts have been reported in the past in these areas, between the Government and armed indigenous groups. At present, the Government has cease-fire agreements with many of these groups but there are still many highly sensitive areas where the risk of conflict around development projects remains high. Descriptions of two potentially significant social problems that could accompany development projects are:

- **Hydropower Projects:** In Myanmar, there are an estimated 48 hydropower projects planned, in construction, or existing along major rivers including the Salween, Irrawaddy, Ayeyarwaddy, Chindwin, and Sittoung rivers, as well as their tributaries (BEWG 2011). Dam construction can be accompanied by the forced relocation of local communities, without consideration for appropriate relocation measures or sites being provided. According to some reports, people have been forced to relinquish traditional customs and/or accept poorer living conditions. In addition, water degradation can be associated with some of these projects and can adversely affect human health and accelerate the prevalence of diseases like malaria and dengue.
- **Oil and Gas Extraction Projects:** According to reports, pipeline construction in the late 1990s resulted in serious human rights abuses and considerable environmental destruction (BEWG 2011). Potentially negative impacts of oil and gas project development include: militarization of nearby areas, involuntary relocation of people with little or no compensation, confiscation of agricultural lands, forced labor for the construction of military camps and infrastructure, sexual abuse, land clearing, etc.

## **3.3 Climate Change**

Myanmar ratified the United Nation Framework Convention on Climate Change (UNFCCC) in 1994 as a non-Annex I Party. UNFCCC requires these Parties to make initial national reports on greenhouse gas emissions and reduction. Myanmar conducted its first GHG inventory study with the assistance of ADB in 1997. Figure 3.10 illustrates the change in the world's GHG emissions and reductions between 2000 and 2005. Global GHG emissions from the transportation sector increased by 14.3%, suggesting that transportation sector development and investment can contribute largely to reducing GHG emissions.



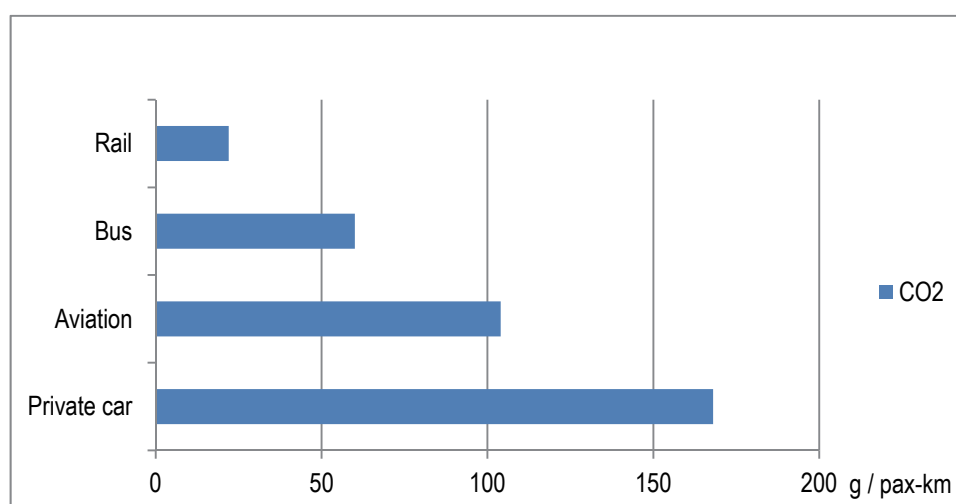
Source: Climate Change Secretariat, United Nations, 2007

**Figure 3.10 Changes in Global GHG Emissions and Reductions between 2000 and 2005**

In the transportation sector, the following activities can contribute to reducing emissions and hence, mitigating climate change.

#### Modal shift

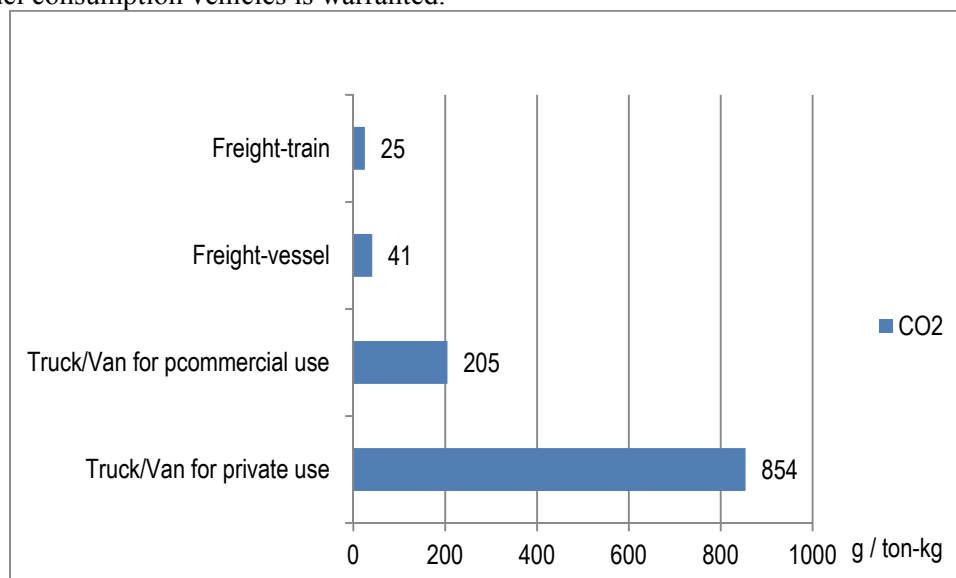
Trains and buses are generally considered more effective in reducing GHG emissions than private vehicles, as shown in Figure 3.11, suggesting that a shift to lower-fuel consumption vehicles is warranted.



Source: Ministry of Land, Infrastructure, Transport and Tourism, Japan (2012)

**Figure 3.11 Estimated CO<sub>2</sub> Emissions by Transport Mode (passenger transport)**

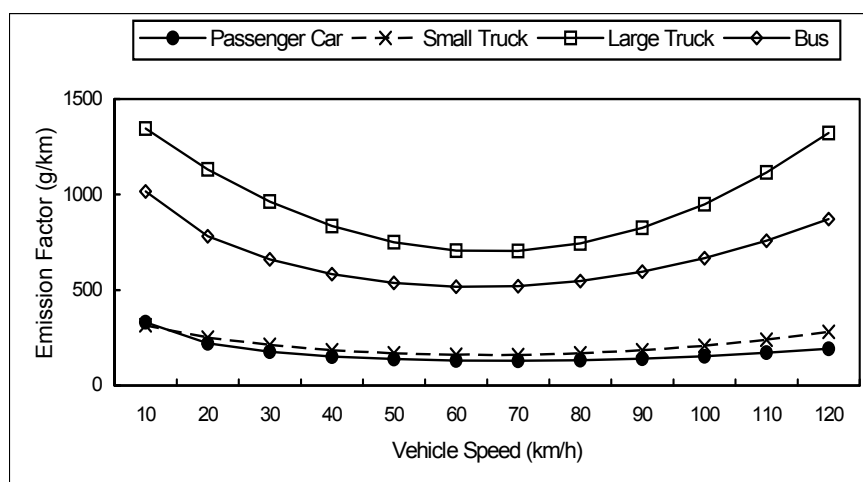
For freight transportation on land, trains and buses are generally considered more effective in reducing GHG emissions than private vehicles, as shown in Figure 3.12, suggesting that a shift to lower-fuel consumption vehicles is warranted.



Source: Ministry of Land, Infrastructure, Transport and Tourism, Japan (2012)

**Figure 3.12 CO<sub>2</sub> Emission Factors by Vehicle Type (freight transportation)**

Proper traffic flow management: Traffic congestion leads to an increase in CO<sub>2</sub> emissions and generates air pollution. Figure 3.13 describes the relationship between CO<sub>2</sub> emissions and vehicle speed.



Source: Osaki, *et al.*, Fuel Consumption and Emission Factors of Carbon Dioxide for Motor Vehicles.

**Figure 3.13 CO<sub>2</sub> Emission Factors by Vehicle Type and Speed**

### **3.4 Environmental Suitability Analysis**

#### **3.4.1 Purpose of Environmental Suitability Analysis**

Strategic Environmental Assessment (SEA) provides a methodology not only for evaluating the impact of policies, plans and programs on the environment, but also for addressing the impact of environmental change on policies, plan and program. It may thus offer a useful framework for effectively mainstreaming climate change adaptation into policy-making processes at the national level.

The MYT-Plan Strategic Environmental Assessment (SEA) includes an environmental suitability analysis and provides recommendations that identify areas where proposed transport infrastructure projects should be situated, in order to mitigate negative social and environmental impacts. In addition, this analysis can be used as a tool to conduct environmental management in the implementation of the Master Plan.

The suitability analysis addresses two aspects of natural disasters: a socio-ecological aspect and a risk aspect. The socio-ecological aspect determines environmental features that are of high ecological or social value and should be preserved (e.g. rich forests and biodiversity). The risk aspect determines level of risk for natural disasters and which impacts should be prioritized for action (e.g. cyclones, floods, earthquakes and landslides).

An additional tool for the suitability analysis is a natural disasters' spatial analysis, which:

- Identifies areas that are environmentally vulnerable and determines constraint factors on development planning so activities for conservation can be applied
- Guides the development of the national transport master plan from the standpoint of environmental conservation, disaster prevention and economic improvement

#### **3.4.2 Methodology**

##### **(1) Scoping for Selection of Key Environmental Issues**

The MYT-Plan includes environmental analysis from a review of available literature, environment-related policies, plans, and legislation, as well as interviews with researchers and other stakeholders. From this research, this Report identifies a number of major environmental constraints to transportation infrastructure development. As the scope of this study is the whole country, those environmental conditions that do not affect a large spatial area (e.g. cultural heritage sites) were excluded due to the relatively minor effect that point data on a map has in terms of a national-level transportation planning. Similarly, conflict zones and areas with land mines were also excluded because conditions in those areas can change dramatically in the near future, given the current political climate. In addition, reliable and comprehensive information is lacking for these locations.

A stakeholder workshop to determine priority environmental issues was held on 20 May, 2013 in Nay Pyi Taw. One of the objectives of this workshop was to reach consensus on the selection of key environmental issues to be analyzed and to inform environmental considerations in the design of the Master Plan. The workshop revealed particular issues that warrant special attention in planning processes, which can also be used to identify areas with high agricultural productivity, including:

##### **I. Environmental Sensitivity**

Evaluations of natural resource conservation may be conducted using two approaches. The

“environmental related legal framework” is a legal approach for the protection and conservation of natural resources. This often-used approach relates to national Protected Area Systems (PASs), which are identified and designated for protection, due to their unique, endangered, or sensitive ecosystem status. The Myanmar Government (MOECAAF) has registered such areas and started the process of establishing guidelines for natural resources management in these areas.

Another approach is to highlight ecological hotspots evaluated by land cover (e.g. forest area) and Key Biodiversity Areas (KBAs). KBAs represent the most important sites for biodiversity conservation worldwide.

## **II. Natural Disaster Risks**

Another factor used to evaluate levels of environmental risk is natural disasters. Based on MYT-Plan research and consultation with line governments and stakeholders, the following four disasters were selected as most relevant to transport sector development: flood-prone areas, landslide-prone areas, earthquake-prone areas, and cyclone-prone areas.

## **III. Economically important areas**

Myanmar has enjoyed high productivity in its agricultural sector. The following typical agricultural products are relevant to the transport sector: rice, beans (black and green gram, pigeon pea and soy bean), sugarcane and rubber.

## **(2) Methodology – Preparatory Work**

The locations of the above-noted high priority areas are, in many cases, not readily identifiable, as determining probable locations of these important areas requires analysis of a number of related data. However, analysis for the MYT-Plan was successful in determining priority areas and their locations for the Master Plan. This analysis included assigning scores to thematic maps, according to level of constraint or potential, which ranged from 0 to 3 (level 3 representing the highest potential/constraint). These thematic maps were then integrated to develop scoring maps. The scoring maps’ constraint level scores were calculated by aggregating scores from three areas, as shown in Table 3.3. Finally, scoring maps were developed and show results of the analysis and indicating classifications. This approach is presented in detail via two GIS maps (Figure 3.13). The first map illustrates six particular environmental issues containing risk from natural disasters. These issues are identified for each area on the map and include their potential severity. This second map indicates the social and economic costs required to develop transportation infrastructure in such areas.

**Table 3.3 Parameters for Evaluating Constraint / Potential**

Parameters	Type of Data and Data Sources
<b>Environmental Sensitivity</b>	
Protected area systems	Location of designated protected area, wildlife sanctuary, etc. (MOECAAF)
Reserved or public reserved forest	Location of designated reserved and public reserved forest (MOECAAF)
Land cover	Land cover map (FAO)
Biodiversity	Key biodiversity area map (MOECAAF)
<b>Natural Disaster Risks</b>	
Flood	Monsoon season flooding occurrence between 200 and 2010 (MIMU)
Landslide Slope Rainfall Soil condition  Active Fault	SRTM (Shuttle Radar Topography Mission), NASA/JPL, DLR, ASI Annual and seasonal rainfall in methodological stations (FAO) Multi-Hazard Risk Assessment (MHRA) and Nargi-affected areas, Hazard risk and Vulnerability Assessment Report (UNDP) Distance for active faults, Multi-Hazard Risk Assessment(MHRA) and Nargi-affected areas, Hazard risk and Vulnerability Assessment Report (UNDP)
Earthquake	Seismic zone map of Myanmar (Tint Lwin Swe)
Cyclone	Cyclone Intensity between 1975 and 2007 (MIMU)
<b>Economically important areas</b>	
Agricultural Production Rice Beans Sugarcane Rubber	Annual Agricultural Production at district levels

Source: JICA Study Team

The second map indicates overall levels of constraint against transport sector development that exists in different parts of the country. Although this map does not indicate why a particular area indicates a high (or low) constraint level, it can be useful as a first screening of potential projects to determine the degree to which the project site is prone to environmental considerations.

This Report uses these two maps to shape environmental conservation analysis and develop recommendations for the transportation Master Plan. The thematic maps and associated scoring / rankings are listed in Table 3.4.

**Table 3.4 List of Maps Developed**

Thematic Maps		Scoring / Ranking Map	
Protected area systems	Environmental related legal framework	Natural Resources Constraint	Natural resources and disaster constraint (Consolidated suitability)
Reserved or public reserved forest			
Land cover	Ecological hotspots		
Biodiversity			
Flood		Disaster Prone	
Landslide <sup>1)</sup>			
Earthquake			
Cyclone			
Rice			Agricultural production potential
Beans			
Sugarcane			
Rubber			

Notes: 1) developed by combining slope, rainfall, soil condition and active faults.

Source: JICA Study Team

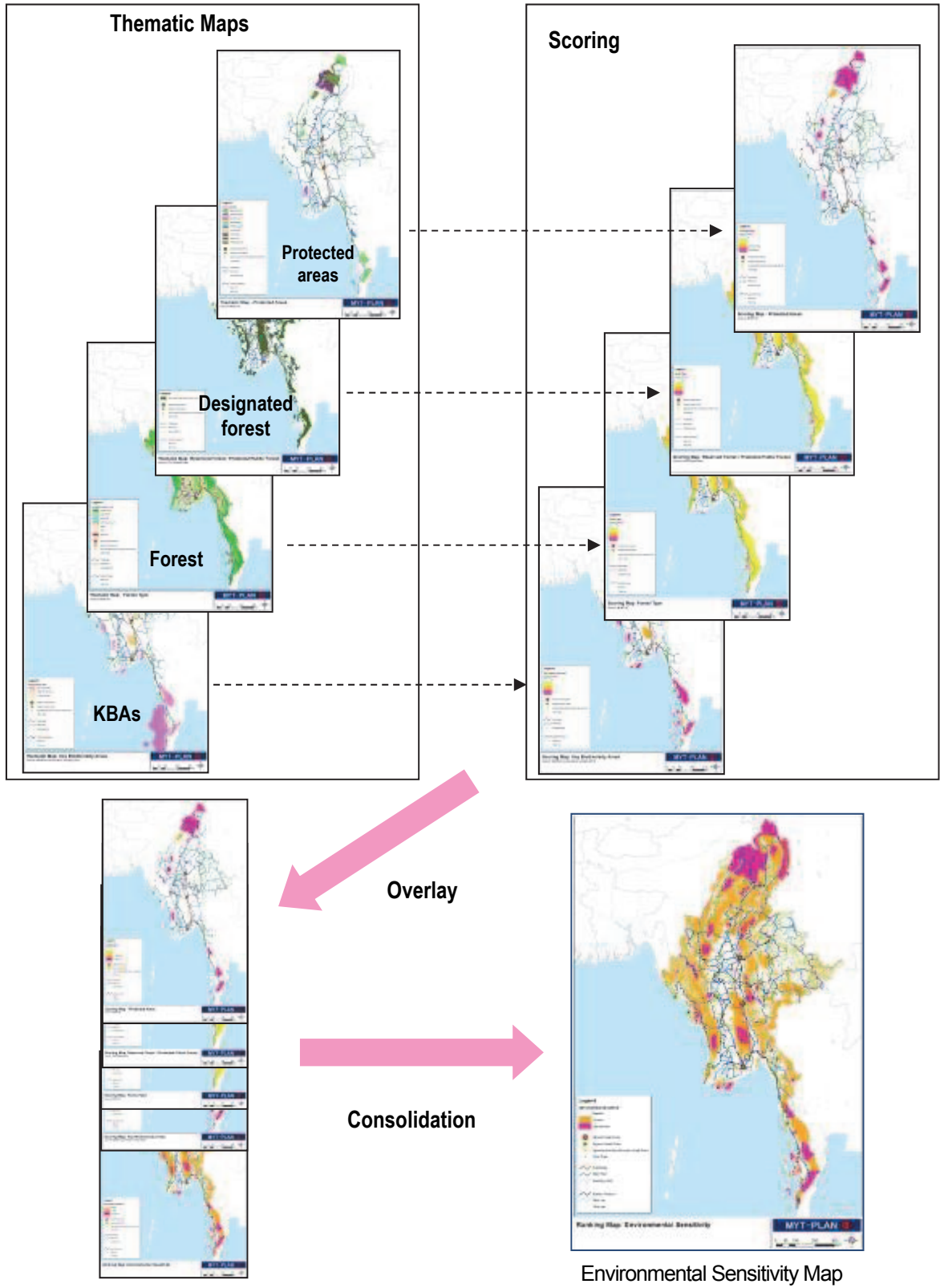
Finally, the following ranking maps were also integrated.

**Table 3.5 Types of Ranking Map and their Classifications**

Types of Ranking Map		Classifications		
1	Environmental sensitivity	Available	Sensitive	Very Sensitive
2	Risk on natural disaster	Low	Medium	High
3	Consolidated sustainability	Suitable	Marginally Suitable	Unsuitable
4	Agricultural production potential	Low	Medium	High

Source: JICA Study Team





Source: JICA Study Team

**Figure 3.13 Approach for GIS Mapping (Example of Environmental Sensitivity)**

The MYT-Plan uses a Strategic Environmental Assessment (SEA) and the following scoring and ranking methods (A: Environmental Sensitivity Analysis, B: Risk Analysis of Natural Disasters, C: Consolidated Sustainability Analysis, and D: Suitable Agriculture) to inform the environmental analysis.

## A Environmental Sensitivity Analysis

### A-1 Environment-related legal framework)

Environmental Features	Level of Constraint				Weight	Remarks
	0 (low)	1	2	3 (high)		
a. protected areas	no		yes (proposed site)	yes (existing site)	2	Different weight was assigned PAs that are protected by law and those that are not
b. reserved forest or protected public forest	no		yes		2	

### A-2 Ecological hotspots

Environmental Features	Level of Constraint				Weight	Remarks
	0 (low)	1	2	3 (high)		
a. forest type	others	open- and closed-canopy <sup>2</sup> forests		mangrove forest	1	Apply to Mon and Thanintharyi state
	others	open-canopy forest	closed-canopy forest	mangrove forest	1	Apply to other region
b. biodiversity	others	low priority areas	medium priority areas	high priority areas	1	

### Environmental Sensitivity

$$\text{Total Score} = (\text{A-1}) \times 2 + (\text{A-2})$$

Total Score	0-3	4-6	7-12 + PAs
Constraint Level	1 (Available)	2 (Sensitive)	3 (Very sensitive))

## B Risk Analysis of Natural Disasters

### B-1 Flood-prone

Environmental Features	Level of Constraint				Weight	Remarks
	0 (low)	1	2	3 (high)		
Monsoon season flooding recurrence between 2000-2010	Others		At least 10 days of flooding during monsoon season	At least 100 days of flooding during monsoon season	1	

<sup>2</sup> Closed-canopy forests include large area of rubber plantation and hence were given the same level of constraints as open-canopy forests in Mon state and Thanintharyi state.

**Final Report**

**B-2 Landslide**

Environmental Features	Level of Constraint				Weight	Remarks
	0 (low)	1	2	3 (high)		
a. slope (degrees)	$X < 30$	$30 \leq X < 45$	$45 \leq X < 50$	$60 \leq X$	1.0	Steepest slope in a 90m by 90m area is shown in a 10km by 10km area
b. total rainfall during peak season (Jun-Aug; mm)	$X < 500$	$500 \leq X < 1,500$	$1,500 \leq X < 2,500$	$2,500 \leq X$	0.7	
c. geology	hard rock; hard and soft rock	soft rock	alluvial land		1.0	
d. distance from active faults	others	$X < 50\text{km}$			1.0	

**B-3 Earthquake**

Environmental Features	Level of Constraint				Weight	Remarks
	0 (low)	1	2	3 (high)		
a. seismic zones <sup>3</sup>	I (minor damage)	II, III (moderate to high damage)	IV (severe damage)	V (very severe damage)	1.0	

**B-4 Cyclone**

Environmental Features	Level of Constraint				Weight	Remarks
	0 (low)	1	2	3 (high)		
a. intensity of past cyclones in each area <sup>4</sup>	others	Category 1	Category 2-3	Category 4	1.0	

**Risk on Natural Disaster**

$$\text{Total Score} = (\text{B-1}) + (\text{B-2}) \times (3/9) + (\text{B-3}) + (\text{B-4})$$

Total Score	0-4	5-7	7-12
Constraint Level	1 (Low)	2 (Medium)	3 (High)

<sup>3</sup> Zone I (minor damage) : MMI VIII, pga 0.2-0.3g; Zone II and III (moderate to high damage); MMI V-VII, pga 0.075-0.2g; Zone IV (severe damage): MMI VIII, pga 0.2-0.3g; Zone V (very severe damage): MMI IX, pga 0.3g-

<sup>4</sup> Classification based on MIMU and UNEP

## C Consolidated Sustainability Analysis

Consolidated Sustainability

Total Score\* = A\*\* + B

\*: double score in the PAs (3 to 6)

\*\*: If score of environment-related legal framework is "0", the level is set as "1 (Sustainable)".

Total Score	1-2	3-5	6-9
Constraint Level	1 (Suitable)	2 (Marginally suitable)	3 (unsuitable)

## D Suitable Agriculture

D. Areas with high agricultural productivity

Environmental Features <sup>5</sup>	Level of Productivity				Weight	Remarks
	0 (low)	1	2	3 (high)		
a. Rice production (1,000t)	others		$1,000 \leq X < 2,000$	$2,000 \leq X$	1.0	
b. Bean production (1,000t)	others	$90 \leq X < 170$	$170 \leq X$		1.0	Black gram, Green gram, Pigeon pea, Soy bean
c. Sugarcane production (1,000t)	others	$300 \leq X < 600$	$600 \leq X$		1.0	
d. Rubber production (1,000t)	others	$1.7 \leq X < 3.5$	$3.5 \leq X$		1.0	

(Suitable agricultural areas)

Total Score = a. + b. + c. + d.

Total Score	0-1	2-3	4
Constraint Level	1	2	3

<sup>5</sup> Source: FAO Digital Atlas

### 3.4.3 Results of Spatial Analysis and Development Concept

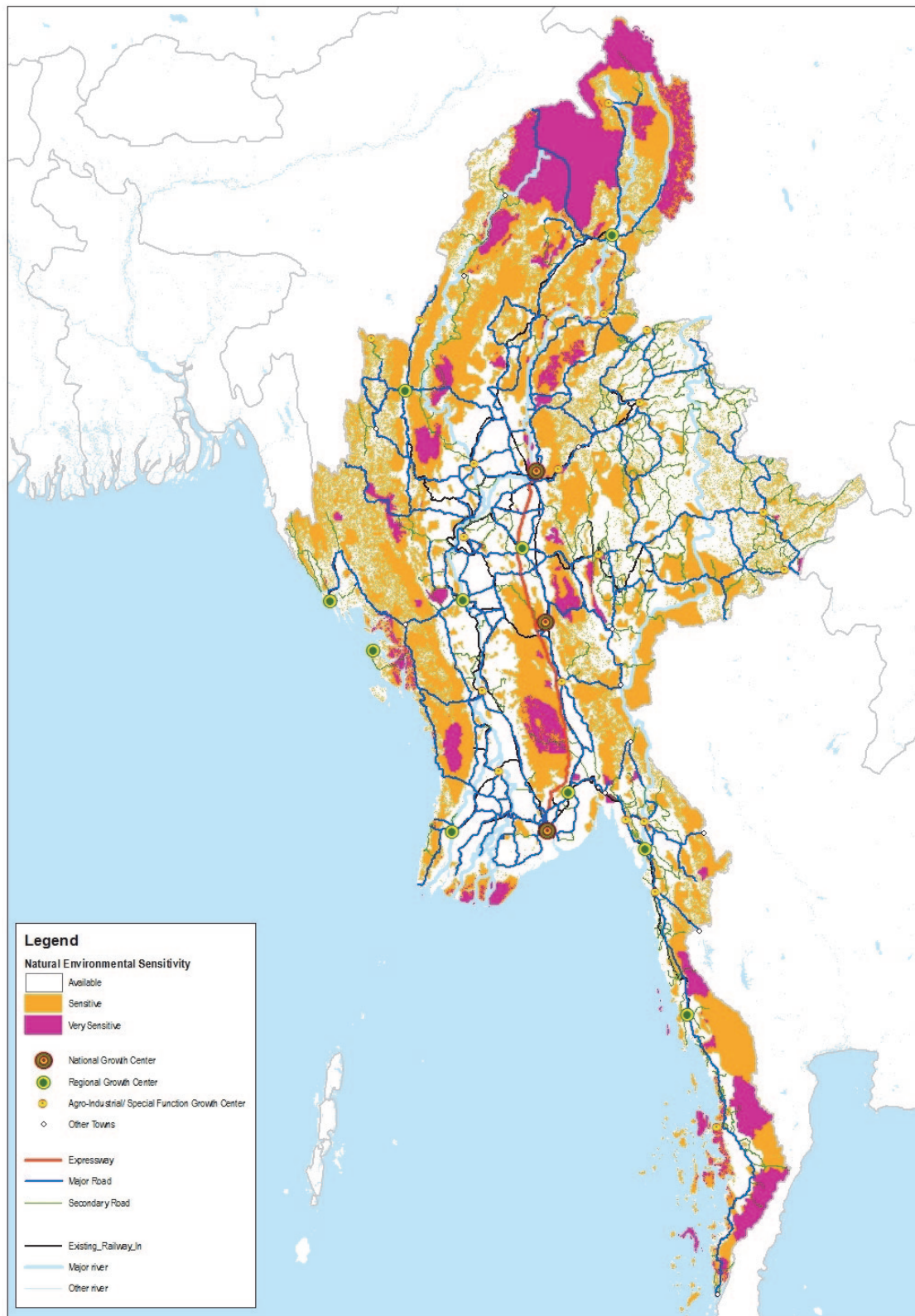
#### (1) Environmental Sensitivity Analysis

The MYT-Plan conducted environmental sensitivity analysis on Myanmar's natural resources, as shown in Figure 3.14. The study area was categorized into three zones of sensitivity (Not Sensitive, Sensitive and Very Sensitive). For each sensitivity zone, Table 3.6 indicates the relevant environmental sensitivity, in terms of transportation sector.

**Table 3.6 Transportation Development and Environmental Sensitivity**

	Not Sensitive	Sensitive	Very Sensitive
Percentage of sensitive land in Myanmar (%)	50.0	38.8	11.2
Description of the Area	Those areas where the environmental sensitivity is determined low or nominal	Those areas where the environmental sensitivity is determined significant, but not high  Includes high priority KBAs (e.g. closed canopy forest)	Those areas where the environmental sensitivity is determined to be very high
Analysis	Fewer restrictions needed for project planning. Activities that are likely to degrade natural resources will require impact mitigation measures	These areas will require impact mitigation measures. These areas shall be also given special attention for environmental sensitivity	These areas will require special attention under legal instruments that ensure strict conservation. Projects should be avoided in these areas.  New projects should be prohibited  Only rehabilitation / improvement of existing infrastructure are acceptable.  Special measures must be taken not to degrade natural environmental conditions  Designated protected areas are required
Examples of acceptable or unacceptable types of projects, and consideration points	Any project but efforts included to minimize adverse impacts.	Large-scale development projects that occupy large areas shall be avoided as much as possible.  The location with least environmental impacts must be selected.  Alternatives, which can minimize adverse impacts, shall be examined.  Project must include specific environmental management strategies including natural resources restoration plan (e.g. re-forestation)	Rehabilitation of existing roads / railways  Necessary roads for implementation of nature conservation activities Community access roads for persons who reside in the area  Projects should not trigger a development which will likely change land use along the corridor (e.g. commercial / town development, railway station, logistics center) Projects occupying large areas are not acceptable.

Source: JICA Study Team



Source: JICA Study Team

**Figure 3.14 Environmental Sensitivity Analysis**

## (2) Risk Analysis for Natural Disasters

The MYT-Plan risk analysis of natural disasters, as shown in Figure 3.14, was categorized into three risk zones (Low, Medium, High), each describing the planned zoning and environmental sensitivity in terms of transportation development, as explained in Table 3.7. The analysis of zoning impact on natural resources is shown in Figure 3.15. As with the environmental sensitivity analysis, the study area was categorized into three zones.

It is noteworthy that projects should be designed to not only mitigate against natural disasters but also to avoid accelerating damage to the natural environment, thereby reducing the chances of triggering disasters. For example, large-scale land clearance in sloped areas can precipitate landslides, and river dredging or reclamation can change river flow patterns, leading to floods as well as erosion and sedimentation.

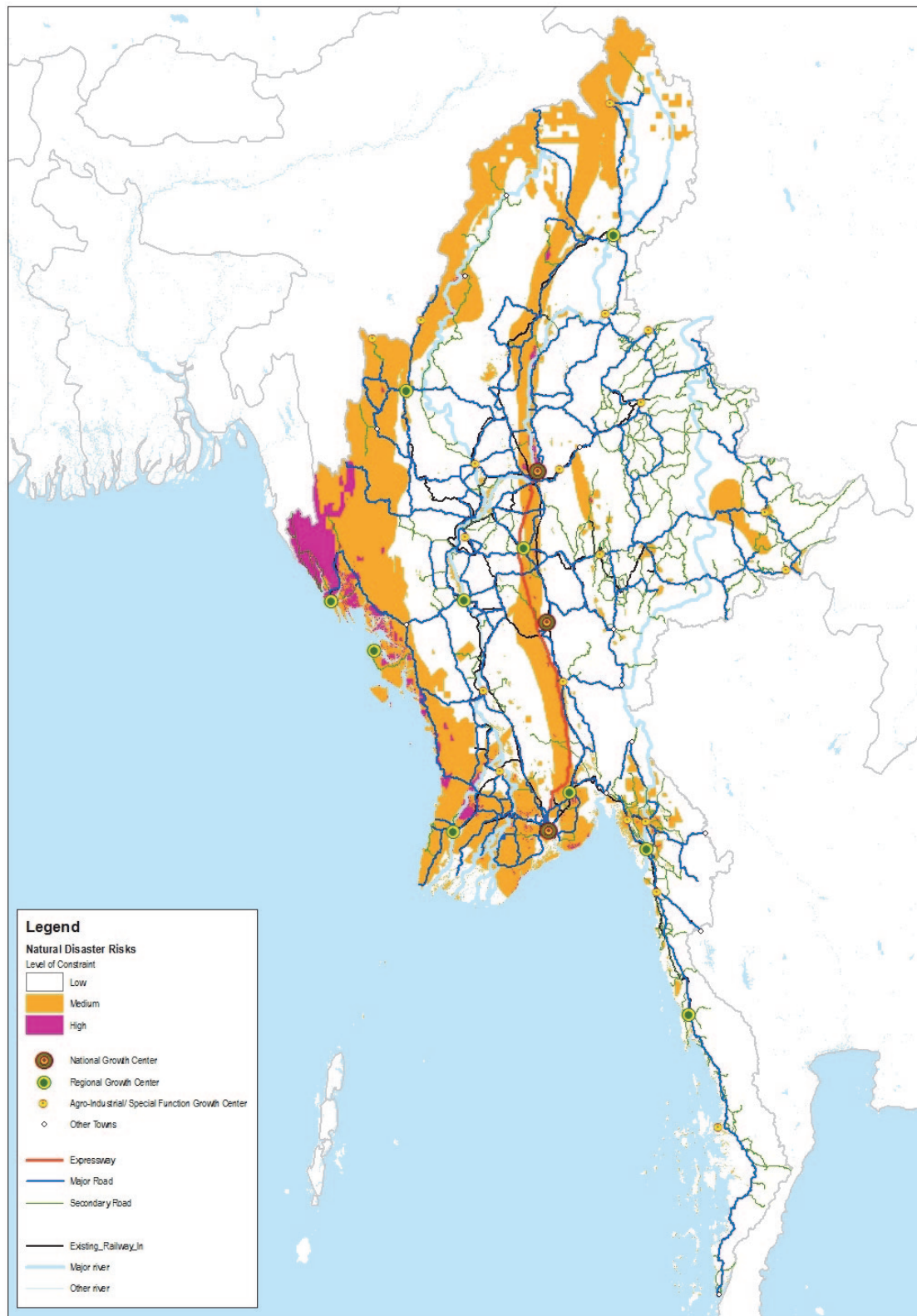
Table 3.7 illustrates the various zoning areas and possible impacts from natural disasters prevention in the transportation development policy are explained in Table 3.7.

**Table 3.7 Transportation Development and Risk of Natural Disasters**

	Low	Medium	High
Percentage of disaster prone land in Myanmar (%)	70.5	27.3	2.2
Description of Area	Those areas that are likely exposed by no more than one natural disaster annually  Additionally, small but disaster-prone areas are included (e.g. flood prone areas along upper Ayeyarwaddy River, regional landslide areas in Mon, Kayin State).	Those areas in high seismic zones and/or cyclone zones  Areas experiencing more than one natural disaster annually	Those areas including western coastal area, which are suffering from high risk of cyclones and earthquakes  Some small areas in southern delta area show risk of floods and cyclones. Cyclones can worsen damage caused by flooding
Analysis	Fewer restrictions needed for project planning.	These areas will require proper mitigation measures  In addition, environmental improvement / restoration plans are recommend to be included in project (e.g. reforestation to reduce chances of landslides)	These areas have a risk of significant damage from multiple disasters  Project planning and design will include measures to mitigate damage to surroundings, to reduce chances of natural disaster
Examples of acceptable or unacceptable types of project, and consideration points	Any project but efforts included to mitigate damage from disasters	These projects will include reasonable efforts to mitigate damage from disasters	The projects will include significant disaster mitigation measures (e.g. dyke road, station / logistics center used for shelter in case of disaster).

Source: JICA Study Team





Source: JICA Study Team

**Figure 3.15 Risk Analysis of Natural Disasters**



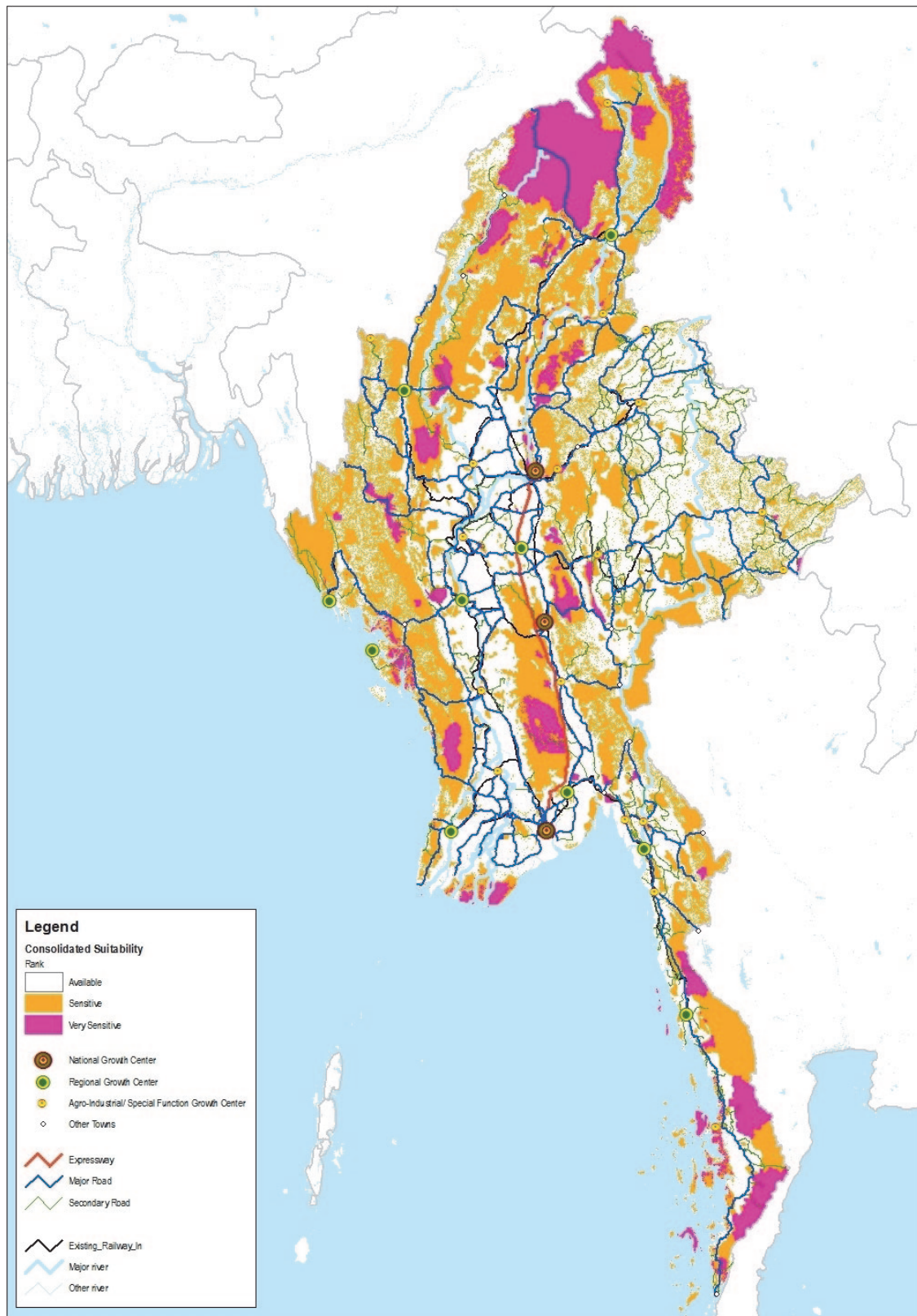
### (3) Consolidated Suitability Analysis

The MYT-Plan analysis consolidated the environmental sensitivity with the disaster analysis, resulting in the findings presented in Table 3.8.

**Table 3.8 Transportation Development and Consolidated Environmental Sustainability**

	Suitable	Usable, subject to local conditions	Unsuitable
Percentage of disaster prone land in Myanmar (%)	48.8	40.0	11.1
Description of Area		These areas' environmental value is moderate, consisting of forest, low / medium KBAs, etc. However, these areas are prone to risks from natural disasters	These areas are predominantly highly sensitive environmental zone
Concept	Fewer restrictions needed for project planning  Any impacts which likely degrade natural resources shall be mitigated  Adequate disaster prevention plans will be required	These areas will require proper mitigation measures given conservation concerns  Disaster prevention measures will be developed for projects	These areas should not be available for project development.  Disaster prone physical structures will be strictly prohibited  Changing environmental features (thereby increasing chances of disaster damage) is likewise prohibited
Examples of acceptable or unacceptable project types and consideration points	Any project but efforts included to mitigate damage to the environment and activities that exacerbate damage from natural disasters	These projects will not include large-scale development that encompasses a large area, in order to conserve natural resources  Project must provide for specific environmental management, including a natural resources restoration plan (e.g. reforestation) is indicated  Location with the least likelihood of negative environmental impacts must be selected	Rehabilitation of existing roads / railways  Necessary roads for implementation of nature conservation activities  Community access roads for persons who reside in the area Projects should not trigger a development which will likely change land use along the corridor (e.g. commercial / town development, railway station, logistics center)  Projects occupying large areas are not acceptable. Necessary roads for implementation of natural conservation activity. Projects designed for disaster prevention are acceptable

Source: JICA Study Team



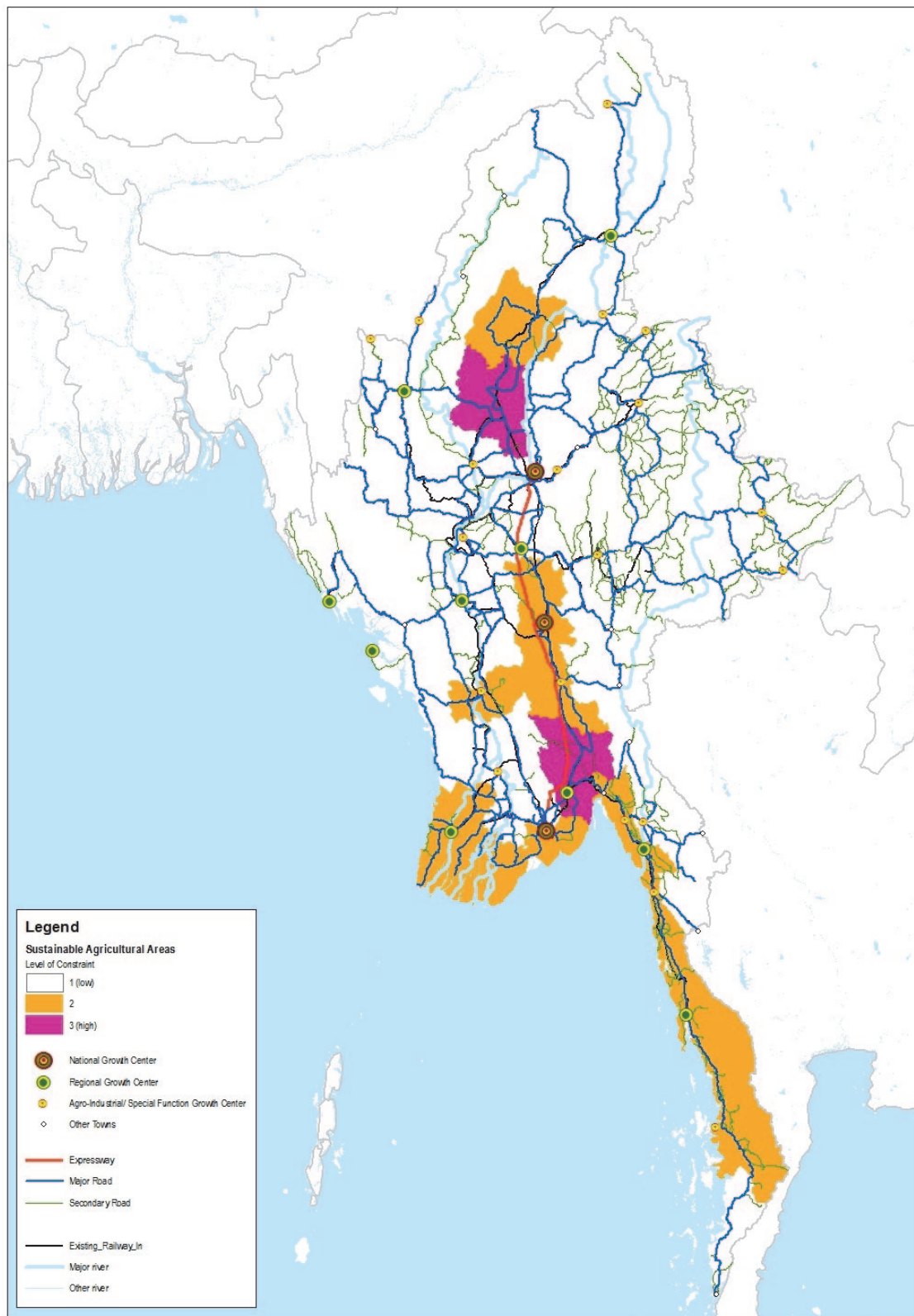
Source: JICA Study Team

**Figure 3.16 Consolidated Suitability Analysis**

#### **(4) Economic Potential (Agricultural Production)**

The MYT-Plan analysis includes agricultural production and findings are described in Figure 3.17. Those areas that have high agricultural productivity may require transportation infrastructure improvements. Figure 3.17 also highlights three areas that have higher potential for agricultural production, including:

- The Southern delta along the Ayeyawaddy River, which is rich in rice production; rice is one of the most important export crops for Myanmar's economy
- The central dry area where various agricultural products are cultivated; beans are a major export from this area, rice is also harvested
- The South-eastern area with its small but lucrative production of rubber; it is mostly produced in Mon State, Kayin State and Tanintharyi Region



Source: JICA Study Team

**Figure 3.17 Economic Potential (Agricultural Production)**

### 3.5 Rapid Environmental Evaluation of the proposed projects

#### 3.5.1 Method of Evaluation

The MYT-Plan analysis conducted a rapid evaluation of the environmental and disaster factors for probable projects; the approach taken is described below.

##### (1) Key Environmental Factors

The key environmental factors that are most likely to cause negative environmental impacts are identified and described below:

###### A. Pollution

- (1) Air pollution and noise disturbance
- (2) Water quality
- (3) Waste

###### B. Natural Environment

- (4) Ecosystem: including legal systems for the designation of protected areas, forest, KBAs, etc. The ecosystem impact may be evaluated by environmental sensitivity analysis.
- (5) Disaster: evaluated through risk analysis of natural disasters, geographic, topographic, and hydrological figures.

Impacts on the natural environment (ecosystem and disaster) were spatially evaluated, based on the environmental suitability analysis (see section 3.4.3).

###### C. Social Environment

- (6) Land acquisition and resettlement
- (7) Local issues, including local economy, community conflict, etc.
- (8) Rights, including access rights to water, children, women, disabilities, etc.

##### (2) Scoring Method

The above-noted impacts were evaluated using the following three evaluation factors, namely “magnitude”, “duration” and “extent”.

**Table 3.9 Evaluation Factors**

Evaluation Factors	Score			
	0	1	2	3
Magnitude	No or less	Small	Medium	Significant
Duration	-	During construction activities only	Several years	Long
Extent	-	At the construction site only	Local	Wide

##### (3) Scoring and Overall Evaluation

An overall score is calculated using the eight environmental factors (above) in the following formula:

---

Overall Score = (1) + (2) + (3) + (4) x 2 + (5) + (6) x 2 + (7) + (8)

It should be noted that values of “(4) ecosystem” and “(6) land acquisition and resettlement” are doubled. These factors are considered more important (via the SEA stakeholder meeting) as they carry more risk of objection and greater potential for project delays.

Finally, the overall evaluation for each proposed project is rated below:

**Table 3.10 Classifications on Evaluation Results**

Classification	Overall Score
Significant	Total score $\geq 50$
Moderate	$49 \geq$ Total score $\geq 42$
Rare	$41 \geq$ Total score, but not 0
No impact	Total score = 0

#### **(4) Summary of Rapid Evaluation**

The results of the rapid environmental evaluation for proposed projects are summarized in Table 3.11.

Table 3.11 Rapid Environmental Evaluation for the Proposed Projects

Sector	Environmental Impact Evaluation														
	Corridor	Project ID	Location	Project Description	Pollution			Natural Environment		Social Environment				Total Score	Overall
					(1) Air Quality / Noise Disturbance	(2) Water Quality	(3) Waste	(4) Ecosystems	(5) Disaster	(6) Land Acquisition / Resettlement	(7) Local Issues	(8) Rights			
Aviation	A1,B1,H1,K1	A001	Yangon International Airport	Improvement	5	5	5	5	5	6	3	2	47	Moderate	
	A1,B1	A002	Hanthawaddy International Airport	Improvement	5	5	5	5	5	6	3	2	47	Moderate	
	A2,A3,C1,D1,K2	A003	Mandalay International Airport	Improvement	5	5	5	5	5	6	3	2	47	Moderate	
	E1,L2	A004	Heho International Airport	Improvement	5	5	5	5	5	6	3	2	47	Moderate	
	K2,D1	A005	Nyaung U International Airport (Alt. Pakokku)	Improvement	5 (5)	5 (5)	5 (5)	5 (5)	5 (5)	6 (6)	4 (3)	2 (2)	48 (47)	Moderate (Moderate)	
	Other	A006	Thandwe International Airport	Improvement	5	5	5	5	5	6	3	2	47	Moderate	
	E1	A007	Tachileik Airport	Improvement	5	4	4	4	5	5	3	2	41	Rare	
	A3	A008	Myitkyina Airport	Improvement	5	4	4	4	5	5	3	2	41	Rare	
	E1	A009	Sittwe Airport	Improvement	5	4	4	4	6	5	3	2	42	Moderate	
	B2,J2,J3	A010	Dawei Airport (International)	Improvement	5	4	4	4	5	5	3	2	41	Rare	
	J2,J3	A011	Myeik Airport	Improvement	5	4	4	4	5	5	3	2	41	Rare	
	J3	A012	Kawthoung Airport	Improvement	5	4	4	4	5	5	3	2	41	Rare	
	Other	A013	Putao Airport	Improvement	5	4	4	4	5	5	3	2	41	Rare	
	E1	A014	Ann Airport	Improvement	5	4	4	4	6	5	3	2	42	Moderate	
	E1	A015	Kyaukphyu Airport	Improvement	5	4	4	4	6	5	3	2	42	Moderate	
	C1	A016	Lashio Airport	Improvement	5	4	4	4	6	5	3	2	42	Moderate	
	E1	A017	Kengtung Airport	Improvement	5	4	4	4	5	5	3	2	41	Rare	
	A3	A018	Bhamo Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate	
	L1,L2	A019	Loikaw Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate	
	D1	A020	Monywar Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate	
	B1,B2,J1	A021	Mawlamyine Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate	
	D1	A022	Kalay Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate	
	J3	A023	Bokpyinn Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate	

Sector	Environmental Impact Evaluation													
	Corridor	Project ID	Location	Project Description	Pollution			Natural Environment		Social Environment			Total Score	Overall
					(1) Air Quality / Noise Disturbance	(2) Water Quality	(3) Waste	(4) Ecosyste ms	(5) Disaster	(6) Land Acquisition / Resettlement	(7) Local Issues	(8) Rights		
	E1	A024	Mong-Hsat Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate
	D1	A025	Hommalin Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate
	D1	A026	Kanti Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate
	H1	A027	Pathein Airport	Improvement	5	4	4	4	5	5	4	2	42	Moderate
	E1,G2,K1,K2	A028	Magway Airport	Improvement	5	4	4	4	5	5	3	2	41	Rare
	K1,K2,D1	A029	Kyauktu Airport	Improvement	5	4	4	4	5	5	3	2	41	Rare
	Other	A030	Coco Island Airport	Improvement	5	4	4	4	5	5	3	2	41	Rare
	Other	A031	Soft Component	Technical assistance	0	0	0	0	0	0	0	0	0	No impact
	Other	A032	Soft Component	Technical assistance	0	0	0	0	0	0	0	0	0	No impact
	B1	R001	Thaton – Eindu – Kawkareik – Myawaddy Road	Improvement	4	4	3	6	5	6	3	2	45	Moderate
	J1	R002	Three Pagoda Pass	Improvement	4	4	3	6	5	6	3	2	45	Moderate
	Road	B2,J3	R003	Thanbyzayat – Dawei – Myeik – Kawthong Road	Improvement	4	4	3	5	5	6	3	2	43
E1		R004	Taunggyi – Lolim – Kyaington Road	Improvement	4	4	3	5	6	6	3	2	44	Moderate
E1		R005	Kyaington – Mongla Road	Improvement	4	4	3	5	5	6	3	2	43	Moderate
D1		R006	Monywa - Pale - Gangaw – Kalaymyo Road	Improvement	4	4	3	5	5	6	3	2	43	Moderate
A3		R007	Shwebo – Myitkyna Road	Improvement	4	4	3	5	6 –	6	3	2	44	Moderate
E1		R008	Minbu – Ann – Kyauktaw – Sittwe Road	Improvement	4	4	3	5	6	6	3	2	44	Moderate
A1, A2		R009a	Bago – Mandalay Road	Improvement, widening	4	4	4	5	6	8	4	2	50	Significant
A1, A2		R009b	Yangon - Bago Road	Improvement, widening	4	4	4	5	6	8	4	2	50	Significant
K1		R010	Yangon – Pyay - Mandalay Road	Improvement, widening	4	4	4	6	5	8	4	2	51	Significant
D1,K1,H1		R011	Monywa – Pathein Road	Improvement	4	4	3	5	5	6	3	2	43	Moderate
C1		R012	Mandalay – Lashio – Muse Road	Improvement	4	4	3	5	5	6	4	2	44	Moderate



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Sector	Environmental Impact Evaluation													
	Corridor	Project ID	Location	Project Description	Pollution			Natural Environment		Social Environment			Total Score	Overall
					(1) Air Quality / Noise Disturbance	(2) Water Quality	(3) Waste	(4) Ecosyste ms	(5) Disaster	(6) Land Acquisition / Resettlement	(7) Local Issues	(8) Rights		
	A3	R013	Mandalay – Thabeikkyin – Tagaung – Bhamo Road	Improvement	4	4	3	6	6	6	4	2	47	Moderate
	L2	R014	Thibaw – Lollem Road	Improvement	4	4	3	6	6	6	3	2	46	Moderate
	J2	R015	Dawei – Phunamron Road	Improvement	4	4	3	5	6	6	3	2	44	Moderate
	B1,B2	R016	Payagyi – Mawlamyaine - Thanbuzayat Road	Improvement	4	4	3	5	5	6	3	2	43	Moderate
	D1	R017	Monywa – Yargyi – Kalewa Road	Improvement, widening	4	4	4	5	5	8	4	2	49	Moderate
	H1	R018	Yangon – Patheiri Road	Improvement	4	4	3	5	6	6	3	2	44	Moderate
	L1	R019	Taunggyi – Loikaw – Hpapun – Pha an Road	Improvement	4	4	3	5	5	6	4	2	44	Moderate
	J3	R020	Tanintharyi – Mawtaung Road	Improvement	4	4	3	7	5	6	4	2	48	Moderate
	B1	R021	Gyaing (Kawkareik) Bridge	Improvement	4	5	4	5	5	6	3	2	45	Moderate
	Urban	R022	New Thaketa Bridge	Improvement	4	5	4	5	6	6	3	2	46	Moderate
	Urban	R023	Bago Bridge	Improvement	4	5	4	5	5	6	3	2	45	Moderate
	B1	R024	Don Tha Mi and Naung Lon Bridge	Replacement	4	5	4	5	5	7	3	2	47	Moderate
	B1	R025	Gyaing (Zarhapyin) Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	B2	R026	Atran Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	A2	R027	2 bridges on Yangon-Mandalay Road	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	H2	R028	Hinthata Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	D1	R029	Yaw Chaung (Yepyar) Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	D1	R030	Yaw Chaung (Ohn Taw) Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	Urban	R031	Dala Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	H1	R032	Hlaing River Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	C1	R033	New Goat twin Viaduct	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	J3	R034	Tha Mouk Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	Urban	R035	Wataya Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	D1	R036	Chindwin (Kalaywa) Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate

Sector	Environmental Impact Evaluation													
	Corridor	Project ID	Location	Project Description	Pollution			Natural Environment		Social Environment			Total Score	Overall
					(1) Air Quality / Noise Disturbance	(2) Water Quality	(3) Waste	(4) Ecosyste ms	(5) Disaster	(6) Land Acquisition / Resettlement	(7) Local Issues	(8) Rights		
	H1	R037	Thetkal Thoung Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	B2	R038	Thanlwin (Chaungsone) Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	B1	R039	Chaungnikwa Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	Urban	R040	Thanlwin (Tarsopha) Bridge	Replacement	4	5	4	5	5	6	3	2	45	Moderate
	A1	R041	Yangon - Mandalay Expressway	Improvement	4	4	3	5	6	6	3	2	44	Moderate
	B1	R042	Yangon City - Thilawa Port Expressway	Improvement, widening	4	4	4	5	5	6	3	2	44	Moderate
	B1	R043	Yangon City - Hanthawaddy - Existing Expressway	New construction	4	4	4	5	5	7	3	2	46	Moderate
	A2,A3	R044	Mandalay Circular Expressway	Improvement	4	4	4	5	6	7	4	2	48	Moderate
	Other	R045	Road to Sittwe Port	New construction	4	4	4	5	6	6	3	2	45	Moderate
	G2	R048	Loikaw - Magway Road	Improvement	4	4	4	7	6	5	4	2	48	Moderate
	G1	R049	Hapasawing - Pyay Road	Improvement	4	4	4	7	6	5	4	2	48	Moderate
	A1, A2	RW001	Yangon - Mandalay	Improvement	4	4	5	4	6	5	3	2	42	Moderate
Railway	A3	RW002	Myohaung-Myitkyina	Improvement	4	4	5	5	6	6	3	2	46	Moderate
	B1	RW003	Bago-Mawlamyine	Improvement	4	4	5	4	5	6	3	2	43	Moderate
	K1	RW004	Yangon-Pyay	Improvement	4	4	5	4	6	6	3	2	44	Moderate
	H1	RW005a	Yangon-Pathein	Improvement	4	4	5	4	6	6	3	2	44	Moderate
	H1	RW005b	Bridge	New Construction	4	5	5	5	6	7	3	2	49	Moderate
	D1	RW006	Myohaung-Monywa	Improvement	4	4	5	5	6	6	3	2	46	Moderate
	E1	RW007	Pyawbwe-Shwemyaung	Improvement	4	4	5	5	6	6	3	2	46	Moderate
	A1	RW008	Bago-Hanthawaddy	New construction, extension	5	5	5	5	6	8	4	2	53	Significant
	A1	RW009	Yangon - Hanthawaddy	New construction, extension	4	4	5	5	6	8	4	2	51	Significant

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Sector	Environmental Impact Evaluation													
	Corridor	Project ID	Location	Project Description	Pollution			Natural Environment		Social Environment			Total Score	Overall
					(1) Air Quality / Noise Disturbance	(2) Water Quality	(3) Waste	(4) Ecosyste ms	(5) Disaster	(6) Land Acquisition / Resettlement	(7) Local Issues	(8) Rights		
Sea Port	Other	RW010	Togyang-Thilawa	Improvement	4	4	5	5	6	7	4	2	49	Moderate
	Other	RW011	Naypyitaw - Bagan	Improvement	4	4	5	5	6	6	4	2	47	Moderate
	A1	RW013	Yangon MR ICD	New construction	5	5	6	4	5	8	4	2	51	Significant
	A3	RW014	Mandalay MR ICD	New construction	5	5	6	4	4	8	4	2	50	Significant
	A1,B1,H1,K1	PT001	Yangon Port (Thilawa)	Improvement	4	5	4	6	6	5	4	2	47	Moderate
	A1,B1,H1,K1	PT002	Yangon Port (Post Thilawa)	Improvement	4	5	4	6	6	5	4	2	47	Moderate
	A1,B1,H1,K1	PT003	Yangon Port (Post Thilawa)	Improvement	4	5	4	6	6	5	4	2	47	Moderate
	A1,B1,H1,K1	PT004	Offshore Yangon River (Deep Seaport)	New construction	4	6	4	6	6	6	4	2	50	Significant
	A1,B1,H1,K1	PT005	Offshore Yangon River (Deep Seaport)	New construction	4	6	4	6	6	6	4	2	50	Significant
	B2, J2, J3	PT006	Dawai Port	Port construction	5	6	6	6	5	7	4	3	55	Significant
	E1	PT011	Sittwe Port	Improvement	4	4	4	6	5	5	4	2	45	Moderate
	Other	PT013	Yangon Port Channel	Navigation safety instrument	2	2	3	4	5	2	5	2	31	Rare
	Other	PT014	Navigation	River mouth improvement	2	2	3	4	5	2	5	2	31	Rare
	Other	PT015	Law & Regulation	Technical assistance	0	0	0	0	0	0	0	0	0	No impact
Other	PT016	Soft Component	Technical assistance	0	0	0	0	0	0	0	0	0	No impact	
Other	PT017	Yangon-Thilawa Port	Technical assistance	0	0	0	0	0	0	0	0	0	No impact	
IWT	F1,F2	IW001	Mandalay Port	Improvement	4	4	5	6	6	6	4	2	49	Moderate
	F1	IW002	Yangon Port	Improvement	4	4	5	6	6	7	4	2	51	Significant
	F1	IW003	Bhamo Port	Improvement	4	4	4	7	6	6	4	2	50	Significant
	F1,F2	IW004	Pakkokku Port	Improvement	4	4	4	6	6	6	4	2	48	Moderate
	F1	IW005	Magway Port	Improvement	4	4	4	6	6	6	4	2	48	Moderate
	F2	IW006	Monywa Port	Improvement	4	4	4	6	6	6	4	2	48	Moderate

Sector	Environmental Impact Evaluation													
	Corridor	Project ID	Location	Project Description	Environmental Impact Evaluation								Overall	
					Pollution			Natural Environment		Social Environment				Total Score
					(1) Air Quality / Noise Disturbance	(2) Water Quality	(3) Waste	(4) Ecosyste ms	(5) Disaster	(6) Land Acquisition / Resettlement	(7) Local Issues	(8) Rights		
F2	IW007	Kalewa Port	Improvement	4	4	4	6	6	6	4	2	48	Moderate	
F1	IW009	Yangon - Mandalay	Navigation	3	5	4	6	6	6	3	4	2	42	Moderate
F1	IW010	Mandalay - Bhamo	Navigation	3	5	4	7	6	6	3	4	2	44	Moderate
F2	IW011	Monywa - Upstream	Navigation	3	5	4	6	6	6	3	4	2	42	Moderate
F1	IW012	Ayeyarwady Delta	Navigation	3	5	4	6	6	6	3	4	2	42	Moderate
F1	IW015	Yangon - Mandalay	Navigation	3	5	4	6	6	6	3	4	2	42	Moderate
F1	IW016	Mandalay - Bhamo	Navigation	3	5	4	7	6	6	3	4	2	44	Moderate
F2	IW017	Monywa - Upstream	Navigation	3	5	4	6	6	6	3	4	2	42	Moderate
F1	IW018	Ayeyarwady Delta	Navigation	3	5	4	6	6	6	3	4	2	42	Moderate
Urban	IW021	Dalla Shipyard	New construction	3	4	5	6	5	5	4	3	2	42	Moderate
F1,F2	IW022	Mandalay Shipyard	Upgrading	3	4	5	6	5	5	4	3	2	42	Moderate
F1	IW025	Ayeyarwady Delta	Navigation	3	5	4	6	6	6	3	4	2	42	Moderate
Other	IW030	Service	Technical assistance	0	0	0	0	0	0	0	0	0	0	No impact
Other	IW032	Soft Component	Technical assistance	0	0	0	0	0	0	0	0	0	0	No impact
Other	IW033	Soft Component	Technical assistance	0	0	0	0	0	0	0	0	0	0	No impact
Other	IW034	Soft Component	Technical assistance	0	0	0	0	0	0	0	0	0	0	No impact
Other	IW035	Soft Component	Technical assistance	0	0	0	0	0	0	0	0	0	0	No impact
Other	IW036	Soft Component	Technical assistance	0	0	0	0	0	0	0	0	0	0	No impact

Total Score = (1) + (2) + (3) + (4)x2 + (5) + (6)x2 + (7) + (8)

Significant Total Score = >50

Moderate Total Score = 42 to 49

Rare Total Score = 1 to 41

No impact Total Score = 0

Source: JICA Study Team



## **Chapter 4 National Spatial Planning Framework**

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### **4.1 Overview**

#### **4.1.1 Background**

This Chapter provides an introduction to the National Spatial Development Framework (NSDF), its scope and an overview of those Government Ministries and Agencies involved in spatial planning and legislation related to spatial development. It also summarizes the key objectives and policies of relevant land development Ministries and Agencies in terms of employment and economic activity, such as agriculture and agro-industries, industry and Industrial Zones, Special Economic Zones and tourism.

The Chapter also outlines aspects of urbanization, using projected distributions of future population at the state/region and Traffic Analysis Zone (TAZ) levels, which led to the proposal for a National Spatial Development Framework (NSDF). The NSDF will develop a land development framework to support the Myanmar National Transport Development Plan (MYT-PLAN), which will guide future transport investment at the national and state/regional levels. The NSDF will also inform key transport sector stakeholders about linkages between their own plans, policies and programs so that they can implement them more efficiently.

#### **4.1.2 Planning Horizon**

##### **(1) Timescale**

The planning horizon for this study is the year 2030. This horizon is based on current tools like the “Existing Context 2012” and a “Committed Projects Map” covering the period 2012- 2015, which includes the current land use conditions plus known Government projects under construction or committed (i.e. with approval/funding in place). The NSDF Strategy Map has been prepared also with the time horizon of 2030, though the focus and intent of the strategy is more important than its particular time horizon, which could change from what is currently planned.

##### **(2) Monitoring and Updating**

The NSDF should be revisited every five years and adjusted and updated when relevant by the Ministry of Construction’s (MOC) Department of Human Settlements and Housing Development (DHSHD), Ministry of Environmental Conservation and Forestry, Ministry of Agriculture and Irrigation and Ministry of Home Affairs in consultation with other key stakeholders, including state/regional governments and City Development Committees (CDCs). Population and other related socio-economic data should be monitored and updated periodically by the Central Statistical Organization (CSO) of the Ministry of National Planning and Economic Development (MNPED) and other relevant Agencies.

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#### **4.1.3 Purpose of the National Spatial Development Framework**

The purpose of the NSDF is to bring together the key spatial policies and programs of the major transport sector stakeholder Ministries, Agencies and private sector organizations with an interest in strategic land development. In this way, it is expected that the national, state/regional and CDC stakeholders will be able to understand how departmental plans, policies and programs can work together and where there are gaps, allowing stakeholders to plan in more efficient and integrated ways for future implementation. To fulfill stakeholder expectations, the NSDF should be:

- Complementary with the Myanmar National Transport Development Plan
- Consistent with the DHSHD's Concentrated Decentralization Development Strategy and MNPED's National Comprehensive Development Plan (NCDP)
- Balanced in terms of enabling growth in urban and rural regions and states
- Focused on key growth centers to optimize investment funds and community benefits
- Multi-centric to improve access to a range of employment opportunities and social and community facilities
- To optimize utilization of land and natural resources for sustainable development and environmental conservation

In order to achieve these aims, the MYT-Plan developed the following key objectives for the preparation of the NSDF. The objectives are to:

- Complement the Myanmar National Transport Development Plan (MYT-Plan), DHSHD's Concentrated Decentralization Development Concept and MNPED's NCDP
- Identify strategic transport network/facility linkages between key cities/activity hubs
- Develop a hierarchy of centers and related economic, social and community facilities and services
- Provide a focus for future public and private sector urban development and related transport investments
- Assist Government Agencies and international donor agencies to formulate priority transport projects for investment and implementation

## **4.2 National Economic and Social Policy Framework**

### **4.2.1 Framework for Economic and Social Reforms (FESR)**

In June 2012, H.E. President U Thein Sein announced the second phase of the Government's Framework for Economic and Social Reform (FESR) strategy, setting a high economic growth rate target (in per capita GDP) by the end of the five year Plan. The President also announced four economic policies to guide the future economic and social development of the country:

- Development of agriculture and overall development
  - Balanced and proportionate growth in regions and states
  - Inclusive growth for the entire population
-

- Emergence of reliable statistics and improvement of statistical systems

The policies are framed to achieve macro-economic stability, quick-wins to 2015 for inclusive growth and sectoral and structural reforms for sustainability.

The NSDF and related Transport Vision 2030 must be consistent with the FESR and the four economic policies, as well as with other national and regional programs and plans, in particular, the National Comprehensive Development Plan (NCDP) being prepared by the Ministry of National Planning and Economic Development (MNPED). In relation to this strategic policy and plan framework, an inclusive and equitable growth vision was developed by Government to steer the future long-term development of the country, which is *“To become a modern developed nation that meets the aspirations of its people for a better life.”*

#### **4.2.2 National Comprehensive Development Plan 2011-2030 (NCDP)**

The Ministry of National Planning and Economic Development (MNPED) is now drafting the National Comprehensive Development Plan (NCDP) for 2011-2030 to reflect the new Government's priorities and major reforms; the NCDP is scheduled for release in 2014. The NCDP includes people-centered development priorities derived from the Government's Framework for Social and Economic Reforms. It is being prepared with consultation at village, township and district levels as well as with expert advice from state/regional and national level stakeholders.

The NCDP is being designed to provide the development policy framework for Township Development Plans, District Development Plans, State and Regional Development Plans as well as Urban Development Plans. The NCDP will include an interim roadmap that sets short/medium term directions for state and regional programs and projects. The roadmap will set a broad, long-term strategic direction for Development Plans that includes reforms needed to deliver quick wins. In summary, the NCDP goals focus on:

1. Improving the living standard of the entire population
2. Increasing per capita GDP
3. Promoting public utilities and social sector development such as transportation, water and sanitation, electric power, education, health and social security etc.
4. Creating job opportunities
5. Conserving natural resources
6. Achieving the Millennium Development Goals (MDGs) and other human development objectives by 2015
7. Fully implementing economic integration with ASEAN, in accordance with its ASEAN Economic Community (AEC) 2015 schedules

#### **4.2.3 Myanmar Comprehensive Development Vision (MCDV)**

The Myanmar Comprehensive Development Vision (MCDV) provides guidance on future national development in relation to ASEAN policies and programs and is being developed by the Economic Research Institute for ASEAN and East Asia (ERIA). The MCDV is a long-term development vision incorporating growth strategies for economic policies, infrastructure and human resource development (HRD) plans, industrial sector-wise growth paths, region and state development master plans etc. In summary, the MCDV:



- Envisages Myanmar's development over 20 years, the same timeframe as with the NSDF
- Intends to become a comprehensive reference for the Myanmar economy, now and for the future

Consistent with the FESR and the NCDP, the MCDV's objective is human-centered development through growth strategies that are high-growth and globally linked, inclusive and balanced, and green and sustainable.

#### **4.2.4 Regional Transport Integration: ASEAN and GMS**

In 2004, the ASEAN International Transport Forum adopted the ASEAN Transport Action Plan 2005-2010 and approved 48 Action Plans covering sea transport, land transport, transport facilitation and air transport. These Action Plans included development of road and railway networks and cross border transport facilitates. In 2005, the Forum signed the "ASEAN Framework Agreement on Multimodal Transport" to accelerate regional integration. According to this agreement, the Asian Highways road network was to be improved and expanded in Indochina (Thailand, Cambodia, Vietnam and Laos). Subsequently in 2010, the 17th ASEAN Summit adopted the Master Plan on ASEAN Connectivity (MPAC) and proposed strategies and actions to improve regional connectivity within ASEAN. MPAC defined 15 priority projects as part of its roadmap to 2015 (the target year for ASEAN integration) with Myanmar selected host nation for the ASEAN summit in 2014.

In Myanmar, the regional transport network and system improvement plans are becoming increasingly important, due to a growing number of cross-border transport facilities, brought on by implementation of the ASEAN Framework Agreement on Multimodal Transport, as well as general infrastructure improvements and services for land transport, and increased private sector participation. However, improvements to the road network are needed to complete missing links, reduce delays due to capacity bottlenecks and fully establish cross border transport facilities. When these improvements are implemented, the MYT-Plan and the related NSDF should emphasize the importance of regional connectivity with neighboring countries, such as Thailand, India and China, ensure updated policies and programs to develop and complete strategic transport networks. These improvements are proposed for the Greater Mekong Sub region (GMS) including the East-West Economic Corridor and the North - South Economic Corridor.

### **4.3 Institutional and Legislative Aspects**

#### **4.3.1 Overview of Institutions Involved in National Spatial Development**

##### **(1) Myanmar Government Institutions**

Myanmar's State Constitution, which was ratified and promulgated by a national referendum in May 2011, defines Myanmar's administrations in terms of seven Regions, seven States and the Government territories. States and regions are further divided into districts, which consist of townships that include towns, village-tracts and wards (village-tracts are groups of adjacent villages). All levels of government fall under the jurisdiction of the Myanmar Government, though states and regions have local authorities like Chief Ministers, other Ministers and Advocate Generals. Legislative authority resides with the State Hluttaw or Regional Hluttaw, and includes elected civilian members and representatives of the Armed Forces.

## **(2) Institutions involved in National Spatial Development Planning**

National public works projects are normally carried out by the Ministry of Construction (MOC) in partnership with other Governmental organizations. Individual line Ministries carry out specific projects following requests from regions, states or other local administrative jurisdictions. The MOC has two main executive Departments:

- 1) Public Works, which generally plans and implements infrastructure such as roads, bridges, airfields and buildings
- 2) Human Settlements and Housing Development (DHSHD), which plans and implements urban development and housing, and is one of the responsible agencies for national spatial development planning and the preparation of national physical development plans. The Urban and Regional Planning Division, based in Nay Pyi Taw, is the planning authority within DHSHD (refer to Figure 4.1).

Historically, DHSHD works to support the country's physical and social infrastructure by planning, managing and implementing:

- Urban development and redevelopment projects incorporating planning for water supply and sanitation
- New town and satellite town developments
- Various types of housing development including affordable housing, public and rental housing, sites and services and slum and squatter upgrading schemes
- Industrial zone development
- State owned and urban land, especially in Yangon
- Joint venture investment zones

In addition to DHSHD, the Department of General Administration under Ministry of Home Affairs and the Department of Land Record and Settlements within the Ministry of Agriculture and Irrigation also has responsibility for spatial and land use planning and land management. Furthermore, the Ministry of Agriculture and Irrigation and the Ministry of Environmental Conservation and Forestry have responsibility for land use planning outside urban areas whilst the Ministry of the Development of Border Areas and National Races has particular functions and responsibilities for border areas.

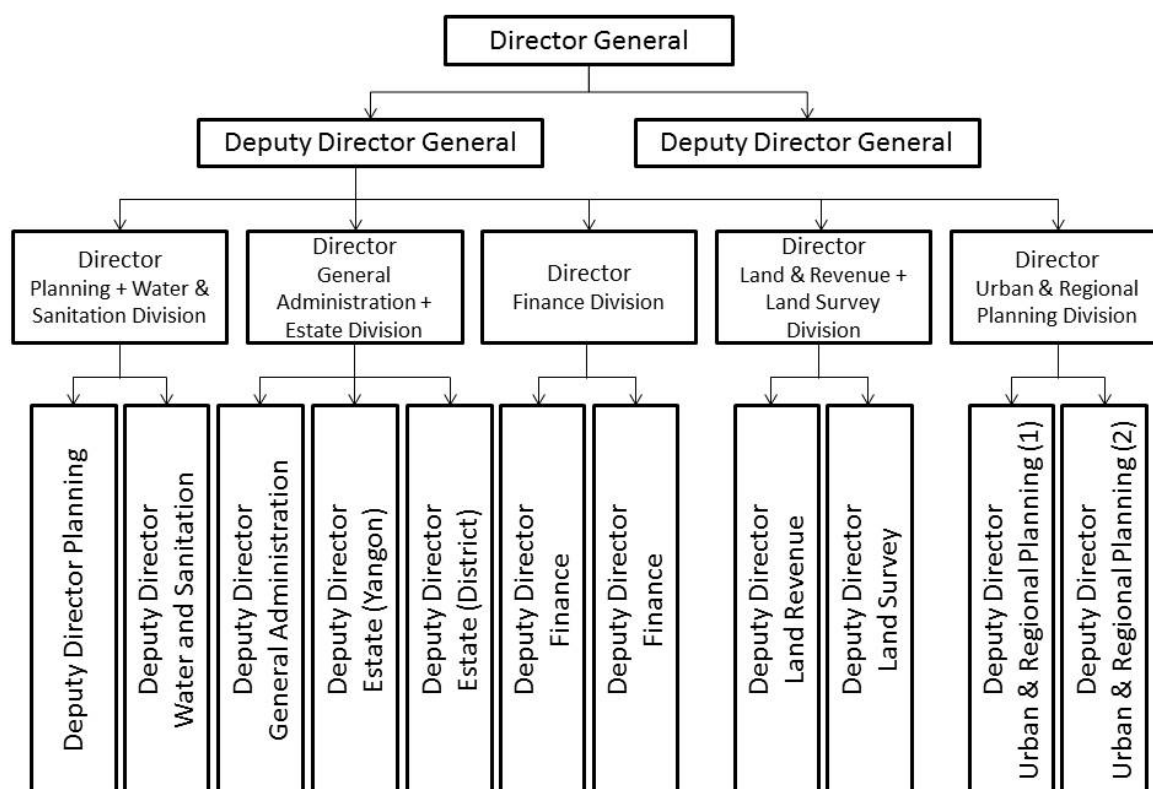
Presently, the MOC is restructuring in line with the Government's Reform Strategy to focus more on policy making, planning, controlling, guiding, regulating and monitoring urban and regional development and construction. Consistent with the MOC's shift in function and responsibilities, the role of the DHSHD is also being re-structured from that of "Provider" (of housing) towards "Facilitator" (of urban development) and "Enabler and Regulator". As this shift occurs and the MOC/DHSHD moves toward adopting the role of regulator and they aim to promote capacity building, the public sector urban planning and development functions must continue and be upgraded, for which appropriate budgetary allocation would be needed.

The future responsibilities of the DHSHD will include the following services:

- Drawing up the National Spatial Development Plan incorporating an Urban Development Policy and National Housing Policy, an integrated urban network system (National Urban System Plan), and a comprehensive land use plan making

effective utilization of resources, consistent with the emerging National Comprehensive Development Plan (NCDP). (The Union Government assigned the Land Allocation and Utilization Scrutinizing Committee in collaboration with Ministry of Environmental Conservation and Forestry for the task of developing a National Land Use Policy. Now this policy is in draft-stage and National Land Law based on this national land use policy will be enacted as the legal basis to guide all other existing land legislation in Myanmar in a harmonized manner.)

- Assisting the regional and state governments and City Development Committees (CDCs) as required, with activities such as urban planning/human settlement planning. For this assistance to be effective, strengthening the capacity of the respective Urban Planning and Housing Development Departments at region and state level will be required to help prepare urban and regional development and city/town development plans (i.e. concept plans, structure plans and local plans/detailed guidance for major cities), as well as providing advice and assessing development permit applications.
- Improving access to basic social services in urban and rural areas such as shelter, education, health, potable water, and creating a livable environment while protecting the natural environment from exploitation.
- Establishing and modifying planning laws and regulations, including the Condominium Law the Town and Country Planning Law (Urban and Regional Planning Law), Underground Water Act, and Housing Development Law (update of 1951 National Housing and Building Act). In this regard, DHSHD will participate in promulgation of Spatial Planning Law together with other in-line ministries.
- Assisting the Union Government to establish a national (union level) spatial planning system in collaboration with in-line ministries such as Ministry of National Planning and Economic Development, Ministry of Home Affairs, Ministry of Agriculture and Irrigation, Ministry of Environmental Conservation and Forestry and City Development Committees.



Source: DHSHD

**Figure 4.1 Organization of the Department of Human Settlements and Housing Development (DHSHD)**

### (3) Institutions with Responsibilities in Urban and Regional Planning

For Yangon city area, Yangon Regional Government and Yangon City Development Committee (YCDC) are the relevant administrative organizations with responsibility for urban and regional planning. Yangon Region consists of 44 townships, 33 of which form the four districts that make up the City of Yangon. Each township is administered by an executive officer of the General Administration Department (GAD) who authorizes city beautification measures and infrastructure investment. The YCDC is a Development Committee prescribed by the City of Yangon Development Law 1990. The Committee is not defined in the Constitution and its legal status is different from that of regions and states, being technically independent of the Government. The Committee is able to raise its own revenues through tax collection, fees, licenses and property development.

Since World War II, Yangon's urban expansion was supported by new town development and sites and services projects by the public sector, mostly by the Ministry of Construction. After the enactment of the 1990 YCDC Law, responsibilities for urban development were split between MOC/DHSHD and YCDC. Currently, the demarcation of responsibilities for development planning between the two organizations can be broadly considered as follows:

- YCDC and DHSHD manages urban land
- Private sector land is administered by YCDC, whereas DHSHD manages Government-owned land

In YCDC, the Department of City Planning and Land Administration is responsible for urban planning, though initially the Department was involved in land administration issues. In order to strengthen the urban planning capacity of the department, the Urban Planning Division (UPD) was established with the following technical sections:

- Land Use and Environmental Planning
- Urban Sociology, Economics and Population Studies
- Infrastructure and Urban Amenities Planning
- Urban Transportation and Road Network Planning

In addition to Yangon, two other cities have launched Development Committees. The Capital City of Nay Pyi Taw is under the direct administration of the President and the Constitution prescribes Nay Pyi Taw Development Committee (NDC) as the responsible organization for its administration. By virtue of Order No. 3: Conferring Powers Relating to Land Administration (2007), the Committee is responsible for administering all lands within the Nay Pyi Taw development area.

The City of Mandalay Development Law (2002) notes that the Mandalay City Development Committee (MCDC) is responsible for development works and functions within the City of Mandalay. Its functions and duties are broadly similar to those of YCDC.

#### **(4) Summary of Key Issues**

The following key findings are relevant for national spatial development planning:

- a) At the national level, the DHSHD has historically carried out urban planning and development functions within Myanmar but is now changing its role to a national policy-maker and regulator, while leaving the responsibility of formulating and implementing regional and urban plans to regional/state governments and the CDCs.
- b) The CDCs are the implementation agencies for urban planning in Yangon city area, Mandalay city area and Nay Pyi Taw administrative capital area and are administered by the CDC laws and related regulations. Yangon and Mandalay Regional Governments also have responsibility for regional planning functions as established under the new Constitution
- c) Currently, as the various levels of Government administration responsible for regional and urban planning are undergoing a transitional phase, the demarcation of responsibilities between the DHSHD other related Government ministries/agencies and the state/regional governments and the CDCs must be further clarified, as some overlapping functions appear to be present. This appears to be the case with the national planning regulator and the primary implementation body of urban planning in Yangon, Mandalay and Nay Pyi Taw. As well, linkages between the DHSHD and the CDCs should be clarified, their coordination strengthened and their human resource capacity upgraded.
- d) With regard to the functions and roles of the three CDCs, in relation to future citywide spatial development planning, the following improvements are recommended:
  - Formalization of City Development Plans as they are brought forward and approved as the official development planning and control tools in Yangon, Nay Pyi Taw and Mandalay.
  - Introduction/updating and legalization of respective planning bylaws and regulations.

- Improvement of development control procedures including development permit assessment procedures, appeals mechanisms and inspection/enforcement.
- Significant upgrading in training programs and related resource enhancements to improve the capacity in the urban and regional planning sector of Government at all relevant levels (national, regional and the CDCs).

#### **4.3.2 Legal and Regulatory Framework**

##### **(1) Key Provisions in the Constitution**

Key provisions in the State Constitution related to urban planning and land management include:

- The Government is the ultimate owner of all lands and natural resources in the Union (Section 37).
- The Government guarantees the right to ownership and use of property (Section 372).
- All citizens have a duty to assist the Government in preserving and safeguarding cultural heritage and the environment, supporting human resource development and protecting and preserving public property (Section 390).
- The Region or State Hluttaw (Congress) has the right to enact laws for its jurisdiction, in whole or in part, and to matters such as town and housing development as prescribed in Schedule Two of the Region or State Hluttaw Legislative List (Section 188).
- The Union Government is responsible to enact necessary law to supervise extraction and utilization of State-owned natural resources by economic forces (Section 37-b).

##### **(2) Laws and Regulations related to National, Regional, and Urban Planning**

Currently, Myanmar has no urban and regional planning legislation in law. However, with the adoption of the new Constitution, a number of relevant laws and regulations are being prepared, enacted or modified that may serve this purpose. In this context, the DHSHD is preparing a Town and Country Planning Law (Urban and Regional Planning Law), which will be submitted to Congress, while the MOC is believed to be preparing a uniform Building Code to supplement current building controls from the safety and urban planning perspective. The preparation of this draft Building Code will be entrusted to the Association of Myanmar Architects and Myanmar Engineering Society (MES).

In the interim, a number of historic laws and regulations are still being used for urban planning, land management and housing including:

- a) Land Acquisition Act (1894) – This Act stipulates that the Government can acquire land if it is deemed to be in the interest of the public. Religious lands such as pagodas, stupas, shrines and cemeteries are not subject to Government acquisition.
- b) State's Housing Rehabilitation and Town and Country Development Board Act (1951) – After World War II, a large number of people moved from the countryside to the cities and towns and housing was in short supply. This Act was promulgated to solve the shelter problem through town and village development projects and public housing rehabilitation projects. It enabled town and village development, supervision of public housing rehabilitation, management and improvement of land management and other related

activities on a nationwide basis.

- c) Urban Rent Control Act (1952, amended in 1960) – This Act regulated rents in urban areas to affordable levels but in so, it discouraged basic maintenance and upgrading of rental properties by most property owners.
- d) City of Yangon Development Law (1990), Development Committees Law (1993), City of Mandalay Development Law (2002) and Order no. 3 Conferring Powers Relating to Land Administration (2007) – These laws and regulations enabled the Yangon, Mandalay and Nay Pyi Taw City Development Committees (CDCs) to carry out development works in their respective territories, including drawing up plans and carrying out town planning, laying down policy, giving guidance and carrying out the following:
  - New town and land settlement projects
  - Civil projects including:
    - Construction, repair, demolition and re-settlement of squatter buildings and squatter wards
    - Construction and maintenance of gardens, parks, playgrounds, recreation centers
    - Construction and maintenance of roads, bridges, street lighting
    - Construction and maintenance of reservoirs, water supply and pipelines
    - Construction and maintenance of buildings under the charge of the Committee
  - Granting permission for the construction of private buildings within the Development Committee boundary limit and supervision thereof
  - With the approval of the Ministry of Home Affairs, granting permission for the construction and supervision of private buildings in rural areas outside the Development Committee boundary limit, specified by notification
  - Demarcation and re-demarcation of the territorial limits of each City's development area, drawing up development work bylaws in accordance with existing laws and rules and administration of lands

The 1993 Development Committees Law also prescribes planning functions for each state/region, supervised by the CDCs and submitted to the Director General of the Department of the General Administration, Ministry of Home Affairs, as follows:

- Scrutinizing short-term and long-term projects drawn up and submitted by the Committee
  - Supervising budgets for development works
  - Coordinating development functions to ensure conformity with relevant laws, rules, bylaws and directives
  - Inspecting works, buildings, proceedings, documents and accounts relating to the Committee
- e) Development of Border Areas and National Races Law (1993) – This law relates to Myanmar's border areas, as determined by the State Law and Order Restoration Council. The objectives of border development are to develop border area economic, social, and infrastructure development and to manage ethnic relations, in ways that do not challenge or diminish the Government's authority, solidarity or sovereignty over the lands. In addition,

the Law aims to preserve the culture, literature and customs of Myanmar's indigenous peoples and different ethnic groups.

The Council has formed a Central Committee to guide the development of border areas and Myanmar's people, using the following duties and powers:

- Developing policy to implement the above objectives
  - Validating, supervising and assisting with the implementation of long-term and short-term master plans, drawn up by the Ministry of the Development of Border Areas and National Races, and submitted through the Works Committee
  - Implementing priority development works in the border areas
  - Carrying out measures to maintain the culture, literature and customs of Myanmar's ethnic groups
  - Maintaining security, law and order and regional peace and security, in order to encourage development works in the border areas
  - Identifying development areas that should be expanded
- f) Farmland Law (2012) – This is a new law that came into effect in August 2012 under the new Constitution. This law is to be accompanied by Farmlands bylaws and vacant, fallow and virgin lands management bylaws, to be approved by the Government. The Farmland Law enables all farmers across the country to enjoy land use rights through a land registration process.
- g) Planning and Development Regulations – Currently, planning law in Myanmar does not clearly define permitted and restricted land uses. The process for converting and developing agricultural land requires a farmland development permit to be submitted by a developer to the Central Board for Farmland Management, which is headed by the Government Minister of the Ministry of Agriculture and Irrigation. The application must include details of the crops that have been planted and the size of the agricultural land to be converted.
- h) Other Regulations concerned with Land Management – The Lower Burma Town and Village Land Manual (1898), The Lower Burma Land Revenue Manual, The Burma Boundaries Manual (1927), The Burma Land Record Manual (1946) and Unmovable Property Act (1987).

In terms of urban planning and infrastructure, there are a number of bylaws in effect in YCDC that were enacted between 1995 and 2001. The bylaw on Town Planning and Land Use (No 3/2001) includes the following provisions:

- Formulating City Development Plans
- Managing land use, in accordance with City Development Project/Plan
- Managing land and land acquisitions, buying and transferring land and relocation of squatters and trespassers and appeals

### **(3) Summary of Key Issues**

The MYT-Plan's review of the legal and regulatory framework for national spatial planning, identified the following key issues:

- a) For transparency and social equity reasons, urban and regional planning institutions must regulate the means by which individuals, community groups and companies pursue their
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property rights towards the overall benefit of the nation. The formulation of a Town and Country Planning Law (Urban and Regional Planning Law) and related Regulations is currently underway at the national level by the MOC/DHSHD. Donors or international development partners should be invited to assist in this process.

- b) The Regulations should incorporate planning and design guidance such as Planning Policy Statements (PPS) to guide permit applications for key land use developments such as residential, industrial and commercial use. Regulations should also include advice on best practice building design and the preparation of urban design guides for use by permitting authorities at relevant levels of Government, together with consistent and regularly updated advice on their implementation.
- c) A national land use policy is drawn (second draft) by Ministry of Environmental Conservation and Forestry. In addition to the MOC/DHSHD, other relevant Ministry stakeholders including the Ministry of Agriculture and Irrigation, the Ministry of National Planning and Economic Development and the Ministry of Border Affairs should also be involved in the formulation of a national land use policy. In this context, the Government has established a Land Allocation and Utilization Security Committee for urban development and investment projects to formulate land utilization policy in line with laws, rules and regulations. In effect, each Government Ministry and Region/State Government will have to submit their proposals for land allotment and utilization for urban development and other development projects.
- d) At the local government level, the Yangon, Mandalay and Nay Pyi Taw CDCs are supported by various development laws and bylaws. While these provide a general framework for urban planning implemented at the local level, the actual regulations are neither well established nor well publicized to the general public. To improve awareness and enhance transparency in the permit process, the regulations for building control and permit approvals should be clearly identified and publicized, information about their relevance to particular developments should be made available to prospective developers and individuals and feedback from their usage regularly monitored and updated.

#### **4.4 Sector Plans, Policies and Programs**

This section summarizes the relevant plans, policies and programs of sectors related to national spatial development planning and transport investment. More information about these initiatives can be found in individual sector chapters later in this report.

##### **4.4.1 Urban and Regional Development**

###### **(1) Urban and Regional Development Policies and Programs**

Highlights of the Government's social and economic reform programs relating to urban planning and development include the following:

- a) Government Ministries are urged to draw up sector-wide development plans, while the Region/State Governments are instructed to draft regional development plans, urban development plans and rural development plans.
- b) The Myanmar Government is reviewing and drawing up a 30-year National Development Plan, which will become a Comprehensive Development Plan through the following (plans):

- Rural Development and Poverty Alleviation Plan
- Human Resources Development Plan
- Investment Plan
- Trade Sector Development Plan
- Industrial Development Plan
- Financial and Currency Sector Development Plan
- Regional plans
- Sector-wide Plans

Specific policies and policy actions that will guide development plans are not yet complete, but the MOC/DHSHD's vision and objectives (described below) are clear about the need for sector and regional development plans.

#### Vision

- To develop an urban network system that contributes towards balanced and sustainable development of settlements throughout the country, and
- To upgrade living standards and provide adequate housing for all citizens.

#### Objectives

- To draft and implement a National Spatial Development Plan that will support and implement the National Comprehensive Development Plan (NCDP).
- To set up a planning process that will serve as a foundation for the drafting of regional/state, township, town/city and rural spatial development plans, to include concept plans, structure plans, urban development plans and village development plans.
- To prepare policies that strengthen and reform the MOC/DHSHD.
- To provide adequate and affordable housing for people through sustainable ways.
- To establish housing finance mechanisms that will support house ownership, promote construction industry development and implement proper housing delivery systems in a transparent manner (through pilot projects).

In terms of programs and priorities for transport sector development, the DHSHD has established the following policy actions:

- Conducting feasibility studies for urban infrastructure on the regional road network and economic corridors and connecting to neighboring countries.
- Carrying out a periodic National Housing Census.
- Coordinating, cooperating with, guiding and monitoring regions and states in their implementation of pilot urban slum infrastructure upgrading schemes (e.g. water supply, electricity, sanitation, drainage, etc.) through foreign aids, grants and technical assistance.
- Increasing housing production through pilot projects in Ayeyarwon, Yadanar and Yangon (over 10,000 housing units).

- Implementing low-income affordable housing pilot projects in cooperation with the private sector and in accordance with regional priorities.

## **(2) Socio-Economic Development Policies and Programs**

### Housing Sector

In Myanmar, 90% of the people live in timber and bamboo-structured housing. Since 1958, the DHSHD has provided subsidized housing and improvement schemes including public rental housing, sites and services, slum and squatter upgrading and low cost housing development, especially in Yangon. About 200,000 land plots serviced with basic infrastructure have been provided over a 20-year period. The most extensive housing scheme was the ‘hut to apartment’ housing projects, targeting people living in slum and squatter areas. Approximately 12,600 households have benefited from 32 of these housing schemes.

The DHSHD also manages housing estates in Yangon and other towns in the country, under Public Rental Housing schemes. Since 1960, 10 housing estates in Yangon and additional 34 estates in other regions and states have been established. Currently, the Department owns 20,000 rental units, which were built and sold to the public from 1989 to 2009. It is now introducing an estate renewal program in Yankin Estate in Yangon, modeled on Yankin Palm Village completed in 2009, which is the largest housing estate redevelopment project. In the housing sector, public private partnerships have been widely and successfully adopted, especially in the shelter/housing sector. Other area-wide development projects include land readjustment or whole area development schemes and urban land densification.

Under the new Constitution, the President has set guidelines and policies to raise the quality of life for Myanmar’s people, especially for civil servants, by making available affordable housing, especially for the low-medium income group in Yangon and other cities. In accordance with the new policy direction, 1 million new houses will be built over the 20-year period (2011-2030) with additional pilot affordable housing schemes being developed. The approach will improve access to basic social services in both urban and rural areas, including education, health and potable water and shelter. The Dagon Seikkan housing project, which plans to provide 18,000 units for low-income target groups, is an example of such pilot projects. This DHSHD initiative is part of an overall concept to deliver more appropriate housing in the country by promoting new technology in mass production of housing, upgrading the quality of construction industry by substitution of innovative and cost effective building materials and promotion of their production locally as well as setting their norms and standards and mobilizing private sector participation in housing development.

### Urban Development

The quantity and quality of urban housing and infrastructure is a key indicator of development in a modern nation. In Myanmar, the DHSHD is cooperating with other departments and agencies to implement new projects in urban areas, new towns and industrial zones by providing basic infrastructure (e.g. communications, power, transportation and irrigation for flood and erosion control). Mixed-used development consisting of condominiums, commercial buildings and shop houses managed by DHSHD, has signaled the success of private participation in the urban development process.

Urban area development projects have been developed to enhance the general appearance of urban areas. To meet the needs of the city’s residents for recreation and leisure facilities, as well as to enhance the image of the City of Industry (Hlaing Tharyar), Pan Hlaing Golf and Country Club has been developed as a joint venture project between DHSHD and Yangon Nominees Co. Ltd. The Golf Course Project includes an 18-hole golf course to international standards along

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with a housing project. Moreover, Pan Hlaing (2) Golf Course coupled with Star City Condominium Project in Thanlyin near Thilawa SEZ are also under construction.

The DHSHD has also leased land for service apartments and hotels on a Build-Operate-Transfer (BOT) basis including MiCasa Serviced Apartments, Sakura Serviced Apartments, Mingalar Garden Hotel and Governor's Residence Hotel etc. The Department has also managed land and building rental for foreign embassies in Myanmar.

#### **4.4.2 Economic Development and Employment**

##### **(1) Background**

The MYT-Plan analysis finds that a strong set of guidelines for spatial development will follow with Myanmar's integration into the ASEAN. As such, the Myanmar National Transport Development Plan (and the related National Spatial Development Framework) must be consistent with the ASEAN and other ASEAN country strategic land use and transport policies and programs.

To assist in this process, various agencies, including the Economic Research Institute for ASEAN and East Asia (ERIA), are developing strategic plans and programs, such as the Myanmar Comprehensive Development Vision (MCDV). The MCDV will identify major economic development corridors where future investment can maximize economic and social benefits in regions that have advantageous locations. Some of these corridors already exhibit economic growth characteristics where strategic-level transport networks and facilities have been established or are in the process of being upgraded (e.g. main highway and railway corridors with connections to major ports and airports). In and around these corridors, clusters of industry and commercial activities can also be found with connections to regional/state administrative capitals or border towns with specialized services and facilities.

Although these regions are likely to benefit more than others in the short term, benefits are likely to spill over to wider catchments in the long term. By pursuing development along these corridors, future transport investment can support the growth of regional and state activity hubs and their mainly agricultural hinterlands, so that travel and transport patterns of passengers and cargos may be refocused accordingly. For some key cities already well-established within or adjacent to the corridors such as Yangon, Mandalay, Nay Pyi Taw, Bago and Mawlamyine, further (transport) investments will serve to reinforce and enhance their roles as key activity hubs in the spatial development framework. In particular, the importance of Mandalay should be recognized as it lies at the intersection of several corridors, making it an important future transport and development activity hub. In the future Bago, Dawei and Kyaukphyu will also become more strategically important as Government investments in new airports and ports start to mature.

The development policies in terms of economic corridors should not only address transportation, but also consider the development of strategic employment-generating land use activities such as industrial zones (manufacturing) and Special Economic Zones within and adjacent to them. The development of social and community infrastructure such as health facilities, schools and community centers by Government agencies should follow.

The Transport Vision in 2030 should consider these spatial and structural changes. However, the development of these economic corridors present technical challenges, especially to improve accessibility to rural regions, including management of road quality, hilly areas that constrain implementation, increased traffic flows, etc. More studies and data are therefore needed before the potential of these economic corridors can be harnessed.

## (2) Agricultural and Agro-Industry

The amount of land under agricultural production has expanded during the last two decades, but there is a relatively high level (8% of the national territory) that is arable but underutilized – this land could be reclaimed and put to more productive use. Table 4.1 indicates that in 2011-2012, some 55% of the total area of Yangon Region was under cultivation, in Mandalay Region the total was 60% and in Ayeyarwaddy Region the total was 62%. This is partly due to the proximity of good quality agricultural land close to the major markets for agricultural products, which also represents a significant constraint in terms of land available for future development.

In 2009, the IMF estimated that agriculture contributed nearly 43% of Myanmar's GDP and around 38% in 2011-2012. The sector will continue to be a main source of employment for the foreseeable future, though the share of employment in agriculture will likely decline as GDP per capita increases. In the long term, the industrial/manufacturing and services sectors will need to create more jobs to meet increasing demand from displaced agricultural workers. However, this is likely to be a slow transformation process, with the decline in agriculture's share of employment being slower than that of GDP's share, given the experiences of Myanmar's neighbors (e.g. even Thai agriculture absorbed about 40% of total employment in 2009).

**Table 4.1 Total Agricultural Cultivation by Region / State, 2011-2012**

No.	Region State	Area (Square Mile)	Population (‘000)	Cultivated Acres (‘000)	Percentage
1	Kachin State	34,379.22	1,598	1,433.7	4.2
2	Kayah State	4,529.56	360	584.5	12.9
3	Kayin State	11,730.85	1,836	1,457.9	12.4
4	Chin State	13,906.97	563	362.7	2.6
5	Sagaing State	36,178.72	6,598	9,719.3	26.9
6	Tainingtharyi Region	16,735.56	1,734	1,441.2	8.6
7	Bago Region	15,214.13	6,067	6,494.9	42.7
8	Magway Region	17,305.32	5,677	8,098.8	46.8
9	Mandalay Region	11,925.95	7,353	5,923.5	49.7
10	Mon State	4,747.76	3,165	2,128.8	44.8
11	Rakhine State	14,200.08	3,339	1,914.6	13.5
12	Yangon Region	3,967.85	7,097	2,195.9	55.3
13	Shan State	60,155.23	5,720	4,820.9	8.0
14	Ayarwadi Region	13,525.88	8,124	8,419.5	62.3
15	Naypyitaw Concl Territory	2,724.76	1,153	592.9	21.8
	Total	261,227.84	60,384	55,589.1	21.3

Source: UN FAO

Myanmar's agriculture is no longer rice-dominated and is now more diversified as the share of paddies in sown acreage has continuously declined since the 1960s. The share of pulses increased in the 1990s due to exports, mainly to India, but stagnated in the first decade of the 2000s. Oilseeds (e.g. groundnuts, sesame) have declined in sown acreage over the last two decades due to palm oil imports from Malaysia and Indonesia. Other crops such as rubber, sugarcane, cotton, maize, fruit and vegetables have continuously increased since the 1960s, while livestock and fisheries also have huge potential.

The MYT-Plan analysis suggests that a future Agriculture Strategy related to spatial development planning should be developed and include:

- Productivity enhancement and broadened economic activities along the value chain.
- Improvements in access to land uses, land tenure security and land development by the private sector and foreign agri-business entrepreneurs.
- Protecting equity access to lands for small and medium farmers for their sustainable livelihood.
- Encouraging responsible expansion of lands and development of agricultural lands.
- Adopting agricultural land settlement scheme for rural landless, returnees from migration and internally displaced population (IDP) for any causes of political unrest and armed conflicts in ethnic areas.

### **(3) Industry**

#### Industrial Sector and Industrial Zone Development

Myanmar is said to be a resource-rich country, based on the availability of oil and natural gas, hydro-electric power, wood products, jade and gems, copper, lead, tin, coal, limestone, etc. Although export of these resources leads to foreign exchange income, Myanmar is not maximizing this potential and foreign exchange income is low. For example, while exports of natural gas earned US\$3.1 billion in 2008, this translated to only about US\$50 per capita. On the other hand, Myanmar imported diesel and gasoline costing more than US\$1.0 billion in 2010 and the country suffers from serious shortages of electricity, even though Bangkok benefits from the export of natural gas from Myanmar. The IMF estimated that in 2009, the industrial sector contributed 19.8% of GDP while in 2011-2012, a significant increase to about 27% was predicted.

Since 1985, 18 Industrial Zones have been established throughout the country with the aim of consolidating existing scattered industries, improving cooperation and linkages between industries and enabling industrial development assistance as necessary. In addition to a number of zones in and around Yangon, there are also industrial zones in Mandalay Region (Mandalay, Meiktila and Myingyan), Sagaing Region (Kale and Monywa), Magway (Pakokku and Ye Nan Chaung), Shan State (Taunggyi), Bago (Pyay), Ayeyarwaddy (Myaung Mya, Hinthada and Patheingyi), Mon State (Mawlamyine), and Tanintharyi Region (Myeik).

In order to create more job opportunities, increase the availability of sites for industry and extend private sector and FDI development opportunities, seven additional zones are planned in outskirt and border areas including Yadanar in Mandalay Region, in Nay Pyi Taw, Hpa-an, Hpapun and Myawaddy in Kayah State, Phone Nar Kyun in Rakhine State and Nan-on in Shan State.

The types of industry that are being promoted include:

- Large-scale Special Industrial Zones (SIZ/SEZ) (Dawei, Mawlamyine, Kyaukpadaung, South Yangon-Thilawa).
- Small and Medium Enterprises (Outskirts of major urban areas).
- International/Cross Border Trading (FTZ) (Thailand: Tachileik, Myawaddy etc., China: Muse, Bhamo etc., India: Tamu, Bangladesh: Maung Taw etc.).
- Tourism-based (Bagan, Inle Lake, Andaman Islands).
- Resource-based industries (Fishery processing, Agro-based).

In spatial development terms, more than 40% of large-scale private factories are located in Yangon, with 20.7% being located in Mandalay (2009). Approximately 60% of large private factories are found in just two major cities. The MYT-Plan's analysis suggests that it is likely that Yangon and Mandalay will continue to form the country's major industrial activity hubs for the short and medium term, pending major investment and expansion elsewhere (e.g. in the SIZs/SEZs-see below).

At the same time, pro-poor industries will need to be promoted to absorb not only the growing urban labor force in major cities and state/regional capitals, but also as a result of the rural-urban drift that will take place as workers move out of the agricultural sector in search of an urban lifestyle and a perceived better quality of life. In the future, the industrial sector will need improved physical infrastructure such as electricity generation and distribution, better connectivity and logistics by waterway, road and rail transport and to a lesser extent air transport, telecommunications, and the successful establishment of technical centers and institutions, modern industrial zones and SEZs.

#### Special Economic Zone Planning

In promoting a market-oriented economy, Myanmar is encouraging investments in Special Economic Zones (SEZ) to operate high tech industries and businesses through the Myanmar Special Industrial Zone Law (2011). A National Myanmar Economic Zone (MEZ) strategy has been drawn up with the assistance of Japan Overseas Development Corporation (JODC); Thilawa near Yangon, Dawei in Tanintharyi Region and Kyaukphyu in Rakhine State are to be developed as priority SEZs for short-term implementation.

Thilawa SEZ covers about 2,400ha of land and is located in Thanlyin township in Yangon Region some 18km from Yangon port and 30km from downtown Yangon. Its aim is to develop a Free Trade Zone (FTZ) for export processing and promotion including an IT software and R & D area, commercial area, wholesale area, residential area, health care and hospital area, education area and administrative area.

The Dawei SEZ on the river Dawei in Tanintharyi Region is being planned and implemented by the Myanmar Port Authority in joint venture with Italian Thai Company and is to include a deep sea port, Dawei-Kanchanaburi (Thailand) highway and railway corridor and an industrial estate on 250 sq km of land. The construction of a gas pipeline to Kanchanaburi province also offers potential for commercial and residential development in that area.

The Kyaukphyu SEZ is being planned at a natural harbor at Kyaukphyu city in Rakhine to improve transit linkages between Yangon, Chittagong and Calcutta as well as acting as a focus for improved linkages with Kunming (China) oil via a 1,060km long pipeline expected to be completed during 2013. Proposed construction of railway lines and upgrading of the existing airport are also planned to meet international standards.

#### **(4) Services and Tourism**

In 2009 the IMF estimated that the services sector including tourism contributed 37.3% of GDP and in 2011-2012, around 35% of the total was predicted. Priority actions in the tourism sector include:

- To develop identified hotel zones and encourage the construction of hotel projects.
  - To improve travel routes and transportation for travelers.
  - To develop attractive tourist destinations.
  - To develop quality tourism services.
-

- To develop communication technology and systems.
- To develop easy and effective monetary practices.
- To provide technical assistance and education for human resource development in hotels and tourism.
- To communicate and cooperate with local and foreign investors and international organizations for tourism developments.

## **(5) Rural Areas and Border Development**

### Rural Areas

Poverty is not only widespread in rural areas, but rural areas account for almost 85 % of total poverty in Myanmar. Myanmar's poverty incidence in 2010 was about twice as high in rural areas compared with urban areas.

Poverty is multi-dimensional because its measurement includes both income needed for basic needs but also human, physical, political, and social capital as means to earning income. An integrated rural development approach is being adopted to improve the economic and social life of Myanmar's rural poor through interaction with donor agencies, though there has been limited analysis to date of the nature of rural poverty and performance of rural development in different States/Regions.

Consistent with the Government's new Social and Economic Reform agenda, the approach focuses on supporting people-centered rural development planning, which emphasizes gender equality by promoting:

- Women in development for achieving Millennium Development Goals (MDG 3 - equality between men and women is crucial to reducing poverty).
- Long-term economic, social and political stability of rural communities on a self-help basis with employment generation programs.
- The establishment of a pattern of growth and emerging employment opportunities by improving the factors of backward and forward linkages that influence agro-based industry and/or non-farm sector development.

Myanmar plans to drastically reduce national poverty incidence from 32 per cent in 2005 to 16 per cent in 2015 through a variety of poverty reduction programs being implemented in all regions and states, which includes development in the agricultural sector, livestock and fisheries, small-scale rural-based industry development, socio-economic development in rural areas, rural energy, and environmental conservation.

### Border Areas

Myanmar is surrounded by wealthy countries and shares a number of characteristics with its neighbors. Border area development can take advantage of some of these similarities, especially as Myanmar currently lacks basic infrastructure in these areas, such as electricity, internet, etc. that are necessary for industrial development. Myanmar's border economic zones can make use of the infrastructure of neighbor countries when exporting labor and inputs. Border area development can also help Myanmar contribute to the production networks of ASEAN and reap the benefits from improved connectivity.

Border area development is attractive because of its potential for social progress resulting from human resource development, it is also important for balanced growth. Special

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Industrial/Economic Zones (SIZ/SEZ) or other similar mechanisms should be considered at selected border areas to attract companies and focus investment on infrastructure, improved administrative procedures and support for human resource development.

Border zones are also important for the tourism industry. Moreover, as these areas are often the first places seen by regional visitors and tourists when they enter the country, they should offer a positive impression and act as Myanmar's gateway. To ensure effective development of these border economic areas, they must be attractive places for neighboring countries' industry. Increasing social stability, demonstrating good governance, committing to trade openness, enforcing justice, are all critical for border area development.

Future border area development programs related to spatial planning should consider the following aims and issues:

- Socio-economic life of the rural population (livelihood support programs)
- Health improvement issues (water quality, sanitation and hygiene)
- Infrastructure development (rural feeder roads/bridges, inter-district roads and bridges, electricity and water supply)
- Education and vocational training
- Cultural and heritage values of the national races

Possible locations for these enhanced border towns include Myawaddy, Kengtung/Tachileik, Muse and Tamu.

#### **4.4.3 Environment**

In the past, more than 50% of Myanmar's land area was covered with forests. Due to population increases, over-exploitation of timber, unsustainable investment and development programs, the forest cover is gradually decreasing and by 2010, forest coverage amounted to 46.9 % of the total land area.

Myanmar's environment policies are aimed at achieving harmony and balance in terms of the environment through the integration of environmental considerations into the development process. Environmental protection should always be a primary objective when promoting development. Key environmental objectives ascribed to the Ministry of Environment Conservation and Forestry are discussed later in this section.

#### **4.4.4 Transport**

The key Ministries in Myanmar's transport sector include the Ministry of Transport, the Ministry of Rail Transportation (MRT) and the Ministry of Construction(MOC), as well as the following Departments and Agencies: Department of Civil Aviation (DCA), the Department of Marine Administration (DMA), Directorate of Water Resources and Improvement of River Systems (DWIR), Myanma Port Authority (MPA), Inland Water Transport (IWT), Transport Planning Department (TPD), Road Transport Administration Department (RTAD) and Myanma Railways (MR). The objectives and policies of each sub sector are described in this Report's relevant Chapters.

### **4.5 National Spatial Development Framework**

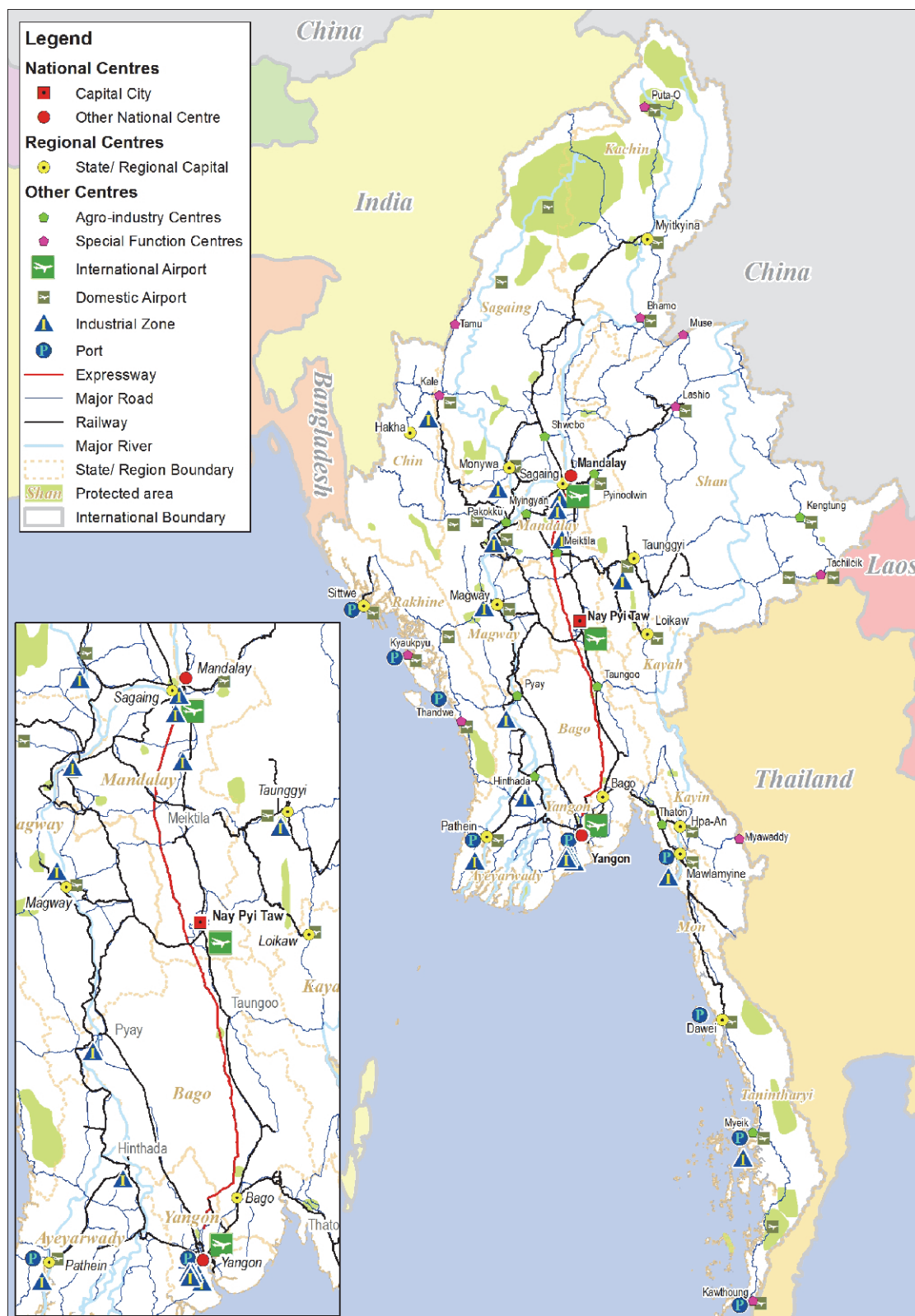
This section summarizes relevant plans, policies and programs of those sectors with an interest in national spatial development planning and transport investment.

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#### **4.5.1 Present Development and Urbanization Trends**

The Spatial Development Framework should be developed using current conditions and projected social, economic, environmental, etc. changes for the short and medium terms. This includes existing land use and transport developments as well as investments in major projects that are either under construction or committed and programmed by the Government for future implementation. Linked with future growth in population and GDP, these developmental activities will have a major influence on how the urban development pattern of the country will evolve over the next 20 years or so, and the most likely directions of that growth.

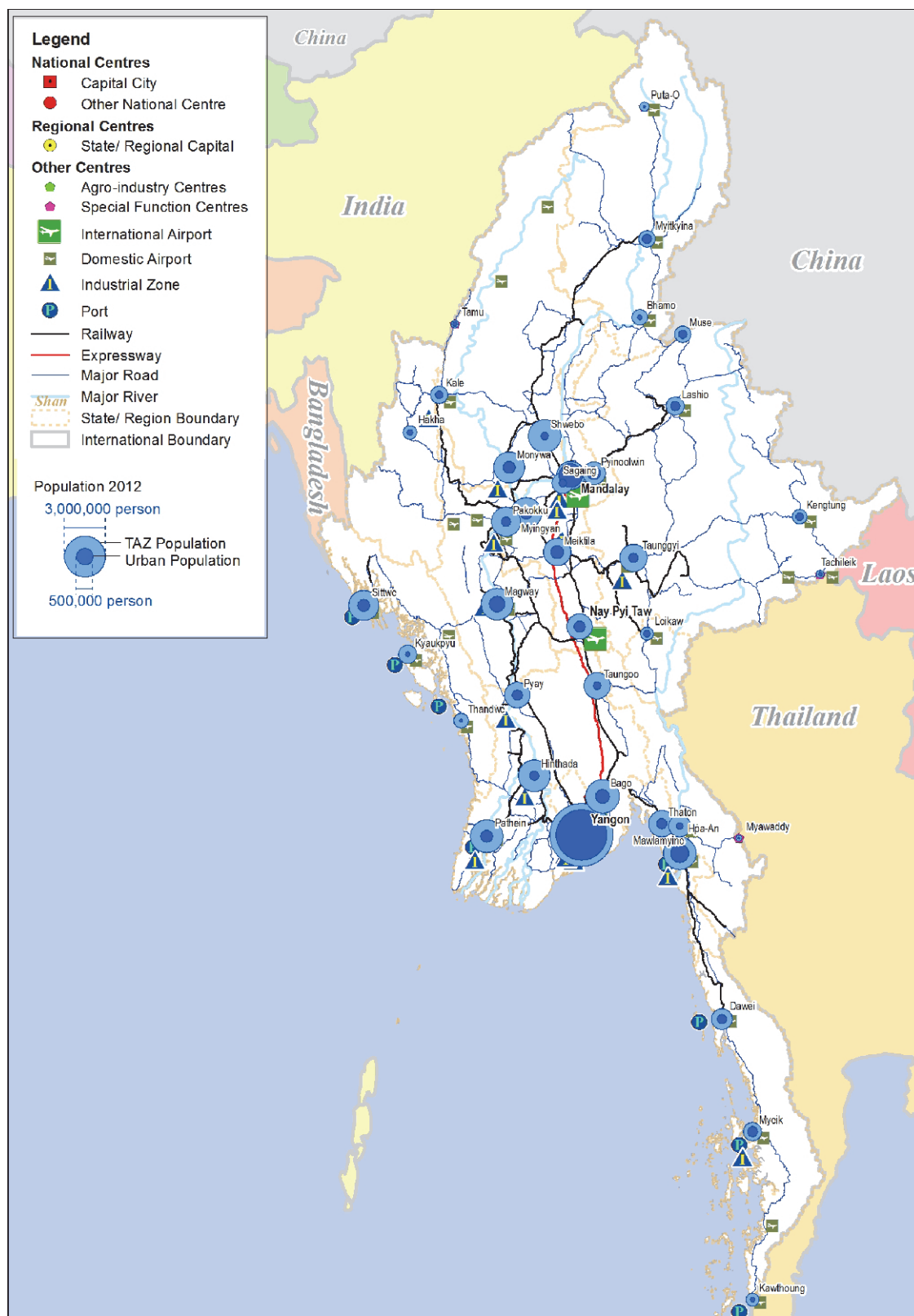
In 2012, Myanmar had an estimated population of 61 million, of which about one third or 20.3 million was urbanized. In general, seven regions in the central core of the country have high population densities, while the seven states that form the border areas are sparsely populated (refer to Figure 4.2, Existing Context).



Source: JICA Study Team

Figure 4.2 Existing Context

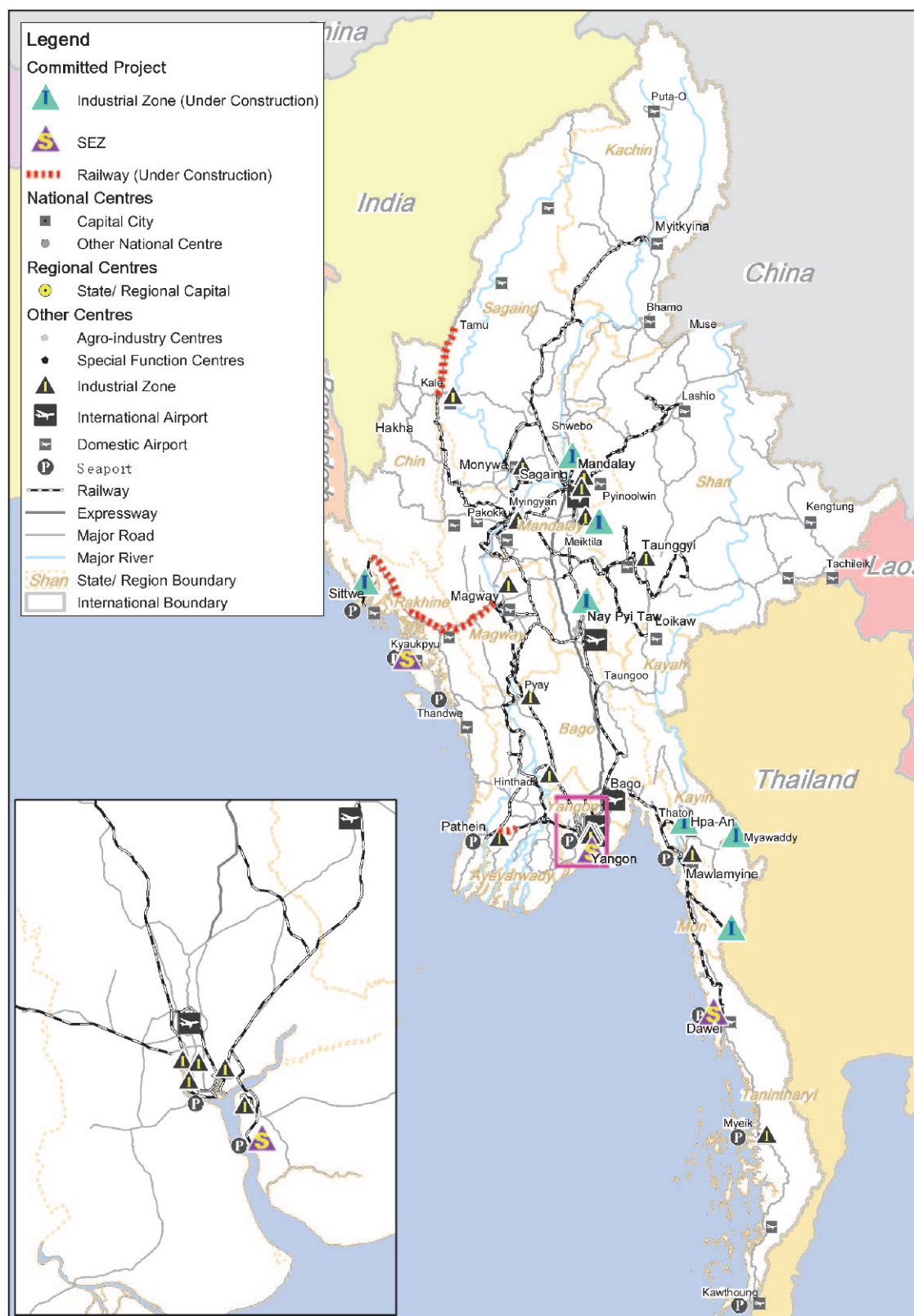
Currently, Yangon city region has a population of about 8.8 million. The Ayeyarwaddy Delta forms its hinterland and accounts for the second largest population (about 14%) in the country. The second largest city is Mandalay with about 1.5 million people. Mandalay is surrounded by the Central Dry Zone (CDZ), comprised of 11 districts within three regions (i.e. Mandalay, Sagaing and Magway) and including about 18% of total population. The country's capital city, Nay Pyi Taw, has an urban population of about 0.4 million and a rural population of 0.7 million. In addition, there are 30 towns with populations over 0.1 million and over 300 smaller towns. On the other hand, the Ayeyarwaddy Delta and CDZ have large numbers of poor. The state of Rakhine, and particularly the northern districts are also densely populated and have a high poverty ratio (refer to Figure 4.3).



Source: JICA Study Team

Figure 4.3 Urban Population 2012

From a strategic development perspective, the Yangon/Mandalay (north-south) transport and development corridor is likely to continue to be an important component of the country's future socio-economic evolution. The further development of specialized administrative and logistic functions and support services at the national capital Nay Pyi Taw will add strength to this developmental axis. However, rapid economic growth resulting from changes in political and economic policies has also led to urbanization pressures and has strained the urban development process, especially around Yangon. In addition, Yangon and Mandalay have the largest industrial sectors in Myanmar with more than 40% of large-scale private factories located in Yangon and a further 21% being located in Mandalay (2009). Combined, these cities contain more than 60% of large private factories in Myanmar. Projects such as the proposed development of Hanthawaddy international airport and the SEZs at Dawei, Kyaukphyu and Thilawa could affect these patterns in selected cities and regions (refer to Figure 4.4).

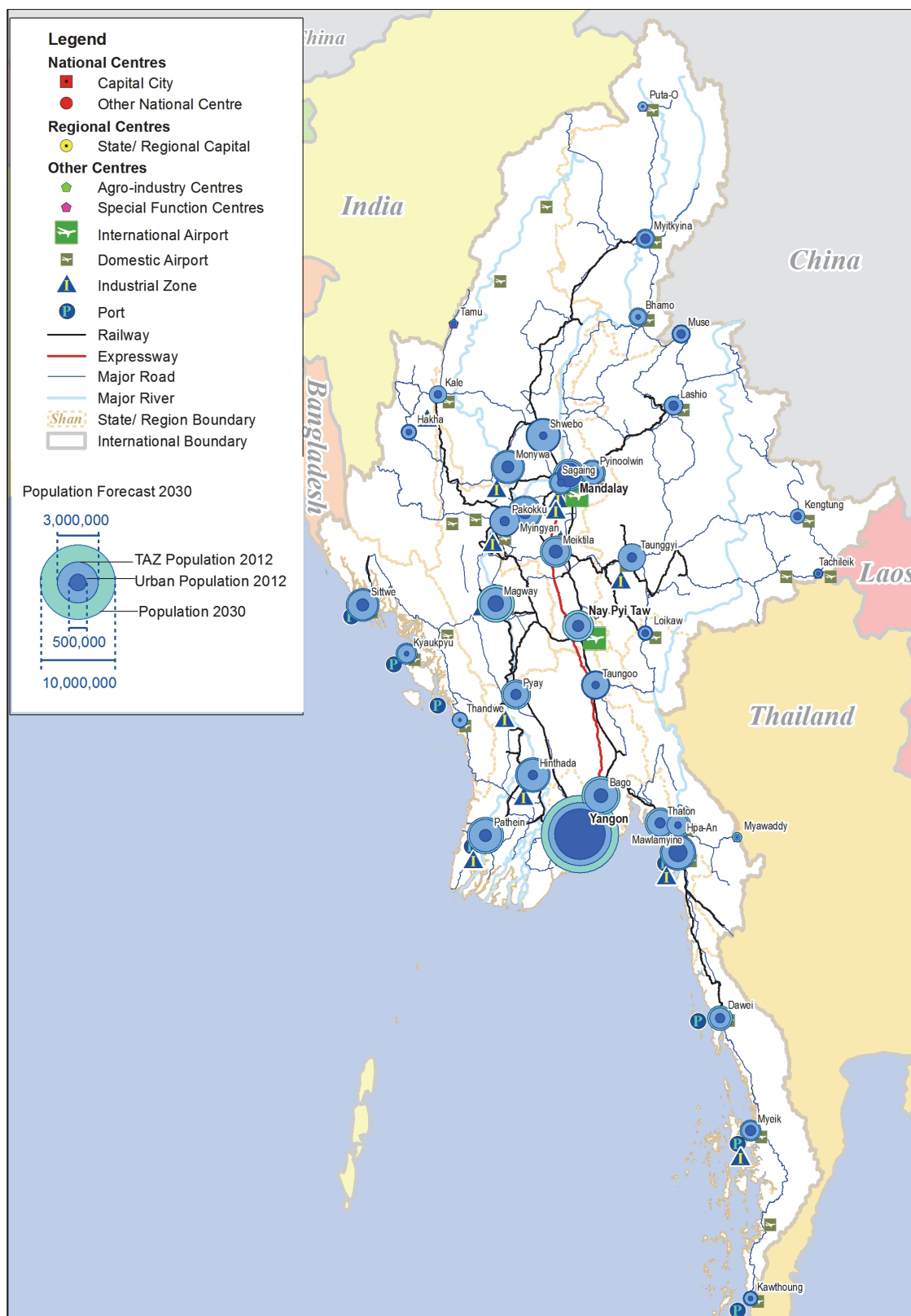


Source: JICA Study Team

Figure 4.4 Committed Projects 2015

The DHSHD estimates that 37% of Myanmar's 76 million people will live in urban areas by 2030, according to current economic growth rates. Yangon city is forecast to grow from about 5 million to 8 million people by 2030. With a current average household size of 4.7 persons, this growth will require an additional 3.2 million new houses or about 175,000 new units per annum to meet demand. This demand does not include those units likely to be required due to urban regeneration and housing redevelopment/improvement schemes. At the TAZ level, which may be considered equivalent to a city region as it includes both urban and rural areas of each traffic zone, MYT-Plan forecasts indicate that Yangon could reach 12.6 million people by 2030, with Mandalay/Sagaing city region reaching 2.9 million people and Nay Pyi Taw reaching a population of 1.7 million (refer to Figure 4.5).





Source: JICA Study Team

Figure 4.5 Population Forecast 2030

In order to better plan and manage the urban growth in and around Yangon city, the DHSHD has prepared a draft Yangon City Concept Plan (Vision 2040), which describes the city as the economic hub of the country and promotes it as the focus of inland and international ports, as a green and healthy city, as a multi-ethnic city of heritage, culture and tourism and a city of education and knowledge. Building on this Vision, the YCDC is drafting a City Development Concept Plan and Infrastructure Improvement Plan and is preparing a Greater Yangon Strategic Plan, with the support of the DHSHD and JICA. This Plan will embody the principles of comprehensive urban planning, sustainable development of heritage conservation and urban renewal integrated with recreation and green zones and improved infrastructure services.

Similarly, the DHSHD is preparing a Concept plan for the Greater Mandalay Plan to guide future growth in Myanmar's second largest city, in association with the Mandalay CDC. Nay Pyi Taw has a well-developed transport infrastructure system (e.g. major highways, railway and international airport) with considerable spare capacity and is ideally located to absorb and support future Government administrative and specialized commercial and leisure growth opportunities.

In contrast, outside the three large cities, four regions (Yangon, Ayeyarwaddy, Mandalay and Magway) account for more than half of the population who are living in poverty. In these regions, pro-poor policies and activities will need to be promoted to support the growth of agro-industrial and agri-business clusters, for which programs aimed at improving farm to market roads, public health infrastructure programs and inland waterways will need to be prioritized. As such, a key challenge for the preparation and implementation of an effective National Spatial Development Framework and National Transport Plan is to identify the different development potentials of each state, region, major city and town, and match these to the levels of existing and likely future capacity (investment) in strategic transport networks and facilities to ensure an optimum distribution of benefits.

#### **4.5.2 The Draft National Spatial Development Framework (NSDF)**

##### **(1) Method Statement**

Based on the international, national, regional and city development policies and the transport networks and facilities outlined above, a National Spatial Development Framework (NSDF) has been designed to assist decision-makers to determine priorities for future transport investment. Key building blocks of the Draft NSDF include:

- Synthesis of regional (i.e. international/ASEAN/Asian/GMS) and national transport sector strategies, policies and programs including economic corridors concepts.
- Identification of existing and committed international, national and regional highway/railway corridors and strategic transport facilities (i.e. ports, airports, rail stations and interchanges) within the framework laid down under the item above.
- Identification of specialist centers that exhibit commitment to urbanization and investment in terms of transport networks and facilities. The MYT-Plan reviewed the centers' current and future (year 2030) potential in terms of functions and services, based on population, density criteria and other attributes like proximity to urban centers, ports, airports, railway hubs, industrial zones/SEZs, border towns, tourism hubs.

- Analysis of the centers' role within the Department of Human Settlements and Housing Development's Concentrated Decentralization Strategy and Ministry of National Planning and Economic Development's National Comprehensive Development Plan.

In order to identify how these centers relate to each other in the hierarchy, activity hubs were selected on the basis of four main criteria:

- The estimated population in 2012 in each of 71 urban centers, as defined by the Department of Human Settlements and Housing Development of the Ministry of Construction
- The proportion of the urbanized (urban center) population in each Traffic Analysis Zone (TAZ), as defined by the JICA study team, based on the above DHSDD work
- The predicted (study team) TAZ population in 2030
- The estimated population density in each TAZ in 2030

In addition, two other criteria were taken into account:

- The function of the urban center as a State or Regional Capital
- The attributes of the city/town/center (as outlined above) in relation to its function as a border town, port and/or airport, or railway hub and/or industrial zone/SEZ hub or tourism hub (or having a combination of these)

## **(2) Hierarchy of Centers**

Table 4.2 describes the criteria and results of the urban centers selection process for the NSDF.

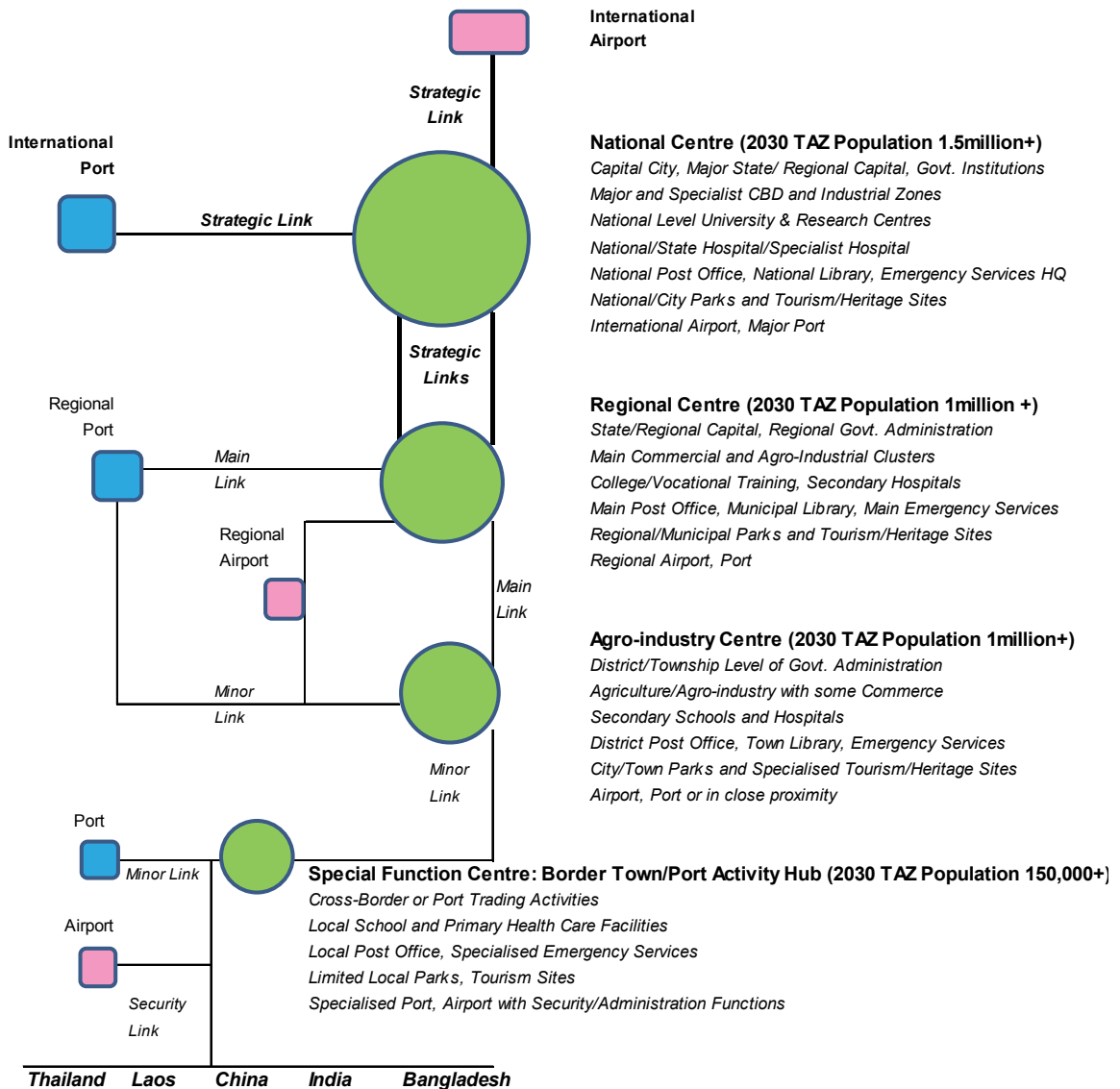
Figure 4.6 illustrates the concept of a 4-level centers hierarchy (national, regional, agro-industrial and special function) and the typical range of functions and services they provide or can be expected to provide in the future.

Table 4.2 Selection of Activity Hubs

City/Town Reference Number	Traffic Analysis Zone (TAZ)					Selection Criterion				Criteria Achievement:				
	Name	Reference Number/ Attribute	Population Estimate 2012	Density P/sq.km 2012	Area km2	Urban Pop >100,000 2012	Urban/TAZ Pop>20% 2012	TAZ Pop. >500,000 2030	TAZ Density >75pop/sq.km 2030	4	3	2	1	0
<b>National Centres</b>														
	Yangon N	47	1,937,869	417.3				3,082,000						
	Yangon E	48	2,454,529	6812.3				3,468,000						
	Yangon S	49	1,568,679	331.4				2,183,000						
	Yangon W	50	1,208,735	16853.4				1,713,000						
1	Yangon	47-50SAPRIT	7,169,812	730.9	9,809	4,654,126	64.9	10,446,000	1,064.9	Yangon				
2	Mandalay	33SARIT	1,446,957	1584.0	913	1,062,569*	73.4	1,841,000	2,015.3	Mandalay				
3	Nay Pyi Taw	40SARI	1,164,299	164.6	7,072	249,362	21.4	1,684,000	238.1	Nay Pyi Taw				
<b>Regional Centres</b>														
4	Bago	24SR	2,112,954	158.8	13,308	362,922*	17.2	2,592,000	194.8	Bago				
5	Hpa-an	7SAI	915,953	126.1	7,262	92,333	10.1	1,172,000	161.3		Hpa-an			
6	Taunggyi"	51SI	1,401,821	57.9	24,232	161,668*	11.5	1,336,000	55.1		Taunggyi/Kalaw			
7	Sittwe	43SAP	1,611,505	141.0	11,426	281,367*	17.5	1,888,000	165.2	Sittwe				
8	Myitkyina	1SAR	523,072	14.9	35,165	157,170	30.1	677,000	19.3	Myitkyina				
9	Dawei	21SAPIT	811,093	58.3	13,901	154,655	19.1	1,105,000	79.5	Dawei				
10	Mawlamyine	41SAPRI	1,941,904	317.3	6,120	641,326*	33.0	2,231,000	364.5	Mawlamyine				
11	Patheingyi	64SAPRI	1,950,863	186.6	10,455	254,553	13.1	2,349,000	224.7	Patheingyi				
12	Loileik	5SA	308,972	46.8	6,603	93,808	30.4	392,000	59.4			Loileik		
13	Magway	28SA	1,892,467	195.8	9,663	450,509*	23.8	2,451,000	253.6	Magway				
14	Falam^	11S	337,841	20.8	16,271	62,808*	18.6	420,000	25.8				Falam/Hakha	
15	Sagaing	13S	784,548	320.0	2,452	105,082	13.4	1,005,000	409.9	Sagaing				
<b>Agro-industry Centres</b>														
16	Monywa	15SAI	1,780,212	176.9	10,061	276,902	15.6	2,025,000	201.3	Monywa				
17	Pynoolwin	34	946,936	113.2	8,367	323,109*	34.1	1,138,000	136.0	Pynoolwin				
18	Meiktila	39I	1,375,698	237.7	5,789	313,646*	22.8	1,674,000	289.2	Meiktila				
19	Pakokku	31ARI	1,559,972	187.7	8,310	155,209	9.9	1,638,000	197.1	Pakokku				
20	Pyaw	26I	1,228,977	161.3	7,617	187,507	15.3	1,525,000	200.2	Pyaw				
21	Myingyan	36I	1,732,053	266.1	6,508	282,240*	16.3	2,017,000	309.9	Myingyan inc. Bagan				
22	Hintha	65RI	1,814,695	259.0	7,007	166,225	9.2	2,127,000	303.6	Hintha				
23	Shwabo	14	1,903,318	128.8	14,871	118,659	6.2	2,190,000	147.3	Shwabo				
24	Taungoo	25RI	1,266,025	118.6	10,678	104,546	8.3	1,394,000	130.5	Taungoo				
25	Thaon	42	1,251,166	241.6	5,179	205,512*	16.4	1,615,000	311.8	Thaon				
26	Kale	17ABRI	547,515	63.5	8,625	119,676	21.85	438,000	50.8		Kale			
27	Lashio	54AR	633,971	49.0	12,946	182,482	28.78	674,000	52.1	Lashio				
<b>Special Function Centres</b>														
28	Kengtung	60A	427,846	39.6	10,803	111,494	26.1	406,000	37.6	Kengtung				
29	Myeik	22API	622,737	14.5	42,936	196,062	31.5	802,000	18.7	Myeik				
30	Bhamo	3B	439,870	40.5	10,864	44,719	10.2	580,000	53.4		Bhamo			
31	Putao	4AB	165,545	5.9	27,865	12,707	7.7	155,000	5.6				Putao	
32	Myawaddy	8BI	63,671	20.1	3,165	14,214	22.32	166,000	52.4		Myawaddy			
33	Tamu	18B	102,050	52.3	1,951	41,910	41.07	86,000	44.1		Tamu			
34	Kawthoung	23ABP	321,428	25.9	12,424	53,862	16.8	394,000	31.7				Kawthoung	
35	Kyaikpyu	45API	593,287	65.2	9,106	41,406	6.98	811,000	89.1	Kyaikpyu				
36	Thandwe	46APT	398,577	37.8	10,540	26,043	6.53	442,000	41.9				Thandwe	
37	Muse	55B	486,384	65.2	7,456	140,913*	28.97	644,000	86.4	Muse				
38	Tachileik	62AB	105,251	26.5	3,968	31,523	29.95	173,000	43.6				Tachileik	
39	Nyaung-U**	37ART	369,983	253.6	1,459	63,318	17.11	293,000	200.8				Nyaung-U	

Notes: \* TAZ includes population in adjacent Townships; \*\* TAZ includes Kalaw; ^ TAZ includes Hakha; \*\* TAZ includes Bagan  
Attribute: A: Airport; B: Border Town; P: Port; ; R: RailwayHub; S: State/Regional Capital; I: Industrial Zone/SEZ; T: Tourism Hub  
Sources: Ministry of Construction, Department of Human Settlements and Housing Development, 2013  
Ministry of National Planning and Economic Development, Central Statistical Organization, 2012  
Consultant's Estimates, 2013

Source: JICA Study Team



Notes:

General Priority for Transport Network Investment: 1. Strategic Link, 2. Main Link, 3. Minor Link

Security Link will normally take precedence

Source: JICA Study Team

**Figure 4.6 Hierarchy of Centers Concept**

At the primary level in the hierarchy are the national strategic centers Yangon, Mandalay and Nay Pyi Taw where major concentrations of population, economic activity and transport investment already exist and where future investment to increase capacity in highways, railways, ports and airports is being committed or planned. These centers also provide strategic locations for identifiable commercial zones or CBDs and separate clusters of industrial activities with potential for the establishment of SEZs to attract FDI. They are also the prime centers of national Government administration institutions, national universities and hospitals and research centers. In the case of Yangon and Mandalay, they perform a role as tourism hubs both for their regions and for the south and north of the country as a whole, supported by national/city parks,

heritage sites and international airports and ports.

At the secondary level are the regional cities that have grown up at strategic locations where the inter-connection of highways, railways and/or rivers has formed important transport activity nodes. In these centers, clusters of commercial and industrial activities are found, and state/regional-level government administration, education and health, and other social and emergency services provided. In some locations regional tourism and heritage sites are located nearby and regional airports and ports have been developed to serve the wider area.

At the tertiary level there are major concentrations of population and agro-industrial activities that provide services for their mainly rural and agricultural catchments. Commercial activities are often related to the agricultural economic base of the area. Local markets for farm produce, livestock and agri-businesses as well as small scale repair and maintenance workshops including for farm vehicles and equipment are clustered in these locations. District and township level administrative functions and services are provided and lower levels of health and education, and social and community services and facilities are being supplied with support from the national and regional governments. In some small airports, these centers support the provision of Government and business services to the local community.

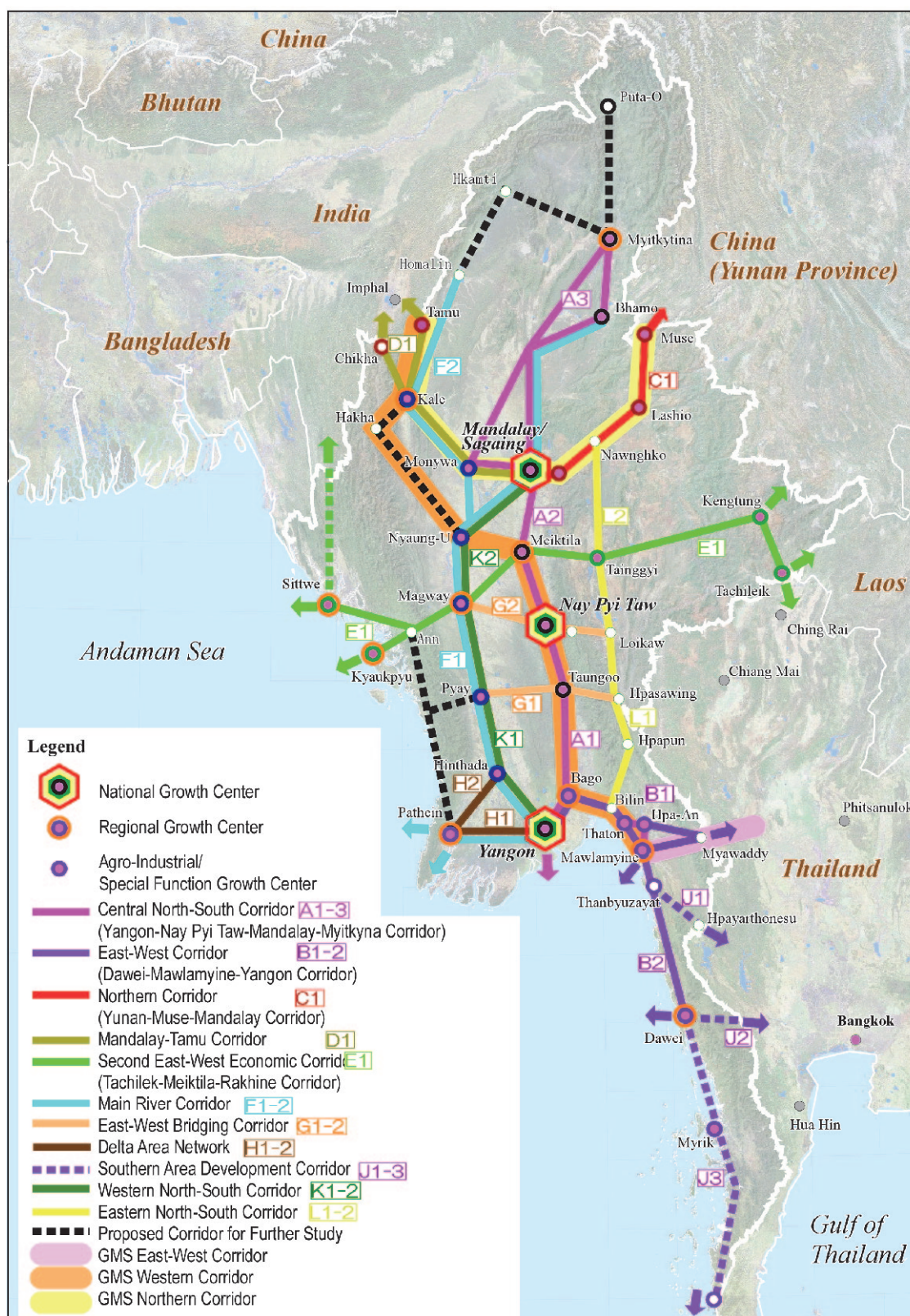
At the lowest level in the centers' hierarchy are border towns and other special function settlements that provide a more localized or specialized function because of their particular location at the national/international border or because they have grown up around a domestic port or other transport hub. Some specialized administrative and security/emergency services are provided depending on the particular function of the center. These specialized centers and port towns have often evolved in response to Government investments in infrastructure (e.g. port or handling equipment improvements or dredging), as well as cross-border trading conditions and market demand from neighboring countries.

These centers vary in size depending on their historical roles and the level of Government and private sector investment in specialized facilities and services, including activities that are based on agricultural and agro-industrial products being moved around and in and out of the country. Some Government social and community services are provided but typically, they lack a full range of facilities, due to their specialized functions and predominant workforce-based demographic and economic profile.

### **(3) National Spatial Development Framework Map**

Figure 4.7 illustrates the centers and the hierarchy of strategic linkages that provide a focus for prioritizing future transport sector investments and the foundation for the 2030 National Spatial Development Framework.





Source: JICA Study Team

**Figure 4.7 Selected Centers and Related Hierarchy of Strategic Linkages**

The NSDF incorporates strategic activity hubs, based on nationally-important cities, regional/state capital cities and other main urban centers/concentrations of population and economic activity such as industrial zones and Special Economic Zones (SEZs), agro-industrial based centers. Other key cities/towns that provide more specialized functions (e.g. port activities, rail transport hubs, airports and national/international tourism hubs, and/or important border trade towns) are also identified.

The NSDF also includes strategic transportation networks, including ASEAN/trans-national highway and railway corridors, Asian Highways, Myanmar national expressways and other major roads, railways and major rivers with an inland waterway function, which are required to underpin and strengthen the transport (and thereby economic) linkages between the strategic activity hubs. The major constraints for development include environmentally-sensitive areas, such as protected wildlife sanctuaries and national parks, and protected state and other forest zones.

In relation to the above key activity hubs and main transport networks/interchanges and facilities, future major land use development should be guided and encouraged, and permit applications for a mix of uses. This includes Transit Oriented Development (TOD), which should be permitted to capitalize on available or committed transport systems and infrastructure capacity. In this context, Figure 4.8 shows that about 65.7 million population (urban = 30.1 million, rural = 35.6 million) is likely to benefit from improved accessibility as a result of further transport investments in the strategic corridors over the next 20 years or so (refer to

In relation to the strategic environmental constraint and vulnerability areas suggested by the suitability analysis, major new land use and transport development should not be encouraged and new projects should not normally be permitted, unless these are in the national interest.

The National Spatial Development Framework (the balanced mix of economic activity hubs, strategic transport networks and facilities and major environmental protected areas) can therefore provide a useful and robust tool that will assist decision-makers in determining priorities for future transport investment decisions.



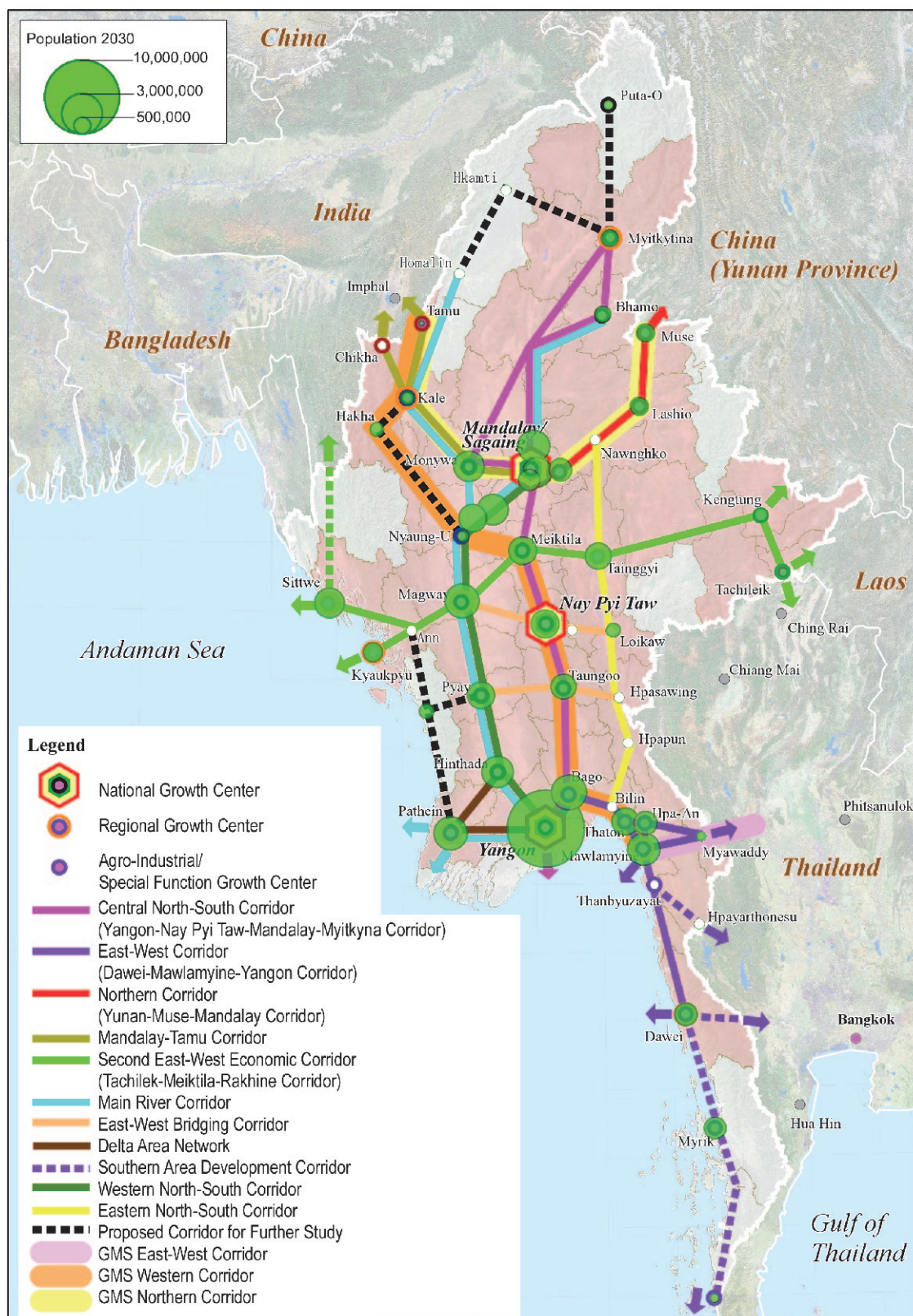


Figure 4.8 Populations with Access to Strategic Corridors, 2030

## Chapter 5 Institutional Framework

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This Chapter describes Myanmar's institutional framework and relevant government authorities for the transport sector. The organizational structure, functions and policies of each Department are listed. While the MYT-Plan recommends policies, strategies and actions to improve sector performance, it does not propose institutional changes to existing government organizations.

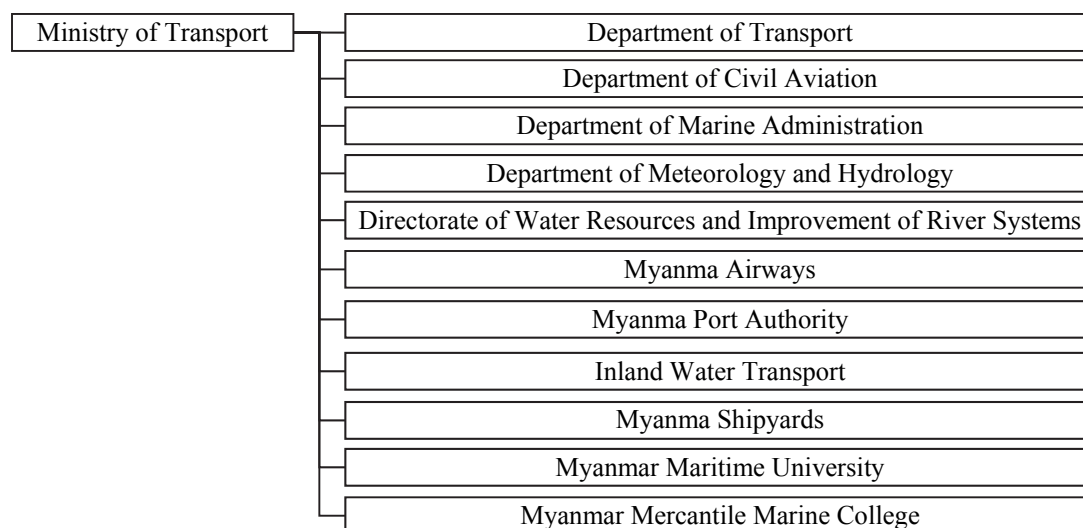
There are three ministries that are responsible for the development of major transport infrastructure, namely:

- The Ministry of Transport (MOT)
- The Ministry of Rail Transportation (MRT)
- The Ministry of Construction (MOC)

### 5.1 Ministry of Transport

Departments and organizations under the Ministry of Transport (MOT) include:

- Department of Transport (DOT)
- Department of Civil Aviation (DCA)
- Department of Marine Administration (DMA)
- Department of Meteorology and Hydrology (DMH)
- Department of Water Resources and Improvement of River System (DWIR)
- Myanma Airways (MA)
- Myanma Port Authority (MPA)
- Inland Water Transport (IWT)
- Myanma Shipyards (MS)
- Myanma Maritime University (MMU)
- Myanmar Mercantile Marine College (MMMC)



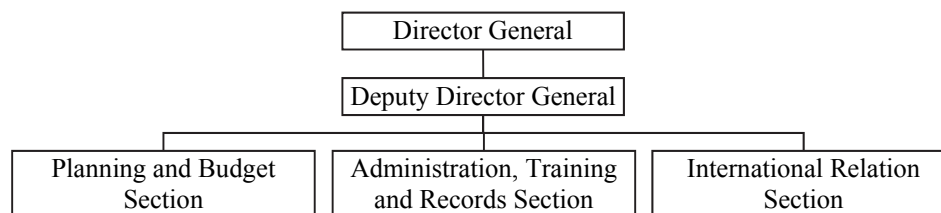
Source: MOT

**Figure 5.1 Organization of MOT**

### 5.1.1 Department of Transport (DoT)

#### 1) Organization

The organizational structure of the Department of Transport is shown in Figure 5.2, below.



Source: MOT

**Figure 5.2 Organization of DOT**

#### 2) Objectives

- To formulate transport policies and monitor the impacts of policy initiatives
- To ensure that approved transport policies are reflected in the laws and regulations governing the sector
- To monitor transport costs, prices and the efficiency of the transport system
- To cooperate in the development of action plans of international and regional organizations (eg. ASEAN, BIMSTEC, ACMECS, GMS)
- To promote efficient human resources development, related to the transport sector

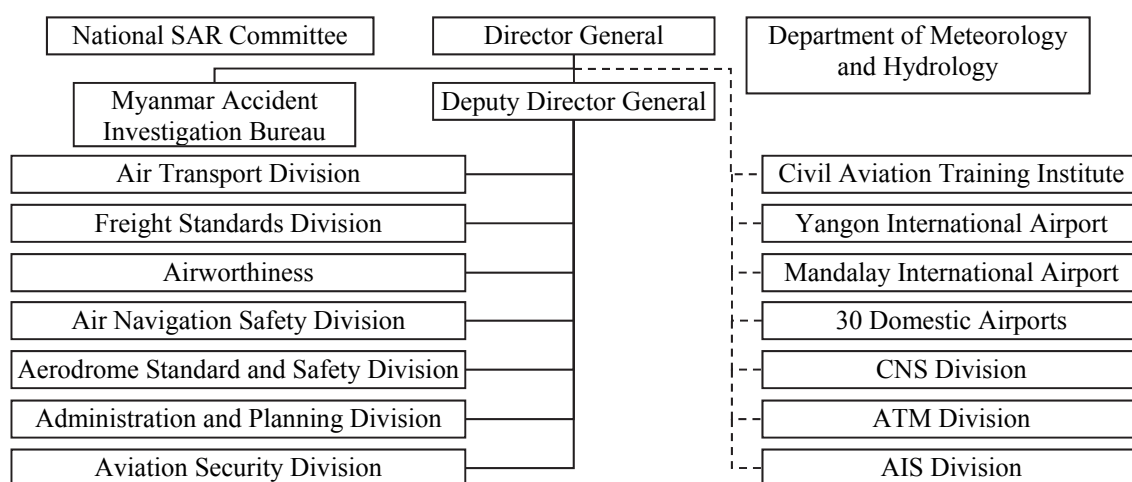
### 3) Functions

- Establishing high reporting standards for the implementation of long and short term plans, undertaken by the Departments and Enterprises sections, under the Ministry
- Monitoring Ministry GDP growth rates, which are estimated by the states
- Scrutinizing projects financed by foreign loans and the foreign exchange income of transport Departments and Enterprises
- Consulting the administration and archives of Departments, Enterprises, Universities and Institutes, under the Ministry of Transport
- Assuming responsibility to cooperate with international and regional organizations for all action plans in the transport sector

#### 5.1.2 Department of Civil Aviation (DCA)

##### 1) Organization

The organizational structure of the Department of Civil Aviation is shown in Figure 5.3, below.



Source: MOT

**Figure 5.3 Organization of DCA**

##### 2) Policies

The Department of Civil Aviation's mandate is to ensure the safe, smooth and secure operation of domestic and international air transport, in compliance with the rules and procedures of Myanmar's Aircraft Act and the standards and recommended practices of the ICAO. The DCA undertakes its functions according to the following policies:

- Safe operation
- Regular flights
- Economical operation
- Efficient operation
- Secure operation

### 3) Services

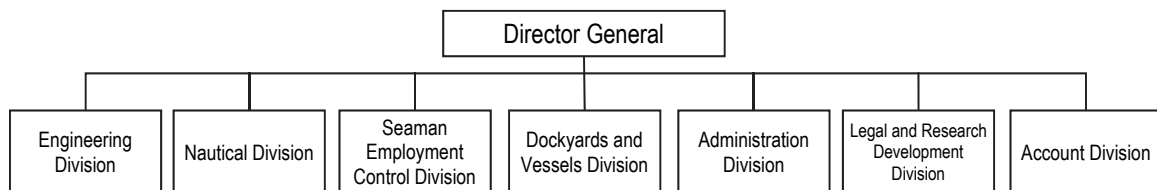
- Air traffic services
- Communication and radio navigation facilities
- Licensing of pilots and aircraft maintenance engineers and flight checks
- Construction, maintenance and management of airports
- Airworthiness control
- Issuing permits and licenses to domestic and international airlines
- Concludes bilateral air agreements
- Relations with ICAO and other international organizations
- Training of civil aviation personnel

#### 5.1.3 Department of Marine Administration (DMA)

##### 1) Organization

The Department of Marine Administration includes seven administrative sub-divisions, as follows:

- Engineering Division
- Nautical Division
- Seaman Employment Control Division
- Dockyards and Vessels Division
- Administration Division
- Legal and Research Development Division
- Account Division



Source: MOT

**Figure 5.4 Organization of DMA**

##### 2) Policies

- To ensure that national ships conform to safety standards, safe practices and standards of competence for their marine personnel
  - To promote human resources development, manpower planning and the optimum utilization of such manpower, in the maritime sector
-

- To improve the safety record of vessels registered in Myanmar
- To improve life saving efforts for those in distress at sea and protect the marine environment

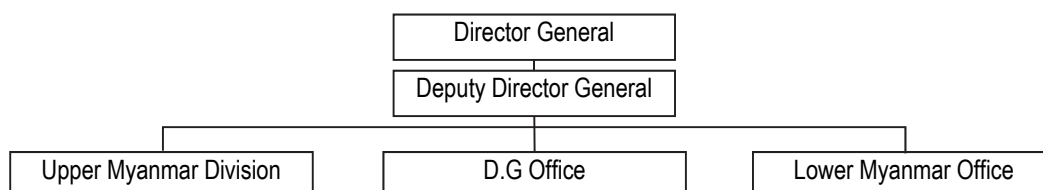
### 3) Functions

- Advise authorities on the implementation of updated conventions and codes concerning maritime affairs
- Registration of inland powered vessels
- Examine and register all types of new powered vessels
- Conduct examinations and issue certificates of competency for Deck Officers and Engineer Officers
- Conduct examinations and issue certificates of competency for coastal and inland Masters, Mates, Chief Engineers and Engine Drivers
- Inspect inland powered vessels (cargo, fishing and schooner) and issue penalties and fines for vessels that contravene rules and regulations, as prescribed by the Inland Steam-vessels Act
- Investigate accidents when they arise, such as collisions in waterways
- Recruit and train new seafarers and issue certificates of competency, exemptions, clearance and registration
- Ensure the rights and welfare of seaman are respected
- Arrange bareboat charters to increase foreign investment

## 5.1.4 Department of Meteorology and Hydrology (DMH)

### 1) Organization

The organizational structure of the Department of Meteorology and Hydrology is shown Figure 5.5, below.



Source: MOT

**Figure 5.5 Organization of DMH**

### 2) Objectives

- To take precautionary measures against and to minimize the effects of natural disasters
- To promote safety, comfort, efficiency and regularity of air, land (rail and road), sea and inland water transportation

- To promote agriculture and food production
- To assist in all national projects
- To support environmental protection and the sustainable production of natural resources
- To undertake international collaboration in the fields of research and public awareness and education on various aspects of meteorology, hydrology and seismology

### **3) Services**

- Meteorological services to the aviation sector
- Meteorological and hydrological services for shipping and inland water transport
- Meteorological services to the agricultural sector
- Hydrological services
- Seismological services
- Provide lectures for:
  - Defense Service Technical Academy
  - Myanmar Maritime University
  - Institute of Marine Technology
  - Military Meteorological Unit
  - Air Traffic Controller Course
  - Air Transport Pilot License Course
  - Departmental Training Courses
  - Natural Disaster Prevention Course

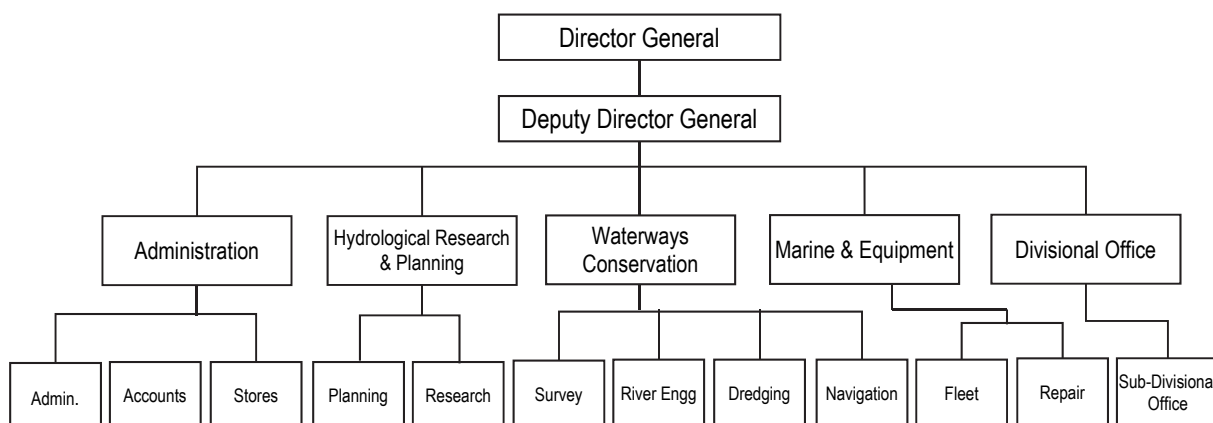
Since the 1993-94 academic year, DMH had offered degrees of B.Sc.(Honors) Meteorology and B.Sc.(Honors) Hydrology to university honors students, in collaboration with Yangon and Dagon Universities.

## **5.1.5 Directorate of Water Resources and Improvement of River System (DWIR)**

### **1) Organization**

The organizational structure of the Directorate of Water Resources and Improvement of River System is shown Figure 5.6, below.





Source: MOT

**Figure 5.6 Organization of DWIR**

## 2) Objectives

- To improve navigation channels and stabilize inland river ports
- To protect against riverbank erosion
- To cooperate with other organizations in the demarcation of dangerous water levels
- To utilize the river water year round for domestic and agricultural purposes
- To protect border rivers against bank erosion
- To preserve long-term performance of cross-river bridges, from a river engineering point of view
- To manage activities that prevent river water pollution
- To ensure adequate water depth to maximize vessel loading capacity

## 3) Functions

### a) Hydrographic Survey Section

- Channel surveying and mapping
- Surveying and technical advice for waterways adjacent to cross-river bridges
- Engineering and technical advice for the construction of cross-river bridges

### b) River Engineering Section

- Construction of river training structures to achieve adequate water depth
- River bank protection
- River training and bank stabilization for the long-term performance of cross-river bridges
- Bank protection of border rivers



- Utilize the river water year round for agricultural purposes

**c) Dredging Section**

- Dredging, where river water flow is constrained
- Bend cutting for improvement of waterways and erosion protection
- Dredging to improve approach channels for pump irrigation
- Dredging for new navigation channels

**d) Navigation Selection**

- Provision of navigation aids
- Promulgation of navigation warning
- Snag removing
- Monitoring and marking of approach channels for cross-river bridges, according to seasonal changes
- Administration of Twantay canal navigation

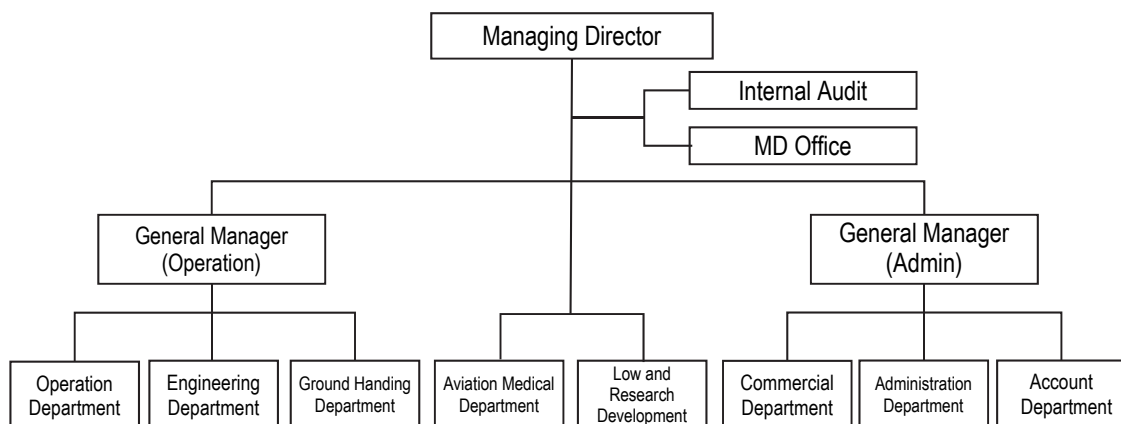
**e) Hydrological Research and Planning Department**

- Establish data banks to support river training works
- Predict Least Available Depth, along the inland rivers
- Execute research for river training activities
- Monitor environmental impact of changes in water quantity and quality
- Develop yearly, monthly and daily data for water level hydrographic envelopes

**5.1.6 Myanma Airways (MA)**

**1) Organization**

The organizational structure of Myanma Airways is shown Figure 5.7, below.



Source: MOT

**Figure 5.7 Organization of MA**

## 2) Services

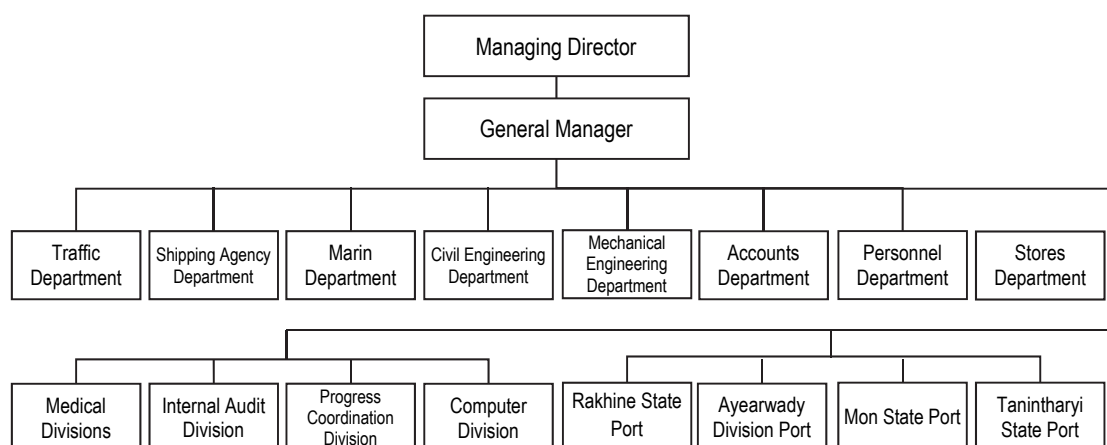
In 1948, the "Union of Burma Airways" was established and began to fly domestic scheduled services. The airline was reformed as a board under the Union of Burma Airways Acts of 1952. In 1972 the airline was again reorganized as "Burma Airways Corporation". In 1989, when Burma was officially renamed Myanmar, the airline was retitled "Myanma Airways". The airline operated international scheduled flights from 1950 until 1993, when Myanmar Airways International Co. Ltd. was created by a joint venture between MA and a foreign investor. Currently, the airline operates domestic service only; its main base is Yangon International Airport.

The MOT intends to privatize MA step by step; the next step toward privatization would see Myanma Airways become a corporate unit.

### 5.1.7 Myanma Port Authority (MPA)

#### 1) Organization

The organizational structure of the Myanma Port Authority is shown Figure 5.8, below.



Source: MPA

**Figure 5.8 Organization of MPA**

#### 2) Objectives

To provide required services (loading, discharging, storage of cargo, receipt and delivery of transit cargo, etc.) for vessels calling to all ports on Myanmar, within a minimum turn around time.

#### 3) Functions

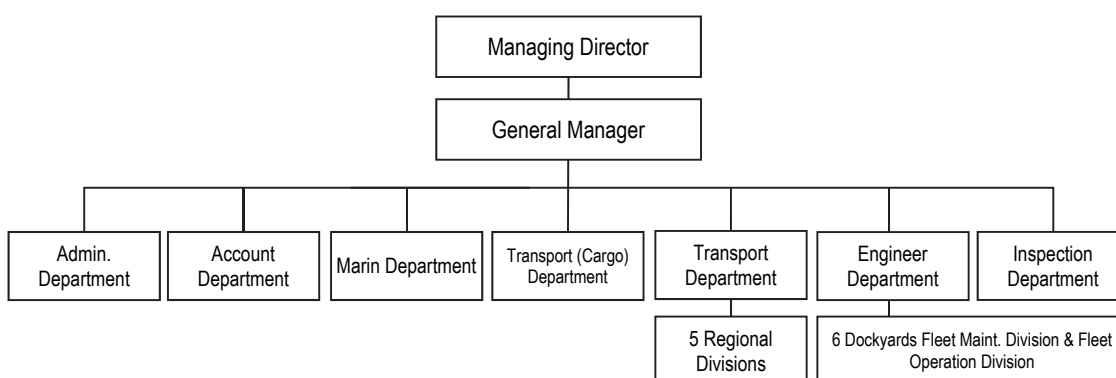
- Pilotage
- Container and General Cargo Handling and Storage
- Diving Service
- Tug Service
- Shipping Agency Service
- Fire Fighting

- Port Security
- Fresh Water Supply
- Ship Repairs

### 5.1.8 Inland Water Transport (IWT)

#### 1) Organization

The organizational structure of Inland Water Transport is shown Figure 5.9, below.



Source: IWT

**Figure 5.9 Organization of IWT**

#### 2) Responsibility

- Provide public passenger and cargo transport services using domestic inland waterways
- Own, maintain and repair ships for inland water transport
- Own, operate and maintain public shipyards

### 5.1.9 Myanma Shipyards (MS)

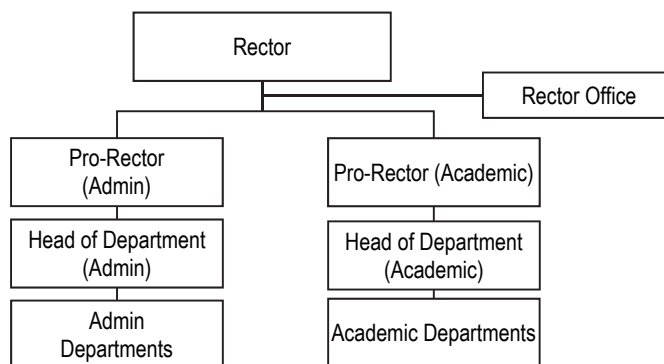
#### 1) Functions

MS is capable of building seagoing, coastal and inland water vessels of up to 2,000 tons dwt, in accord with international classifications. MS is capable of repairing seagoing, coastal and inland water vessels of up to 12,000 dwt in their slipway yard and a newly built dry dock. MS has facilities capable of machining steel up to 40 ft. long and 10 ft. in diameter and casting steel up to 2 tons melt weight.

### 5.1.10 Myanma Maritime University (MMU)

#### 1) Organization

The organizational structure of Myanma Maritime University is shown Figure 5.10, below.



Source: MMU  
**Figure 5.10 Organization of MMU**

## 2) Objectives

The aims of the University are as follows:

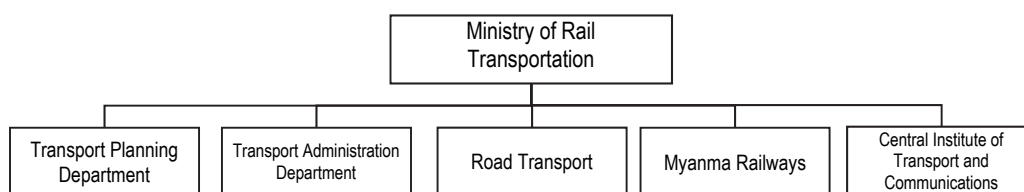
- To contribute towards modernization and development of the State, by the maritime industry
- To nurture the ethical, skillful and reputable maritime experts
- To teach science and technology contributing to the maritime profession
- To make plans and arrangements for the perpetual development of the maritime industry
- To know and comply with the provisions and standards prescribed by the International Maritime Organization
- To carry out necessary research for the development of the maritime industry

The goals of MMU are to use a scientific and practical approach as follows:

- Develop a Comprehensive Maritime Education System for the nation
- Establish an effective Maritime Education and Training program for the international maritime community
- Prepare and develop a clear link between practical skills and management techniques

## 5.2 Ministry of Rail Transportation

Ministry of Rail Transportation (MRT) includes five departments, as shown in Figure 5.11, below.



Source: MRT

**Figure 5.11 Organization chart of Ministry of Rail Transportation**

### **5.2.1 Transport Planning Department (TPD)**

#### **1) Objectives and Duties**

- To scrutinize plans, budgets and financial affairs of organizations under the Ministry of Rail Transportation and to compile and prepare summaries for the Ministry
- To coordinate the transportation of cargo
- To inspect operational accounts and social welfare works of departments and organizations under the guidance of the Minister
- To act as the focal point for implementing the tasks of ASEAN, Greater Mekong Subregion (GMS), and the BIMST-EC land transport activities, such as the ASEAN Framework Agreement on the Facilitation of Goods in Transit, the Agreement on Inter-State Transport and GMS Cross-Border Agreements

#### **2) Responsibility**

- To coordinate and arrange the transportation of State and cooperative goods, etc. with State, cooperative and privately-owned vehicles
- To coordinate and arrange the smooth flow of passenger transport, in accordance with relevant authorities

### **5.2.2 Road Transport Administration Department (RTAD)**

#### **1) Responsibilities**

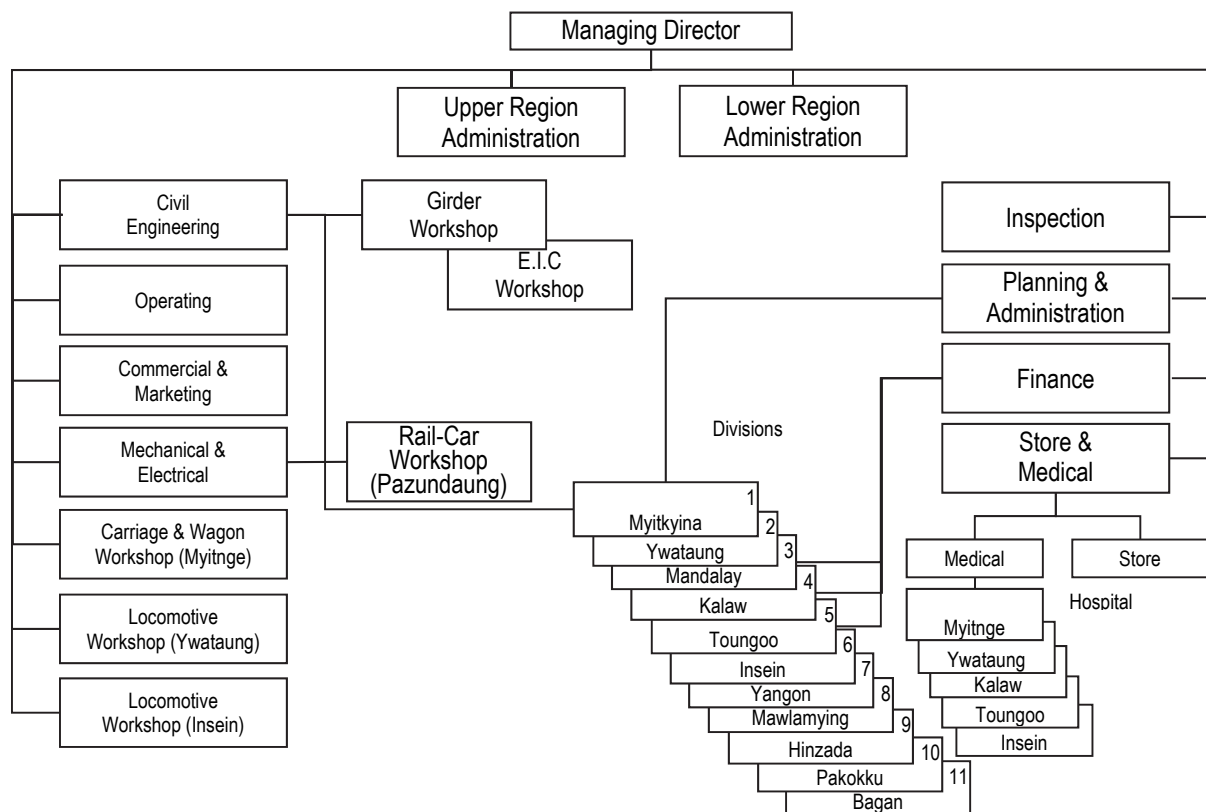
The four main responsibilities of the Road Transport Administration Department are as follows:

- Vehicle inspection and registration for road worthiness, in accordance with the laws and regulations
- Driving tests and issuing of driving licenses, in accordance with the laws and regulations
- Issuing road user traffic regulations for road safety measures
- Levying taxes and revenues for the State, in accordance with laws and regulations

### **5.2.3 Myanmar Railways (MR)**

#### **1) Organization**

The organizational structure of Myanmar Railways is shown Figure 5.12, below.



Source: Facts about Myanmar Railways

**Figure 5.12 Organization of MR**

### 5.3 Road Transport

#### 1) Responsibility

- Ensure open competition, prevent the development of monopoly situations and develop adequate safety policies
- Provide transport services dutifully to safeguard the sovereignty of the State, border area development, State-run development projects, State-sponsored ceremonies and other transport services as required by the State
- Participate in the domestic production of motor vehicles, spare parts and major-repair of the MR fleet

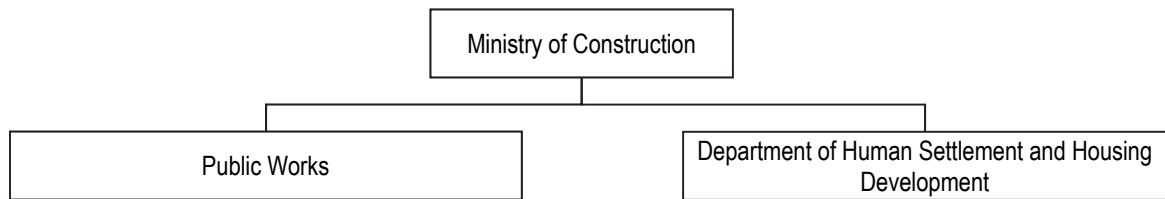
### 5.4 Central Institute of Transport and Communications

The Central Institute of Transport and Communications provides training and certification for officials and service staff from the Departments and Corporations under the Ministry of Rail Transportation, such as: Myanmar Railways, the Road Transport Corporation, the Department of Transportation (Plan), the Department of Transportation and Communications and the Central Institute of Transport and Communications. Training courses are conducted to fulfil the following objectives:

- To train service personnel to be skilled in their trades, in accordance with the procedures in their Manuals, and to keep abreast of modern techniques
- To train service personnel to be skilled in management and to make use of their abilities in the performance of their duties
- To nurture the transport sector's human resources so that they will be able to raise the standard of their all-round transportation tasks.

## 5.5 Ministry of Construction

The organizational structure of the Ministry of Construction is shown Figure 5.13, below.



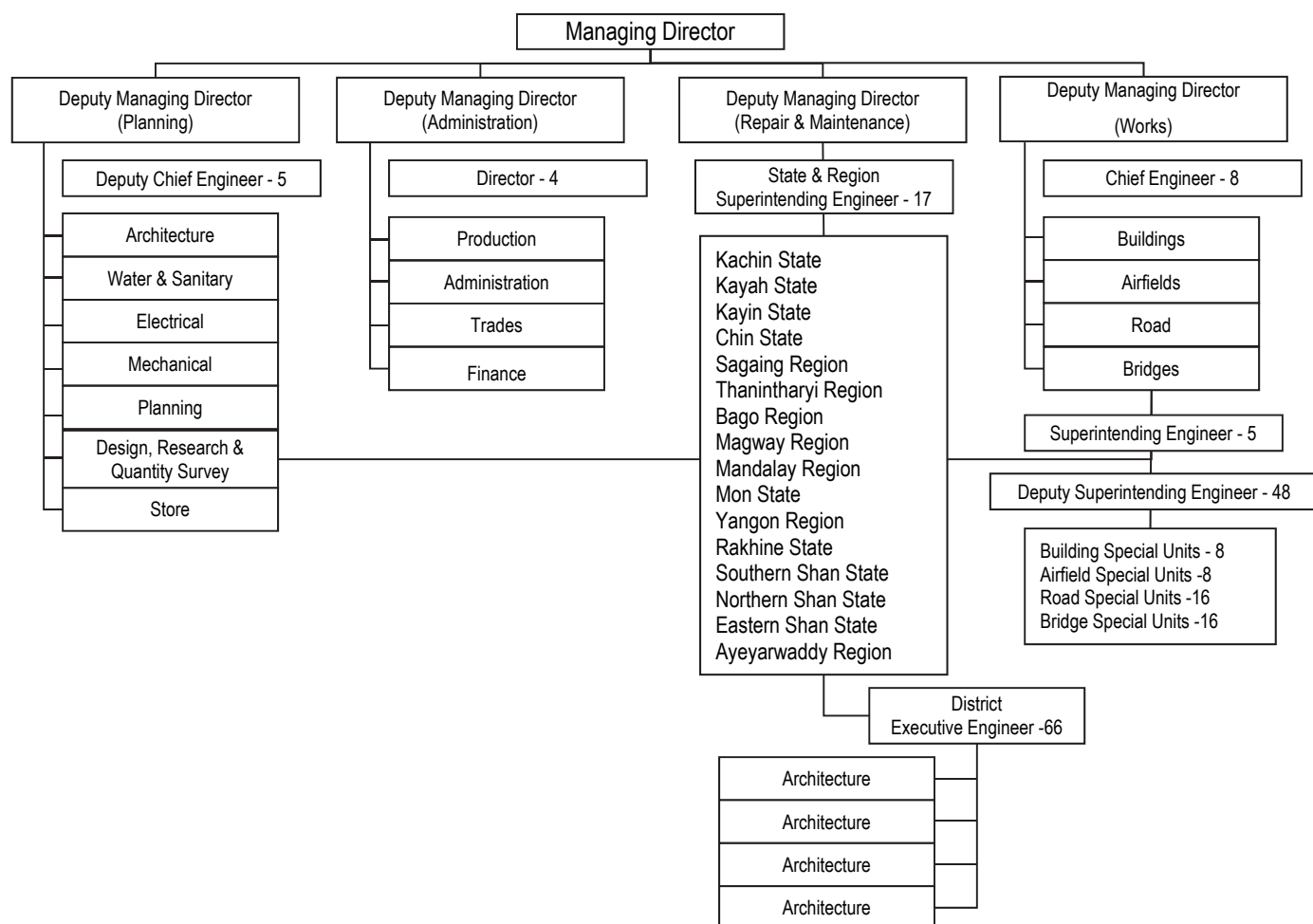
Source: MOC

**Figure 5.13 Organization of MOC**

### 5.5.1 Public Works

Public Works (PW), which was established in 1965 and is governed together with Department of Human Settlement and Housing Development (DHSHD) under the Ministry of Construction (MOC), is the main organization that administers road and bridge operations and developments in Myanmar. PW has its headquarters in Nay Pyi Taw and regional offices in each State and Region. The Department consists of four sections: planning, administration, maintenance and works and employs more than 23,000 staff, including 16,000 engineers and skilled technicians. PW is managed by a management board that is chaired by a Managing Director, in collaboration with three Deputy Managing Directors. There are eight Chief Engineers and five Deputy Chief Engineers who operate the divisions at headquarter level. There are also four supporting divisions headed by four Directors, who are non-technical senior administrative officers.

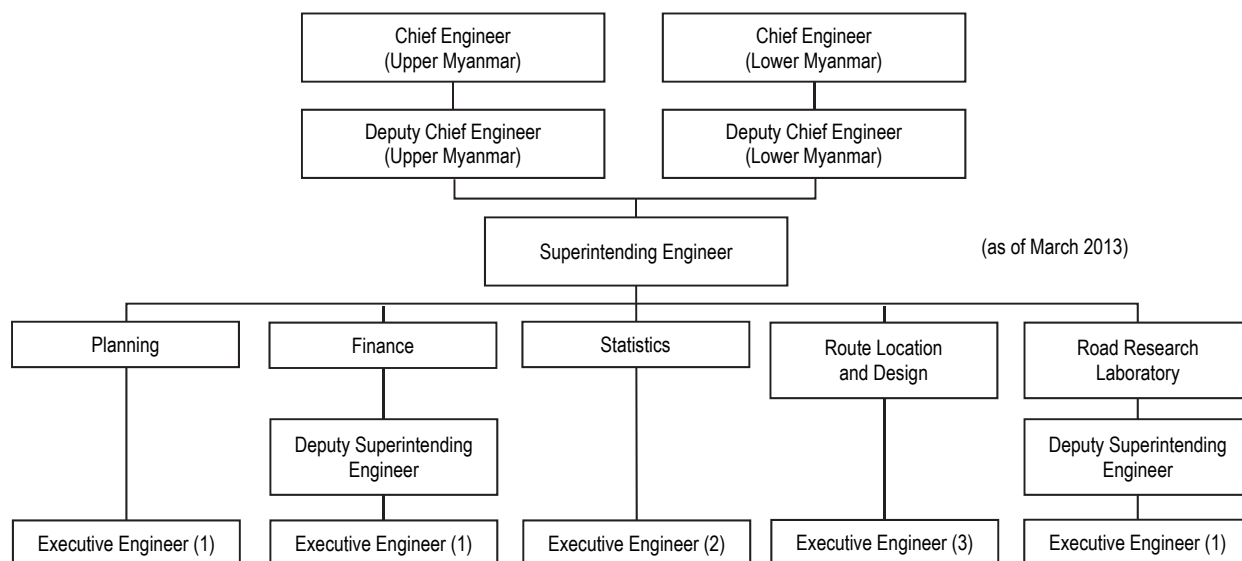
Unlike other developed countries, subcontracting the private sector to design and construct transportation infrastructure is not common practice in Myanmar, with most design, cost estimate and construction of roads and bridges executed by PW. PW's construction works follow the annual construction plan and are carried out by special units deployed in the regions that include mechanical units that provide equipment for each construction project. The regional office has the responsibility for maintenance of the national and regional road and bridge network. The regional government assumes the cost of maintenance work for regional roads. Materials and equipment distributed to each construction unit and regional office is based on the annual implementation plan, established by the central government. The Road Research Laboratory (RRL) and Soil Research Laboratory (SRL) located in Yangon have responsible for material tests and borehole investigations.



Source: Department of Public Works, Ministry of Construction (MOC)

**Figure 5.14 Public Works Organization Chart**

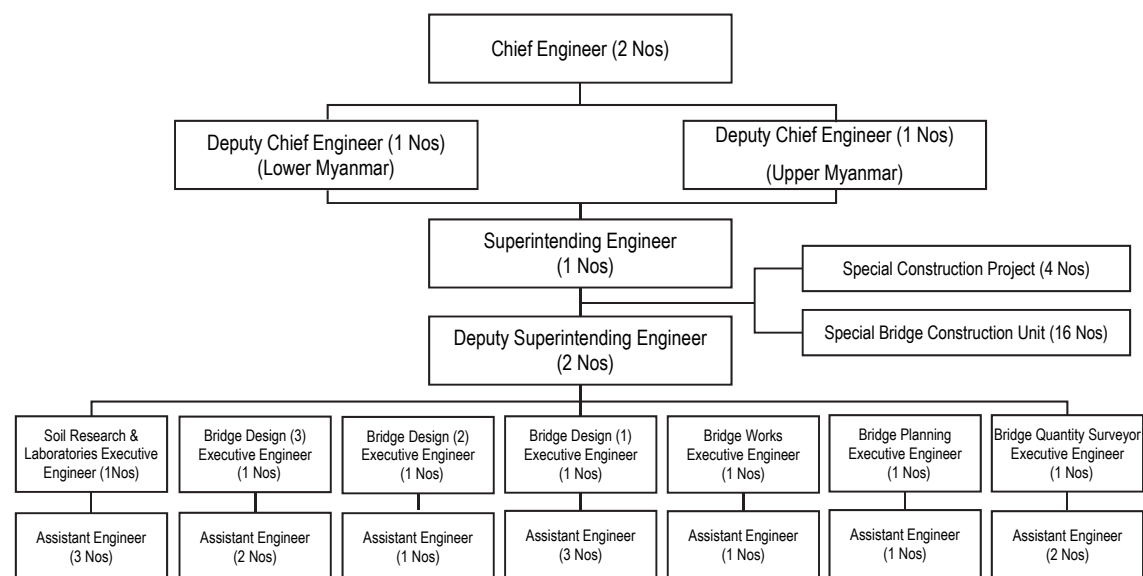




Assistant Engineer	(22)	Surveyor Grade I	(8)	Draftsman Grade I	(8)	Research Assistant Grade I	(4)	Section Clerk	(4)
Junior Engineer Grade I	(2)	Surveyor Grade II	(16)	Draftsman Grade II	(16)	Research Assistant Grade II	(12)	Senior Clerk	(8)
Junior Engineer Grade II	(10)	Surveyor Grade III	(20)	Draftsman Grade III	(8)	Research Assistant Grade III	(15)	Junior Clerk	(16)
Junior Engineer Grade III	(12)	Surveyor Grade IV	(15)	Chainman	(16)	Research Assistant Grade IV	(19)	Head Worker	(17)
Junior Engineer Grade IV	(10)	Surveyor Grade V	(5)	Junior Typewriter	(8)	Research Assistant Grade V	(9)	Worker	(21)
Computer Staff	(8)	Assistant Computer Staff	(4)			Office Assistant	(3)	Guard	(4)

Source: Department of Public Works, Ministry of Construction (MOC)

**Figure 5.15 Road Sector Organization Chart**



1	B.C	(-)	11	Assistant Computer Programmer	(2)	21	Typist	(2)
2	Draft Man (1)	(2)	12	Draft Man (3)	(4)	22	Head Worker	(7)
3	Branch Clerk (1)	(3)	13	J.E (3) Civil	(5)	23	Office Helper	(1)
4	Computer Programmer	(7)	14	U.D	(4)	24	Security	(1)
5	Skill (2) (Test)	(5)	15	Accountant (3)	(2)	25	Labour	(12)
6	J>E (2) Civil	(8)	16	Skil (4) (test)	(7)			
7	Skil (2) (soil Sample)	(5)	17	Skil (4) (Soil Sample)	(10)			
8	Draft Man (2)	(2)	18	J.E (4) Civil	(11)			
9	Draft Man (2)	(4)	19	Draft Man (4)	(7)			
10	Accountant (2)	(1)	20	L.D	(5)			

Source: Department of Public Works, Ministry of Construction (MOC)

**Figure 5.16 Bridge Sector Organization Chart**

**Table 5.1 Road and Bridge Construction Unit**

Road construction unit		Bridge construction unit	
Group	Location	Group	Location
1G	Shan State	1G	Yangon Region
2G	Ayeyarwady Region	2G	Bago Region
3G	Magway Region	3G	Nay Pyi Taw
4G	Ayeyarwady Region	4G	Magway Region
5G	Nay Pyi Taw	5G	Ayeyarwady Region
6G	Kachin State	6G	Mon State
7G	Bago Region	7G	Magway Region
8G	Rakhine State	8G	Rakhine State
9G	Kayin State	9G	Shan State
10G	Sagaing Region	10G	Sagaing Region
11G	Chin State	11G	Sagaing Region
12G	Chin State	12G	Ayeyarwady Region
13G	Mandalay Region	13G	Yangon Region
14G	Kachin State	14G	Mandalay Region
15G	Yangon Region	15G	Kachin State
16G	Tanintharyi Region	16G	Tanintharyi Region

Source: Department of Public Works, Ministry of Construction (MOC)



## **Chapter 6 ASEAN Transport Agreement and Action Plan**

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### **6.1 Background**

#### **6.1.1 ASEAN Transport Agreements**

An efficient, secure and integrated transport network in ASEAN is vital to realizing the full potential of regional economic integration, as well as enhancing the attractiveness of the region, its tourism and as an investment destination. An integrated transport network is also vital for narrowing the current development gaps in the region. This task was set as the goal for the cooperation and integration of the ASEAN transport sector in the 1992 Framework Agreement on Enhancing ASEAN Economic Cooperation, which is reaffirmed in the ASEAN Economic Community Blueprint and the Roadmap for the ASEAN Community adopted by the ASEAN Leaders in 2009. To achieve this goal, cooperation and integration of the ASEAN transport sector has been guided by a series of action plans. These include: the ASEAN Plan of Actions in Transport and Communications 1994-1996, the Transport Action Agenda and Successor Plans of Actions 1996-1998 and 1999-2004 and the ASEAN Transport Action Plan 2005-2010 that covers land, air, and maritime transport, and transport facilitation.

#### **6.1.2 Action Plan**

The ASEAN Strategic Transport Plan 2011-2015, also referred to as Brunei Action Plan, provides the main reference that guides ASEAN transport cooperation and integration in between 2011 and 2015. Based on a comprehensive assessment of the transport context in ASEAN, the Brunei Action Plan identifies strategic actions to be implemented to support the goals of the ASEAN Economic Community by 2015, as well as the priority of enhancing regional connectivity identified in the Master Plan on ASEAN Connectivity.

The following analysis highlights strategies and activities of the transport sectors listed in the Brunei Action Plan and identifies priority actions that the Myanmar Government should implement by 2015.

### **6.2 Transport Agreement and Action Plan**

#### **6.2.1 Land Transport**

The main goal for land transport is to establish a safe, efficient, environmental-friendly and integrated regional land transport system to promote trade and tourism within ASEAN and with neighboring countries. In the region, priority is given to the completion of the ASEAN Highway Network and the Singapore – Kunming Rail Link (SKRL), so land transport infrastructure can contribute to the development of economic corridors. The role that railways and inland waterway play in terms of climate and environmental benefit is increasingly understood in ASEAN. This is demonstrated in the seven strategic goals and actions set for the land transport sector in the 2010 Brunei Action Plan.

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1. Accomplish the implementation of the SKRL project
2. Complete the ASEAN Highway Network
3. Reduce road fatalities by 50% in ASEAN Member States by 2020
4. Establish efficient and integrated inland waterway transport (IWT) network
5. Develop Intelligent Transport System (ITS)
6. Enhance human, technical and institutional capacity in ASEAN Member States
7. Establish a sustainable, energy efficient and environmental-friendly transport system

### **6.2.2 Road**

According to the ASEAN Highway Network Project, the ASEAN road network designates 23 roads into five types: Primary, Class I, Class II, Class III and Below Class III. In total, these road types represent about 38,400 km of the highway network. As of 2008, Class III's two-lane roads distance totaled about 35% of the total highway length and the Below Class III amounted to approximately 15% of total highway length. The 2010 Brunei Action Plan identified 17 priority road improvement projects to improve the ASEAN Highway Network. The recommended projects include:

1. Upgrade Below Class III roads on Transit Transport Routes (TTR) by 2012
  - Lao PDR: AH12 (293 km) and AH 15 (98 km)
  - Myanmar: AH1 (781 km), AH 2 (593 km) and AH3 (93 km)
  - Indonesia: AH25 (141.55 km)
2. Construct other missing link sections on the AHN
  - Myanmar: AH 112 (60 km) and AH 123 (141 km)
3. Upgrade other Below Class III roads
  - Viet Nam: AH13 (215.5 km) by 2011 and AH132 (160 km) by 2012
  - Indonesia: AH150 (1762.3 km) and AH151 (611.9 km)
  - Lao PDR: AH131 (96 km) and AH 132 (126 km)
  - Myanmar: AH111 (239 km) and AH112 (1085 km)
  - Malaysia: AH150 (40 km)

In Myanmar, the 2010 Brunei Action Plan identified some 3,000 km of road for priority improvement projects, though some of these road sections were already upgraded under the BOT scheme. However, the condition of most of the road sections proposed for improvement is still poor and progress for these sections is much needed.



Figure 6.1 ASEAN Highway Route Map

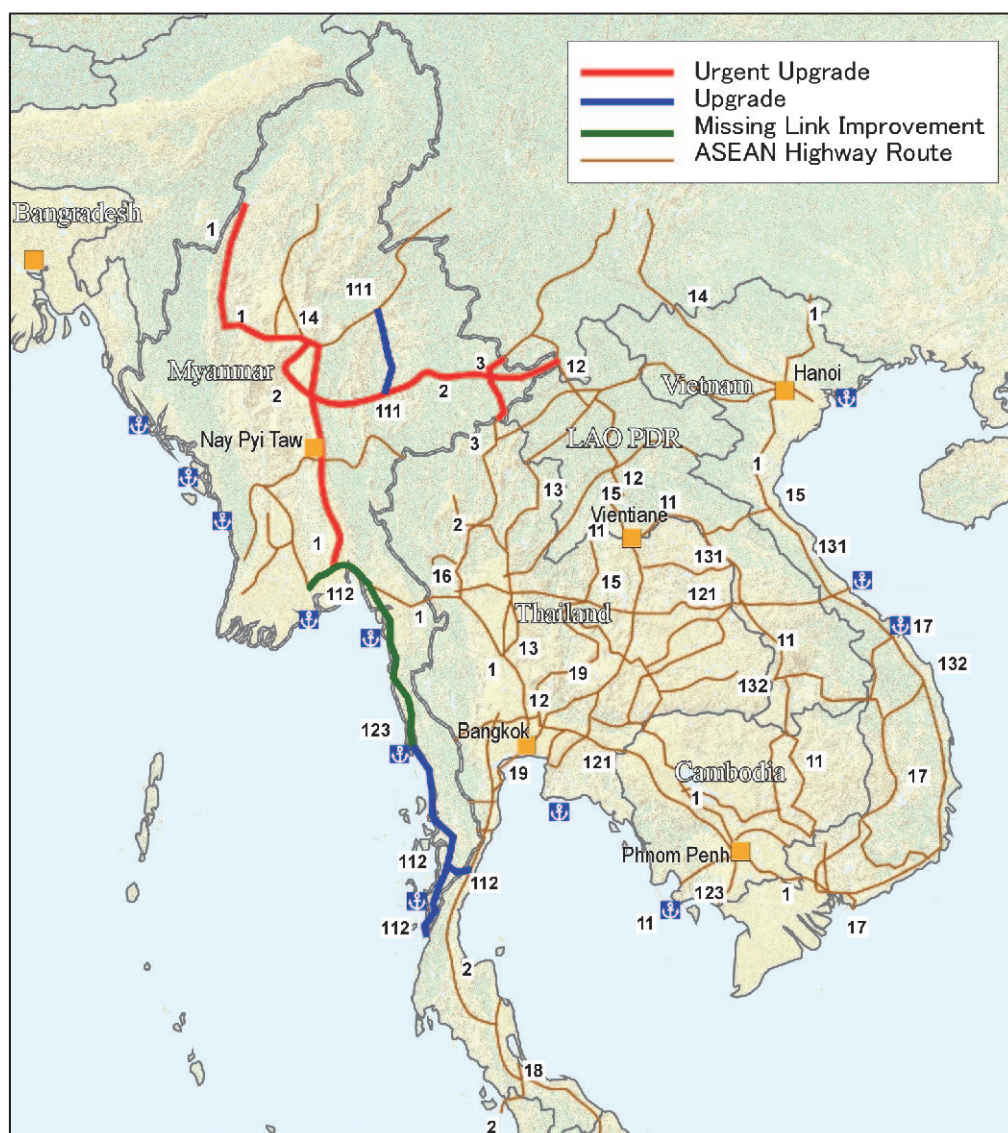


Figure 6.2 Road Improvement Projects in Myanmar proposed in 2010 Brunei Action Plan

The following table summarizes the road projects proposed and agreed to in the Brunei Action Plan and how the Myanmar Government plans to complete the projects in 2015.

**Table 6.1 List of Actions Proposed for Road Sector in Brunei Action Plan**

Strategies	Actions
1. Complete the ASEAN Highway Network	<ul style="list-style-type: none"> <li>Complete the <u>ASEAN Highway Network</u> by constructing the missing link and upgrading to Class III or better</li> <li>Identify and develop a network of <u>ASEAN dry ports</u>, in accordance with existing ASEAN initiatives such as the ASEAN Highway Network and the SKRL</li> <li>Install <u>common road signs and route numbering system</u> in all designated routes with priority on Transit Transport Routes</li> <li>Conduct a feasibility study on the bridges connecting mainland and archipelagic Southeast Asia</li> </ul>
2. Reduce the road fatalities by 50% in ASEAN Member States	<ul style="list-style-type: none"> <li>Formulate the ASEAN Regional Road Safety Strategy Plan 2012-2020 and National Road Safety Strategic Plan 2012-2020 by 2012 and their implementation</li> </ul>
3. Develop Intelligent Transport System (ITS)	<ul style="list-style-type: none"> <li>Formulate the ITS Master Plan by 2013 and its implementation</li> <li>Implement the ITS Capacity Building Program in order to develop ITS</li> </ul>

Source: ASEAN (2010) Brunei Action Plan 2011-2015

### 6.2.3 Rail

ASEAN Member States agree that the critical rail transport project, listed in the action plan and agreed to by ASEAN Member States, is the Singapore – Kunming Rail Link (SKRL). For the Rail Link, the ASEAN Connectivity Master Plan proposed two routes: an eastern line (passing through Thailand, Cambodia and Vietnam), a western line (passing through Thailand and Myanmar), and each of these lines connected, once the eastern line is complete. To successfully complete the work needed for the SKRL, a number of needed infrastructure (missing links) were identified and recommended for completion in the 2010 Brunei Action Plan. These projects include:

- Cambodia: Poipet – Sisophon (48km) by 2013
- Thailand: Aranyaprathet – Klongluk (6km) by 2014
- Cambodia: Phnom Penh – Loc Ninh (255km) by 2015
- Viet Nam: Loc Ninh – Ho Chi Minh (129km) by 2020
- Viet Nam: Mu Gia – Tan Ap – Vung Ang (119km) by 2020
- Lao PDR: Vientiane – Thakek – Mu Gia (466km) by 2020
- Myanmar: Thanbyuzayat – Three Pagoda Pass (111 km) by 2020
- Thailand: Three Pagoda Pass – Nam Tok (153km) by 2020





Source: ASEAN (2010) Brunei Action Plan 2011-2015

**Figure 6.3 Railway Projects proposed in 2010 Brunei Action Plan**

In addition, the Brunei Action Plan recommended a feasibility study and preliminary design for the railway spur line between Kanchanaburi and Dawei. This is currently underway by Italian Thai Development Pcl, the former concessionaire of the port and industrial development project in Dawei. Table 6.2 summarizes the rail sector projects proposed and agreed to in the Brunei Action Plan and their priority; it also notes those that should be implemented by the Myanmar Government by 2015.

**Table 6.2 List of Actions Proposed for Rail Transport in Brunei Action Plan**

Strategies	Actions
1. Complete the implementation of SKRL (Singapore-Kunming Rail Link) Project	<ul style="list-style-type: none"> <li>• Construct the missing link sections and spur lines of SKRL</li> <li>• Supplementary upgrading work in ASEAN Member States to support SKRL</li> <li>• Formulate a strategy for a seamless operation of SKRL by 2013</li> <li>• Mobilize financial resources and technical assistance from external partners, either on a bilateral basis or with the coordination of ADB, to support the complementation of SKRL in accordance with the agreed deadline</li> <li>• Study the possibility of extending the SKRL to Surabaya, Indonesia</li> <li>• Conduct a feasibility study and preliminary design for the railway spur line between Kanchanaburi and Dawei</li> </ul>

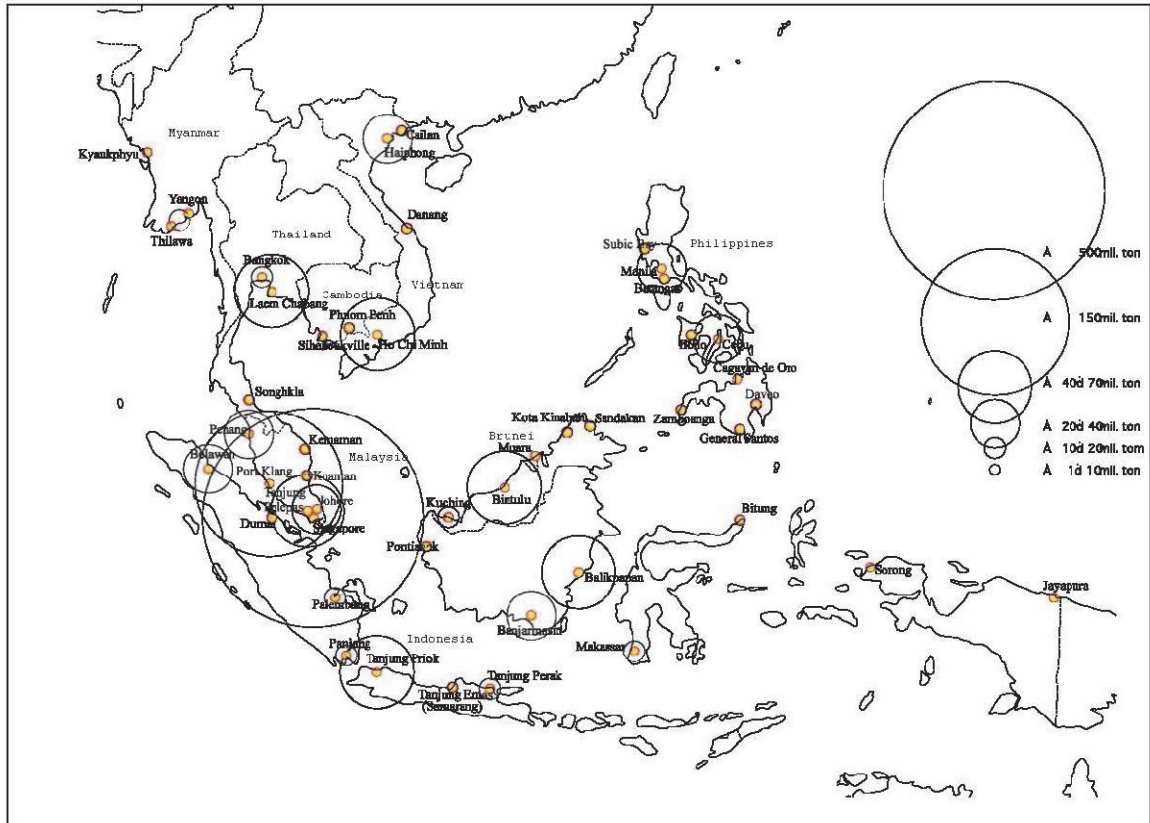
Source: ASEAN (2010) Brunei Action Plan 2011-2015

#### 6.2.4 Maritime and Port Facilities

The main goal for the maritime transport sector is to establish an integrated, competitive and seamless maritime transport network, paying particular attention to promoting maritime safety and security, and developing ports that are environmentally sustainable and user friendly. The sector's three specific goals are:

- Accomplish an integrated, efficient, and competitive maritime transport system
- Develop safety navigation system and establish an advanced maritime security system in line with international standards
- Complete the Eco-Port and ensure environmental-friendly shipping

ASEAN has designated 47 ports as the main trans-ASEAN network ports, as shown in the Figure 6.4, including several in Myanmar, including the Yangon Port, Thilawa Port and Kyaukpyu Port. The Myanmar Government faces a number of challenges in providing efficient shipping network services in these three ports. For example, the efficient handling of cargo depends on the capacity of ships calling at the ports, also on cargo handling capacity, land transport and logistics capacity, customs and administrative clearance procedures.



Source: ASEAN (2010) Master Plan on ASEAN Connectivity

**Figure 6.4 47 Designated Main Ports identified in the ASEAN Connectivity Master Plan**

Table 6.3 summarizes the maritime/port-related projects proposed and agreed in the Brunei Action Plan, which should be prioritized and those that should be implemented by the Myanmar Government by 2015.

**Table 6.3 List of Actions Proposed for Maritime/Port Development  
in the Brunei Action Plan**

Strategies	Actions
1. Develop an integrated, efficient and competitive maritime transport system	<ul style="list-style-type: none"> <li>• Develop an ASEAN Single Shipping Market by 2015</li> <li>• Enhance the capacity of 47 Designated Ports by 2015</li> <li>• Establish efficient and reliable shipping routes, including RORO connections between mainland and archipelagic Southeast Asia, and strengthen the linkages with global and domestic routes by 2015</li> <li>• Establish and enhance the Cruise Corridors by 2015</li> </ul>
2. Develop safety navigation system and establish advanced maritime security system in line with international standards	<ul style="list-style-type: none"> <li>• Review ASEAN Near Coastal Voyage Limits as part the required Standards of Training, Certification and Watch-keeping Convention by 2012</li> <li>• Enhance Search and Rescue (SAR) capability through combined air and maritime SAR exercises by 2015</li> <li>• Develop human resources to strengthen port and shipping operations, including the introduction of advanced technologies for navigation safety, maritime security and environmental preservation</li> </ul>
3. Accomplish the Eco-Port and environmentally-friendly shipping	<ul style="list-style-type: none"> <li>• Enhance Eco-port activities in cooperation with IMO and promote the negotiation and implementation of relevant IMO initiative conventions.</li> </ul>
4. Establish an efficient and integrated inland water transport system	<ul style="list-style-type: none"> <li>• Formulate a regional plan for developing an inland water transport network in ASEAN by 2012, and begin implementation thereafter</li> </ul>

Source: ASEAN (2010) Brunei Action Plan 2011-2015

### 6.2.5 Air

Among ASEAN Member States, including Myanmar, the liberalization of the air transport service has become a central feature of liberalization measures and is being deployed across the region to allow for open sky transport service between ASEAN cities. In 2004, ASEAN countries agreed to a roadmap for the integration and liberalization of air transport services in the air travel sector. To achieve these sector reforms, Transport Ministers signed a Multilateral Agreement on the Full Liberalization of Air Freight Service (MAFLAFS) in 2009 as well as a Multilateral Agreement on Air Service. In 2010, Ministers signed a Multilateral Agreement on the Full Liberalization of Passenger Air Services (MAFLPAS).

The Brunei Action Plan (2011-2015) also proposed air transport strategies and actions and an Implementation Framework of the ASEAN Single Aviation Market was adopted at the 17th ASEAN Transport Minister Meeting in December 2011. Key elements of the ASEAN Single Aviation Market (ASAM) are summarized in Table 6.2. With regard to the market access, Myanmar has already ratified all protocols of MAFLAFS and MAFLPAS. Among the remaining elements to be implemented, the following are priorities for the Myanmar Government: (i) airport user charges, (ii) aviation safety, (iii) aviation security, and (iv) air traffic management.

**Table 6.4 Key Elements in Implementation Framework  
of the ASEAN Single Aviation Market**

Subject	Measures
Market Access	
Charters	<ul style="list-style-type: none"> <li>• Liberalize charters on international routes, which are not served by scheduled airlines -consider others on a case-by-case basis</li> </ul>
Ownership and Control	<ul style="list-style-type: none"> <li>• Work towards adoption of the principal place of business and effective regulatory control criteria in the designation of airlines of ASEAN Member States</li> <li>• Commence discussions on further liberalization of ownership and control of airlines of ASEAN Member States, including the concept of an 'ASEAN Community Carrier'</li> </ul>
Tariffs	<ul style="list-style-type: none"> <li>• Work towards no filing of tariffs</li> </ul>
Commercial Activities	<ul style="list-style-type: none"> <li>• Provisions for commercial activities to be liberalized, except where there are existing contractual obligations</li> <li>• Services to be provided on a non-discriminatory basis</li> <li>• Provisions for commercial activities to be liberalized, as existing contractual obligations phase out</li> </ul>
Competition Law	<ul style="list-style-type: none"> <li>• To be governed by ASEAN all-sector approach</li> </ul>
Consumer Protection	<ul style="list-style-type: none"> <li>• To be governed by ASEAN all-sector approach</li> </ul>
Airport User Charges	<ul style="list-style-type: none"> <li>• To be established in line with ICAO principles and guidelines</li> </ul>
Dispute Resolution	<ul style="list-style-type: none"> <li>• To be governed by the ASEAN Enhanced Dispute Settlement Mechanism</li> </ul>
Dialogue Partners Engagement Mechanism	<ul style="list-style-type: none"> <li>• Further strengthen engagement with Dialogue Partners in the development of the ASEAN air transport sector, while maintaining ASEAN's centrality as the primary driving force</li> <li>• Conclude Air Transport Agreements with China by 2010, India, the ROK and possibly other Dialogue Partners, not later than 2015</li> <li>• Consider concluding Air Transport Agreements with other partners</li> </ul>
Aviation Safety	<ul style="list-style-type: none"> <li>• Align regulatory capability and safety standards with ICAO SARPs</li> <li>• Identify priority areas for human resource development and training related to aviation safety</li> <li>• Develop a mutual recognition instrument (i.e. Mutual Recognition of Aviation Related Certification Agreement)</li> <li>• Develop an inventory of standards to facilitate the preparation of Mutual Recognition of Aviation Related Certification Agreement</li> <li>• Establish a framework to share ramp inspection information among ASEAN Member States</li> <li>• Establish mutually agreed minimum standards and capabilities for the purpose of possible mutual recognition</li> <li>• Commence mutual recognition for selected components of the following priority areas of: <ul style="list-style-type: none"> <li>• air operator certification</li> <li>• aircraft airworthiness (approved maintenance organization)</li> <li>• flight crew/engineer licensing</li> </ul> </li> <li>• in accordance with the Mutual Recognition of Aviation Related Certification Agreement instrument</li> <li>• Conclude Mutual Recognition of Aviation Related Certification Agreement for remaining safety areas</li> <li>• Develop and implement a 'common rules' framework, which comprises a common set of ASEAN-wide aviation safety rules</li> <li>• Establish an appropriate ASEAN aviation safety setup</li> </ul>

Subject	Measures
Aviation Security	<ul style="list-style-type: none"> <li>• Share information on latest trends and developments in aviation security, including the experiences and knowledge of the use of technology</li> <li>• Leverage existing aviation security points of contact and networks of ASEAN Member States to facilitate information sharing among Member States</li> <li>• Identify areas for capacity building by ASEAN Member States</li> <li>• Leverage existing capacity building mechanisms such as those offered by the ICAO Asia and Pacific Regional Office, as well as new mechanisms</li> <li>• Align aviation security measures with ICAO Standards</li> <li>• Develop practical, harmonized and cost effective aviation security measures</li> <li>• Harmonize areas such as screening technology and processes for screening of liquids, aerosols and gels (LAGS), passenger pre-board screening, air cargo and supply chain security</li> <li>• Enable ASEAN to engage other regional entities to better facilitate air travel to ASEAN and onward to other destinations.</li> </ul>
Air Traffic Management	<ul style="list-style-type: none"> <li>• Develop an inventory of air traffic management or share information for the purpose of gap analysis</li> <li>• Identify and endorse key enabling technologies and initiatives for regional implementation</li> <li>• Support ICAO's efforts and implementation plan for air traffic management in the Southeast Asia Region</li> <li>• Enhance training for the identified key technologies and initiatives</li> <li>• Continue to support ICAO's efforts and implementation plan for air traffic management in the Southeast Asia Region</li> <li>• Track European Union's 'Single European Sky Air Traffic Management Research Programme (SESAR)' and Federal Aviation Administration's next Generation Air Transportation System (NextGen) and other regional concepts/developments</li> <li>• Adapt concepts/framework/technologies and/or identify new building blocks that may be essential for harmonization of air traffic management procedures</li> <li>• Explore options for an ASEAN Air Traffic Management Harmonization Master Plan.</li> <li>• Integrate some of these initiatives together with the other stakeholders such as IATA, CANSO, ICAO, etc.</li> <li>• Review the key elements/building blocks and work towards full harmonization of air traffic management procedures.</li> <li>• Seek to comply with the interoperability of air traffic management requirements together with the rest of the Asia-Pacific region.</li> </ul>

Source: ROADMAP FOR THE ECONOMIC ELEMENTS OF THE ASAM

### 6.2.6 Transport Facilitation

The main goal of transport facilitation is to establish an integrated, efficient and globally competitive multimodal transport system to enhance connectivity within ASEAN and with a rest of the world. The aim is also to pursue “green logistics” for environment preservation. The following four specific goals place prime importance on the transport facilitation framework in the Brunei Action Plan. The goals include issues covering three transport sectors: land, air and maritime transport.

- Establish integrated and seamless multimodal transport system
- Enhance the competitiveness of ASEAN Logistics Industry
- Establish safe and secure inter-state transport system
- Develop environment-friendly logistics

Table 6.5 summarizes the actions, related to transport facilitation, proposed in the Brunei Action Plan, which should be prioritized and implemented by the Myanmar Government, which has already ratified several.

**Table 6.5 List of Actions Proposed for Transport Facilitation in Brunei Action Plan**

Strategies	Actions
1. Establish integrated and seamless multimodal transport system to make ASEAN the transport hub in the region	<ul style="list-style-type: none"> <li>Fully operationalize three ASEAN Framework Agreements on transport facilitation</li> <li>Implement initiatives to facilitate inter-state passenger land transportation</li> <li>Conduct studies on potential multimodal transport corridors to empower parts of ASEAN to function as land bridges for global supply routes</li> <li>Complete the East West Economic Corridor</li> <li>Promote the Mekong India Economic Corridor as a land bridge</li> <li>Produce a comparative study between EU and ASEAN region for development of efficient transport system by 2013 and its adoption</li> <li>Promote the usage of transport terms and practices related to multimodal transport, including INCOTERMS (International Commercial Terms)</li> </ul>
2. Enhance the competitiveness of ASEAN logistics industry	<ul style="list-style-type: none"> <li>Develop and upgrade skills and build capacity for MOTs (multimodal transport operators) and LSPs (logistics service providers) through joint training and workshops</li> <li>Establish national/regional centers of training centers, national skill certification systems and common core curriculum</li> <li>Identify and develop the ASEAN logistics network and formulate the necessary infrastructure development requirements</li> </ul>
3. Establish safe and secure inter-state transport system	<ul style="list-style-type: none"> <li>Share and apply appropriate technologies of information systems for promotion of supply chain security initiatives</li> </ul>
4. Develop environmental-friendly logistics	<ul style="list-style-type: none"> <li>Develop green logistics through increase in logistics management efficiency and utilization of environmentally -friendly transport modes, fuel, fleets, supporting logistics facilities</li> </ul>

Source: ASEAN (2010) Brunei Action Plan 2011-2015

Building on the example of the ASEAN Framework Agreements on Transport Facilitation, ASEAN has introduced a number of transport facilitation initiatives over the years to create an efficient logistics and multimodal transport system for the seamless movement of goods, connecting land, maritime, and air transport. These initiatives include:

- (a) ASEAN Framework Agreement on the Facilitation of Goods in Transit (AFAFGIT)
- (b) ASEAN Framework Agreement on Multimodal Transport (AFAMT)
- (c) ASEAN Framework Agreement on the Facilitation of Inter-State Transport (AFAFIST)

Table 6.6 summarizes the status of the ASEAN Transport Facilitation Agreement ratification. Myanmar already acceded to the AFAFGIT in 1998 and signed 7 Protocols between 2002 and 2011. The Government is now required to implement transport facilitation measures such as: designation of transit transport routes and facilities, types and quantity of road vehicles, technical requirements of the vehicles, motor insurance, etc.

**Table 6.6 Status of Ratification of ASEAN Transport Facilitation Agreement**

Protocol Number	Subjects	Brunei	Cambodia	Indonesia	Laos	Malaysia	Myanmar	Philippine	Singapore	Thailand	Vietnam
1	Designation of Transit Transport Routes and Facilities	Ratified 19-10-09	Ratified 27-10-09	Signed 8-2-07	Signed 8-2-07	Signed 8-2-07	Signed 8-2-07	Ratified 13-11-07	Signed 8-2-07	Ratified 22-6-11	Ratified 10-10-07
2	Designation of Frontier Posts	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed
3	Types and Quantity of Road Vehicles	Ratified 5-9-04	Ratified 9-5-07	Ratified 23-6-00	Ratified 19-1-00	Ratified 24-7-09	Ratified 21-8-00	Ratified 25-11-99	Ratified 2-5-06	Ratified 19-4-10	Ratified 15-11-99
4	Technical Requirements of Vehicles	Ratified 6-9-04	Ratified 9-5-07	Ratified 23-6-00	Ratified 19-1-00	Ratified 24-7-09	Ratified 21-8-00	Ratified 25-11-99	Ratified 2-5-06	Ratified 19-4-10	Ratified 15-11-99
5	ASEAN Scheme of Compulsory Motor Vehicles Insurance	Ratified 8-9-02	Ratified 30-1-02	Ratified 30-7-02	Ratified 6-11-02	Ratified 26-3-02	Ratified 16-10-03	Ratified 22-9-03	Ratified 29-8-02	Ratified 8-1-03	Ratified 2-7-01
6	Railways Border and Interchange Stations	Signed 16-12-11	Signed 16-12-11	Signed 16-12-11	Signed 16-12-11	Signed 16-12-11	Ratified 3-2-14	Signed 16-12-11	Signed 16-12-11	Ratified 3-9-12	Signed 16-12-11
7	Custom Transit System	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed	Not Signed
8	Sanitary and Phytosanitary Measures	Ratified 7-8-10	Ratified 23-5-03	Ratified 31-12-02	Ratified 9-5-01	Ratified 10-8-10	Ratified 10-10-02	Ratified 26-11-09	Ratified 30-3-06	Ratified 23-8-03	Ratified 29-3-01
9	Dangerous Goods	Ratified 30-3-04	Ratified 9-5-07	Ratified 24-8-03	Ratified 19-5-03	Signed 20-9-02	Ratified 25-4-03	Ratified 5-5-03	Ratified 12-9-07	Signed 20-9-02	Ratified 15-11-02

Source: MORT, TPD





## **Chapter 7 Overview of the Transportation Sector**

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### **7.1 Road Infrastructure Sector**

#### **7.1.1 Road Network**

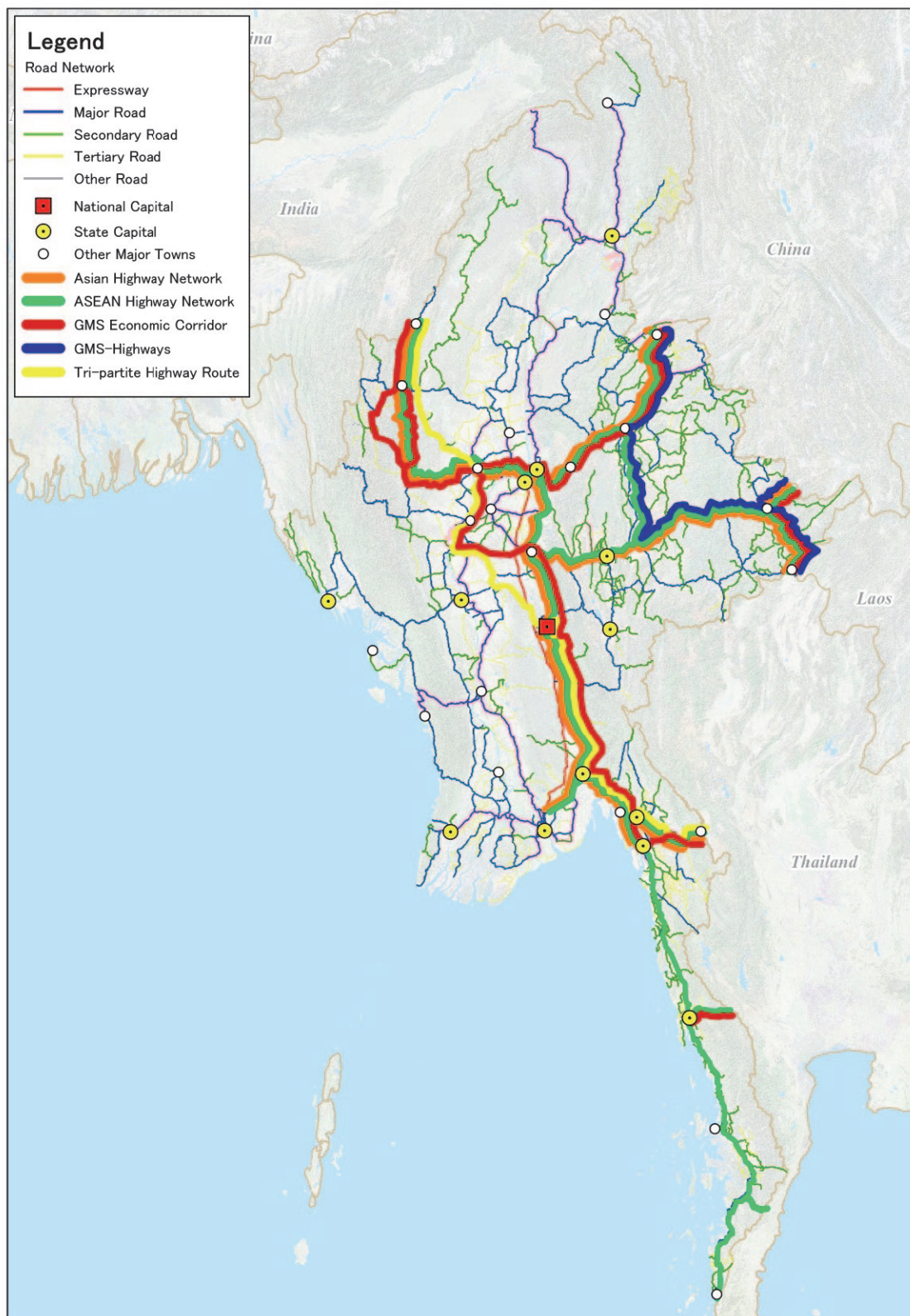
##### **(1) Network of Corridors**

The Department of Public Works (PW) in the Ministry of Construction (MOC) is the main implementation body for trunk road and bridge construction in Myanmar. PW has developed a 30-year highway development plan that includes six 5-year plans and explains the strategy and implementation activities for the future development of the highway network.

PW places a high priority on certain segments of the highway network that link into the regional network, namely, the Asian Highway, ASEAN Highway, GMS Economic Corridor, GMS Highway and Thai-Myanmar-India Tripartite highways. PW expects that further development of these network segments will accelerate the country's economic growth by encouraging international trade with neighboring countries.

Within Myanmar, the expressway connecting three major growth centers (Yangon, Nay Pyi Taw, and Mandalay) is not integrated into the regional road network, though it will play an important role in strengthening the Central North – South corridor.

As of 2013, the total road length in Myanmar reaches approximately 150,000 km, as shown in Figure 7.1.



Source: JICA Study Team

Figure 7.1 Road Networks

**Table 7.1 Length of Regional Highway Networks**

Asian Highway Network		
No.	Section	Length (km)
AH1	Myawaddy - Payagyi - Yangon - Meiktila - Mandalay - Tamu	1,665
AH2	Tachileik - Kengtung - Meiktila - Mandalay - Tamu	807
AH3	Mongla - Kengtung	93
AH14	Muse - Lashio - Mandalay	453
Total		3,018
ASEAN Highway Network		
No.	Section	Length (km)
AH1	Myawaddy - Payagyi - Yangon - Meiktila - Mandalay - Tamu	1,665
AH2	Tachileik - Kengtung - Meiktila - Mandalay - Tamu	807
AH3	Mongla - Kengtung	93
AH14	Muse - Lashio - Mandalay	453
AH 111	Thibaw - Loilem	239
AH 112	Thaton - Mawlamyine - Thanbyzayat - Ye - Dawei - Lehnya - Khamaukgyi, Lehnya - Khong Loy	1,145
AH 123	Dawei - Maesamee Pass	141
Total		4,543
GMS Highway		
No.	Section	Length (km)
R3	Tachileik - Kengtung- Mailar (overlap with AH2 and AH3)	257
R4	Lashio - Muse (overlap with AH14)	176
R5	Kengtung - Loinlin - Thibaw- Lashio (overlap with AH2, AH14 and AH111)	666
Total		1,099
Tri-Partite Highway Route		
No.	Section	Length (km)
	Tamu - Kalaywa - Chaungma - Lingadaw - Pakokku - Theegone - Naypyitaw - Payagyi - Thaton - Hpaan - Myawaddy	1,285

Source: Department of Public Works, Ministry of Construction (MOC)

**Table 7.2 GMS Economic Corridor**

GMS Economic Corridor		
Corridor Name	Section	Myanmar
North-South Corridor	Kunming - Bangkok	Yes
East-West Corridor	Mawlamyine - Danang	Yes
Southern Corridor	Dawei - Quy Nhan/Vung Tau	Yes
Northern Corridor	Gangheng - Tamu	Yes
Western Corridor	Tamu - Mawlamyine	Yes
Central Corridor	Kunming- Sihanoukville / Sattahip	No
Eastern Corridor	Kunming - Ho Chi Minh City	No
Southern Coastal Corridor	Bangkok - Nam Can	No
Northeastern Corridor	Nanning - Bangkok - Laem Chabang	No

Source: Asian Development Bank

### 7.1.2 Bridges

There are about 500 bridges in Myanmar that have lengths longer than 54m and a great many more shorter span bridges, according to information available as of July 2012. The exact number of bridges is unknown as there is currently no accurate government inventory of bridges or roads.

Myanmar's bridges are designed, constructed and maintained by PW directly, while private

companies under BOT schemes operate some trunk roads.

Regional technical and financial support for Myanmar's bridge infrastructure began with JICA's Bridge Engineering Training Center Project (BETC), implemented from 1969 to 1975. This support contributed to the technical capacity of PW staff and increased the number of bridge engineers in Myanmar. During the period of economic sanctions on Myanmar, several bridges, including the portable Bailey bridges, were constructed with Chinese and Indian technical and financial support.

**Table 7.3 Bridges on Major River**

No.	Name	Span (feet)	Type of Bridge
<b>River Ayeyarwady</b>			
1	Innwa Bridge (Sagaing)	3,960	Steel Truss
2	Nawaday Bridge	4,183	Steel Truss
3	Maubin Bridge	2,362	Steel Truss+ RCC
4	Bala Min Htin Bridge	2,688	Steel Truss
5	Bo Myat Htun Bridge	8,544	Steel Truss
6	Anawrahtar Bridge	5,192	Steel Truss
7	Ayeyarwady Bridge (Magway)	8,989	Steel Truss+ PC+RCC
8	Dadaye Bridge	4,088	Steel Truss+ RC
9	Ayeyarwady Bridge (Yadanarpon)	5,641	Steel Truss
10	Ayeyarwady Bridge (Nyaungdone)	7,402	Steel Truss
11	Ayeyarwady Bridge (Pakokku)	11,431	Steel Truss
12	Ayeyarwady Bridge (Sinkhan)	3,215	Steel Truss+ PC+RCC
<b>River Sittaung</b>			
13	Sittaung Bridge (Theinzayat)	2,320	Steel Truss
14	Sittaung Bridge (Taungngu-Mawchi-Loikaw)	680	CH Steel Girder
15	Sittaung Bridge (Shwe Kyin-Madauk)	1,500	PC+RCC
16	Sittaung Bridge (Mokepalin)	2,393	Steel Truss+ Plate Girder + RC
17	Sittaung Bridge (Natthankwin)	720	Steel Truss
<b>River Thanlwin</b>			
18	Kwan Lon Bridge	789	Steel Suspension
19	Tar Kaw Bridge	780	Steel Truss
20	Thanlwin Bridge (Hpa An)	2,252	Steel Truss
21	Thanlwin Bridge (Tarsan)	900	Suspension
22	Thanlwin Bridge (Mawlamyine)	11,575	Steel Truss+ PC+RCC
23	Thanlwin Bridge (Tarpar)	600	Steel Suspension
24	Thanlwin Bridge (Tarkaw At)	600	Bailey
<b>River Chindwin</b>			
25	Shinphyushin Bridge	4,957	Steel Truss
26	Chindwin Bridge (Monywa)	4,730	Steel Truss

Source: Department of Public Works, Ministry of Construction (MOC)

### 7.1.3 Sector Funding

#### (1) Road and Bridge Budgeting

Construction of the main roads and bridges in Myanmar is budgeted by the central government, based on the national annual budgetary plan, with funds generated from tax levies on fuel, vehicles, etc. Other countries, including Japan, allocate funding specifically for road and bridge construction.

The planned and actual expenditure for road and bridge construction and maintenance between 2005 and 2013 is shown in Table 7.4 and Table 7.5. Between 2005 and 2009, the level of infrastructure expenditure was approximately 100 billion Kyat, though after 2010 it increased sharply, reaching about 600 billion Kyat in 2012/2013 (Figure 7.2). Since then, it has decreased and the planned budget for 2013/14 is approximately 355 billion Kyat.

The planned road and bridge budget of 355 billion Kyat for 2013/14 is comprised of road construction (40%), bridge construction (25%), and infrastructure maintenance (35%).

**Table 7.4 Planned Budget for Road and Bridge Development (billion Kyat)**

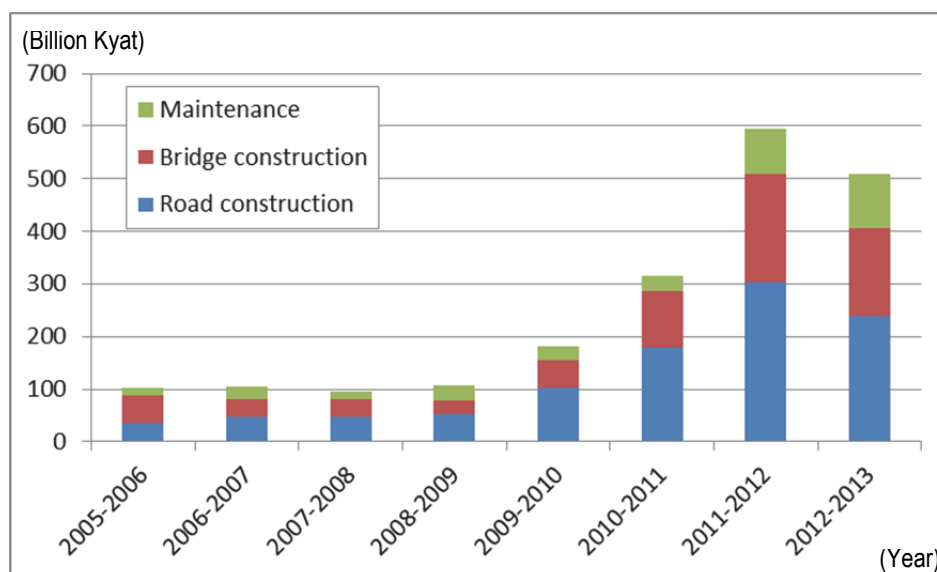
Plan	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
Road construction	35.216	49.187	49.167	52.233	101.398
Bridge construction	52.625	32.772	35.446	27.248	54.154
Maintenance	21.359	34.813	24.413	35.115	56.139
Total	109.201	116.772	109.026	114.596	211.692
Plan	2010-2011	2011-2012	2012-2013	2013-2014	
Road construction	173.872	305.111	238.819	143.931	
Bridge construction	113.188	204.482	181.787	92.396	
Maintenance	42.296	87.154	103.292	118.243	
Total	329.355	596.748	523.899	354.570	

Source: Department of Public Works, Ministry of Construction (MOC)

**Table 7.5 Actual Budget for Road and Bridge Development (billion Kyat)**

Actual	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010
Road construction	35.164	48.430	47.030	51.546	101.615
Bridge construction	52.300	33.297	33.780	27.549	53.703
Maintenance	14.787	23.984	15.712	27.597	26.597
Total	102.252	105.712	96.521	106.692	181.915
Actual	2010-2011	2011-2012	2012-2013	2013-2014	
Road construction	173.872	179.175	303.907	238.701	
Bridge construction	113.188	107.802	205.110	168.077	
Maintenance	42.296	27.740	87.154	103.292	
Total	329.355	314.717	596.171	510.070	

Source: Department of Public Works, Ministry of Construction (MOC)



Source: Department of Public Works, Ministry of Construction (MOC)

**Figure 7.2 Actual Budget for Road and Bridge**

## (2) Private Sector Involvement

The private sector has been an active player in Myanmar's road and bridge sector and is an important source of financing. These businesses collect fees and conduct occasional maintenance work on nearly 400 tollgates on major roads and bridges. These toll fees are obtained through "auctions" (called laylan in the Myanmar language) or Build, Operation and Transfer (BOT) activities and are the main sources of financing for bridge and road operations.

Under the "auction" scheme, PW outsources toll fee collection to a company, but maintains responsibility for the maintenance work, which is financed by PW's budget. In the case of BOT, private companies are responsible for construction (or rehabilitation) of road and/or bridge sections with their own resources, and later recover this investment and generate profit from toll fees.

**Table 7.6 Type and Responsible Body for Operations and Maintenance**

Type of O&M	Responsible body		
	Toll collection	Maintenance	Operation
PW	PW	PW	PW
Auction	Private	PW	PW
BOT	Private	Private	Private

Source: Department of Public Works, Ministry of Construction (MOC)

### 7.1.4 Ongoing Projects and Actions

Myanmar's priority road, bridge and rehabilitation projects were presented by PW at the International Development Cooperation Forum in January 2013 and are summarized below.

#### (1) Priority Road Projects

Priority road projects include seven rehabilitation or new construction projects that share design features, such as a narrower cross section (12 feet) and bituminous treated surfaces. In addition, upgrading of the existing two-lane road network to PW's design standards is a key and urgent

priority. These projects are found mostly in suburban areas. (Table 7.7 and Figure 7.3)

## (2) Priority Bridge Projects

PW has presented a shortlist of priority bridge projects to international donors, seeking their partnership and technical and financial assistance. Some of the proposed bridges require urgent rehabilitation or replacement as they have outlived their designed lifespans and are likely to suffer damage. Many of these planned bridges are expected to improve connectivity between highways, including the high priority Hinthada Bridge, which will be one of the most used crossing points over the Ayeyarwady River. (Table 7.8 and Figure 7.4)

## (3) Priority Bridge Rehabilitation Projects

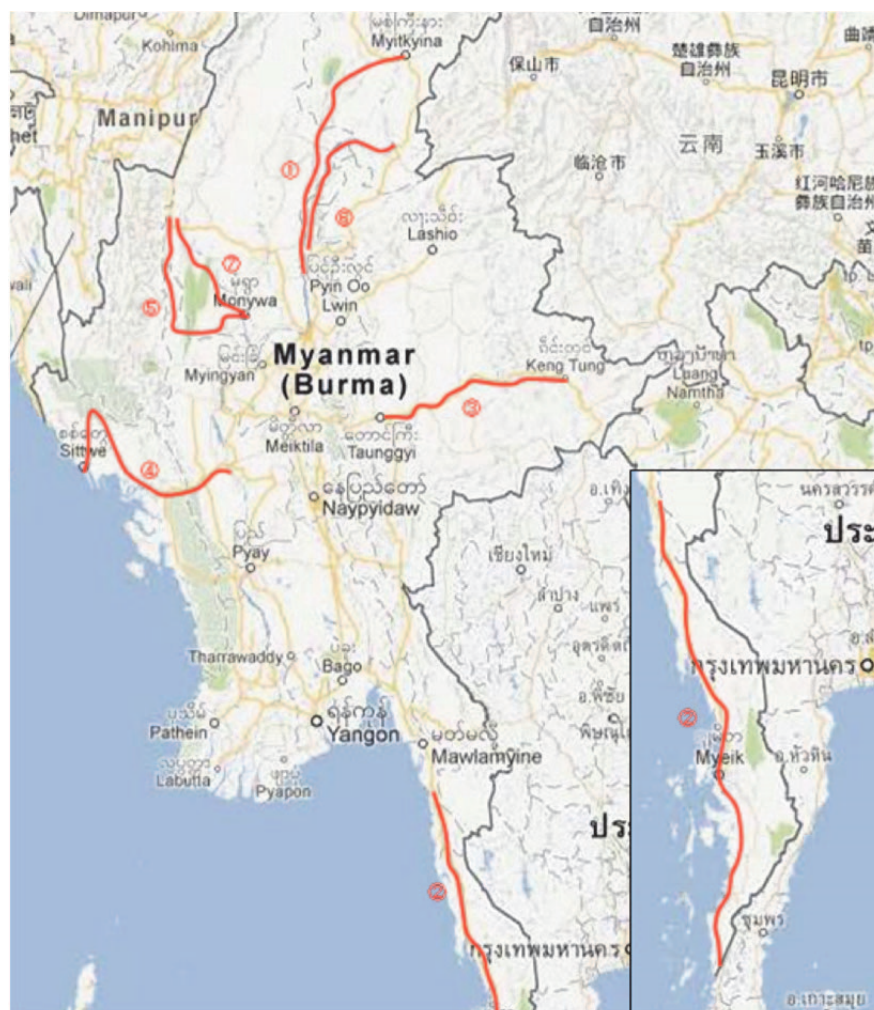
In terms of rehabilitation, a total of 20 existing bridges were prioritized by Myanmar for improvement and require urgent rehabilitation to maintain the reliability of the road network (Table 7.9 and Figure 7.5). These bridges are at a risk of severe damage due to years of accumulated corrosion to piers, abutments, decks and cable. The damage may be attributed, in part, to a lack of engineering skill during construction and corrosion by seawater, which is the main cause of damage in 14 of the 20 bridges located in Rakhine State.

**Table 7.7 Priority Road Projects**

	Road Section	Length (km)	Width of Paved Road (km)			Unpaved Road	Region/State
			12'	22'	24'		
1	Shwebo-Myitkyina	476	406	3	6	61	Kachin / Sagaing
2	Thanphyuzayat-Ye-Dawei- Myeik-Kawtaung	934	559	111	21	243	Mon / Tanintharyi
3	Meiktila-Taunggyi-Loilem- Kengtung	677	439	82	156	..	Mandalay / Shan(S) / Shan(N)
4	Minbu-Ann-Sittwe	477	367	5	6	99	Magway / Rakhine
5	Monywa-Pale-Gangaw- Kalaymyo	311	262	8.5	3	37.5	Sagaing / Magway
6	Mandalay-Thabeikkyin- Tagaung-Bhamo	282	13	13	..	56	Kachin / Sagaing / Mandalay
7	Monywa-Yargyi- Kalewa	186	186				Sagaing

Source: Department of Public Works, Ministry of Construction (MOC)





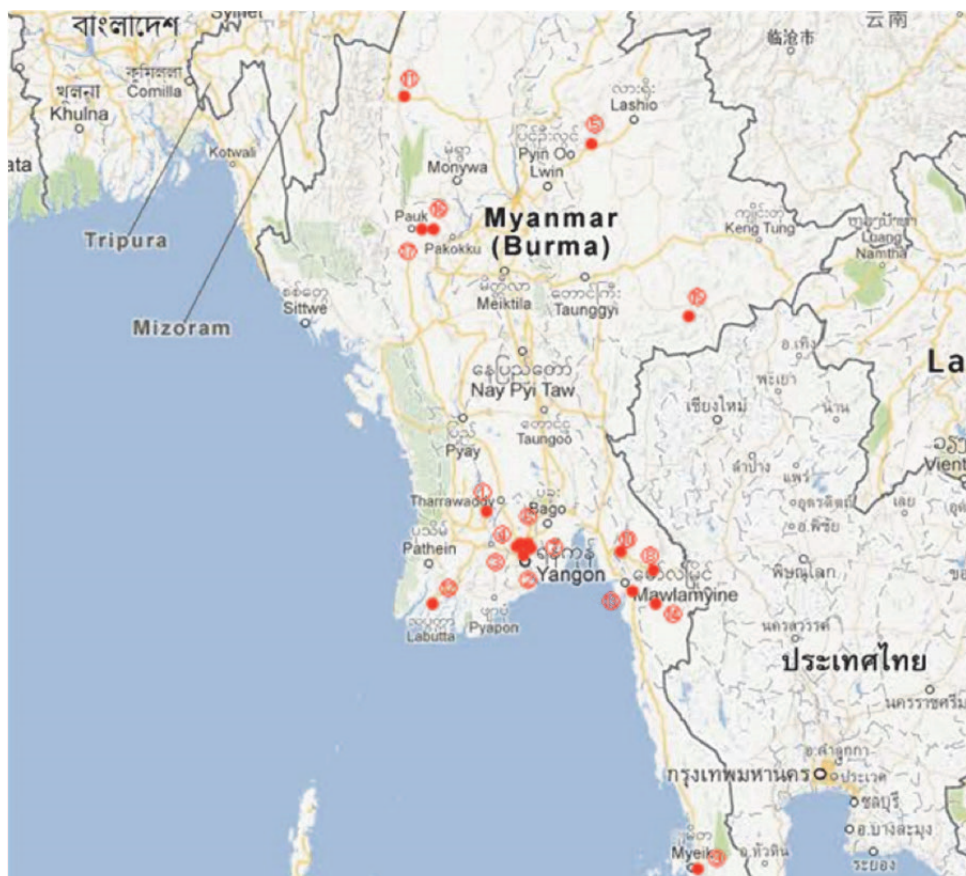
Source: Google Maps, JICA Study Team

**Figure 7.3 Locations of Priority Road Projects**

**Table 7.8 Priority Bridge Projects**

	Name of project	State / Region	Project Type	Length (m)
1	Hinthada Bridge	Ayeyarwady	New construction	3620
2	Dala Bridge	Yangon	New construction	1210
3	Hlaing River Bridge	Yangon	New construction	1200
4	Bayinanung Bridge No.2	Yangon	New construction	1200
5	New Goat twin Viaduct	North Shan	New construction	910
6	Wataya Bridge	Yangon	New construction	500
7	New Thakata Bridge	Yangon	Replacement	190
8	Gyaing (Kawkareik) Bridge	Kayin	Replacement	450
9	Tha Mouk Bridge	Tanintharyi	New construction	350
10	Don Tha Mi Bridge	Mon	Replacement	215
11	Chindwin (Kawlaywa) Bridge	Sagaing	New construction	600
12	Thetkal Thoung Bridge	Ayeyarwady	New construction	760
13	Thanlwin (Chaungsone) Bridge	Mon	New construction	600
14	Chaungnitkwa Bridge	Mon	New construction	360
15	Thanlwin (Tarsotpha) Bridge	Kachin	New construction	305
16	Yaw Chung (Yepyar) Bridge	Magway	Replacement	1000
17	Yaw Chung (Ohn Taw) Bridge	Magway	Replacement	760

Source: Department of Public Works, Ministry of Construction (MOC)



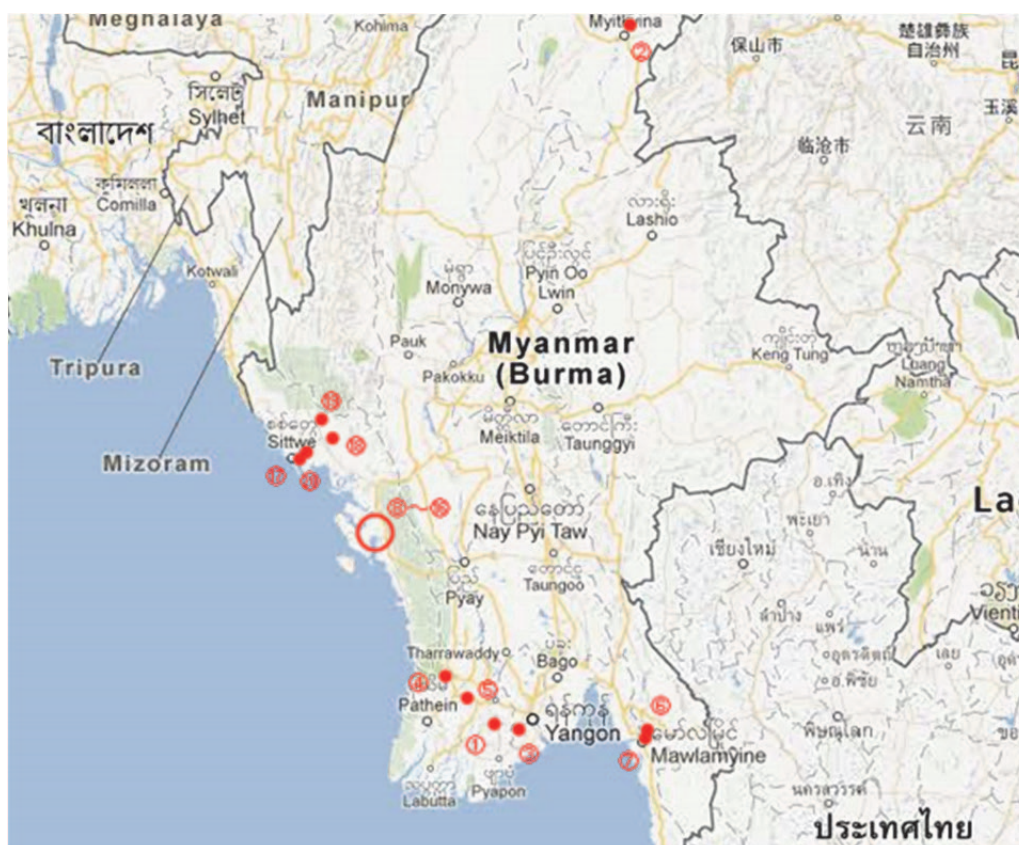
Source: Google Maps, JICA Study Team

**Figure 7.4 Locations of Priority Bridge Projects**

**Table 7.9 Priority Bridge Rehabilitation Projects**

	Bridge name	State/Region	Bridge type	Length (m)
1	Maubin	Ayeyarwady	Steel truss	709
2	Balaminhtin	Kachin	Steel truss	806
3	Twantay	Yangon	steel suspension	1071
4	Pathein	Ayeyarwady	steel suspension	633
5	Myaungmya	Ayeyarwady	Suspension	381
6	Gyaing ( Zarthapyin)	Mon	Suspension	870
7	Atran	Mon	Cable-stayed	426
8	Maei	Rakhine	RC	282
9	Kyaukkyipauk	Rakhine	Steel truss	90
10	Snarepauk	Rakhine	Steel truss	237
11	Lonetawpauk	Rakhine	Steel truss	347
12	Dedokepauk	Rakhine	Steel truss	178
13	Tanthamagyi	Rakhine	Steel truss	166
14	Thanthamachay	Rakhine	Steel truss	180
15	Thazintanpauk	Rakhine	Steel truss	178
16	Wanphite	Rakhine	Steel truss	248
17	Minkyaung	Rakhine	Steel truss	811
18	Yanmaung	Rakhine	Bailey	390
19	Kisspanaddy	Rakhine	Steel truss	754
20	Minchaung	Rakhine	Steel truss	601

Source: Department of Public Works, Ministry of Construction (MOC)



Source: Google Maps, JICA Study Team

**Figure 7.5 Locations of Priority Bridge Rehabilitation Projects**

### **7.1.5 Key Sector Issues**

While PW has made good progress with limited financing to extend the highway network across Myanmar, requirements for future development may exceed the capacity of PW, in a number of ways. For example, international freight forwarders are requiring increasingly higher standards for the transport sector and Myanmar's existing highways are below these design standards and must be upgraded to ensure safe, fast and smooth vehicle operation. In addition, other transport sectors also require accelerated investment in the next decades. PW understands this and is prioritizing improvements in administration, skills and knowledge, even though PW will be faced with budgetary constraints. To overcome this issue, PW should expand their analysis of how the private sector can participate and undertake legal and institutional improvements.

#### **(1) Planning and Coordination**

##### **1) Integrated Long-Term Plan**

The 30-year road development plan, prepared by the PW in 2000, includes six 5-year short-term development plans and informs individual project objectives and priority projects. The 30-year plan's policy, strategy and corresponding projects are limited to the road and bridge sector but must now be integrated with proposed corridor development and adjusted to maximize synergies with other transport sectors.

##### **2) BOT Contract Improvement**

In order to interest private companies in road and bridge construction, operation and management, the existing BOT scheme and the associated contracting models must be reviewed and improved. Current BOT schemes and contracts between PW and private companies are not clear and, at times, include unusual content for a legal document. In addition, some BOT contract documents do not include clear expressions of obligation or responsibility for business risks, others extend concession periods up to 40 years, which is much longer than comparable contracts in other countries.

##### **3) Road and Bridge Inventory Data**

Information about the existing road and bridge system has not been properly recorded in an integrated form or as a comprehensive inventory. Historically, information about road and bridge assets was recorded on a paper basis in the 1990s, and this information has not been digitized or kept current. Accordingly, PW engineers find it difficult and time consuming to understand and analyze the condition of these assets. These data quality challenges also make it difficult for PW to develop a proper investment plan for this infrastructure – road and bridge asset inventories would be improved with a classified road numbering system. However, PW has not yet developed a computer-based asset management system.



## **(2) Infrastructure**

PW places high priority on the improvement and construction of the union highway, as part of the regional (ASEAN) highway network. This commitment should be maintained so the ASEAN highway network can be completed. In addition, regional development can be accelerated with designated development corridors (particularly transport node developments such as Hanthawaddy International Airport, Thilawa SEZ) and should be integrated into union highway and motorway network planning. As well, the Master Plan should address issues related to the existing expressway, such as design and quality issues in comparison with international motorway standards and the expressway's restricted usage (e.g. trucks are not permitted).

## **(3) Safety, Security and Environment**

As traffic volumes increase, the rate of car accidents and fatalities likewise increases – this is a priority issue in Myanmar. On the existing Yangon–Mandalay Expressway, the number of fatal accidents is growing, mainly due to the expressway's poor physical condition and made worse by inadequate horizontal and vertical alignment, poor surface condition, and the shortage of road safety facilities such as guardrails, lighting and service areas.

In the case of union highways, most were not designed to accommodate paved shoulders or sidewalks (footpaths). In addition, highway design standards and supporting technical documents do not require road safety facilities. It is commonplace to see motorcycles and pedestrians sharing union highway carriageways and even expressways. Such behavior comes with a very high risk of injury and should be controlled as much and as soon as possible; these users require dedicated spaces, to ensure their safety.

In addition to the aforementioned weaknesses in infrastructure, right-hand drive vehicles may also pose risks. Myanmar's road network is design for left-hand driven vehicles. Many imported vehicles are of the right-hand variety and are used with no adjustment. For example, the driving lights for left-hand drive vehicles aim slightly leftward, to avoid blinding drivers of oncoming left-hand driven cars. However, this aiming can decrease visibility of drivers of oncoming right-hand drive vehicles.

## **(4) Human Resource, Institution and Regulation**

### **1) The Design Standard**

PW regulates road design standards for union highways and other roads of lower class (e.g. D1 to D6); these standards have been in place since 1969. However, the existing design standard does not cover roads of higher classes, such as motorways (full-access controlled highway), urban expressways (full-access controlled and semi-access controlled), high standard highways suggested by Asian Highway/ASEAN highway plans, or associated facilities such as interchanges. This Report urges PW to revise existing highway design standards urgently.

## **2) Decentralization**

PW has jurisdiction for roads of the D5 and D6 classes, which are mostly found in rural areas. Their work is challenged by the fact that it is quite difficult for a single agency (i.e. PW) to manage these minor roads with a limited staff contingent. This Report recommends that local governments (i.e. regions and states) take responsibility for the construction, operation and maintenance of the D5 and D6 class roads. In highly urbanized areas (e.g. Yangon and Mandalay), the urban expressway systems can be managed by the PW, if the Department is properly resourced. PW may also supervise union highway development, and R&D in the road and bridge sector. As with the D5 and D6 class road, responsibility for urban arterials roads and streets, including urban expressways can be borne by local governments or a specialized urban transport authority.

## **(5) Finance**

A considerable influx of investment is needed in the road and bridge sector over the next two decades, if the Government is to achieve targets for social and economic growth. To achieve the required investment levels, the Government must identify sustainable funding mechanisms. In addition to already-mentioned PPPs, other possibilities include a special purpose tax (or earmarked tax) on fuel, vehicles for private use, and toll fees for exclusive use on highway construction and maintenance.

## 7.2 Road Transport Sector

### 7.2.1 Highway Bus Passenger Transport

#### (1) Bus Transport Network

Myanmar's bus transport business has increased rapidly in recent years. From 2008 to 2011, buses accounted for more than 90% of passenger trips (Table 7.10). Moreover, both the number of registered buses, bus operators and bus passengers has increased sharply, increasing by more than 10 times between 2008 and 2011 (Table 7.11). The increase of registered buses is not distributed evenly across the country, with more than half of registered in Yangon.

**Table 7.10 Number of Passengers by Transport Mode (million trips)**

Mode	2008		2009		2010		2011	
Road	1,632	94%	1,997	95%	1,294	93%	1,233	93%
Rail	75	4%	72	3%	69	5%	67	5%
River	27	2%	27	1%	28	2%	23	2%
Air	1	0%	1	0%	1	0%	1	0%
Total	1,735	100%	2,098	100%	1,391	100%	1,325	100%

Source: TPD/RTAD, MR, IWT, DCA (<http://www.ajtpweb.org/>)

**Table 7.11 Number of Fixed Route Bus Operators**

	2008	2009	2010	2011
Number of fixed route bus operators	1,582	1,129	13,873	16,044

Source: TPD (<http://www.ajtpweb.org/>)

The busiest bus routes are found on five intercity routes, namely: Yangon to/from Nay Pyi Taw (87 buses per day in both directions), Yangon to/from Mandalay (77 buses per day), Yangon to/from Mawlamyine (47 buses per day), Yangon to/from Hpa-an (45 buses per day) and Yangon to/from Hinthada (35 buses per day). Additionally, there are many buses that travel between other major cities.

The intercity buses travel to all capital cities in the 14 states and regions. These also travel to major cross border cities, including Myawaddy (6 buses per day to/from Yangon), Muse (4 buses to/from Yangon/Mandalay) and Tamu (5 buses to/from Yangon/Mandalay).

**Table 7.12 Daily Service Frequency of Intercity Buses by Distance Range**

Distance Range (miles)	Service Frequency per Day (no.)	Composition
0-100	220	18%
100-200	438	36%
200-300	211	17%
300-400	100	8%
400-500	162	13%
500-600	12	1%
600-700	28	2%
N/A	35	3%
Total	1,206	100%

Source: JICA Study Team, based on Myanmar Travels and Tours Directory 2013

## **(2) Registration and Regulation**

### **1) Bus Operation License**

Bus operators must hold an Operation B License, which is provided by the Transport Planning Department, MRT and is valid for only one year. MRT's Road Transport Administration Department inspects and registers these vehicles and bus operator's must submit their license applications at the central government or through one of the 48 region offices.

### **2) Bus Route and Services**

The regional authorities, in consultation with the Bus Control Committee, issue approvals to bus operators for routes and services. There is no restriction regarding trip limits on routes for intercity bus operation.

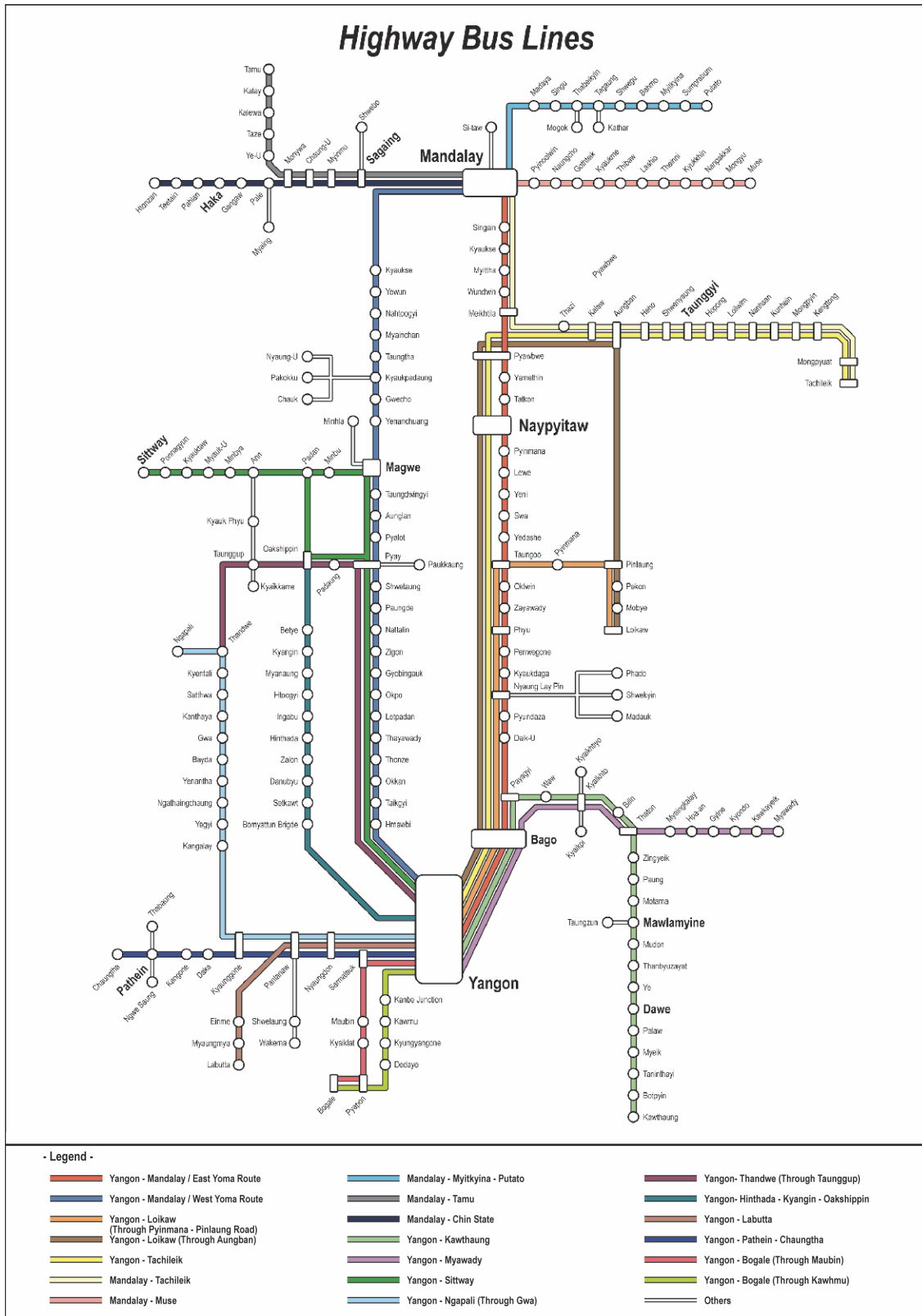
### **3) Bus Fares**

Intercity bus fares are strictly controlled by the central government. The distance-based fare is applied to all intercity bus services, which permits fares of 20 Kyats per mile for non-air conditioned bus and 24 Kyats for air-conditioned bus service. A different distance-based rate is charges for bus service in mountainous areas, which charges 40 Kyats per mile.

### **4) Control of Bus Services**

The intercity bus service is monitored by the Regional Bus Control Committee at the terminals in Yangon, Mandalay and Nay Pyi Taw. While the Committee monitors bus service frequency and inspects the condition of the bus, there is less control on the intercity bus service by the authorities/committees.





Source: JICA Study Team, based on Myanmar Travels and Tours Directory 2013

**Figure 7.6 Myanmar's Inter-city Bus Routes**

## 7.2.2 Highway Truck Transport

The truck transport business in Myanmar shares features with the bus transport business and has expanded rapidly in recent years. Both the number of registered trucks and their transported freight volumes are increasing. As Table 7.13 indicates, the number of trucking companies and domestic forwarders registered in Myanmar has increased 10 times between 2008 and 2011, now numbering more than 7,000 trucking companies and 9,000 forwarders. This increase of trucking companies contributes significantly to traffic congestion in major cities and warrants the construction of a full service and equipped truck terminal.

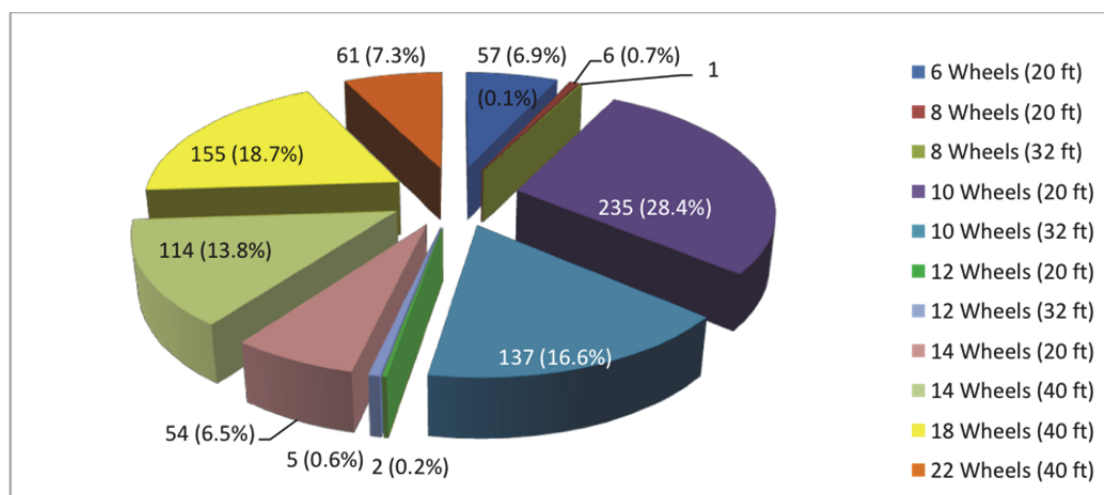
**Table 7.13 Number of Trucking Companies and Domestic Forwarders**

	2008	2009	2010	2011
Number of trucking companies	638	527	6,396	7,112
Number of domestic forwarders	644	716	8,664	9,363

Source: TPD (<http://www.ajtpweb.org/>)

Trucking companies in Myanmar are considered entrepreneurial small-scale enterprises (e.g. one owner/one truck) and those with more than 20 trucks are rare. The service areas for these companies are limited to local distribution centers within states and regions; there is no single trucking company that provides a regular, nationwide service.

The trucking companies registered in Myanmar with the Container Truck Association use various types of vehicles. The most common, used mainly to transport containers between Yangon Port and the industrial zones/warehouses/factories in and around Yangon, are 10-wheeler trucks (45% of the total trucks registered as of 2012), 14-wheeler trucks (20%), and 18-wheeler trucks (19%).



Source: Myanmar Container Trucks Association (2012)





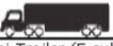







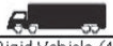











**Figure 7.7 Type of Trucks Registered by the Container Truck Association**

The same 2012 study analyzes the trucking business operating cost structure. The analysis shows that the highest cost item of the transport business is fuel and lubricants, which accounts for 80% of total transport costs in Myanmar. By comparison, fuel accounts for just 50% of Thailand's transport cost for operators. This suggests that there are a number of issues, particular to Myanmar, that contribute to higher than average fleet operating costs, such as poor

road conditions, hilly and mountainous terrain, aging vehicles that require higher maintenance and emissions costs and equipment depreciation, which taken together, all contribute to higher operating costs.

The uneven enforcement of transport regulations is another contributor to operating inefficiencies. Axle load regulations, as shown in Figure 7.8, were strictly enforced from January to March 2011 and then again since November 2011. At the same time, the Government relaxed import license restrictions on new trucks. As a result, operators started purchasing cost-effective 22-wheeler trucks and freight charge decreased significantly.

**Appendix V: The Current Weight Limits in Myanmar 2012**

Vehicle Type	Axle Configuration and Axle Weight			Total Weight (national)	Total Weight (ASEAN)
 Semi-Trailer (6 axles)	 5	 18	 27	50	50.5
 Semi-Trailer (5 axles)	 5	 18	 18	41	46
 Semi-Trailer (4 axles)	 5	 10	 18	33	34
 Single Rigid Vehicle (4 axles)	 5	 5	 18	28	27
 Single Rigid Vehicle (3 axles)	 5	 18		23	23
 Single Rigid Vehicle (2 axles)	 5	 10		15	15-16
<b>Legend</b>  Single Wheel  Double Wheel					

Source: Ksoll and Quarmby (2012)

**Figure 7.8 Current Axle Weight Limits in Myanmar**

### (3) Registration and Regulation

#### 1) Truck Operation License

Like bus operator licenses, the truck operator licenses (i.e. Operating License A) can be obtained at the Transport Planning Department (MRT). The trucking companies and bus operators follow similar procedures regarding licenses, and submit required documents together with negotiated truck routes and services, authorized by the Road Transport and Inland Water Transport Board.

#### 2) Trucking Routes and Services

In Myanmar, the trucking industry associations are a unique organization, called “Gates” which represent a large percentage of the operators. Gates exist in each major city and each Gate specializes in one trunk route. The Gate Manager negotiates rates on behalf of the operators. Generally, the operations of Gates, as well as the trucking companies within these Gates, function well below international standards and are subject to only informal agreement on how they operate.

### **3) Trucking Fares**

Trucking freight charges were once controlled by the regional authority and the standard distance-based charge was determined by the central government. However, authorities have not relaxed freight charges and companies now set these charges independent of the regulator.

### **4) Control of Trucking Services**

This Report finds that there is no authority or committee that monitors and controls the service of the trucking companies.

### **(4) Institutional Arrangement**

Most of Myanmar's transport sector is managed by three ministries and three city development committees. These include: (i) Ministry of Transport (MOT), (ii) Ministry of Rail Transportation (MRT), (iii) Ministry of Construction (MOC), and the Yangon, Mandalay and Nay Pyi Taw City Development Committees. The MRT and the MOC have a particularly important role in the road transport sector. The MRT and City Development Committees play vital roles in road transport sector as a policy maker and regulator, developing long-term policy and guidelines and regulating the road transport business and fares. The MOC is responsible for the developing policies and plans for development of roads, delivering technical training and conducting research for road development and maintenance.

## **7.2.3 Container Truck Transport**

### **(1) Container Truck Handling**

The Myanmar Container Trucks Association (MCTA) has approximately 827 container truck members in 2013, owned by 44 national companies. These container truck companies transport about 350 containers per day on average. Assuming one container truck handles 1.3 TEUs (30% for a 40 ft container or 70% for a 20 ft container), the maximum container carrying capacity by the existing trucks (MCTA) is 392,000 TEUs (1.3 TEUs x 827 vehicles x 365 days) per year, which is almost equal to the containers currently handled at the Yangon ports (about 380 thousand TEU per year).

**Table 7.14 Containers handled by the Container Trucks Association**

	Direction	For Export	Import from overseas	Total	Daily Average	40 feet container	20 feet container
November 2012	Within Yangon Downtown	2,581	5,489	8,070	269	80	189
	From Yangon to Nay Pyi Taw	-	103	103	3	1	2
	From Yangon to Mandalay	-	9	9	0	-	0
	Sub-total	2,581	5,601	8,182	273	81	192
December 2012	Within Yangon Downtown	3,041	6,759	9,800	316	94	222
	From Yangon to Nay Pyi Taw	-	79	79	3	1	2
	From Yangon to Mandalay	-	2	2	0	-	0
	From Yangon to Hlaingtet	-	1	1	0	-	0
	Sub-total	3,041	6,841	9,882	319	95	224
January 2013	Within Yangon Downtown	3,589	7,700	11,289	364	109	255
	From Yangon to Nay Pyi Taw	-	89	89	3	1	2
	From Yangon to Mandalay	-	20	20	1	-	1
	From Yangon to Pyin-oo-lwin	-	2	2	0	-	0
	Sub-total	3,589	7,811	11,400	368	110	258
February 2013	Within Yangon Downtown	3,098	6,651	9,749	348	104	244
	From Yangon to Nay Pyi Taw	-	54	54	2	-	2
	From Yangon to Mandalay	-	13	13	0	-	0
	Sub-total	3,098	6,718	9,816	351	104	246

Note: Hlaingtet is between Meiktila and Kalaw

Pyinoolwin is between Mandalay and Lasho

Unit: The number of containers included 20 and 40 ft.

Empty containers are not included in the figures.

Yangon - Mandalay 40 ft : 20 ft ratio = 30 : 70

Other movement 40 ft : 20 ft ratio = 40 : 60

Source: Container Truck Association, Myanmar

## (2) Diversity of Transportation

Many countries use the multimodal transport system, which includes modal transportation like railways, ships and trucks. This transportation system is adaptable and operators can determine optimal mixes of modes to increase efficiency. The system is flexible and operators are able to decrease the transportation time and cost. Some logistics companies in other countries believe multi-modal transportation may reduce CO<sub>2</sub> emissions, but improved efficiencies with this system require particular equipment to load and offload containers. In Myanmar, mechanical loading and unloading equipment is in short supply at truck terminals. As a result, goods must be transferred with manual labour.

### 7.2.4 Ongoing Projects and Actions

#### (1) Yangon City Public Transport Authority

Myanmar formed Yangon City Public Transport Authority in January 2013, involving 10 representatives from the transport sector agencies. The mission of the Authority is to provide convenient, smooth and efficient transport services to the people in Yangon. The Authority is responsible for coordinating the work of various transport-related agencies in the management of public transport modes in Yangon, and to reduce traffic congestion by drafting a public transport master plan, enforcing traffic measures, developing transport infrastructure and setting up organizations in management and funds with Yangon City Development Committee.

## (2) Tax Reduction

The Myanmar government is undertaking significant tax reforms for local transport operators. One of the outcomes of these reforms is the lowering of import tax for trucks, which was reduced from 30% to 5% (actual tax is 13%, including sales tax and registration tax). As well, the industry noted an increase in the number of registered transport vehicles in recent years. This lowering of duties on truck imports provided local transport operators with incentives to upgrade their trucks to international standards.

## (3) Brunei Action Plan

The Brunei Action Plan, which describes a list of priority actions to accelerate ASEAN Connectivity, was negotiated during an ASEAN Transport Ministries Meeting in 2010. This Action Plan includes clear targets, priority activities and timelines for physical infrastructure projects of all modes of transport and institutional development proposals for the transport sector. The following table summarizes actions for transport facilitation listed in the Brunei Action Plan.

Among these strategies and actions, enhancement of the transport facilitation and development of logistics industry are key policy directions, which Myanmar is adopting.

**Table 7.15 List of Actions Proposed for Transport Facilitation in Brunei Action Plan**

Strategies	Actions
1. Establish integrated and seamless multimodal transport system to make ASEAN the transport hub in the region	(1) Fully operationalize three ASEAN Framework Agreements on transport facilitation. (2) Implement initiatives to facilitate inter-state passenger land transportation. (3) Conduct studies on potential multimodal transport corridors to empower parts of ASEAN to function as land bridges in global supply routes. (4) Complete the East West Economic Corridor. (5) Promote the Mekong India Economic Corridor as a land bridge. (6) Comparative study between EU and ASEAN region for development of efficient transport system by 2013 and its adoption. (7) Promote the usage of transport terms and practices related to multimodal transport, including INCOTERMS (International Commercial Terms).
2. Enhance the competitiveness of ASEAN logistics industry	(8) Develop and upgrade skills and build capacity for MOTs (multimodal transport operators) and LSPs (logistics service providers) through joint training and workshops. (9) Establish national/regional centers of training centers, national skill certification systems and common core curriculum. (10) Identify and develop the ASEAN logistics network and formulate the necessary infrastructure development requirements.
3. Establish safe and secure inter-state transport system	(11) Share and apply appropriate technologies of information systems for promotion of supply chain security initiatives.
4. Develop environmental-friendly logistics	(12) Develop green logistics through increase in logistics management efficiency and utilization of environmentally -friendly transport modes, fuel, fleets, supporting logistics facilities.

Source: MLIT (2012) ASEAN No UNYUJIO

## **7.2.5 Key Sector Issues**

### **(1) Planning and Coordination**

#### **1) Transport Service Provider Development**

Recently, the number of road transport service providers has increased, year by year and despite competition among local operators and despite being regulated by the Government in terms of fares and services. The trend towards ASEAN and GMS regional integration will force the growing number of local transport providers into intense competition with the international market to support operations in an increasingly competitive environment. Transport services and infrastructure must be upgraded to achieve operational cost efficiencies and build capacity among the operators as they work to meet international standards in business and service.

### **(2) Infrastructure**

#### **1) Lack of transport infrastructure and management/facility of the terminal:**

Urban transport issues, especially traffic congestion, seriously affect the road transport business. The traffic congestion in Yangon contributes to increases in the travel/lead times and transportation costs. While the Myanmar government is working hard to reduce traffic congestion, increasing demand has always outstripped the capacity of the traffic infrastructure.

Inadequate infrastructure is also problematic in the bus and truck terminals of Myanmar, which are poorly equipped. There is no cargo handling equipment to load or offload goods, instead goods are transferred with manual labor. This contributes to cargo damage, increased commodity cost as well as poor and unsafe working conditions. In addition, public truck terminals and access roads are always overcrowded during peak hours.

#### **2) Diversify in transport needs:**

Despite Myanmar using a multimodal transport system, it is not easily visible. There is no equipment for cargo/container handling, as such the railway and road networks are not integrated.

Moreover, logistics companies require a variety of transportation for their services, such as containerization and cold chain supply. These issues will soon become serious for Myanmar, especially when the ASEAN member countries are regionally integrated.

### **(3) Safety, Security and the Environment**

#### **1) Poor traffic safety and environmental preservation practices:**

Traffic safety and environmental preservation are priority issues among the transport regulators and operators in developed countries. Some countries provide regulation/guidelines and subsidies to encourage safe and eco-friendly transport services. In Myanmar, traffic accidents are an increasingly worrying issue, though transport users appear ready to pay an additional cost for safer transportation.

### **(4) Human Resources, Institutions and Regulations**

#### **1) Fragmented institutional structure:**

A number of Ministries and their executing agencies, the MOC, MOPBANRDA, and MOD, are mandated to develop and maintain the road transport infrastructure and services. Each Ministry sets up transportation committees to address overlap and lack of coordination between the concerned agencies.

**2) Lack of management/planning tool:**

Data required for planning is lacking in Myanmar (e.g. the last Population Census was conducted in 1989; no updated data is available since then) and this hinders forward planning.

**3) Absence policy/strategy:**

Though the MOT has adopted a long-term national transport policy and strategies and has committed itself to improving the transport network and service to international standards, Myanmar has no long-term road transport policy that includes bus or truck transport conforming to ASEAN transport agreements.

**4) Central control on transport business:**

The road transport business is controlled by the central government. For instance, the government and control committee determine the unit fare and the operators are allowed to charge a fixed rate by travel distance. While the operator licenses can be obtained, this is possible only when the control committee approves, though the process and conditions are not clearly stated.

**(5) Finance**

**1) Severe budget constraints:**

While the government finances the construction and management of the road side terminals, additional budget constraints mean that these terminals have not been upgraded or expanded, even though transport needs are diverse and demands are growing.

**2) Limited subsidy program:**

The Myanmar government is making significant efforts to encourage local transport operators to upgrade services to international standards. For instance, the aforementioned lowering of import tax for trucks and the regulation of the axle loads are examples. These policy reforms act as incentives for transport operators to upgrade truck equipment (e.g. especially 22 wheeled trucks) to reduce the transport costs.



## 7.3 Railway Sector

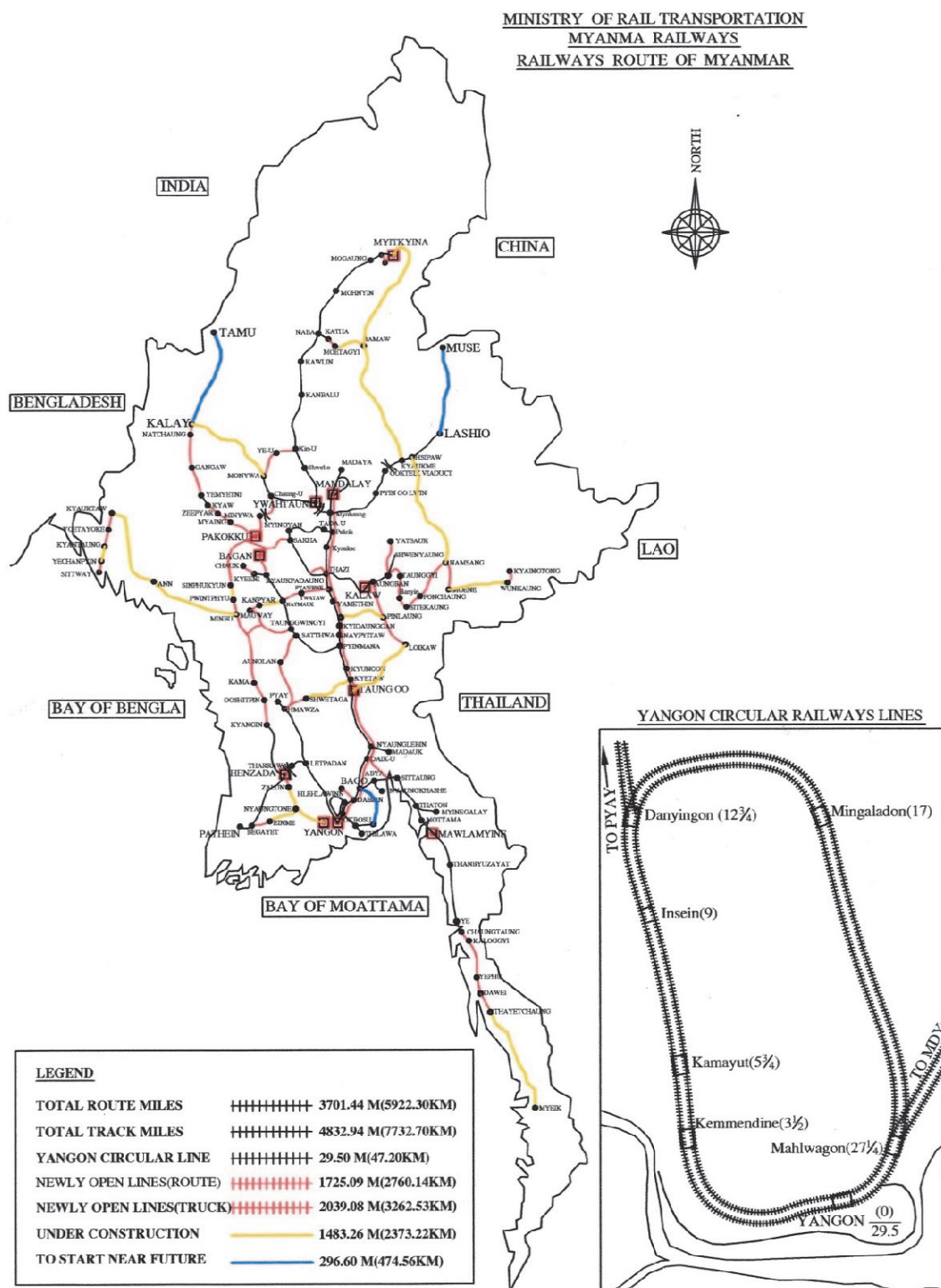
### 7.3.1 Railway Network

Myanmar has a rail network that spans the country with a total distance of 5,933.9 km, including 5,299.9 km of single-track sections and 704.76 km of double-track. Since 1988, Myanma Railways (MR) has expanded the railway network and has plans to add an additional 2,806.11 km and construct a new line of 477.23 km. The rail network includes a variety of facilities and infrastructure including 939 stations, 11,774 bridges, and 12 tunnels. The network operates 427 trains per day, with 200 trains on the Yangon circular and neighboring lines and 29 freight trains. In 2012, Myanmar's inventory of rail equipment included 35 steam locomotives, 405 diesel locomotives, 235 diesel railcars, 1,282 passenger cars, and 3,210 freight wagons. Among the 405 diesel locomotives, 268 locomotives are diesel electric locomotives (DEL) and 137 locomotives are diesel hydraulic locomotives (DHL). During the past five years, the number of diesel locomotives has increased by 18% (62 units). These additional locomotives were purchased with assistance from by China, India and other countries.

**Table 7.16 The Number of Rolling Stocks by Type**

Type	FY2008	FY2009	FY2010	FY2011	FY2012
Steam Locomotive	37	37	37	37	35
Diesel Locomotive	343	352	387	394	405
(a) Diesel Electric	243	247	252	257	268
(b) Diesel Hydraulic	100	105	135	137	137
Diesel Car	159	182	182	189	235
Passenger Car	1,209	1,246	1,238	1,277	1,282
Freight Wagon	3,252	3,427	3,331	3,236	3,210

Source: The Facts about Myanma Railways 2012-2013



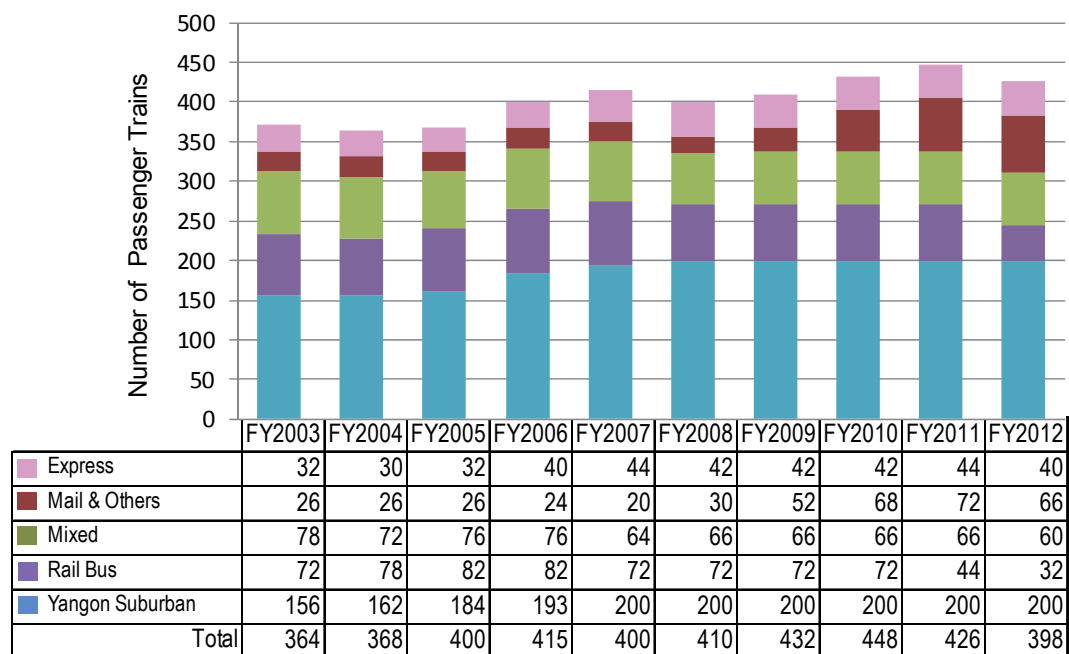
Source: MR

Figure 7.9 Existing Railway Network

### 7.3.1 Rail Passenger Transport Services

#### (1) Passenger Train Operation

Figure 7.10 indicates the number of passenger trains in the 9-year period between 2003 and 2012. Apart from the normal significant traffic along the Yangon circular and suburban lines, there were 198 trains operating per day in 2012.



Source: Facts about Myanmar Railways 2011-2012

**Figure 7.10 Number of Passenger Trains**

Table 7.17 indicates the travel time and the commercial speed of passenger express trains along the four main lines. Because there are so few trains, even express trains must make many stops and operate at night. The average commercial speed on the Yangon – Mandalay railway line is approximately 37.6 km/h.

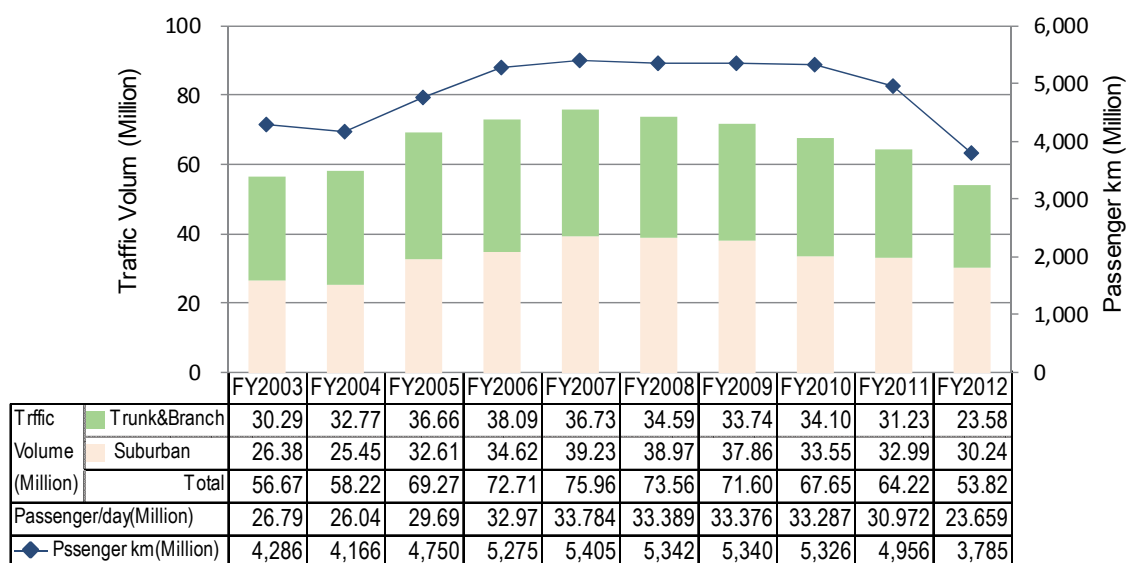
**Table 7.17 Traveling Time of Passenger Express Trains on Main Lines**

Line	Distance (km)	Train No.	Section		Traveling Time	Commercial speed
			From	To		
Yangon - Mandalay	620.3	11 Up	Yangon	Mandalay	16:30	37.6 km/h
Yangon - Pyay	259.0	71Up	Yangon	Pyay	8:30	30.5km/h
Yangon - Mawlamyine	293.2	89Dn	Yangon	Mawlamyine	9:35	30.6km/h
Manadalay- Myitkyina	551.5	55Up	Manadalay	Myitkyina	21:45	25.4km/h

Source: JICA Study team

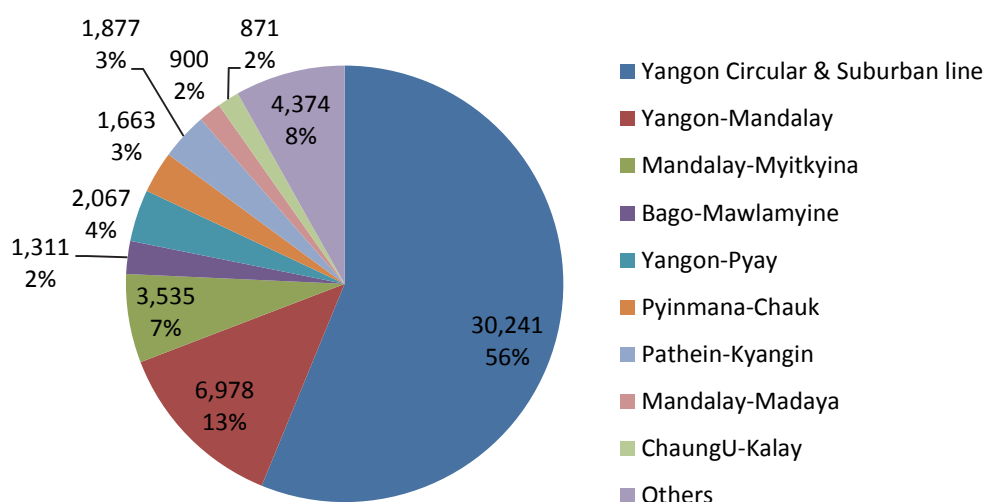
#### (2) Passenger Volume

Figure 7.11 shows the number of passengers during the 9-year period, between 2003 and 2012. Recently, the total number of passengers has decreased dramatically, with total railway passenger count reaching 53.28 million per year in 2012. Included in this total are the top three lines with Yangon circular (56%) and suburban lines of Yangon–Mandalay (13%) and Mandalay–Myitkyina (7%).



Source: Facts about Myanmar Railways 2011-2012

Figure 7.11 Passenger Volume



Unit: Thousand Passengers / Year

Source: Facts about Myanmar Railways 2012

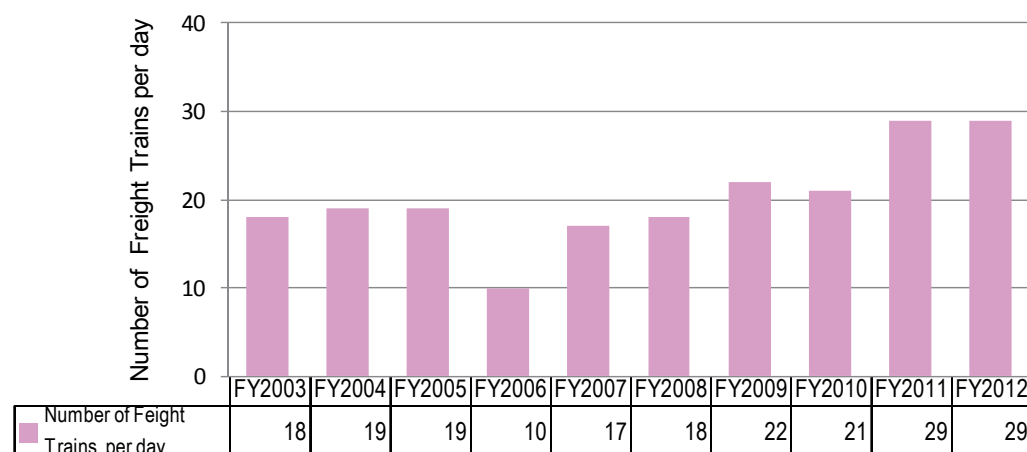
Figure 7.12 Passenger Volume by Railway Line

### 7.3.2 Rail Freight Transport Services

In terms of rail freight transport, MR provides two kinds of service, the freight train system and the parcel transportation system (e.g. goods wagons coupled to a passenger train).

#### (1) Freight Train Operation

Figure 7.13 shows the number of freight trains per day from 2003 to 2012. As of 2012, 29 freight trains per day were being operated. Among these, 16 trains (55.2%) were operated on the Yangon-Mandalay line and 6 trains (20.7%) were operated on the Mandalay-Myitkyina line.



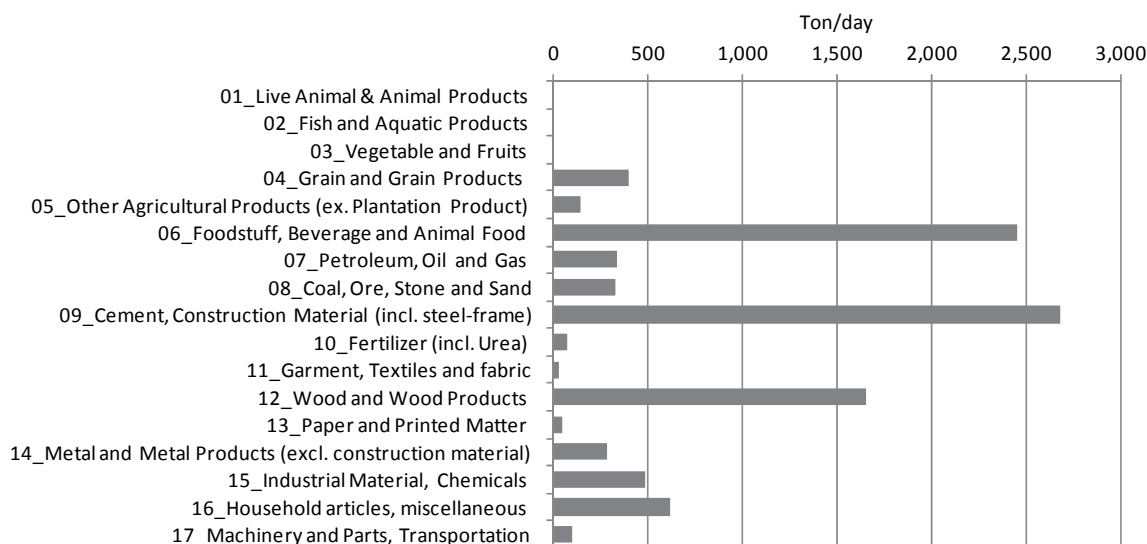
Source: Facts about Myanmar Railways 2003-2013

**Figure 7.13 Numbers of Freight Train**

## (2) Freight Volume

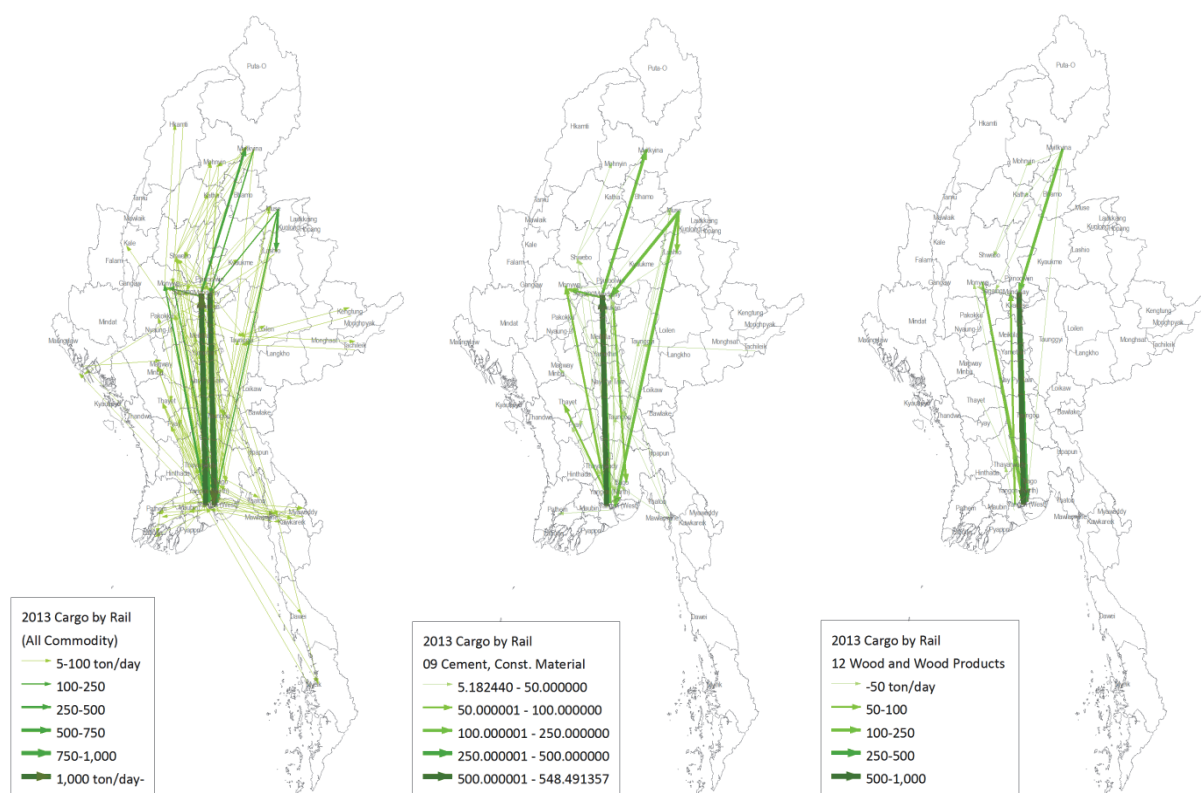
Based on a truck driver interview survey at railway stations and secondary data analysis, the MYT-Plan estimates current cargo flow transported by rail at approximately 9,600 tons per day, which consists of construction materials such as cement (28%), foodstuff and beverage (25%) and wood/wood product (17%), as shown in Figure 7.14.

Figure 7.15 shows the estimated current cargo flow of major commodities transported by rail. The Yangon-Mandalay-Myitkyina line is the backbone of Myanmar's freight transport system.



Source: JICA Study Team

**Figure 7.14 Estimated Current Cargo Volume by Railway**



Source: JICA Study Team

Figure 7.15 Desired Line of Current Railway Cargo

### 7.3.3 Financial Performance and Sector Funding

#### (1) Revenue

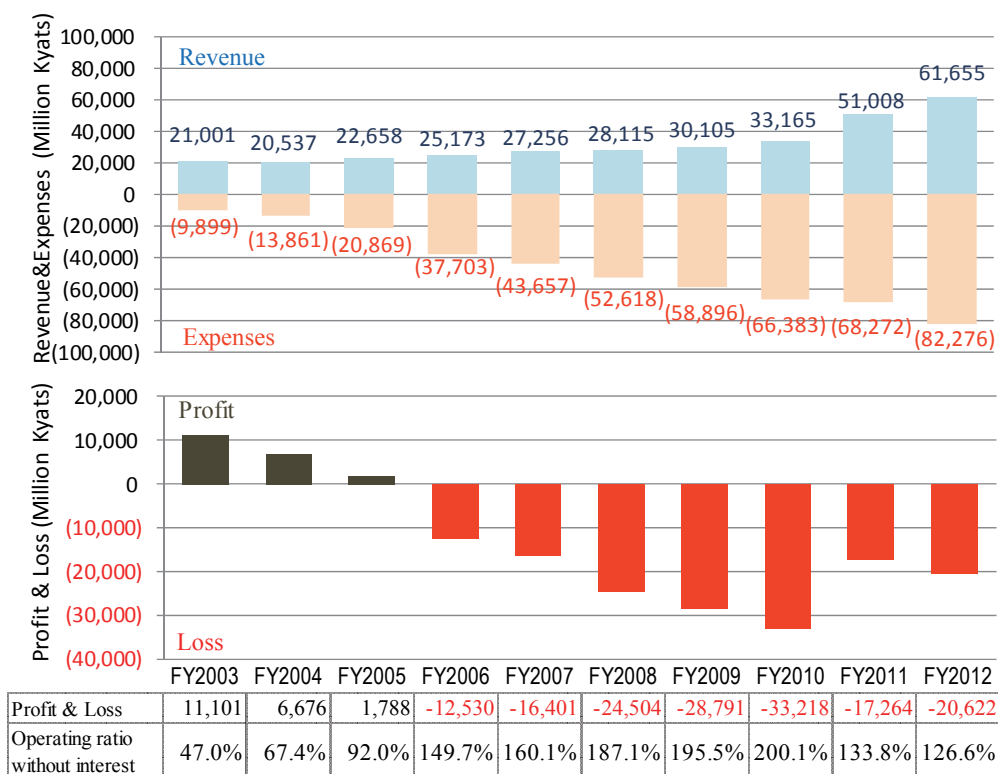
MR had total revenues in 2012 of 61,655 million kyat, which had grown in the two-year period 2011-2012. During this period, fare rates for passengers and cargo were raised. The share of passenger revenue and freight revenue against total revenue was 59% and 32%, respectively. The remaining 9% includes other revenue, such as leasing business of fiber optic cables on the Yangon-Mandalay line.

#### (2) Expenses

MR's expenses in 2012 totaled 82,276 million kyat, influenced by a particularly strong growth period between 2003 and 2012. During that time, MR staff salaries increasing sharply and in 2007, the price of light oil increased by 19 times compared to prices from 2005. These costs are the most significant expenditures for MR, with fuel cost capturing 40% of MR expenses and employees costing 31%. Furthermore, the foreign exchange rate had risen sharply in 2012, and the cost of equipment and foreign spare parts also increased, as much as 150 times in many cases.

### (3) Profit and Loss

Figure 7.16 summarizes the MR's profits and losses between 2003 and 2012. Prior to 2005, MR had been profitable, though since then the Railway's revenues have fallen below expenditures, leaving the MR in deficit by approximately 20,622 million kyats in 2012. The Myanmar government annually provides funds to cover MR losses, funding operating expenses, investment costs and funds reimbursement.

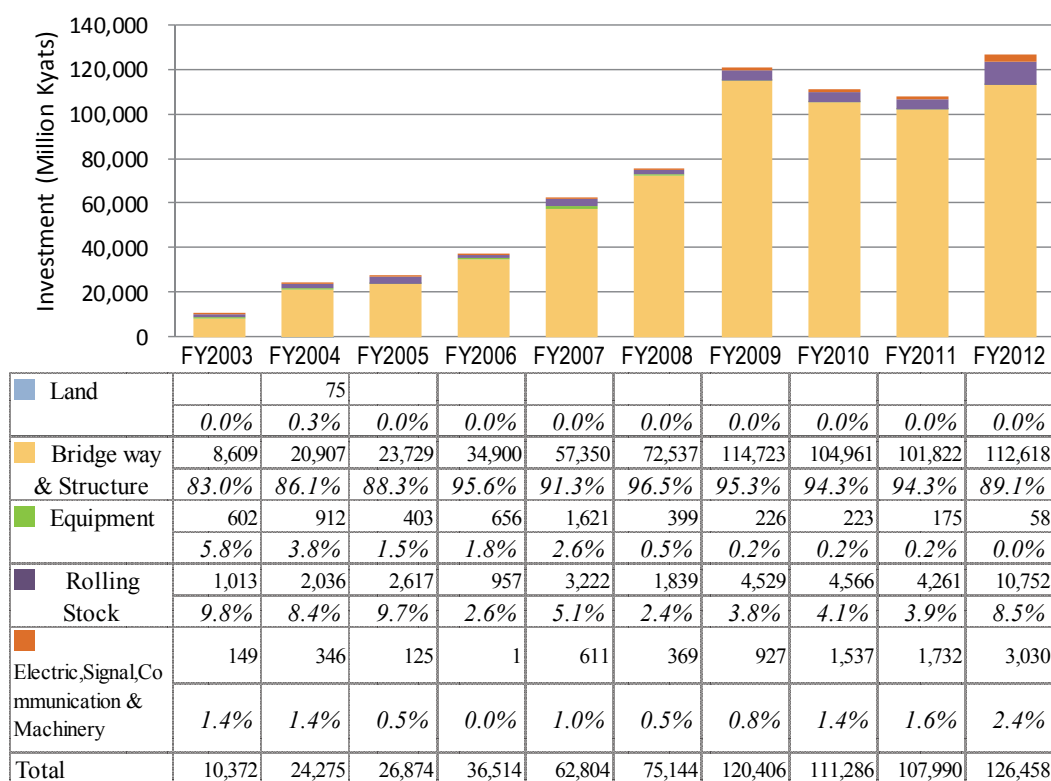


Source: JICA Study Team, Facts about Myanmar Railways from 2003-2012

**Figure 7.16 Profit and Loss for MR**

### (4) Investment

Figure 7.17 shows MR's capital investment between 2003 and 2012 and highlights the significant increased investment and expansion of the rail network. Since FY 2007, annual investment has been more than double total revenues. During the last decade, 92.9% of MR's investments have been made in tracks, bridges and other structures while 6.4% has been invested in rolling stock, electrics, signals, communication and machinery.



Source: JICA Study Team, Facts about Myanmar Railways from 2003-2012

Figure 7.17 Capital Investment of MR

### 7.3.4 On-going Projects and Actions

#### (1) Under Construction Railway Line Projects

While MR has expanded the railway network and has 13 lines under construction, many of these projects are currently suspended, due to recent changes of the development policy as well as the budget constraints.

Table 7.18 Railway Lines under construction

No.	Route	Mile	Remarks
1	Kyangin-Pakokku	22.73	Ongoing / Will be completed
2	Katha-Bhamo	78.19	Ongoing / Will be completed
3	Moene-Kyaingtong	220.4	Partially completed / Suspended
4	Pyawbwe-Nutmuk-Magway	64.91	Ongoing / Will be completed
5	Dawei-Myeik	113.19	Partially completed / Suspended
6	Minbu-Ann-Sittway	203	Ongoing / Will be completed
7	Patheingyi-Einme-Nyaung-U-Yangon	75.76	Ongoing / Will be completed
8	Pyaw-Taungtha-Naypyitaw	100	Partially completed / Suspended
9	Hinthata-Zalun-Danuphyu-Setkauk	31.75	Ongoing/Will be completed
10	Naypyitaw-Sinthe-Pinlong	120	Partially completed/ Suspended
11	Myittha-Bamaw-Moemmyeik-Kyaukse-Thipaw-Lechar-Namsan	474.5	Suspended
12	Monywa-Kani-Miinking-Kalaywa-Kalay	125	Suspended
13	Taungtha-Yado-Loikaw	150	Suspended

Source: Myanmar Railway



## **(2) Future Development Plan of Myanmar Railways**

During the Myanmar Development Cooperation Forum that took place on January 19 and 20, 2013, MRT proposed ten railway projects to rehabilitate and modernize the major trunk lines, which are the backbones of the north-south routes along the Myanmar and Yangon circular lines.

The proposed the ten railway projects include:

1. Yangon-Mandalay Track Rehabilitation and Modernization
2. Yangon City Urban Rail Line Modernization and Rehabilitation
3. Refurbishment of Locomotives (Repower of Locomotives)
4. Upgrading of a Railway Technical Training Center
5. A National Railway Strategic Plan
6. Mandalay-Myitkyina track and signaling Upgrading
7. Track upgrading Projects Bago-Dawei
8. Yangon- Pyay track upgrading Projects
9. Tamu-Kalay-Segy-Monywa-Mandalay Rail connection line Project
10. Purchasing new passenger Coaches

## **(3) Railway links to neighboring countries**

### **1) Myanmar and Thailand Border**

In 2011, when officials from Myanmar and Thailand met in Nay Pyi Taw for the 13th Special Working Group Meeting for the Singapore-Kunming Rail Link Project, both countries agreed to suspend alignment of the Singapore-Kunming railway link. The following year, at the 14th Special Working Group Meeting, held in Vientiane, Laos PDR, representatives from Thailand proposed that a new rail line be constructed between Dawei and Kanchanaburi, replacing the Three Pagoda Pass–Namtok old line. In Dawei (Myanmar), there is an ongoing special economic zone project and the companies involved conducted a feasibility study to construct a Dawei–Kanchanaburi rail line. At the 22nd ASEAN Land Transport Working Group Meeting, Myanmar reported that increased freight and passenger transport between Dawei and Bangkok should be expected during the implementation stage for the Dawei–Kanchanaburi project.

### **2) Myanmar and China Border**

In April 2011, the Muse-Kyaukphyu rail transportation system project was launched through a Memorandum of Understanding (MoU) signed between China Railway Engineering Corporation (CREC) and Myanmar's Ministry of Rail Transportation. In May 2011, a supplementary MoU was signed in Beijing that created a Joint Coordinating Committee that conducted field surveys of the Muse–Kyaukphyu rail line. CREC submitted a feasibility study report for this project in April 2012 though the final alignment of the Muse-Kyaukphyu line is still in development and in July 2013, CREC was given a one-year extension to complete this work.

### **3) Myanmar and India Border**

Myanmar and India had planned a 135km railway line to run from Kalay (existing terminal

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station) to Tamu (border town). A survey team from Rail India Technical and Economics Services (RITES) completed a feasibility study to link these lines in 2004. However, the construction plans for this line were suspended in 2013.

#### **(4) Dry Port Development Projects**

Myanmar has been party to an intergovernmental agreement on dry ports led by UNESCAP since 2010. Since then, Myanmar has proposed 8 possible dry port locations (Mandalay, Tamu, Muse, Mawlamyine, Bago, Monywa, Yangon, Pyay) and presented these at the Forum of Asian Ministers of Transport, held in Bangkok on 7th November 2013.

#### **(5) Project on Improvement of Service and Safety of Railway in Myanmar by JICA**

In October 2012, Myanmar requested Technical Assistance (TA) from the Government of Japan to support improvements to Myanmar Railway's service and safety. Soon after, JICA dispatched a team to investigate existing service and safety conditions at MR; a scope of work for this TA was agreed to in March 2013. This TA started in the middle of 2013 and will be complete in 2015. Two major outputs are expected through this TA:

Output 1: enhanced service and safety in administration and maintenance processes and an improvement plan, informed by analysis of accidents.

Output 2: transfer of track maintenance technology to improve service and safety levels, through implementation of the pilot project.

### **7.3.5 Key Sector Issues**

#### **(1) Planning and Coordination**

Since 1988, MR has expanded the railway network, based on a Government policy that calls for the railway to support the political, social and economic development of all regions. However, while the railway network contributes substantially to regional development in Myanmar, the MR was forced to suspend operations and construction on some lines due to decreasing demand for rail services in other areas. Myanmar has an opportunity to make better use of the railway network and this Report finds that the Government should issue a comprehensive transportation plan and coordinate its development with related agencies. One aspect of this plan should include integration with the feeder service as an integrated and smooth transit and feeder service will stimulate demand for railway services.

This transportation plan should also include sophisticated management and investment plans and a detailed database system for MR. This would include an analysis of existing traffic demand and statistical information such as daily passenger and cargo volumes by origin and destination. Furthermore, to evaluate risk and maintenance costs in future, inventory data systems for infrastructure will be required.

#### **(2) Infrastructure**

MR owns a well-developed railway network. However, most of its infrastructure (e.g. track, embankments, signals, bridges, tunnels, stations) as well as locomotives are seriously damaged and are in urgent need of rehabilitation. Furthermore, the containerization and service levels of competing transportation modes and existing railway infrastructure should be modernized. For example, the maximum authorized axle load is 12.5 tons on existing main lines in Myanmar. However, the maximum authorized axle load for the Trans Asia Railway (TAR) network is a minimum 15 tons for meter gauge track and 20 tons for standard or broad gauge track. Also,

high-feet containers of 8' 6" or more cannot pass under the some bridges. If the railway service levels are upgraded to meet international standards and the railway capacity is enhanced, traffic demand should grow as a result.

### **(3) Safety, Security and the Environment**

Railway infrastructure in Myanmar is heavily damaged due to weak maintenance regimes. In addition, Myanmar's climate, which includes heavy rain and high humidity, accelerates the deterioration of embankments and bridges. Existing signaling systems in MR rely on service peoples' attentiveness to railway performance. However, due to the railway's dependency on manual labor, the railway finds it difficult to manage high-speed train operations and the risk for human error is high. Furthermore, maintaining a standard maintenance regime and inventory of spare parts is made more difficult because there are many different types of rolling stock, due to the fact that much of this was donated from foreign countries, over a long period of time.

While MR's railway is in need of repair, the Railway plans to begin high-speed train operations in near future. This will require a social impact assessment along the railway line.

### **(4) Human Resources and Regulations**

Under Myanmar's Railways Act of 1890, MR carries out the inspection of railways (Railway Act No. 4, 5) and the approval of new railway lines (Railway Act No. 18, 19). MR also has the responsibility to monitor railway technical standards, which include mainly national regulations. The rail sector is organized to ensure that construction and operation of new railway lines is smooth and that the sector is able to expand the railway network rapidly. However, MR has reduced the number of employees while their jurisdiction has increased. This makes it difficult to maintain the railway systems. Furthermore, before a high-speed train is installed, MR will have to deliver more technical training for high-speed operation. This also places Myanmar's rail system in a hazardous position because the railway is less likely to adhere to administration market principles and this monopoly can hinder private sector participation. This is further complicated by MR's dominant position in the sector.

### **(5) Finance**

MR's revenues have surpassed expenditures after 2005 and the deficit in 2012 was approximately 20,622 million kyats. The Myanmar government subsidizes against these losses every year. To increase its revenues, MR must improve its service levels and strengthen its profitable new businesses like station real estate and goods forwarding operations.

## **7.4 Inland Waterway Sector**

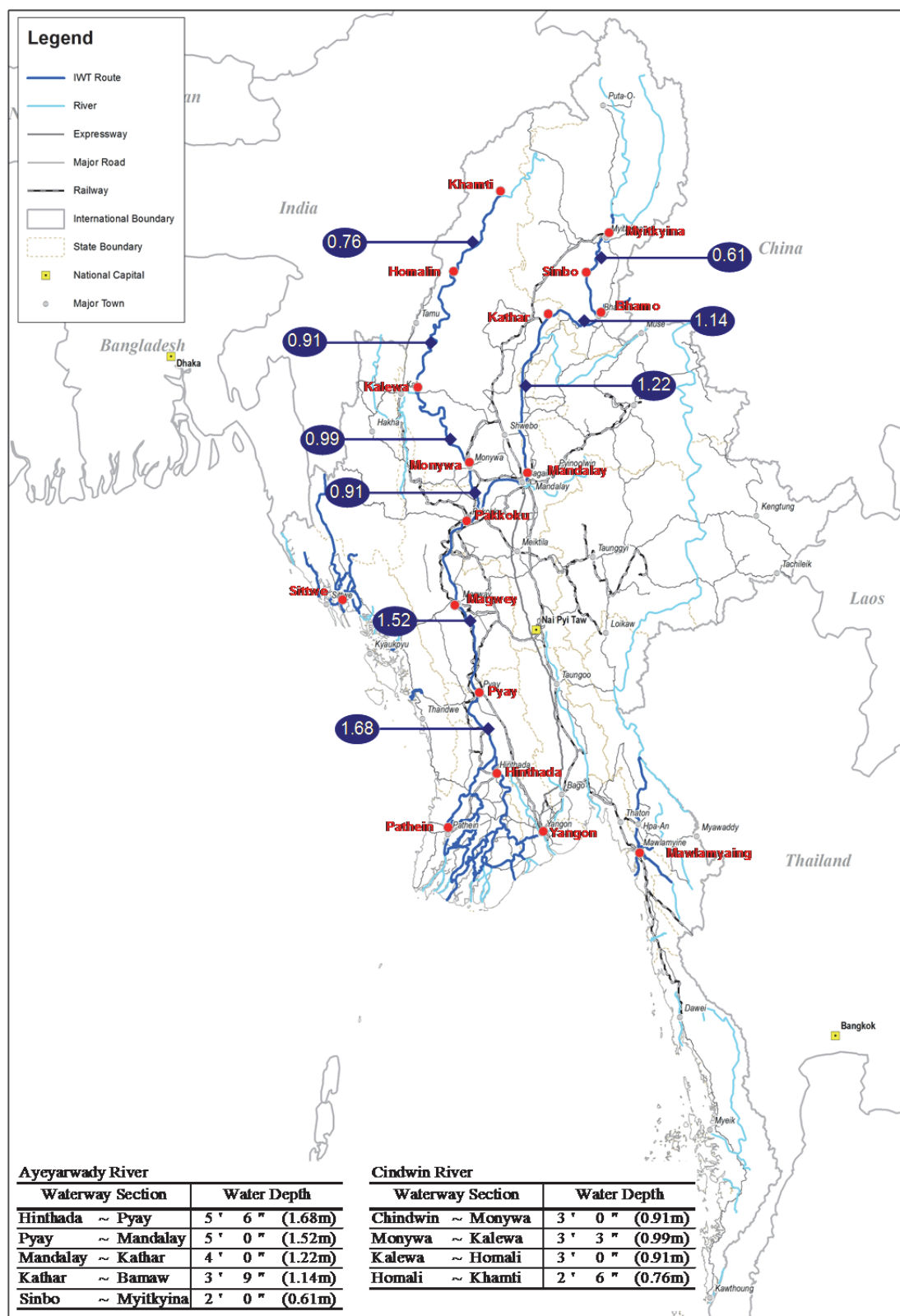
### **7.4.1 River, Port Facilities and Ships**

#### **(1) River and Port Facilities**

There are 6,650km of navigable waterways along major rivers in Myanmar. The longest of which is the Ayeyarwady River, which has a 2,170km long streamline and runs along a north-south direction through the middle of the country. The river's navigable channel length extends 3,938km and includes many branch flows in the delta area, which provides waterways for cargo and passenger ships. Figure 7.18 shows the navigable inland waterways in Myanmar, including the major river ports and the water depth during the dry season. Along the Ayeyarwady and Chindwin Rivers, which are the longest waterways in the country, variations in water depth between the dry and rainy seasons are very significant. For instance, water levels during the flooding season are 8m for Mandalay and 9m for Monywa. The water depth in the dry season is very shallow. For example, the water depth downstream from Mandalay is 1.5m and 1.1m upstream between Mandalay and Bhamo. The water depth of the Chindwin River becomes shallower during the dry season, where it is less than 1.0m. Some of inland water ports have old jetty facilities, however, most of the ports have no mechanical facilities for transfer and the ports rely on manual labor to handle goods.

#### **(2) Ships**

Inland Water Transport (IWT) is a public organization under Ministry of Transport (MOT) and operates ship transportation services using domestic river waterways. In 2013, IWT owned 413 ships including 255 powered vessels, 148 non-powered vessels and 39 stationed pontoons. Of the 225 powered vessels, 146 (65%) are "passenger-cum-cargo" ships, the rest are self-propelled barges and tug boats. The majority of IWT owned passenger-cum-cargo ships are very old, with only 31% (45) being under 20 years old, 22% of ships are between 20 and 50 years old, and 47 % of ships are older than 50 years old.



Source: MIMU, JICA Study Team

**Figure 7.18 Inland Waterway Network and Water Depth**

## 7.4.2 River Passenger Transport Services

### (1) IWT Network

Private companies, as well as the public organization IWT, provide river transport services. Table 7.19 shows the transportation fees applied by IWT for the Yangon, Mandalay, Monywa, Mawlamyaing and Sittwe hub ports. Currently, IWT is delivering regular service to 36 routes, as shown in Table 7.20. Fees for passengers are generally lower than those of private services. The cargo handling is carried out by hand as no equipment is available and cargo workers earn a daily wage of about 2,000 Kyat.

**Table 7.19 Transportation Fee applied by IWT**

Division	Route	Distance (Mile)	Passenger Rate (Ordinary Class) (Kyat/Passenger/Mile)	Cargo Rate (Kyat/Ton/Mile)
Delta	Yangon-Phyapon	64	20.00	36.00
	Yangon-Mawlamyinekun	100	20.00	70.00
	Yangon-Lattputta (Cargo)	171	20.50	60.00
	Yangon-Lattputta (Inner Path)	171	20.83	50.00
	Yangon-Pathein	172	12.00	38.00
	Yangon-Myaung Mya	135	12.00	38.00
	Yangon-Bogalay(Cargo)	87	20.00	40.00
	Yangon-Pyay	263	20.00	36.00
Ayeyarwaddy	Mandalay-Katha(SE)	193	14.00	43.00
	Mandalay-Bammaw (R )	275	14.00	36.00
	Mandalay-Nyaung Oo	119	20.00	36.00
	Mandalay-Pyay	334	20.00	36.00
Chindwin	Monywa-Kalaywa	147	20.00	72.00
	Monywa-Homemalin	327	20.00	72.00
	Monywa-Khamti	454	20.00	72.00
Thanlwin	Mawlamyaing-Kalwi	7	60.00	44.44
	Mawlamyaing-Natmaw	9	51.00	34.56
Rakhine	Sittwe-Taungkyut	224	13.39	69.44
	Sittwe-Bothitaung	80	22.50	125.00
	Sittwe-Myauk OO	40	25.00	77.70

Source: IWT April 2013

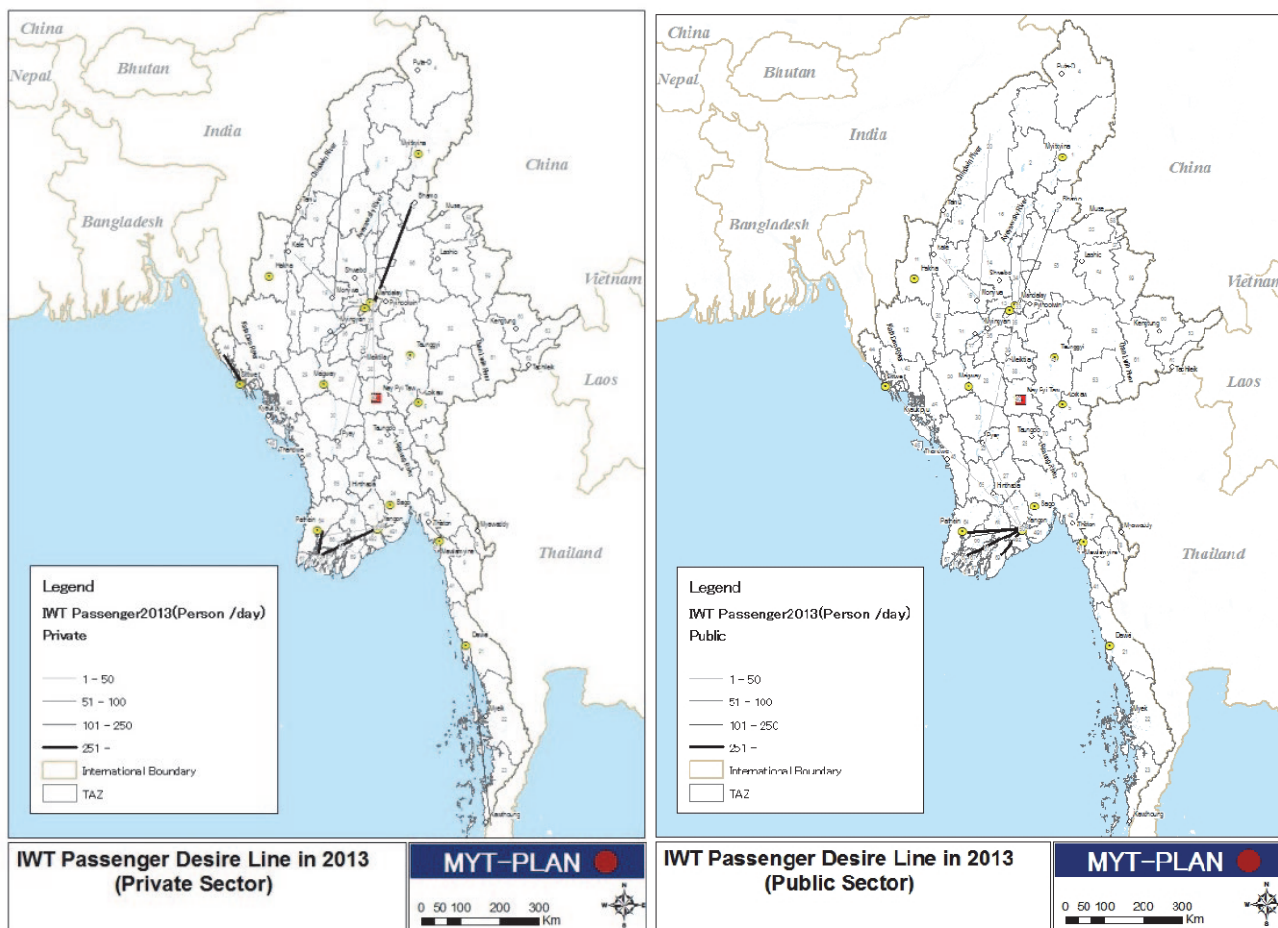
**Table 7.20 IWT Regular Services**

No	Division	Express	Ordinary	Ferry	Special	Total
1	Delta	5	2	5	6	18
2	Ayeyarwady	5	1	1	-	7
3	Chindwin	-	-	-	2	2
4	Thanlwin	-	3	1	-	4
5	Rakhine	-	-	-	4	4
6	Cargo	-	1	-	-	1
Total		10	7	7	12	36

Source: IWT

## (2) Passenger Volume

As of 2013, the number of inter-zonal IWT passengers<sup>1</sup> was estimated at 9,421 trips per day, including some 5,613 passengers who buy IWT service from a private operator. The private sector operators run a large number of inter-regional trips within the Mandalay and Ayeyarwady region. For the public sector, traffic volumes between Yangon and Ayeyarwadi region are high.



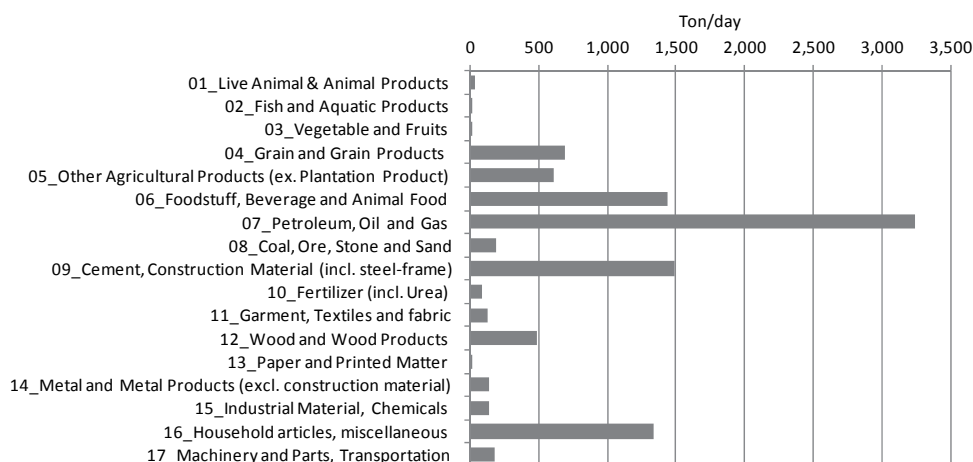
Source: Study Team estimated based on the statistics from IWT and DMA

**Figure 7.19 Estimated Desired Line for IWT Passenger in 2013  
(Private Sector: Left, Public Sector: Right)**

### 7.4.3 River Cargo Transport

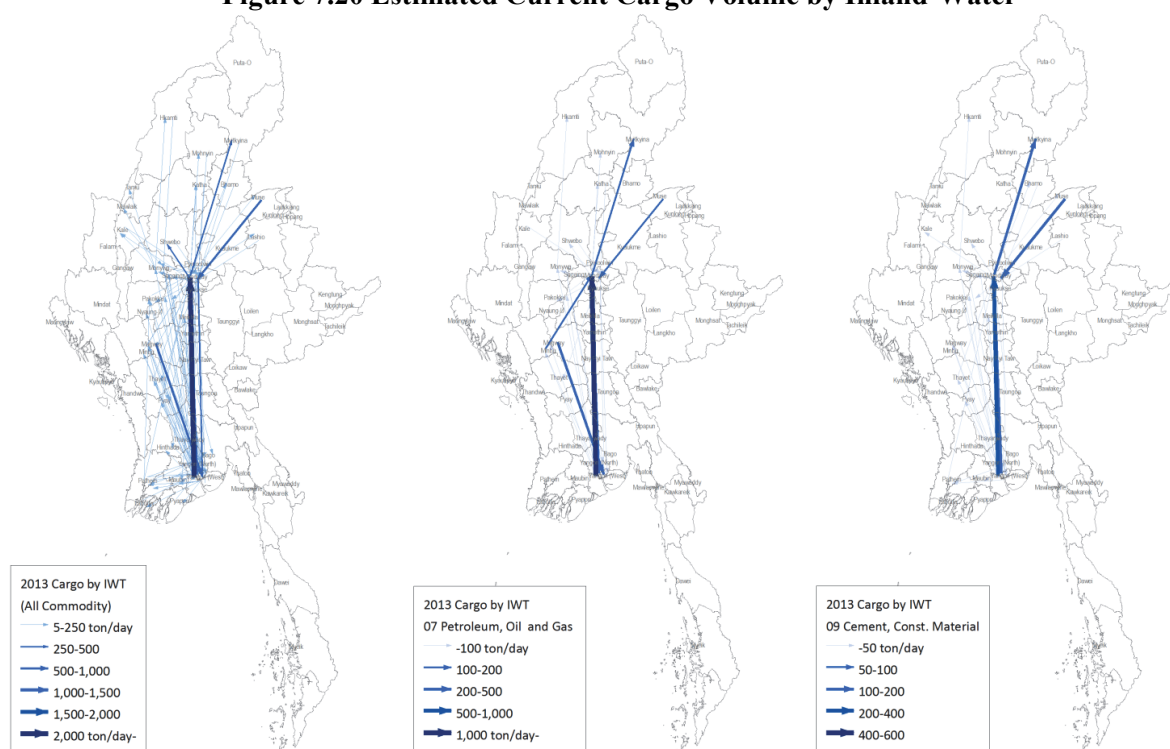
Estimated current cargo flows transported by inland water is about 10,200 tons per day and consists of petrol (32%), construction material (15%), foodstuff and beverage (14%) and miscellaneous (13%), as shown in following figure. Petrol is mainly transported from Yangon to Mandalay.

<sup>1</sup> The IWT passengers who pass through the boundary of traffic analysis zone (TAZ). It should be noted that the OD data from DMA includes many intra-zonal and short distance trips in Yangon and Patheingyi zones. However, the origin or destination of the trips are not clear.



Source: JICA Study Team

**Figure 7.20 Estimated Current Cargo Volume by Inland-Water<sup>2</sup>**



Source: JICA Study Team

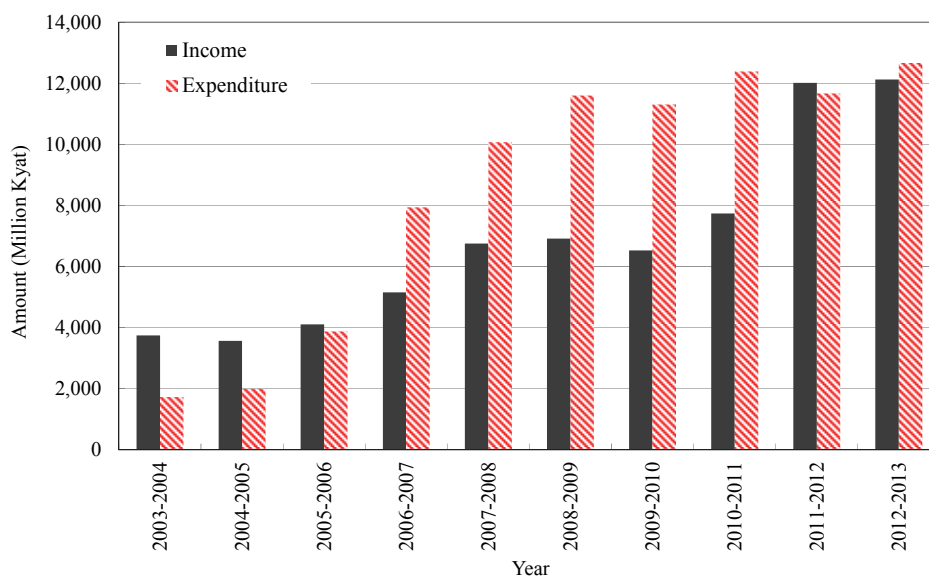
**Figure 7.21 Desire Line of Current Inland-Water Cargo**

#### 7.4.4 Sector Funding

Figure 7.22 presents IWT profit and loss results since 2003. The revenues for 2012 were cargo charges (62% of revenues) and passenger charges of (29% of revenues). In terms of expenses, 52% of costs were spare parts and raw materials, such as petrol. The deficit in 2012 is approximately 594 million kyat.

<sup>2</sup> Total cargo volume was estimated based on the secondary data provided by DMA. The cargo volume by commodity was estimated based on the truck driver interview survey at major IWT ports.





Source: MR

**Figure 7.22 Profit and Loss for IWT**

#### 7.4.5 Ongoing Projects and Activities

##### (1) Upgrading of Dalla Dockyards

IWT owns 6 dockyard facilities in Myanmar, but all are very old and have not been renovated for more than 100 years. Recently, IWT has issued an official request to Japan for ODA assistance to rehabilitate and upgrade the Dalla Dockyards. The proposed project includes the construction of workshop buildings, procurement of ship repair equipment and technical training.

##### (2) New Ships Procurement for Inland Water Transport

Currently, IWT vessels are deteriorating. Their service is also suffering in comparison to private operators. IWT vessels' sailing speed is around 7 to 8 knots while that of private operators is around 15 knots. The poor condition of these vessels and their slow speed are chief causes for IWT's loss of competitiveness and its difficulty to provide reliable and convenient transport services.

As previously noted, IWT is planning to replace its old passenger-cum-cargo vessels with a speed ferry boat service for passenger transport and a shallow draft flat barge for cargo transport to help IWT be more competitive with private operators. Myanmar is also requesting Japan for an ODA loan to procure speed ferries and barges.

##### (3) Development of Regional Ports Plan by MOT

The Ministry of Transport (MOT) is planning to develop regional ports along the Ayeyarwady and Chindwin Rivers. This includes construction of river ports at Sinkhan, Mandalay, Pakokku, Magway on Ayeyarwady River, and Kalaywa and Monywa on Chindwin River as well as the procurement of cargo handling equipment and machinery. According to MOT, the objectives of this project are to: i) promote efficient cargo handling, ii) promote the containerization by using inland waterways, iii) support the facilitation of inland water transport, and iv) create job opportunities and develop the living standards of the people. The project costs for the

construction of river ports is estimated to be approximately ten (10) million USD per port, hence the total project cost of sixty (60) million USD.

#### (4) Total River Flow Management on Ayeyarwady River

Ayeyarwaddy River is braided at many locations and its flow is not stable and changes every year. From the viewpoint of a vessel operator, navigable conditions require Least Available Depth (LAD) and water levels to be maximized, for as long as possible. As such, navigation is most difficult during the dry season, when the draft is limited.

Navigability on the Irrawaddy and Lower Chindwin Rivers was studied in 1988 by UNDP, which investigated the technical and economic feasibility of improving navigation at critical points through the use of local materials. UNDP developed plans for such improvements and recommended riverbed regulation, which includes installation of wooden pile, steel cable and rock fill groynes. In the study, entitled the "Irrawaddy and Lower Chindwin Rivers Report" UNDP identified 46 constrains on Ayeyarwady River and 37 constrains on Chindwin River. Without external financial support, DWIR has been implementing river training work with groynes, funded by the state budget, according to UNDP's development plan. Unfortunately, these efforts are not showing significant progress as yet and financial assistance from donors is again requested for the river training works, which is estimated to cost total approximately 109 million USD, according to MOT documents.

In addition, there is another method of river improvement under consideration, which can be described as a water level regulation method, achieved by constructing weirs and locks. The objectives of the project are to: i) maintain the level of draft for navigation and fresh water needs, ii) reduce the constraints sections and waterways, iii) prevent the flood and erosion, iv) conduct the water level regulation method, and v) strive for the multi-dimensional development. It is expected that this approach will enable smooth navigation throughout the year and mitigate the effects of flood, erosion and drought. It will also generate clean hydropower and promote industrial and passenger/freight transportation, which will lead to the reduction of poverty gaps between rural and urban communities. The construction of weirs is proposed at twelve locations between Bhamo in Kachin and Hinthada in Ayeyarwady region, as shown in below table. The estimated cost for the feasibility study of this project is 2 million EUROS and implementation is 400 million EUROS. MOT is also seeking financial assistance from foreign donors for this project.

**Table 7.21 Proposed Weirs**

ID	Township	Location	Width of River (meter)	Height of weir (Head) (meter)	Back water length (km)	Water surface area bet. Two weirs (sq. km)	No. of Turbine	Output Power (MW)
1	Hinthada	Kyaungkone	1,060	8.0	114	615	9	270
2	Pan taung	Htone Bo	700	9.9	100	265	10	300
3	Aung Lan	Yone Sate	1,310	8.7	92	176	10	300
4	Min Hla	Min Hla	1,170	9.0	142	582	9	270
5	chauk	Lan Ywar	1,050	10.5	124	476	10	300
6	Myingyan	Yantabo	760	8.5	94	240	6	180
7	Sitgaing	Wachat	1,340	8.5	113	244	6	180
8	Thabaitkyin	Shwe Kyin	700	8.0	71	81	6	180
9	Thabaitkyin	In Kone	950	8.9	86	170	6	180
10	Katha	Thapyaytha	1,750	6.6	58	48	4	120
11	Katha	Moe Ta	720	8.3	79	94	4	120
12	Ban Maw	Mya Lael	1,000	8.0	40	52	4	120

Source: MOT presentation material

## **(5) Pathein Port Development Plan by the Private Sector**

A local company has completed a feasibility study on the development of the Pathein jetty as an international port and has started planning its investment. When this project is complete, the new international port will transport rice produced on the western side of Ayeyarwady Region, which had previously travelled to Yangon by road. The new Pathein international port will reduce transportation costs, which will affect the price of rice. Pathein port is located 72 km from the sea and surveys conducted by a private investor in 2011 show that about 46 km would have to be dredged to accommodate vessels with a draft of up to 8 meters. The cost of dredging is estimated to be approximately USD\$ 4.5 million each year. The investor was also proposing to export dredged sand to the Maldives and Singapore. The proposed port would be able to handle containers as well. Further information and present status/progress of the project is to be confirmed during the study.

### **7.4.6 Key Sector Issues**

#### **(1) Planning and Coordination**

Generally, IWT transportation times are longer than those of other transportation modes, such as railway or road. However, IWT is less costly than alternatives and can even be appropriate for swamp areas during the rainy season. With these considerations in mind, heavy and regular cargo such as oil sand is suitable for IWT. For maximum efficiency, investments made in the transport sector should consider suitable role sharing among transportation modes.

#### **(2) Infrastructure**

Currently, the DWIR prohibits night sailings of cargo ships in the river channels for navigation safety reasons. The river channels are not stable and water levels fluctuate seasonally, every year. Although the river channel improvement project for the Ayeyarwady and Chindwin Rivers was recommended by the UNDP studies undertaken in 1988 and 1993, the survey records are now old and require updating. Progress in renewing surveys has been inhibited insufficient funds from the annual government budgets. River channel improvement is important to increase transportation efficiency and navigation safety; this should be carried out at the same time as port development and the installation of cargo equipment.

In Myanmar, a large amount of general cargo is handled manually on the natural riverbanks, but these sandy banks are inadequate as cargo yards. During the flood season, the riverbank cargo yards shrink, due to the rise of water levels. This causes congestion on the public roads around the port area. With economic development, labor costs will increase, this will weaken the competitiveness of IWT. The development and modernization of river ports is the most important and urgent subject for the government in terms of water transport.

#### **(3) Safety, Security and the Environment**

Most the IWT vessels are very old and in poor condition, posing significant risk of severe accident.

Waterway transportation is an environmental friendly shipping mode with low greenhouse gas emission volumes and CO<sub>2</sub>, as compared with other modes of transportation. This environmentally responsible mode is supported by policies within the European Commission, which aim to enhance modal shifts through a “Marco Polo Plan”. Under this plan, the EU government supports private sector proposals on transport modal shifts (from mainly road to waterway or railway) by paying 35% of the initial investment. For modern inland waterway

development plans, environmentally responsibly initiatives like the EU plan should be considered.

#### **(4) Human Resources and Regulations**

There are no port facilities at Myanmar's river ports and government authorities have little experience in port management. Though IWT operates ship services along the rivers, they have few port facilities, except for some small passenger floating pontoons. DWIR governs river channel maintenance, but it does not manage the river port operations. In line with the planned port development project, the government's capacity for port management should be substantially improved.

Though the IWT is a publicly operated waterway transport service, private shipping operators are also operating on IWT routes. Despite this competition, publicly operated transportation still has an important role in the Ayeyarwady Delta and upstream from the Chindwin, as these areas do not have sufficient road infrastructure meaning that these waterway channels are peoples' lifeline. It is important for the government to have a clear policy for improving public services along the waterways, while ensuring that these policies do not disturb or influence the efficient and positive growth rate of the private business market.

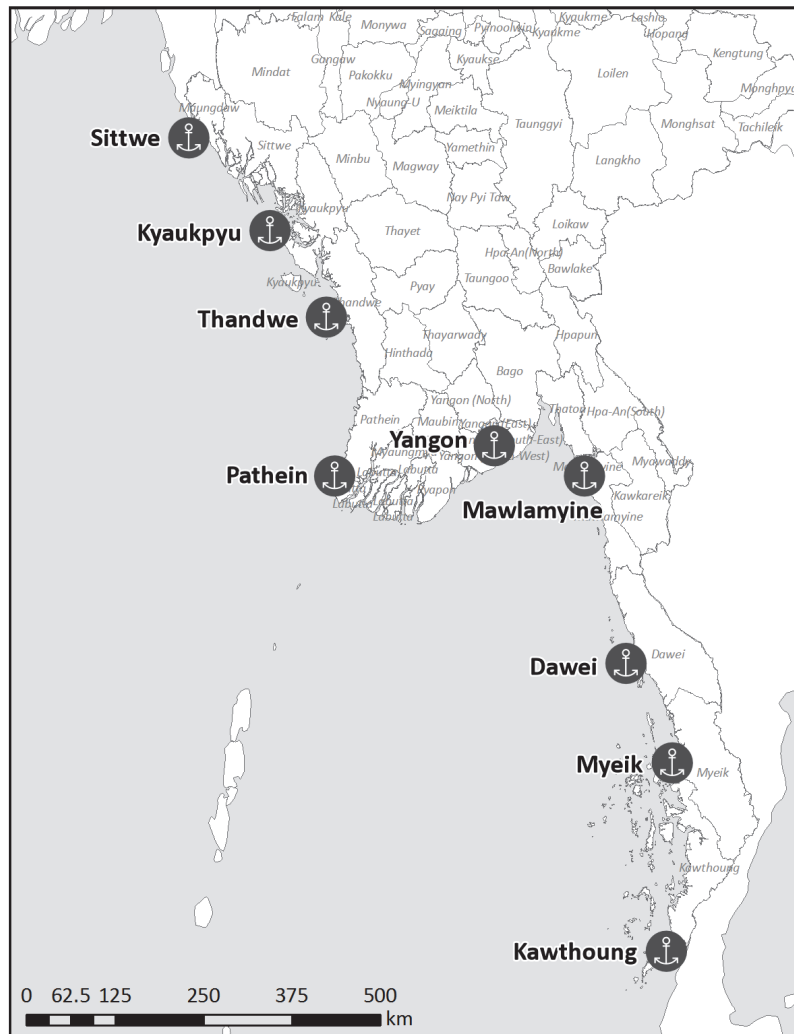
#### **(5) Finance**

As of 2012, IWT's deficit was approximately 594 million kyat. Given IWT's weak fiscal condition, the purchase of new vessels may not be possible. This may lead to increased chance of accidents, due to the continued use of old and weak vessels. As such, public financing may be required to allow IWT to purchase adequate and safe equipment.

## 7.5 Maritime Sector

### 7.5.1 Port Facilities

As shown in Figure 7.23, Myanmar has nine ports in operation, with most coastal freight trips running between Yangon-Dawei, Yangon-Kawthoung, Yangon-Myeik and Yangon-Sittway, according to the MPA.



Source: Myanmar Port Authority

**Figure 7.23 Ports in Myanmar**

#### (1) Yangon Ports (including port in Thilawa area)

The Yangon port (excluding the port in Thilawa area) is Myanmar's largest international gateway port and is located about 32km upstream from the mouth of the Yangon River. This port manages most of Myanmar's international cargo and can accommodate ships of 15,000 DWT and a draft of 9m. Naung Thor Company is developing a new terminal on the upstream side of MIP.

**Table 7.22 Wharves in Yangon Port**

Name of Wharves	Length (m)	Apron Width (m)	Storage Area		Owner	Remarks
			Yard (m <sup>2</sup> )	Shed (m <sup>2</sup> )		
Hteedan Berth	180	21	21738.6	-	MEC	General Cargo
Hteedan Rice Berth	139	12.5	-	6688.8	MPA	Rice & Rice Products
Ahlong Wharves						
No.1	198	30.5	43630	2675.5	AWPM	Container & G.C
No.2	156	19.5	3483	1895	AWPM	Container & G.C
No.3	260	30.5	7928	1859	AWPM	Container & G.C
Myanmar Industrial Port Wharves	310	18	102385	6140	MIP	Container & G.C
Sule Pagoda Wharves						
No.1	137	12.2	6967.5	5016.6	MPA	General Cargo
No.2	137	12.2	5574	5202.4	MPA	General Cargo
No.3	137	12.2	10683.5	3855.35	MPA	General Cargo
No.4	137	12.2	3251.5	6688.8	MPA	General Cargo
No.5	160	15.2	6038.5	17595.26	MPA	General Cargo
No.6	160	15.2	3251.5	16062.41	MPA	General Cargo
No.7	158.5	15.2	1042.3	13098.9	MPA	General Cargo
Bo Aung Gyaw Wharves						
No.1	137	15.2			UMEHL	Container & G.C
No.2	137	15.2	48000	400	UMEHL	Container & G.C
No.3	183	30			UMEHL	Container

Legend: MEC: Myanmar Economic Cooperation (MPA leased the operation in 2010),

AWPM: Asia World Port management Co., Ltd.:

UMEHL: LANN PYI MARINE CO., LTD. Under Union of Myanmar Economic Holding Limited.

(Note: MPA leased the operation in 2010.)

Source: MPA

Yangon Port in Thilawa Area (hereinafter referred to as Thilawa Port) is designed to accommodate ships of 20,000 DWT and drafts of 9 m. The port has 37 plots, some of which are already in operation. The Myanmar Integrated Port Limited (MIPL) operates lot No.4, established on a BOT basis in 1998. Lot No. 5 to 9 are operated by the Myanmar International Terminal Thilawa (MITT), located 25 km from the Yangon River mouth. These lots include five berths and were developed under a BOT project in 1997.

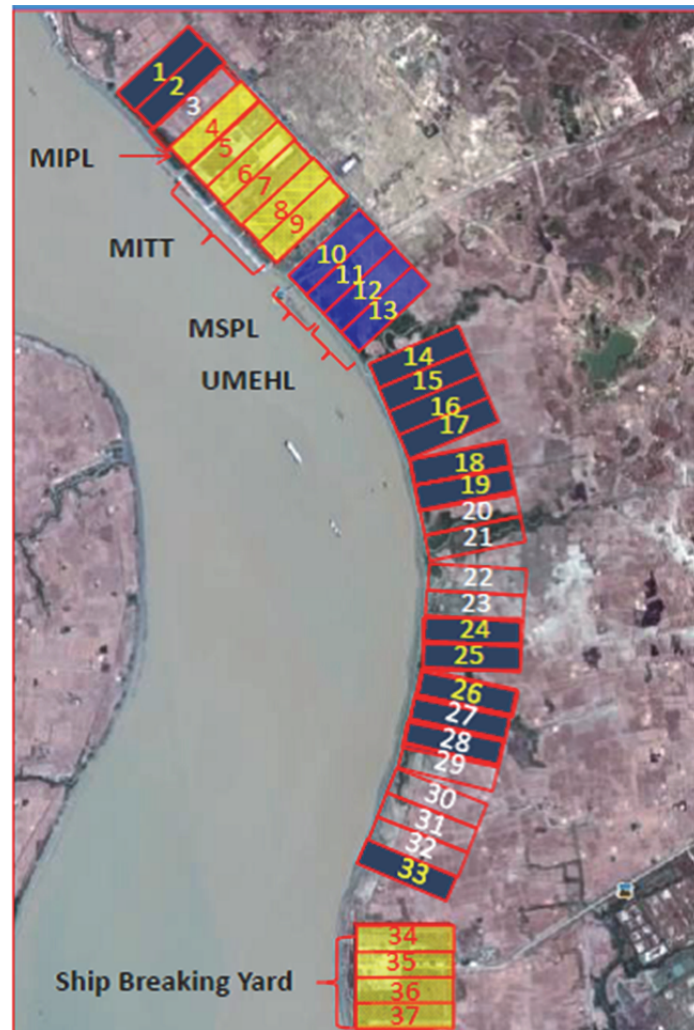


Figure 7.24 Allocated Lots in Thilawa Port

## (2) Sittwe Port

Sittwe port is located approximately 90 km south from the Bangladesh border and about 3 km on the upper streamside of the Kaladan River. MPA owns two jetties at this location and rely on manual labor for loading and unloading cargo. The first jetty, which is located near Sittwe market, is classified as an international port. However, presently only coastal ships traveling from Yangon (sometimes from Patheingyi) to Bangladesh call at this port.

## (3) Kyaukphu Port

In 2010, the Korean company DAEWOO constructed a jetty near the Kyaukphu town area to provide equipment/material to their offshore gas platform. The facility is a T-type jetty with steel pipe pile structure and a berth length of 80 m with +7.00 m height. MPA uses approximately 20 m of this DAEWOO jetty for their cargo, however, the height of the jetty is too high for the MPA ship and MPA has requested DAEWOO to construct a local jetty. In response to MPA's request, DAEWOO has donated a lower-height jetty to the region and a local company is now constructing this jetty. MPA has floating jetties for inland water transport; they have no cargo cranes and are located 2.5 km south of Kyaukphu town.

#### (4) Patheingyi Port

Patheingyi port is located 110km upstream from the river mouth and has only CD of -4 to -5 m depth, on average. The river tide levels change by approximately 3.5 m, as such, this port cannot accommodate larger ships, unless the riverbed is dredged. The river depth is shallow but port activities for inland water transport are vital, especially for private operators, compared to Sittoung & Kyaukpadaung. Most of the jetties in Myanmar are of the old England floating type, with manual loading and unloading.

#### (5) Mawlamyine Port

There are 6 floating jetties and 1 RC jetty along the lower Thanlwin River, on west side of the town center and another floating jetty on the east side. All floating jetties are of the old England type. The RC jetty is partly sloped for easier manual loading and unloading and a flat area for general use.

### 7.5.2 International Cargo Transport

In 2011, the Yangon ports handled approximately 380,000 TUE containers, of which 67 percent (approximately 260,000 containers) were managed through the Asian World Port; the primary destination for these containers were the industrial zones in the west bank area of the Yangon River (Hlaing industrial area).

**Table 7.23 Container Transport at Ports in Yangon**

(Unit: TEU)

Wharf name	Owner	Year	2010	2011	2010	2011
Ahlone Wharves	AWPM	Import	108,135	131,644	62.4%	66.8%
		Export	100,128	124,775		
		Sub-total	208,263	256,419		
Myanmar Industrial Port	MIP	Import	25,770	46,899	16.8%	24.8%
		Export	30,203	48,473		
		Sub-total	55,973	95,372		
Bo Aung Gyaw Wharves	UMEHL	Import	28,173	14,772	16.9%	7.8%
		Export	28,361	15,188		
		Sub-total	56,534	29,960		
Myanmar International Terminals Thilawa	MITT	Import	5,943	1,067	3.9%	0.6%
		Export	7,200	1,172		
		Sub-total	13,143	2,239		
Yangon Total			333,913	383,990	100.0%	100.0%

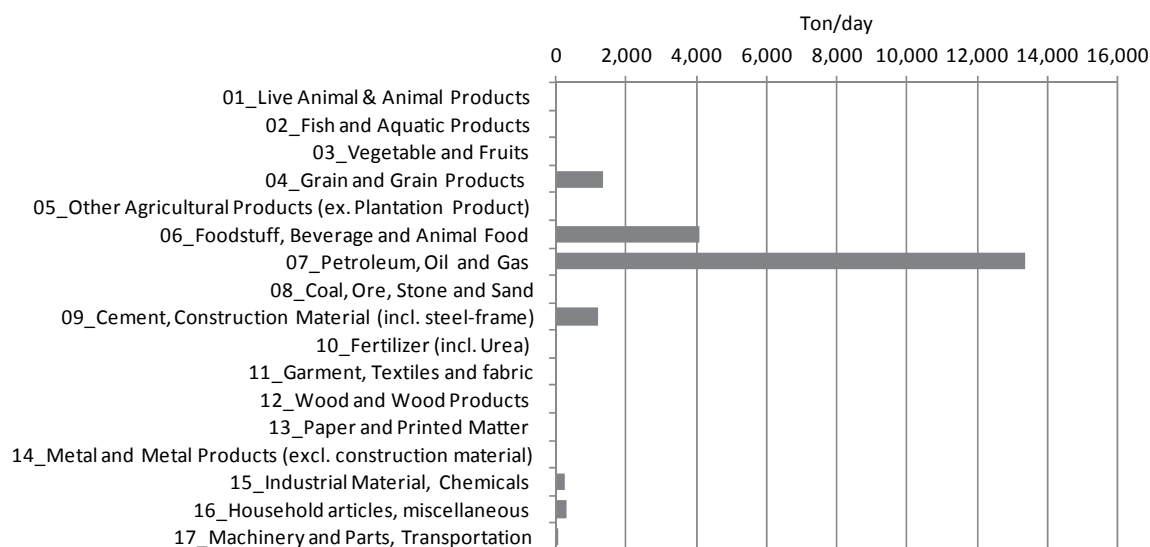
Source: Myanmar Port Authority

### 7.5.3 Coastal Shipping

The cargo OD, by commodity type, is estimated by re-classifying the commodity and converting it to a weight-value factor, which is calculated by dividing the export value by the import value and volume. The estimated current cargo flow transported by coastal trade is approximately 20,600 tons per day, consisting of petrol (65%), foodstuffs and beverages (20%), grain (6%) and construction material (6%), as shown in Figure 7.25.



Final Report



Source: JICA Study Team

**Figure 7.25 Estimated Current Cargo Volume by Coastal Shipping**

**Table 7.24 Coastal Freight Transportation**

From	To	Ave. ton/month (Apr. - Dec. 2012)	Ave. ton/day
Yangon	Dawei	3,592	120
Dawei	Yangon	219	7
Yangon	Kawthoung	2,254	75
Kawthoung	Yangon	5,024	167
Yangon	Myeik	2,149	72
Myeik	Yangon	2,151	72
Yangon	Sittway	4,836	161
Sittway	Yangon	456	15

Source: MPA

The following tables indicate the domestic coastal cargo between Yangon and other domestic seaports. The cargo transported by sea are primarily consumer goods, such as fuel and foodstuffs.

**Table 7.25 Coastal Trade between Yangon and other Domestic Seaports by Type of Commodity (In-Shipments 2012)**

(Unit: million Kyat)

	Sittwe	Myeik	Mawla- myine	Thandwe	Dawei	Kawthaung	Total
Food, Drink and Edible Oil	210	2,172	0	0	5	2,637	5,024
Textiles	0	0	0	0	0	4	4
Medicine	0	0	0	0	0	0	0
Fuel	0	151	0	0	0	4	155
Materials Raw and Semi-Manufactured	193	1	0	0	0	253	447
Others (Including Tires and Tubes)	27	119	0	0	13	1,847	2,005
Sub Total (Consumer Goods)	430	2,443	0		17	4,745	7,636
Building Materials	240	2	0	0	0	168	410
Machinery, Appliance and Apparatus	1	0	0	0	0	49	50
Private Motorcars	13	6	0	0	0	48	67
Bicycle and Parts	0	0	0	0	0	0	0
Other Transport Equipment	0	0	0	0	0	15	15
Others (Including Tires and Tubes)	5	8	0	0	0	149	163
Sub Total (Capital Goods)	259	16	0	0	0	429	705
Total	689	2,459	0	0	18	5,174	8,341

Source: MPA

## 7.5.4 Ongoing Projects and Actions

### (1) Yangon and Thilawa Area

#### 1) Asia World Port Management Co., Ltd. (AWPM)

In 1996, AWPM constructed the Ahlone wharf, which is located about 2 km upstream from MIP and is the first private international wharf in Myanmar. Currently, AWPM is expanding the port with a new 238 m wharf, named No.4 Ahlone Wharf. After this wharf is complete, the total length of the Ahlone wharves will be 852 m.

#### 2) Myanmar Industrial Port (MIP)

MIP is located about 2 km upstream from the Sule Pagoda Wharves and includes two wharves, with a combined length of 310 m and no cargo crane equipment. MIP's No. 2 berth is under construction and MIP has plans to construct a No. 3 berth in the future.

#### 3) Hteedan Wharves

The renovation and development of Hteedan's two wharves began in 2010. One of these is already complete, the other is still under construction. Shwe Nar Wah Company Limited, which is a subsidiary of Asia World Co. Ltd and AWPM, is managing the terminal.

#### 4) New Terminal Development

Naung Thor Company is developing a new terminal on the upstream side of MIP and piling

works are ongoing.

#### **5) Agricultural Terminals in Thilawa Area**

Lots No. 10 and 11 in Figure 7.24 will be completed by Maritime Services Pvt. Ltd and 12 and 13 will be completed by UMEHL. No. 20 and 21 are now undergoing a feasible study to serve agricultural uses by WILMAR in Singapore. Lot No. 29 is by operated by Myanmar Agricultural Company and No. 30 is operated by Diamond Star Company.

#### **6) Yangon Port in Thilawa Area (Thilawa Port) Development by Japanese ODA Loan**

Presently, a feasibility study for Thilawa Port Development is underway. The planned area from Lot No. 23 to 26 has two berths. The recommended berth structure is a jacket type, which is advanced technology in Japan procured for Haneda International Airport in Tokyo. This technology would dramatically shorten the construction period.

#### **(2) Kaladan Multi-Modal Transit Transport Project**

In 2008, the Indian government signed an agreement with the Myanmar government to construct the Kaladan Multi-Modal Transit Transport Project. This project will connect the Kolkata port in India with Sittway port in Myanmar. It can then link Sittway to Mizoram in India via river and road transport. The project is divided into three phases, namely the Sittway port redevelopment, the dredging of the Kaladan River for 158 km between Sittway and Paletwa in Chin State and the construction of a 129 km highway between Paletwa and the Mizoram border. The total project budget is US 140 million. Phases 1 and 2 are almost complete though road construction is delayed, due to EIA procedures. The planned depth of berths at Sittway is -7 meters.

#### **(3) Kyaukphu Deep Sea Port & Pipe Line Project, and Local Jetty Construction**

The Kyaukphu deep-sea port project with an oil tank farm on Madera Island (near China) is almost complete. The port has a depth of -28 m and it can accommodate a 300,000 DWT oil tanker. The main purpose of the port is to function as a gateway port for oil from the Middle East and as a port for natural gas from Bengal Bay, extracted by DAEWOO. These petroleum products are conveyed through pipelines to Kunming in Yunnan province, Luzho, and Guiyang, China, according to China's overall plan for the pipeline project.

In 2009, another development plan called the "Kyaukphu Economic and technological Development project" is a large-scale and complex project containing industrial, agricultural and residential areas and multi modal development including SEZ; this project was agreed-to by the Myanmar and Chinese governments.

#### **(4) Mawlamyine**

Mawlamyine is a proposed candidate for a deep-sea port and a gateway for an east/west corridor in Myanmar. However, the existing shallow riverbed is just 3 to 4 meters in depth in the dry season.

#### **(5) Yangon Offshore Terminal**

Normally, national gateway ports are constructed near the main city, for Myanmar the city is Yangon. Other candidate locations are quite far from Yangon (e.g. Mawlamyine is 300km from Yangon, and the road network is still vulnerable.)

## **(6) Dawei Deep Sea Port and Industrial Estate Project**

This project was being implemented by the Italian-Thai Development (ITD) Public Company Ltd. and includes a deep-sea port with a -20 m access channel and -12 to -16 m berths. The total number of berths number 58, and some are to be artificially excavated. The port is planned as an industrial estate with a power plant and water supply, which are connected to transportation network by rail and road. This port and related facilities are expected to be the gateway of the Southern Economic Corridor of the Greater Mekong Sub region (GMS) and the project is a high priority for the government.

### **7.5.5 Key Sector Issues**

#### **(1) Planning and Coordination**

Considering Myanmar's geographic features, ports are essential transportation facilities. However, ports cannot function without access to transportation infrastructure like roads or railways and a smooth and comprehensive feeder network. In cases of new port development, these access networks are crucial. To avoid mixing cargo traffic with local traffic, the routes for heavy trucks are prescribed for certain areas in Yangon and Mandalay. However, these roads are chronically congested especially in the highly urbanized areas near ports. Furthermore, it is forecasted that the cargo handling volume will increase with economic growth. Considering the future demand for cargo transport, the improvement of feeder infrastructure and industrial areas as well as the port itself is required and coordinating with relevant agencies like MOC, MR and private investors.

The existing inland water transportation services that connect Yangon and Mandalay national growth centers are expected to be further strengthened through future modernization and improvements to carrying capacity. In this regard, modern transshipment facilities in Yangon Port (including Thilawa area) and improvements to the navigation channel of the Ayarwaddy River should be developed in parallel.

#### **(2) Infrastructure**

Thilawa port was constructed as a result of growing cargo demand in Yangon area. However, both Thilawa port and Yangon port are river ports and their maximum water depth is limited. The approach route from Yangon port is approximately 46 km and has two shallows. MPA has conducted dredging work, however, the maximum water depths cannot be modified significantly. If large vessels approach to the Yangon in future, an additional deep-sea port may be necessary.

#### **(3) Safety, Security and Environment**

When large vessels proceed through the approach on Yangon River, a pilot must guide the vessel and navigate the route. To ensure the safety and security of ships entering port at Yangon, advanced navigation system should be installed, such as a Vessel Traffic Service (VTS), which is based on industry standards for navigation safety including regular updates of nautical charts, publications, notices to mariners, reliable tide table, etc. Such information must be updated regularly to provide operators with current conditions for sea and navigable route(s).

## 7.6 Civil Aviation Sector

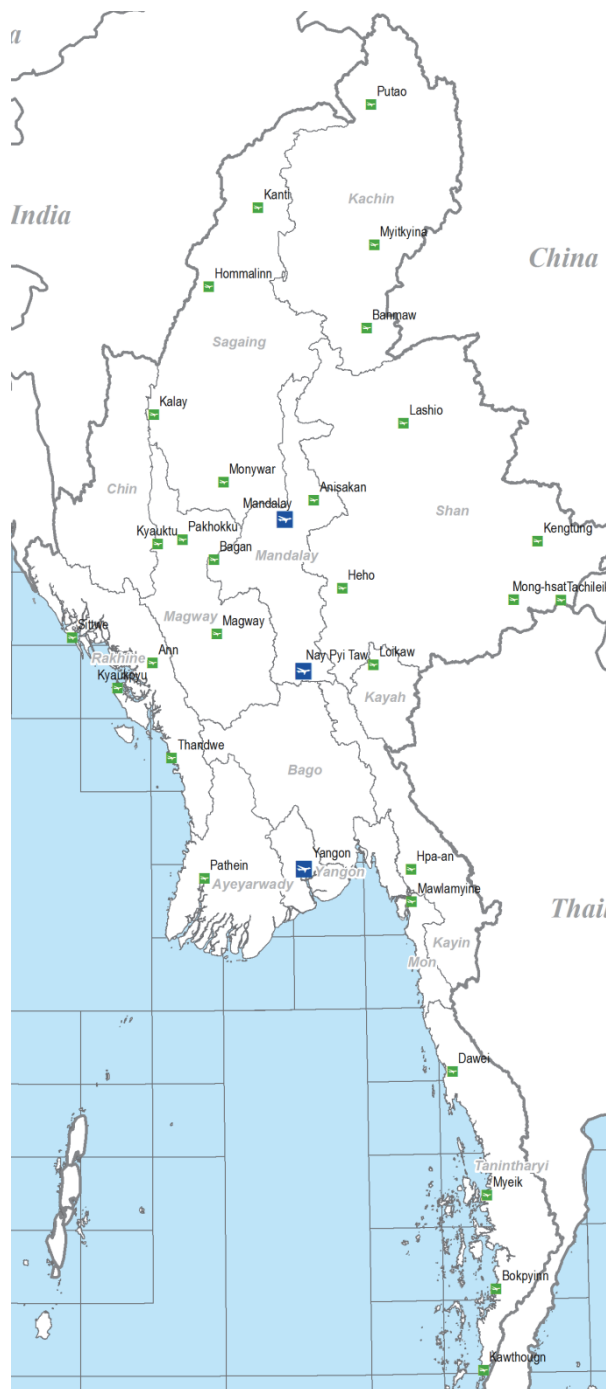
### 7.6.1 Airport Infrastructure

There are 33 airports in Myanmar and scheduled flights are operated at 27 airports of these. At the other 6 airports, only non-scheduled flights are operated. Yangon, Mandalay and Nay Pyi Taw airports are Myanmar's international airports.

The design capacity of the Yangon International Airport (YIA) is approximately 2.7 Million Passengers Per Annum (MPPA)<sup>3</sup> and is expected to reach passenger capacity within the next few years. The other two international airports are rated at 3 MPPA (Mandalay) and 5 MPPA (Nay Pyi Taw) and have not yet reach capacity.

Many of the domestic airports in Myanmar do not fulfill the requisite ICAO standards or recommendations and several lack, even the Precision Approach Path Indicator (PAPI), a critical visual guidance system for approaching aircraft. These deficiencies can both directly and indirectly influence the safety of aircraft operations at the airports, or downgrade the airport serviceability in terms of flight delays and cancellations.

Table 7.26 provides some detail of airport characteristics in Myanmar.



Source: JICA Study Team

**Figure 7.26 Location of Airports in Myanmar**

<sup>3</sup> This is for only the international terminal.

Table 7.26 Summary List of Airports in Myanmar<sup>4</sup>

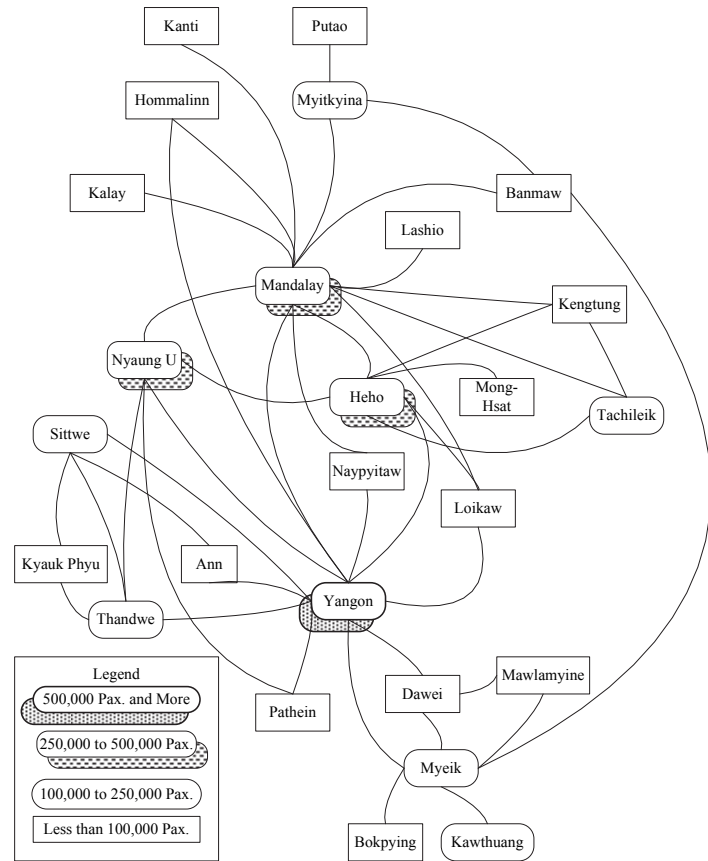
No.	Name	Int'l Pax. (2012)	Dom. Pax. (2012)	RWY (m)	RWY Strength	RWY Strip (m)	Sched. Max. Aircraft	Approach Category	ILS	DVOR/ DME	NDB	HF	VHF	Approach Light	PAPI <sup>1</sup>	RWY Lights	AWOS *3	RFF *2 Category
1	Yangon	1,929,404	1,157,565	3,414 x 61	PCN56/R/C/X/T	4,023 x 150	A330	Precision	✓	(✓)	✓	✓	3	PALS/SALS	PAPI2	✓	✓	9
2	Mandalay	77,995	496,007	4,267 x 61	PCN55/R/A/W/	4,572 x 305	B737	Precision	✓	✓	✓	✓	3	PALS/SALS	PAPI2	✓	✓	7
3	Naypyitaw	-	40,423	3,657 x 61	PCN56/R/A/W/	4,267 x 305	ATR72	Precision	✓	✓	✓	✓	2	PALS/SALS	PAPI2	✓	✓	5
4	Heho	-	377,838	2,591 x 30	68,039 kg	2,895 x 150	F100	Non-precision		((✓))	✓	✓	2	SALS	PAPI (2)	✓	((✓))	4
5	Nyaung U	-	255,046	2,591 x 30	68,039 kg	2,865 x 150	F100	Non-precision		((✓))	✓	✓	2	((SALS))	((PAPI2))	((✓))	((✓))	4
6	Tachileik	-	217,309	2,149 x 30	33,112 kg	2,301 x 150	E190	Non-precision			✓	✓	2	SALS	PAPI2	✓		2
7	Kawthoung	-	146,867	1,829 x 46	60,781 kg	2,133 x 91	E190	Non-precision			✓	✓	2	SALS	PAPI2	✓		3
8	Myittha	-	137,569	1,829 x 46	33,112 kg	1,981 x 150	E190	Non-precision		(✓)	✓	✓	2			✓		3
9	Myeik	-	118,110	2,743 x 61	60,781 kg	2,956 x 150	E190	Non-precision	(✓)		✓	✓	2	SALS	PAPI2	✓		3
10	Sittwe	-	114,187	1,829 x 46	33,112 kg	2,438 x 150	E190	Non-precision			✓	✓	2	SALS	PAPI2	✓		3
11	Dawei	-	108,909	3,657 x 30	395,987 kg	3,870 x 150	ATR72	Non-precision		✓(✓)	✓	✓	2	((SALS))	((PAPI2))	((✓))	((✓))	3
12	Thandwe	-	76,882	2,438 x 30	33,112 kg	Width 150	ATR72	Non-precision		((✓))	✓	✓	2	SALS	PAPI2	✓	((✓))	3
13	Kengtung	-	53,446	2,438 x 46	60,781 kg	2,895 x 150	E190	Non-precision			✓	✓	2	SALS	PAPI2	✓		2
14	Lashio	-	45,692	1,600 x 30	20,412 kg	1,874 x 150	ATR72	Non-precision		✓	✓	✓	1	SALS	PAPI2	✓		2
15	Putao	-	31,462	2,133 x 30	60,781 kg	2,285 x 150	ATR72	Non-precision			✓	✓	2	SALS	PAPI2	✓		3
16	Bamaw	-	28,704	2,286 x 30	33,112 kg	2,438 x 122	ATR72	Non-precision			✓	✓	2	SALS	PAPI2	✓		2
17	Kalay	-	25,376	1,676 x 30	33,112 kg	1,829 x 150	ATR72	Non-precision			✓	✓	2	SALS	PAPI2	✓		2
18	Ann	-	24,093	2,591 x 30	60,781 kg	2,865 x 150	E190	Non-precision			✓	✓	1	SALS	PAPI2	✓		2
19	Kyaikphyu	-	22,005	1,408 x 30	20,412 kg	1,560 x 150	ATR72	Non-precision			✓	✓	2					2
20	Monywa	-	16,440	2,591 x 30	68,039 kg	2,895 x 150	E190	Non-instrument			✓	✓	2					3
21	Hommalin	-	16,072	3,657 x 61	395,987 kg	3,932 x 150	E190	Non-precision			✓	✓	2					3
22	Bokpyinn	-	12,120	3,048 x 30	395,987 kg	3,322 x 150	F28	Non-instrument			✓	✓	1					-
23	Loikaw	-	10,819	1,585 x 23	20,412 kg	1,859 x 150	ATR72	Non-precision			✓	✓	2			✓		3
24	Kanti	-	10,034	1,829 x 30	20,412 kg	1,950 x 152	ATR72	Non-precision			✓	✓	2					2
25	Mawlamyine	-	9,369	1,646 x 46	20,412 kg	1,798 x 150	ATR72	Non-precision			✓	✓	2	SALS	PAPI2	✓		3
26	Mong Hsat	-	6,360	1,524 x 30	20,412 kg	1,798 x 150	ATR72	Non-precision			✓	✓	2	SALS	PAPI2	✓		2
27	Patheingyi	-	778	2,835 x 61	165,000 kg	3,048 x 150		Non-precision	✓		✓	✓	2	SALS	PAPI2	✓		3
28	Magway	-	-	2,591 x 61	165,000 kg	2,895 x 150	No	Non-precision			✓	✓	1	SALS	PAPI2	✓		2
29	Kyaikto	-	-	3,048 x 30	395,987 kg	3,322 x 150		Non-precision			✓	✓	2	SALS	PAPI2	✓		2
30	Hpa-an	-	-	1,371 x 30	20,412 kg	No data		Non-precision			✓	✓	1					2
31	Pakho	-	-	2,591 x 30	68,039 kg	2,895 x 150		Non-instrument			✓	✓	1					1
32	Anisakan	-	-	3,048 x 61	395,987 kg	3,553 x 150	No	Non-precision			✓	✓	1	SALS	PAPI2	✓		-
33	Coco Island	-	-	1,524 x 30**	20,412 kg	1,644 x 150	No	Non-instrument										-

<sup>4</sup> PAPI\*1: Precision Approach Path Indicator, RFF \*2: Rescue and Fire Fighting, AWOS \*3: Automated Weather Observation System, EQ shown in ( ) were already installed by DCA but yet to be commissioned. EQ shown in (( )) will be installed under JICA grand assistance project. \*\*: The runway at Coco Island Airport is being extended by 300 m.

### 7.6.2 Air Transport Services

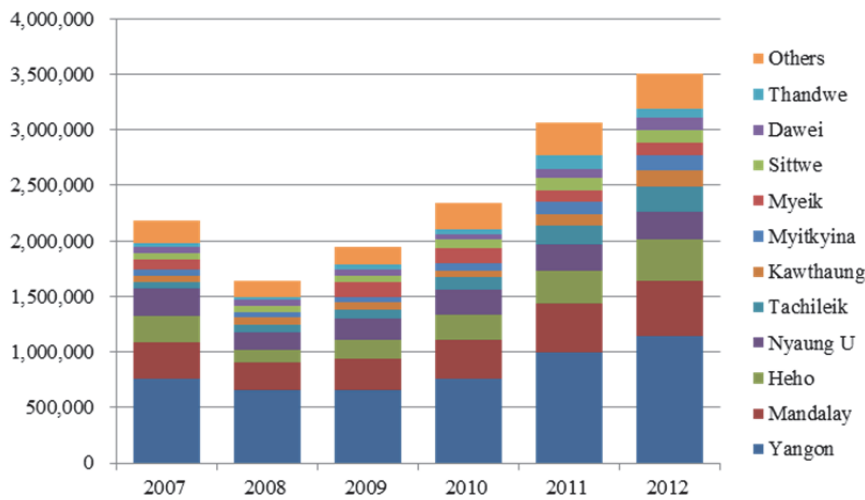
#### (1) Domestic Services

There are seven domestic airlines in Myanmar operating from 27 airports. Yangon and Mandalay Airports are function as domestic hubs. In 2012, the total number of domestic departure/arrival passengers was 3,492,400, of which 32.6% (1,139,654) flew from Yangon International Airport. The balance (65.2%) flew from Yangon and 34.8% flew from other airports. The top five domestic airports in Myanmar are Mandalay, Heho, Nyaung U and Tachileik airports, where more than 200,000 passengers flew during 2012, representing 71.1% of domestic passenger travel.



Source: JICA Study Team

Figure 7.27 Current Domestic Air Services Network



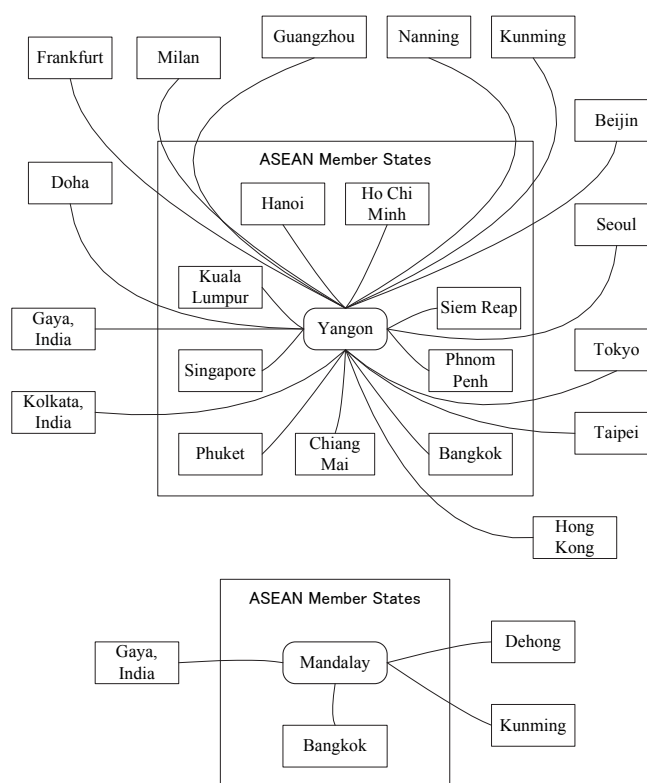
Source: DCA

Figure 7.28 Domestic Passenger Traffic Record

## (2) International Services

Myanmar's international airline is Myanmar Airways International, a joint venture between Myanmar Airways (state enterprise under MOT) and a local investor. In addition, 21 foreign airlines fly into Myanmar. The air service network is shown in Figure 7.29.

Table 7.27 describes international passenger movement to and from Myanmar, indicating marked increases in 2012 movement with an increase of 33.2% at Yangon and 76.3% at Mandalay. Passenger movement at Yangon airport accounts for 96% to 99% of total international passenger movements, which, although historically strong, now shows a slight decrease.



Source: JICA Study Team

**Figure 7.29 Current International Air Services Network at Yangon and Mandalay**

**Table 7.27 International Passenger Movements Record**

Airport	Description	2007	2008	2009	2010	2011	2012
Yangon Int'l	Passengers	867,853	824,595	967,622	1,211,372	1,448,729	1,929,404
	Change	-	-5.0%	17.3%	25.2%	19.6%	33.2%
	Share	-	98.5%	98.0%	97.6%	97.0%	96.1%
Mandalay Int'l	Passengers	10,102	12,232	20,246	30,261	44,234	77,995
	Change	-	21.1%	65.5%	49.5%	46.2%	76.3%
	Share	-	1.5%	2.0%	2.4%	3.0%	3.9%
Total	Passengers	877,955	836,827	987,868	1,241,633	1,492,963	2,007,399
	Change	-	-4.7%	18.0%	25.7%	20.2%	34.5%

Source: DCA

### 7.6.3 Air Traffic Services

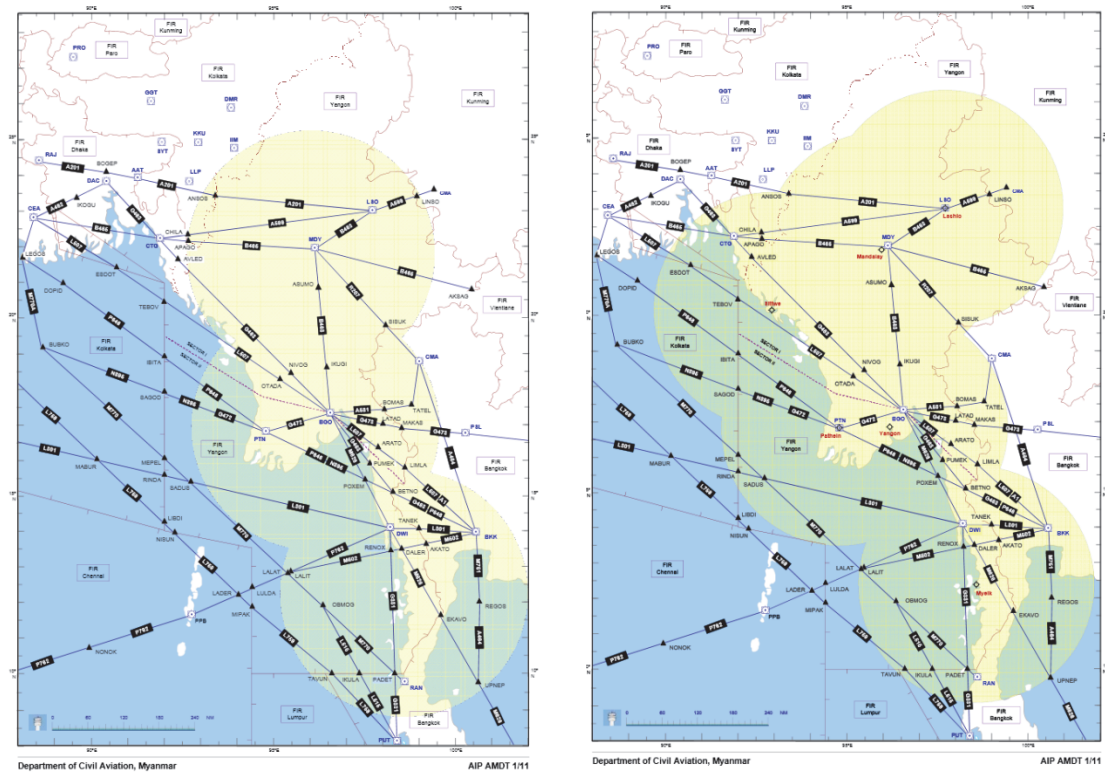
Myanmar's Air Traffic Services (ATS) are provided by air traffic control units such as the Area Control Center, Approach Control Units and Aerodrome Control Towers. Table 7.28 summarizes the air traffic control services being provided within Myanmar's defined airspace.



**Table 7.28 Air Traffic Control Services**

ATC Services	Control Area	ATC Facility
Area Control	Yangon FIR (2 sectors)	Yangon ACC
Approach Control	Mingaladon (Yangon) Terminal Control Area	Mingaladon APP
	Mandalay Terminal Control Area	Mandalay APP
Aerodrome Control	32 airports	Control Tower

Yangon Area Control Center (ACC) provides ATC services for aircraft at the Yangon FIR airport and utilizes Monopulse Secondary Surveillance Radar (MSSR) (in Yangon, Mandalay and Myeik) and six Very High Frequency (VHF) Remote Control Air Ground (RCAG) stations (Yangon, Mandalay, Lashio, Sittwe, Patheingyi and Myeik), which are connected by Very Small Aperture Terminal (VSAT) channel between ACC and each facility. MSSR coverage and VHF RCAG coverage are shown in the Figure 7.30. This equipment monitors almost all of the two sectors within the Yangon FIR, though MSSR and communication coverage gaps still exist in the Bay of Bengal airspace.



**Figure 7.30 MSSR and VHF RCAG Coverage (Line of Sight)**

## 7.6.5 Sector Funding

### (1) Budget of DCA

Table 7.29 and Table 7.30 indicate the annual DCA budgets since 2011 for capital expenditures (including repair) and current expenditures (including equipment maintenance costs). The DCA budget for current expenditures was increased significantly in Fiscal Year 2012-2013, due to the increase of pay allowances, etc., which are a major cost item and accounted for 53% of the total current expenditures in FY 2012/2013.

**Table 7.29 DCA Budget for Capital Expenditures**

(million Kyats)

Category	FY 2010-2011	FY 2011-2012	FY2012-2013
On-Going Construction	12,486.141	13,136.425	16,411.546
New Construction	7,829.095	2,790.374	4,256.157
Machinery & Equipment	9,382.215	1,096.673	351.107
Installation	309.882	184.177	213.156
Total	30,007.332	17,207.649	21,231.967

Source: DCA

**Table 7.30 DCA Budget for Current Expenditures**

(million Kyats)

Category	FY 2010-2011	FY 2011-2012	FY2012-2013
Pay, Allowances, Honoraria, etc.	1,033.862	1,025.123	1,637.033
Travelling Allowances	19.994	35.936	109.304
Goods, Labor, Servicing	875.875	970.797	1,233.037
Maintenance Charges	175.718	215.856	421.712
Transfer Payment	0	0	10.505
Entertainment	0.893	1.199	1.389
Total	2,106.342	2,248.910	3,412.980

Source: DCA

### (2) Revenues from DCA's Activities

Table 7.31 reports revenues earned from DCA activities during the last 3 years. In FY 2012/2013, revenues grew significantly because: (i) currency exchange rates increased; (ii) aeronautical charge increased for domestic flights; and (iii) the DCA introduced service charges for domestic passengers. Total revenues in this fiscal year were more than twice the current and capital expenditures.

**Table 7.31 Revenues from DCA's Activities**

(million Kyats)

Category	FY 2010-2011	FY 2011-2011	FY 2012-2013
Earning from Services	789.493	1,024.162	62,506.414
Earning from Rents	232.357	342.355	2,052.555
Earning from Rents & Taxes	46.674	500.291	967.763
Miscellaneous	6.283	20.289	323.407
Other	33.512	51.147	133.204
Total	1,108.319	1,938.244	65,983.343

Source: DCA

Table 7.32 describes air navigation facility charges collected in FY 2012/2013, when international over-flying aircraft provided the majority of the revenue.

**Table 7.32 Air Navigation Facility Charges Collected in FY 2012/2013**

Type of Flight	Amount
Domestic Flight (including Landing Charge)	K 52.829 million
International Flight (Incoming & Outgoing, including Landing Charge)	US\$ 1.68130 million
International Flights (Over Flight)	US\$ 67.885 million

Source: DCA

Facility charges for international passengers cost US\$10 and domestic passengers are charged Ks1,000. It should be noted that while tariffs on domestic flights increased 100 fold in July 2012, this is still only about 1/4 the industry average charge for international flights, at the current exchange rate.

Compared with neighboring countries such as Vietnam and Thailand, the landing charges in Myanmar are among the lowest in ASEAN. The air navigation facility charge for landing an Airbus A320 (MTOW 73,500kg) is US\$ 99 in Myanmar and US\$ 210 or 255 in Vietnam, depending on the controlled flown distance. The Boeing B767 (MOTW 186,900kg) landing charge is US\$ 304 in Myanmar and US\$ 310 or 390 in Vietnam.

#### **7.6.6 Ongoing Projects and Actions**

##### **(1) Yangon International Airport Development Project**

The Yangon International Airport Development Project is a 30-year BOT and will expand terminal capacity to 6 MPPA. The DCA invited private investors through tender and a contract was announced on 10 August 2013. The total investment proposed by the successful applicant was US\$ 199.5 million, of which US\$ 169 million is to be a loan with 6.30% interest rate.

##### **(2) Hanthawaddy International Airport Project**

Hanthawaddy International Airport is a planned as a new international airport, located 77 km northeast of downtown Yangon. On 09 July 2012, the DCA issued an "Invitation to Prequalification" for this project and a successful tender was announced on 10 August 2013. DCA estimates the capacity limit of Yangon International Airport is 6 MPPA and has noted the following points:

- The existing airport is suitable for short-range flights and propeller or small jet aircraft and can accommodate domestic flights.
- Hanthawaddy airport will be suitable for international flight operation.
- If operating conditions such as aircraft and number of movements can be achieved, national airlines may be able to operate regional routes at the existing airport.

**Table 7.33 Outline of Facility Requirements (Hanthawaddy International Airport)**

		Phase 1	Phase 2
Operation Start		Year 2018	Year 2028
Annual Passengers	International	12 MPPA	24 MPPA
	Domestic	-	6 MPPA
	Total	12 MPPA	30 MPPA
Runway Length		3,600m x 1	3,600m x 2
Apron	Code E	15	26
	Code C	21	51
	Total	36	77
Passenger Terminal Building (floor space)	International	192,000m <sup>2</sup>	256,200m <sup>2</sup>
	Domestic	-	24,000m <sup>2</sup>
	Total	192,000m <sup>2</sup>	280,200m <sup>2</sup>

Source: JICA Study Team

While the Hanthawaddy International Airport project moves forward, it has not yet secured all of its financing and the role of the existing Yangon International Airport, once the HIA is complete, remains unclear. As well, there are no firm plans to build access transport, such as an expressway, union highway or airport rail link.

### (3) Mandalay International Airport Project

DCA issued an Invitation to Prequalification for “Private Sector Participation in the Development of Mandalay International Airport” on 12 September 2012. The project is 30-year BOT and DCA expects the airport to handle 2 MPPA (0.6 MPPA international and 1.4 MPPA domestic) by 2023 and 5 MPPA (1.5 MPPA international and 3.5 MPPA domestic) by 2033. A successful tender was announced on 10 August 2013 and the total investment proposed by the successful bid was US\$22.1 million, all covered by equity.

### (4) Development Plan for Domestic Airports

DCA has a plan to improve many airports in Myanmar, namely: Heho, Nyaung U, Tachileik, Kawthoung, Myitkyina, Myeik, Dawei, Thandwe, Kengtung, Kyaukphyu, Mong-Hsat and Coco Island. Heno and Nyaung O airports are planned to function as international airports<sup>5</sup>.

### (5) Development of CNS/ATM Systems

DCA established the Air Traffic Management Modernization Plan but have no plans in the medium term (2013-2016) to implement ICAO preferred or accepted performance based navigation systems, such as RNAV 5 or RNP 4 for route operation and Expand RNAV 1 or RNP 1 for TMA. TA on CNS/ATM sponsored by JICA is scheduled from the middle of 2014.

### (6) Project for the Improvement of Nationwide Airport Safety and Security Equipment

Japan International Cooperation Agency (JICA) is providing grant aid for the Project for the Improvement of Nationwide Airport Safety and security equipment such as x-ray equipment and an approach lighting system.

<sup>5</sup> DCA announced in November 2013 that it was planning to invite private investors to upgrade 30 domestic airports, mainly due to government budget constraints; many of Myanmar’s local airports also need urgent improvement.

**Table 7.34 Project for the Improvement of Nationwide Airport  
Safety and Security Equipment**

Unit: No.	Yangon	Mandalay	Heho	Nyaung U	Thandwe	Dawei
Major Fire Fighting	1	-	-	-	1	1
Rapid Intervention Vehicle	1	-	1	1	-	-
Friction Testing Vehicle	1	-	-	-	-	-
X-Ray Equipment (Hold Baggage)	2	1	1	2	1	-
X-Ray Equipment (Cabin Baggage)	2	-	1	2	-	1
Doppler Type VHF Omnidirectional Range / Distance Measuring Equipment	-	-	1	1	1	-
Simple Approach Lighting System	-	-	-	1	-	1
Runway Threshold Identification Lights	-	-	-	1	-	1
Precision Approach Path Indicator	-	-	-	2	-	2
Runway Edge/Threshold/End Lights	-	-	-	-	-	1
Automatic Meteorological Observation System	-	-	1	1	1	1
Explosive Trace Detecting System	3	2	-	-	-	-
Voice Communication Control System	1	-	-	-	-	-
Flight Procedure Design System	2	-	-	-	-	-

Source: Study Team

## (7) Reorganization of DCA

DCA is contemplating organizational changes to separate internal service functions from regulatory functions. To achieve this, DCA plans to create an “Airport Authority”, which will provide airport services and create the “Air Navigation Services of Myanmar”. This new entity will provide communications, navigation and surveillance, air traffic management and aeronautical information services.

### 7.6.7 Key Sector Issues

#### (1) Planning and Coordination

DCA is planning to develop a new airport, Hanthawaddy International Airport, to address growing traffic demands and stretched capacity of the existing YIA, as well as to expand YIA via a PPP scheme.

Other efforts that address increased traffic demands, such as enforcement of specific traffic distribution rules, do not appear to be of interest to the Government. As a result, both international and domestic passenger traffic must be accommodated at YIA and HIA, though the private sector will be an important partner to ensure profitability. Furthermore, this two-airport solution will require complex processes and additional investment for airlines and airport services and may result in inconveniences for users and transit passengers. Finally, efficient and reliable airport access will be important for success. HIA is approximately 80 km from Yangon city center, and the construction of rapid road and rail access for HIA will require significant investment, not currently under the control/responsibility of DCA.

## **(2) Infrastructure (Air Traffic Modernization Plan) and Capability Improvement**

DCA has developed an Air Traffic Management Modernization Plan that includes the implementation of Performance Based Navigation (PBN), which will include RNAV 10 for en-route, Basic Required Navigation Performance 1 (RNP) for the terminal and Lateral Navigation (LNAV) / Vertical Navigation (VNAV) Global Navigation Satellite System (GNSS) for approach. However, the plan does not include ICAO preferred or acceptable navigation specifications, such as the RNAV 1, RNP 2, RNAV 2, RNAV for continental en-route, RNP 2, or RNP 4 for oceanic operations. For the seamless and efficient operations of international flights, DCA should implement PBN and modernize CNS/ATM systems in line with ICAO's Global Air Navigation Plan (GANP).

The Mandalay International Airport (MIA) has a runway of more than 4,000 m and passenger terminal capacity of 3.0 MPPA. However, the existing facilities at MIA will not be fully utilized until 2025. Similarly, the facilities at Nay Pyi Taw International Airport (NIA) have a design capacity to accommodate 5.0 MPPA, though this will not be utilized throughout the planning horizon (up to year 2030).

Myanmar's domestic airports are also not compliant with ICAO standards or recommendations. Several of these domestic airports lack even Precision Approach Path Indicator (PAPI), the critical visual guidance system for approaching aircraft. These deficiencies can both directly and indirectly influence the safety of aircraft operations at the airports, or downgrade the airport serviceability in terms of flight delays and cancellations. The lack of night operation facilities at most of domestic airports impose additional limitations on hours of operation and the lack of an aircraft fuel supply facility at many domestic airports require airlines to arrange to carry additional fuel or conduct technical stops during flights.

## **(3) Safety, Security and Environment**

ICAO Annex 11 requires "States shall establish a State safety program, in order to achieve an acceptable level of safety in civil aviation" and "States shall require, as part of their State safety program, that an air traffic services provider implement a safety management system acceptable to the State". For airports, ICAO Annex 14 requires "As part of the certification process, States shall ensure that an aerodrome manual which will include all pertinent information on the aerodrome site, facilities, services, equipment, operating procedures, organization and management including a safety management system, is submitted by the applicant for approval/acceptance prior to granting the aerodrome certificate." Annex 6 requires "States shall require, as part of their State safety program, that an operator implement a safety management system acceptable to the State of the Operator".

## **(4) Human Resource, Institution and Regular**

### **a) Separation of the Regulatory and Service Functions within DCA**

The separation of air traffic regulatory and service functions has not been made. The change of organization structure in legislation may take time, but it shall be rectified, in practice (de facto), as soon as possible for improvement of safety of civil aviation.

### **b) Enhancement of Myanmar Accident/Incident Investigation Bureau**

The Myanmar Accident/Incident Investigation Bureau is headed by an Investigator-in-Charge who presently has just two Investigators from the Airworthiness Division. Aircraft accident investigation is a highly specialized task that should only be

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undertaken by trained personnel. Depending on the types of accident/incident, various specialists are required for a thorough investigation. DCA officers, who have a good and sound working knowledge of aircraft operations and air traffic services, should be trained as Investigators, though foreign technical assistance would be required for training of this type. These staff may work as investigators on-call basis for efficient use of human resources in DCA.

## **(5) Finance**

Successful PPP projects require that public and private partners are equipped with clear and well-planned roles and responsibilities and that they understand their obligations and the potential risks during project preparation stages. These requirements, while important to be set early in the project planning stage, may be adjusted during the tender process through a pre-bid conference, clarification on bid documents, bid document consultation and/or two-stage bidding.

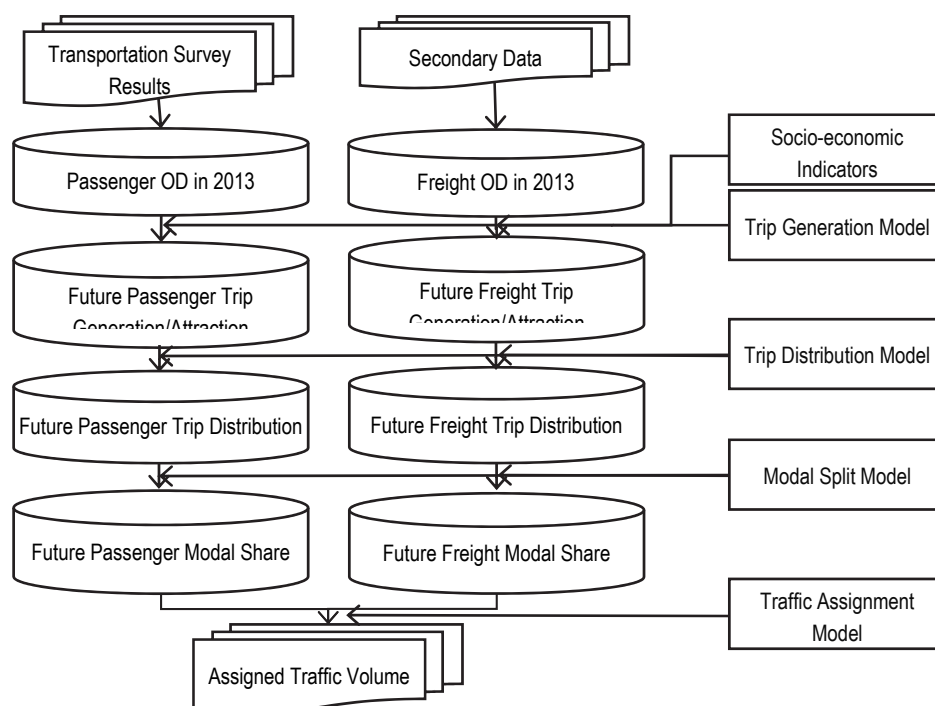
The development of a new international airport requires very substantial funding to construct the runway, taxiway system, apron, CNS/ATM facilities and equipment, passenger and cargo terminal facilities, road and car park, etc. These are partially offset by the passenger terminal facilities, which can generate significant revenues if passenger demand is significant. If this is not the case, the private investor who participated in development of HIA, may require the HIA operator to raise airport tariffs, resulting in the loss of competitive edge.

## Chapter 8 Demand Forecast

### 8.1 Introduction

The MYT-Plan traffic demand forecast models have been developed to simulate inter-city passenger and freight movement in the country. The year 2013 base-year inter-zonal Origin-Destination (OD) matrices are estimated, based on the traffic surveys conducted by the JICA Study Team during the first and second quarter of 2013 and secondary transport statistics provided by the transport related agencies.

Figure 8.1 summarizes the work flow of the MYT-Plan model building. Each of the passenger OD matrices is developed according to the most significant mode of transport (e.g. private vehicle, highway bus, railway, inland water transport and air). Additionally, the freight OD matrices are further broken down by type of cargo (e.g. 17 commodity types such as rice, wood, steel, etc.). A series of conventional four step procedure models are then developed based on existing network attributes, such as distance, travel time, travel speed, etc. Future zonal parameters are estimated separately, based on the given socio-economic framework. By incorporating those future parameters, then future OD matrices are estimated.



Source: JICA Study Team

**Figure 8.1 Demand Forecast Work Flow**



## 8.2 Existing Traffic Demand

### 8.2.1 Passenger Transport

The year 2013 daily passenger travel demand in Myanmar in terms of inter-zonal movement is summarized as follows:

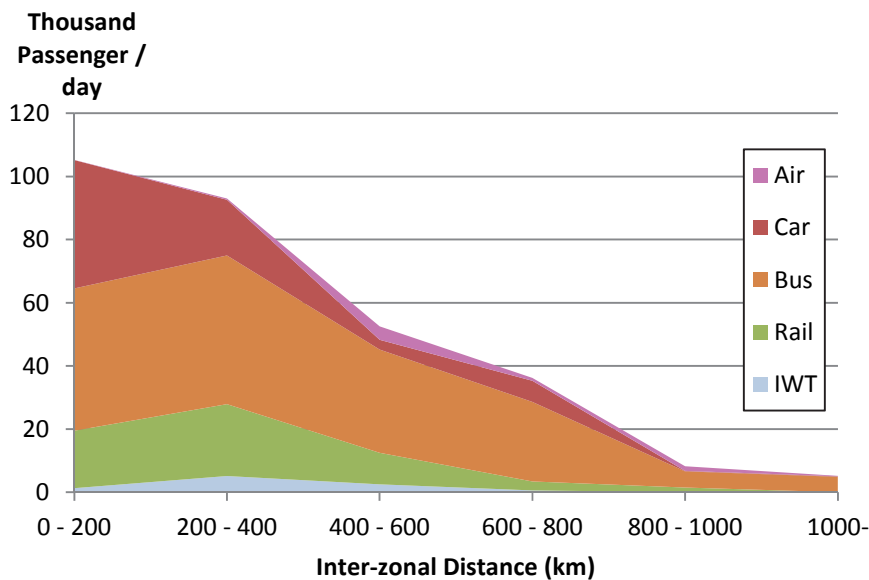
- Total trip generation: approximately 300 thousand trips per day
- Total passenger kilometres: 102 million passenger kilometres per day
- Average travel distance: 340 kilometres per person for a continuous travel

In terms of modal share, bus transportation is dominant, reaching at about 53% of the total, followed by car 23%, railway 18%, IWT 3% and Air 2%. Figure 8.2 illustrates modal share by travel distance.

**Table 8.1 Observed Current Passenger Movement in Myanmar**

Transportation Mode	Inter-zonal Trips (Trips / day)	Modal Share (%)	Passenger * km (thousand)	Average Distance (km/Trips)
Air	7,282	2	4,559	626
Car	68,414	23	14,479	212
Bus	160,042	53	62,689	392
Rail	55,286	18	16,985	307
IWT	9,421	3	3,470	368
Total	300,445	100	102,182	340

Source: JICA Study Team



Source: JICA Study Team

**Figure 8.2 Passenger travel demand by mode of transport and by travel distance**

## 8.2.2 Freight Transport

In 2013, Myanmar's inter-zonal daily freight movement is summarized as follows:

- Total freight traffic generation: 208.9 thousand tons per day
- Mode of transport: truck (81%), followed by coastal shipping (20.6%), inland waterway (10.2%) and railway (9.6%)

**Table 8.2 Current Freight Volume by Mode and Commodity**

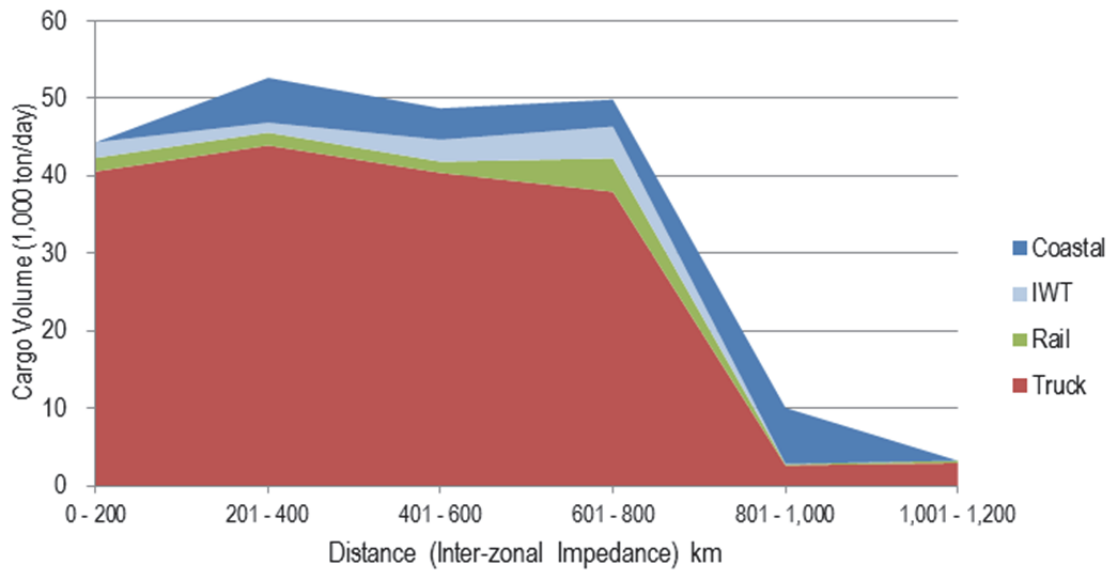
(Unit: thousand ton / day)

Commodity	Truck	IWT	Railway	Coastal	Total
1_Live Animal & Animal Products	1.6	0.0	0.0	0.0	1.6
2_Fish and Aquatic Products	2.6	0.0	0.0	0.0	2.7
3_Vegetable and Fruits	6.0	0.0	0.0	0.0	6.0
4_Grain and Grain Products	31.9	0.7	0.4	1.3	34.3
5_Other Agricultural Products (ex. Plantation Product)	14.2	0.6	0.1	0.0	15.0
6_Foodstuff, Beverage and Animal Food	17.6	1.4	2.5	4.1	25.6
7_Petroleum, Oil and Gas	4.8	3.2	0.3	13.4	21.8
8_Coal, Ore, Stone and Sand	7.9	0.2	0.3	0.0	8.4
9_Cement, Construction Material (incl. steel - frame)	22.7	1.5	2.7	1.2	28.0
10_Fertilizer (incl. Urea)	14.0	0.1	0.1	0.0	14.2
11_Garment, Textiles and fabric	3.3	0.1	0.0	0.0	3.5
12_Wood and Wood Products	3.6	0.5	1.7	0.0	5.8
13_Paper and Printed Matter	1.4	0.0	0.1	0.0	1.5
14_Metal and Metal Products (excl. construction material)	1.9	0.1	0.3	0.0	2.3
15_Industrial Material, Chemicals	6.5	0.1	0.5	0.3	7.4
16_Household articles, miscellaneous	20.3	1.3	0.6	0.3	22.5
17_Machinery and Parts, Transportation	8.1	0.2	0.1	0.0	8.4
Total	168.4	10.2	9.6	20.6	208.9
Share	81%	5%	5%	10%	100%

Source: JICA Study Team

As shown in Figure 8.3, the volume of cargo for which travel distance is longer than 800 km is small (about 6%), in other words, the travel distance of most of the cargo movement falls in within 800km.

Truck transport is a dominant form for cargo transport for distances up to 800 km. The railway and inland waterway seem to be relatively competitive for distance over 400 km.



Source: JICA Study Team

**Figure 8.3 Cargo Trip Distribution by Mode**

### 8.3 Transport Modelling

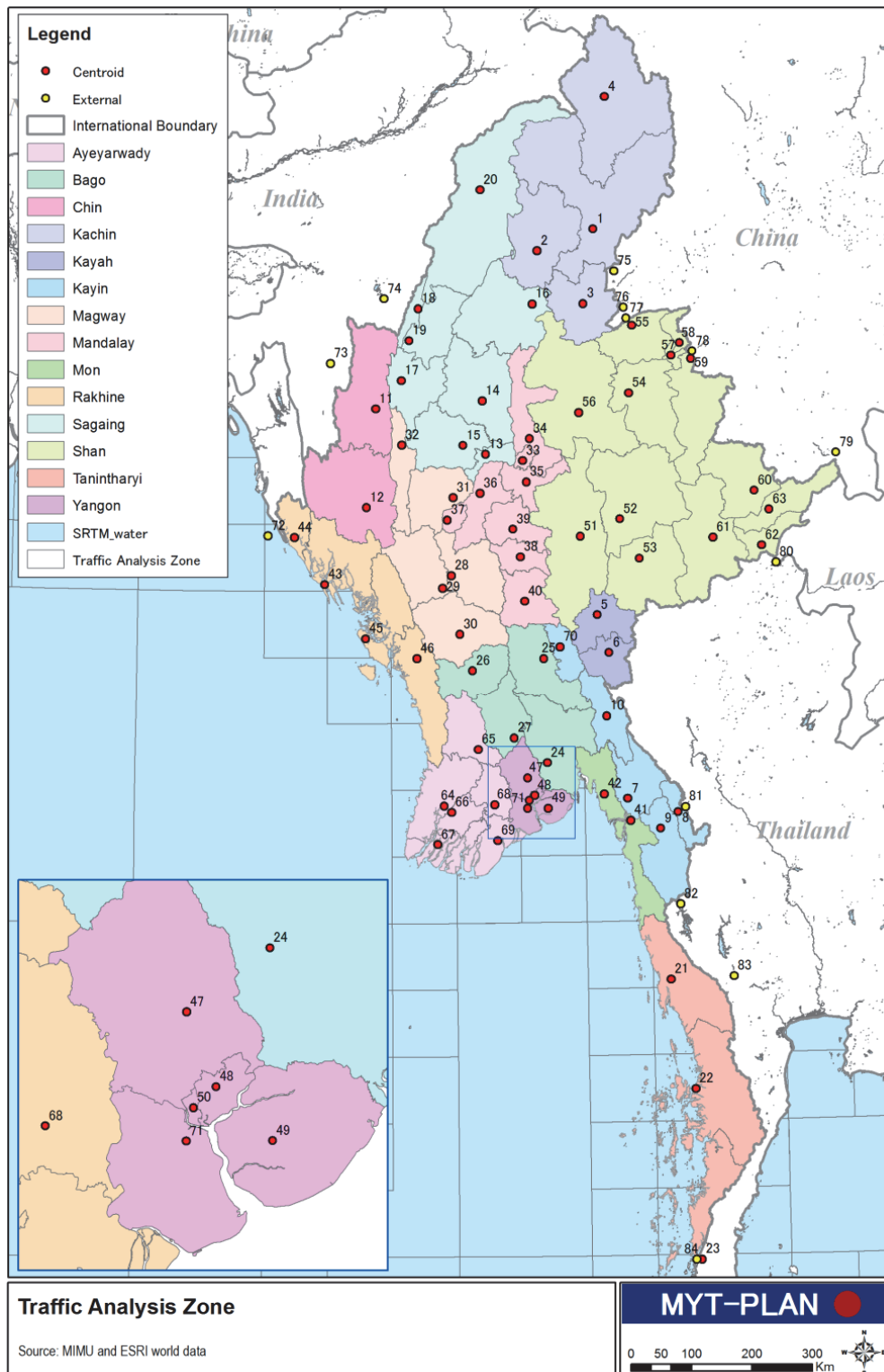
#### 8.3.1 Zoning System and Transportation Network

##### (1) Zoning System

Myanmar is divided into 71 Traffic Analysis Zones (TAZ), based on administrative boundaries and geographic features, which are used as a reference for traffic data collection, analysis, and transport modelling.

The Yangon Region is divided into five TAZs in order to capture traffic demand in a more detailed manner, that is, traffic generation from the western bank of the Yangon River, downtown area including the Yangon Ports, Thilawa SEZ, etc. Similarly, Hpa-an district is divided into two zones because it includes two segregated areas.

In addition to the 71 intra zone system, external zones (zone no. 72 to 84) are identified in order to capture the traffic movement between Myanmar and neighboring countries.



Source: MIMU, ESRI world data, JICA Study Team

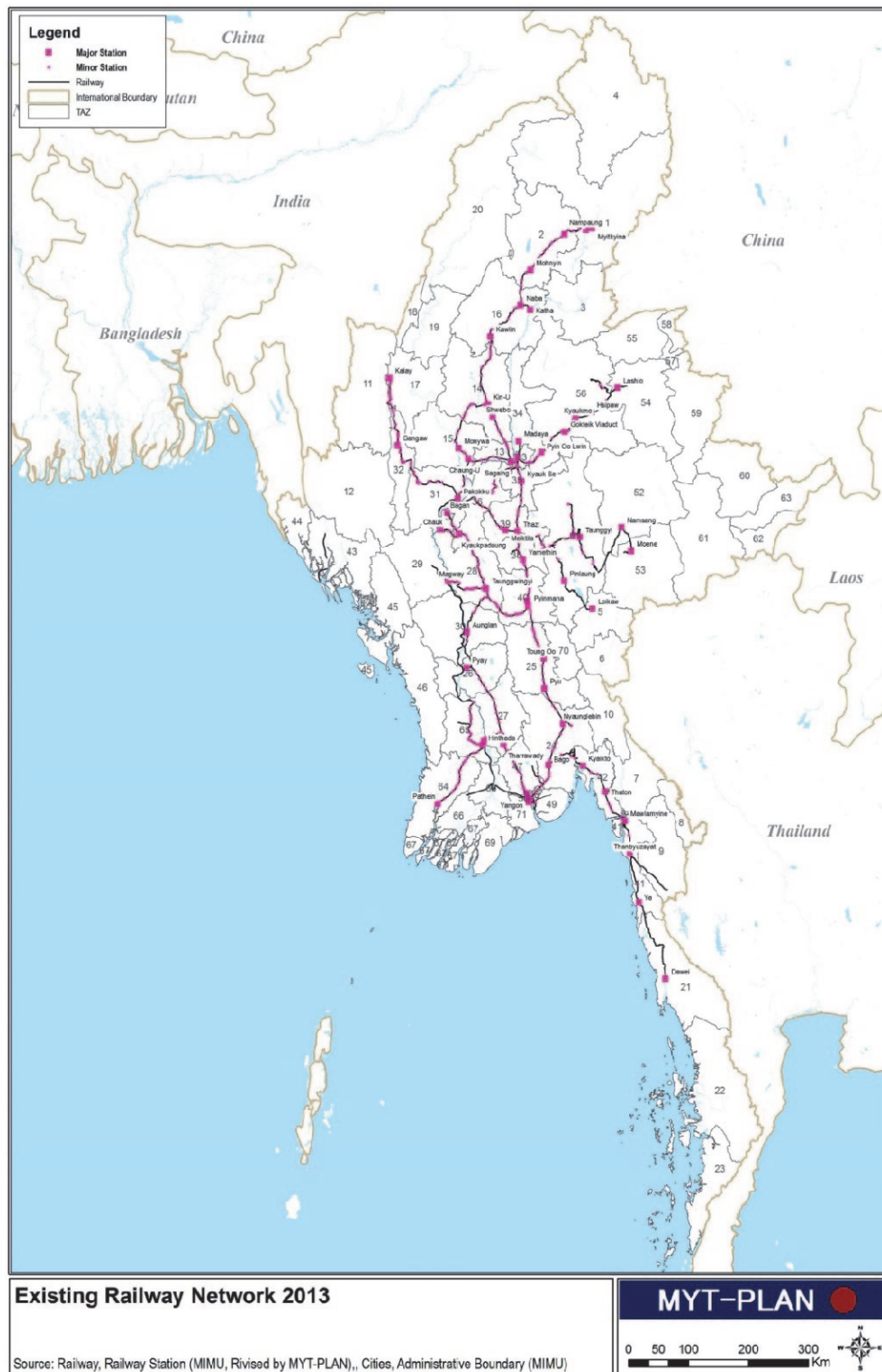
**Figure 8.4 Traffic Analysis Zone**

## **(2) Transport Network**

### **1) The Base Year Transport Network**

The 2013 base year transport network (trunk transport system) was developed based on geographical information from the Myanmar Information Management Unit (MIMU). The data from MIMU was reviewed and updated based on advice from experts of Public Works, Myanmar Railway, Inland Water Transport and a site investigation by the JICA Study Team.

The union highway information was used to develop the computerized road network, while information of regional roads and other roads of lower classes was not updated nor cleaned in terms of GIS.



Source: JICA Study Team and MR

**Figure 8.5 Existing Railway Network**

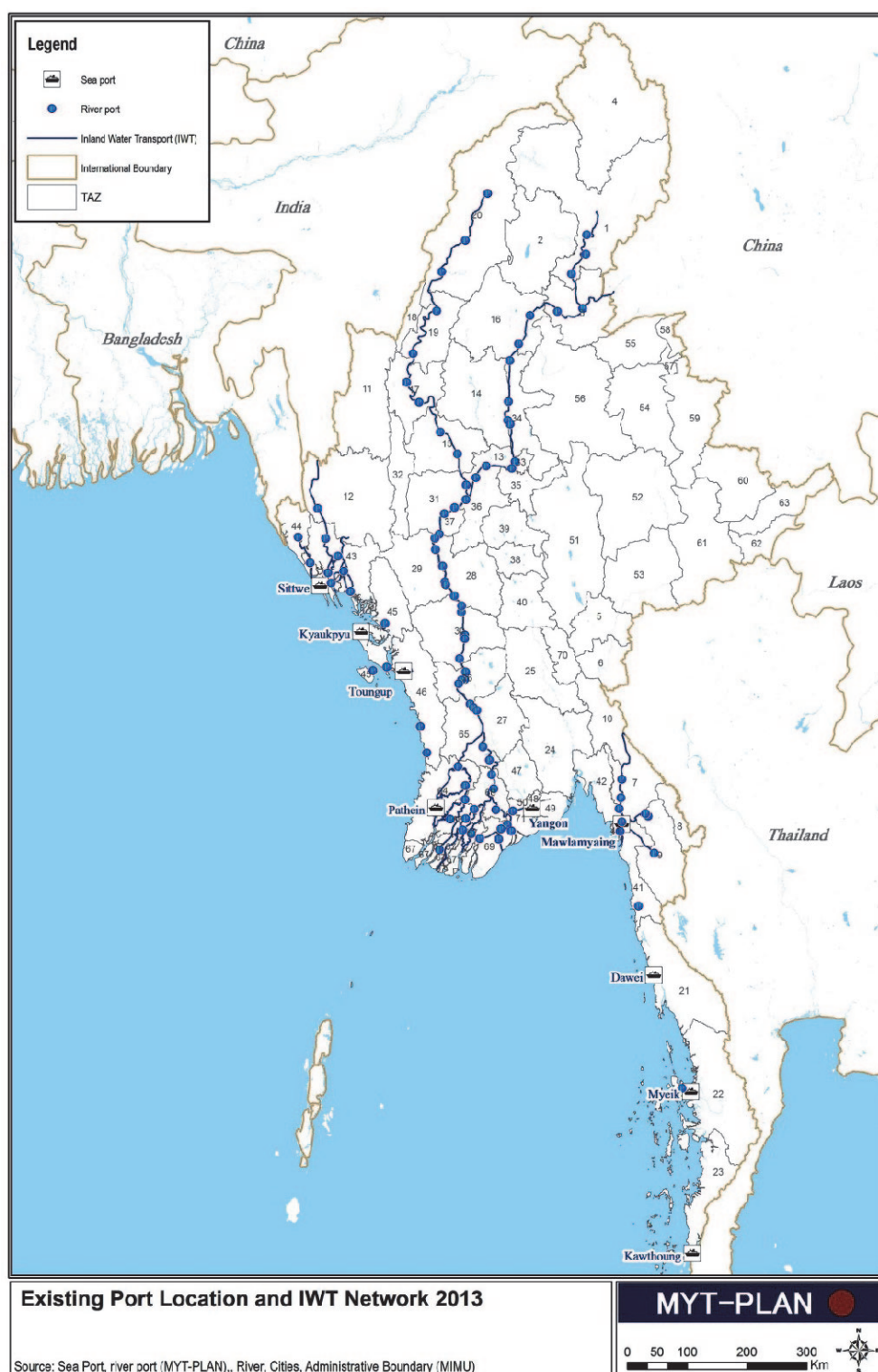
Final Report



Source: JICA Study Team, PW and Ma Hta Tha

**Figure 8.6 Existing Road and Bus Network**



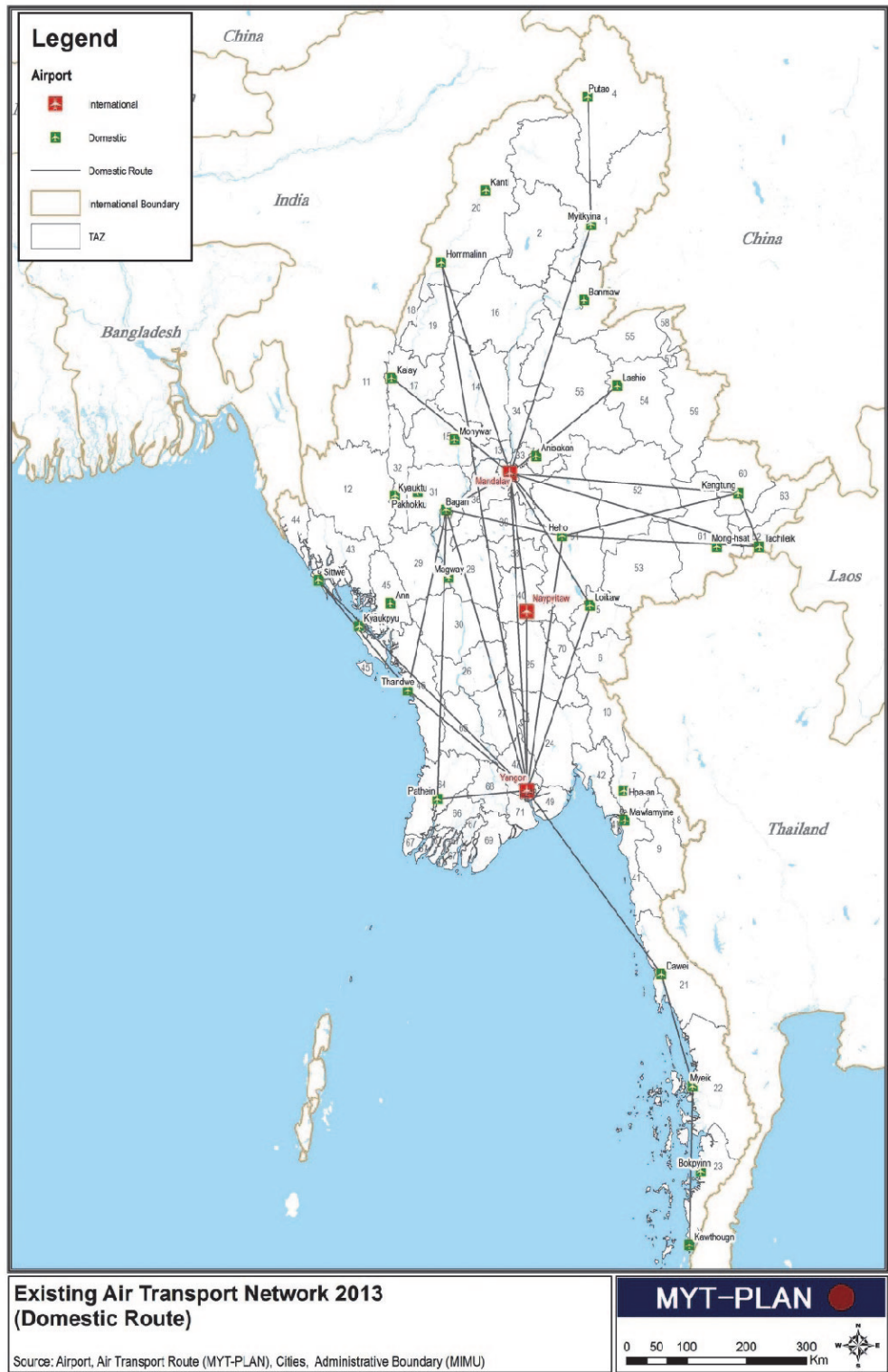


Source: JICA Study Team and IWT

**Figure 8.7 Existing IWT Network**



Final Report



Source: JICA Study Team, Myanmar Travels & Tours Directory 2013

Figure 8.8 Air Transport Network

## 2) Network impedance

### a) Passenger

Figure 8.9 summarises passenger travel fares for each mode. Obviously, air travel has the highest fares, followed by fares of cars using the expressway. There is no significant difference between fares for highway bus and rail (upper class) and between rail (ordinary) and inland water transport, in terms of travel expense.

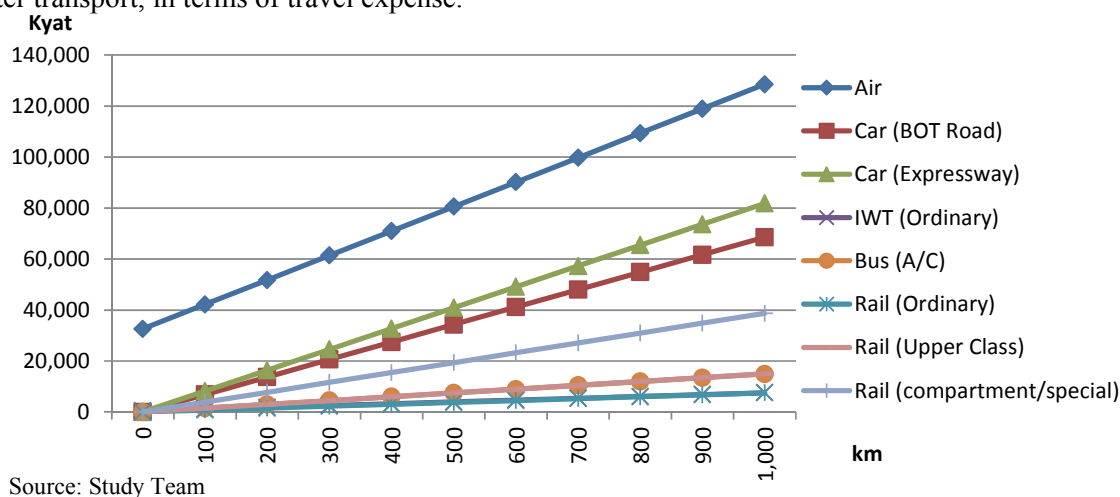


Figure 8.9 Passenger Travel Cost Comparison by Transportation Mode<sup>1</sup>

### b) Freight

Travel time and transport cost of each transport mode are calculated as follows,

- Coastal shipping

Coastal shipping travel times and transport costs include vessel and truck for access/egress to the port. These are calculated by estimating the average speed of bulk/general cargo vessel 20.37 km/h (11 kt) and distance between the ports by “cargo transported by coastal trade” prepared by MOT, which includes inbound/outbound freight by ton and ton-mile. Transport cost (Kyat/ton) by vessel are prepared by conducting analysis on “coastal freight transport, other than Myanmar five star line in Yangon region (MPA)”. Travel times of access/egress truck to/from coastal ports (18 km each) are calculated by accounting for median travel distance and speed (21.6 km/h), based on truck driver interview survey at river ports. Truck transport costs are calculated using a distance proportional model, estimated with a regression model and based on roadside interview surveys.

- Inland waterways

Inland waterway travel times and transport costs also include vessel and truck modes as factors. Vessel travel times between representative river ports for each zone, defined by handling cargo volume, are calculated by travel distances shown in “cargo transported by inland waterways cargo vessels (MPA)” and average travel speeds (5.07 km/h), based on the

<sup>1</sup> Travel Cost for car includes toll and gasoline cost.

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actual operation schedule. Transport costs of vessels an average (15 Kyat/ton/km) of the dry and rainy season rates between Yangon and Mandalay, based on interview survey with forwarders. Travel times and costs of truck access/egress to river ports are calculated by road distances between zone centroids and the nearest river ports, and median travel speeds (21.6 km/h) and the estimated distance proportional fare systems of truck.

- **Railway**

Railway travel times and transport costs consists of railway and truck factors. Railway travel times are calculated by average travel speed (16.7 km/h) based on actual performance in “Strategic Plan (MR)” and distance between representative railway station in each zone selected by handling cargo volume. Transport cost of railway is defined as 36.5 Kyat/ton/km based on freight tariff of express freight train for plain section. Travel time and cost of access/egress truck is calculated by average truck travel speed, distance proportional fare system and average access/egress distance (14.4 km each) based on the results of truck driver interview survey at railway stations.

- **Truck**

Truck travel times are calculated by the median travel speed (21.6 km/h), based on the results of the roadside interview survey and distance by OD pair computed by road network. Truck transport costs are estimated by the following distance proportional fare system, based on the roadside interview survey.

$$\text{Kyat/ton by truck} = 41.7 * \text{distance (km)} + 5,339 \quad (R^2=0.724)$$

### **3) Future Transport Network**

The future transport network, for the year 2013, is developed based on the proposed component projects for each corridor (refer to Chapter 3 of this Final Report).

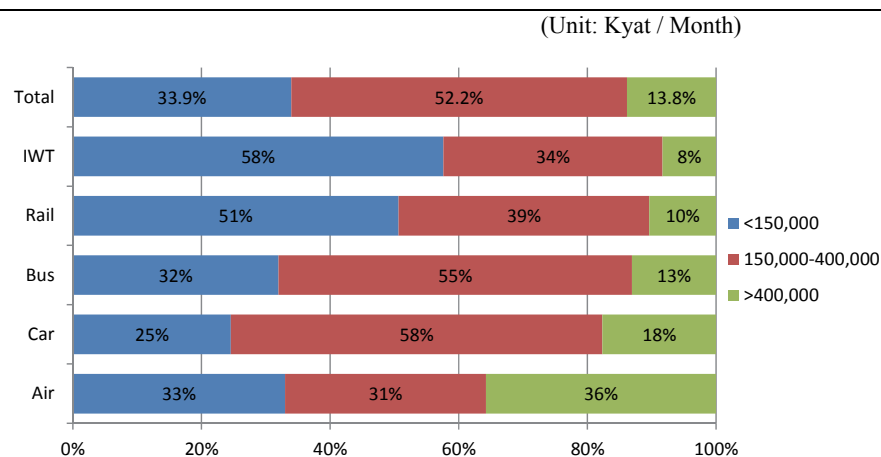
## **8.3.2 Socio-economic Framework**

### **(1) Household Income**

Figure 8.10 indicates the household income distribution of travellers, derived from the JICA Study Team’s transportation survey in 2013. Overall, one third of travellers were higher income earners while slightly more than half were middle income earners.

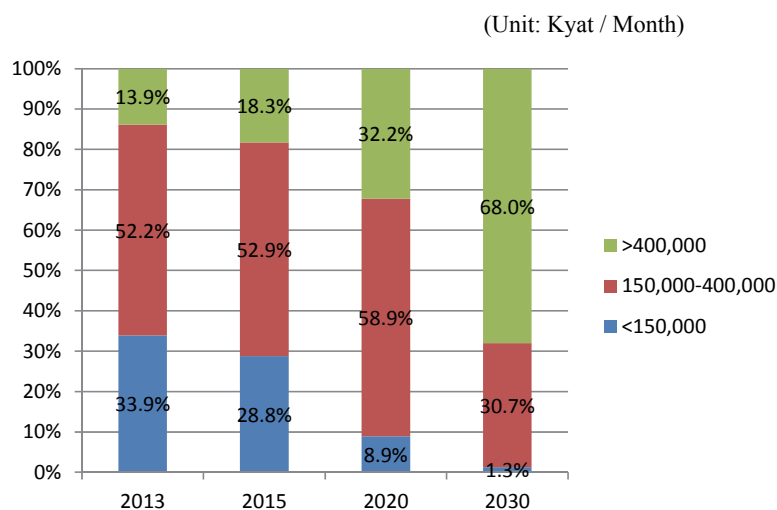
The relationship between household income level and choice of transport mode is clearly indicated in Figure 8.10. That is, a majority of travellers using rail and inland water transport are from lower income households, while the majority of highway bus and car users are from middle income households. In the case of civil aviation, higher income households account for nearly 40% of travellers and 30% are from lower income households.

Figure 8.11 indicates future income distribution, estimated based on the growth ratio of future GDP per capita and highlighting an important change in terms of peoples’ preference in future modal choice.



Source: Study Team

**Figure 8.10 Household Income Distribution by Mode**



Source: Study Team

**Figure 8.11 Forecasts of Household Income Distribution**

## (2) Value of Time

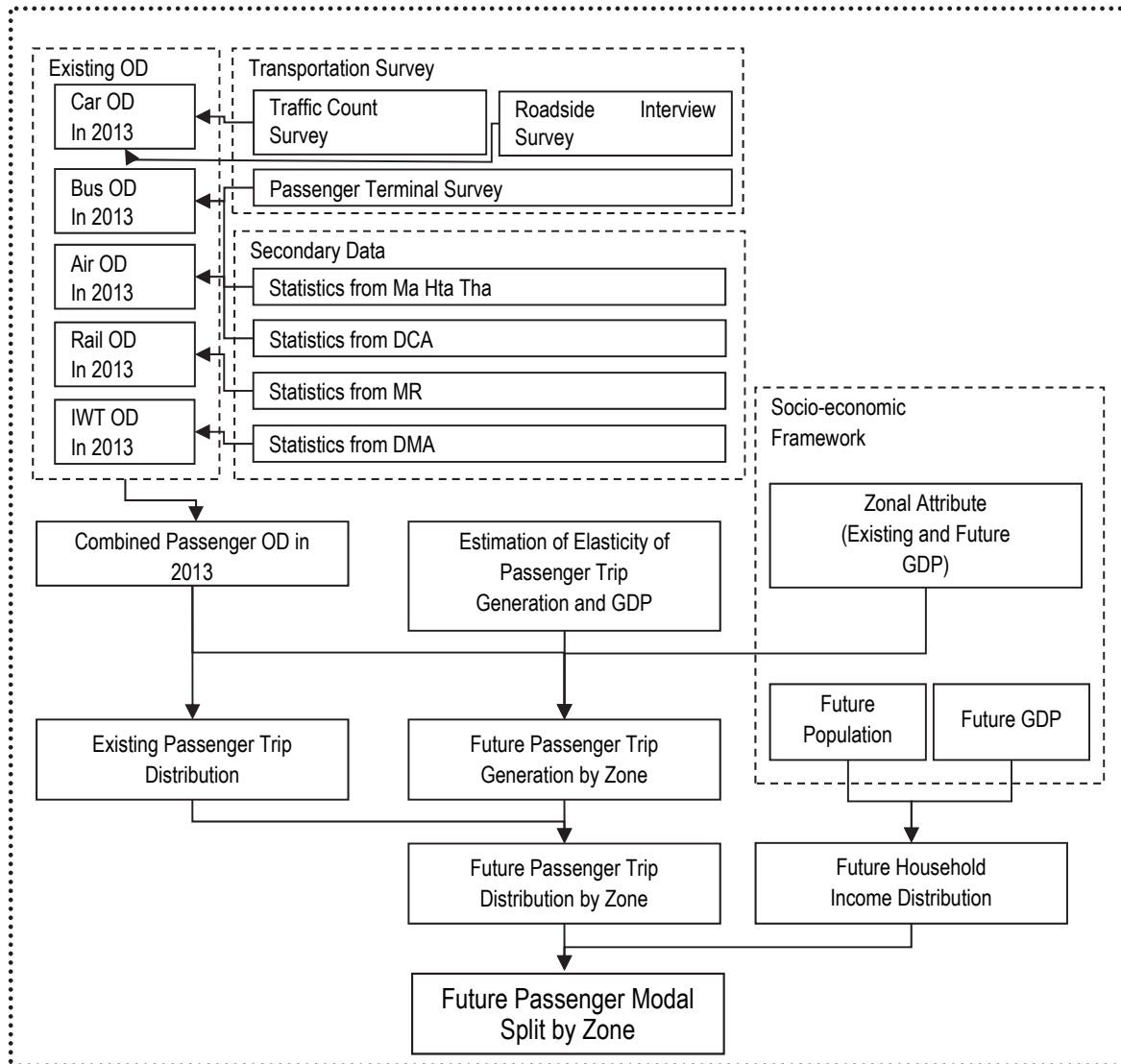
The interview survey findings illustrate respondents' assessment of "value of time"<sup>2</sup>, which is an influential factor in the modal split model. The value of time is determined at 562 Kyat per hour, 1,253 Kyat per hour and 3,636 Kyat per hour respectively, for each of the three economic activity classes (low, mid, and high) in the year 2013 constant prices.

<sup>2</sup> "value of time" is an estimated amount of money, based on monthly household income and average monthly working hour.

### 8.3.3 Passenger Transport

#### (1) Methodology

Figure 8.12 forecasts the flow of passenger demand, based on the conventional four-step method. Based on statistical information and the traffic survey, existing inter-zonal traffic volume was estimated. Trip generation is estimated as a function of the future socio-economic indicator of each zone. Furthermore, modal share of each transportation mode is estimated, comparing travel time and cost of each mode between each zone.



Source: JICA Study Team

**Figure 8.12 Flow of Passenger Demand Forecast**

## (2) Trip Generation

Population growth, economic development and income level improvement will increase the trip generation volume. Considering examples of economic development and traffic growth in neighboring countries, the GDP elasticity of trip generation from each zone, from 2013 to 2015 and from 2015 to 2030, are defined as 1.0 and 1.2 respectively.

## (3) Trip Distribution

The person trip distribution for inter-zone travel is estimated using the Frater method, as shown in following formula.

$$T_{ij} = t_{ij} \cdot \frac{G_i}{g_i} \cdot \frac{A_j}{a_j} \cdot \frac{1}{2} \left( \frac{g_i}{\sum_j t_{ij} \cdot A_j / a_j} + \frac{a_j}{\sum_i t_{ij} \cdot G_i / g_i} \right)$$

where,  $T_{ij}$ : Future trip distribution at zone i to j,  
 $G_i$ : Future trip production at zone i,  
 $A_j$ : Future trip attraction at zone j,  
 $t_{ij}$ : Current trip distribution at zone i to j,  
 $g_i$ : Current trip production at zone i, and  
 $a_j$ : Current trip attraction at zone j

## (4) Modal Split

The modal structure, or hierarchies of person trip types in terms of person model, is depicted in Figure 8.13. Person trips are distributed between five modes (air, private car, IWT, rail and bus) via a hierarchy of binary logit mode splits. The proportion of trips between any two zones (i and j) that identify 'choice one' from the subset of two choices, is calculated as follows:

$$\frac{1}{1 + \exp(-\lambda(C_{ij}^2 - C_{ij}^1))}$$

Where:

$\lambda$  is the scale parameter and is defined in Figure 8.13;

$C_{ij}^1$  is the generalized cost of travel for hierarchical choice 1 between any two zones i and j; and

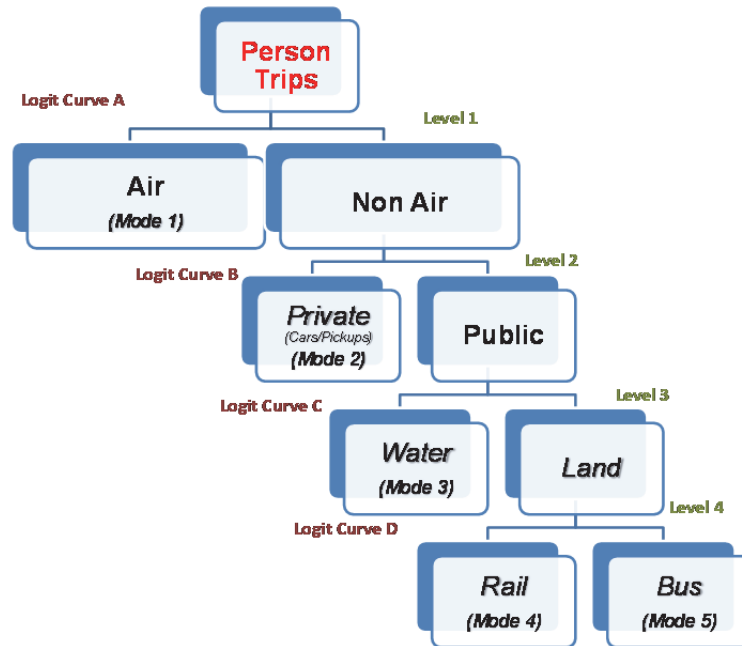
$C_{ij}^2$  is the generalized cost of travel for hierarchical choice 2 between any two zones i and j.

The generalized cost of travel<sup>3</sup> is defined to include all of the perceived travelling costs between any origin and destination. In the case of travel by car, this cost will include time, any tolls and the perceived fuel costs. In the case of non-car travel, the generalized cost includes

<sup>3</sup> This perceived cost is in the form of equivalent minutes.

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fare, travel time and waiting time. The scale parameter is estimated by income class based on the stated preference survey. Table 8.3 illustrates a comparison of the observed modal share and the estimated modal share.



Source: Study Team

Figure 8.13 Modal Split Hierarchy

Table 8.3 Modal Choice Scale Parameters

Mode Split Equation Level	Economic Activity Class s <sup>4</sup>	Choice 1	Choice 2	Scale Parameter
A	1	Air	Non-Air	0.0046
B	1	Car	Public	0.0033
C	1	IWT	Land Public	0.0072
D	1	Rail	Bus	0.0134
A	2	Air	Non-Air	0.0046
B	2	Car	Public	0.0033
C	2	IWT	Land Public	0.0092
D	2	Rail	Bus	0.0191
A	3	Air	Non-Air	0.0073
B	3	Car	Public	0.0082
C	3	IWT	Land Public	0.011
D	3	Rail	Bus	0.0237

Source: Study Team

Table 8.4 Comparison of Observed and Estimated Modal Share

(Unit: Person / day)

Transportation Mode		Air	Car	Bus	Rail	IWT
Estimated	Passenger	9,241	64,501	158,196	57,723	10,785
	Share	3%	21%	53%	19%	4%
Observed	Passenger	7,282	68,414	160,042	55,286	9,421
	Share	2%	23%	53%	18%	3%

Source: JICA Study Team

<sup>4</sup>

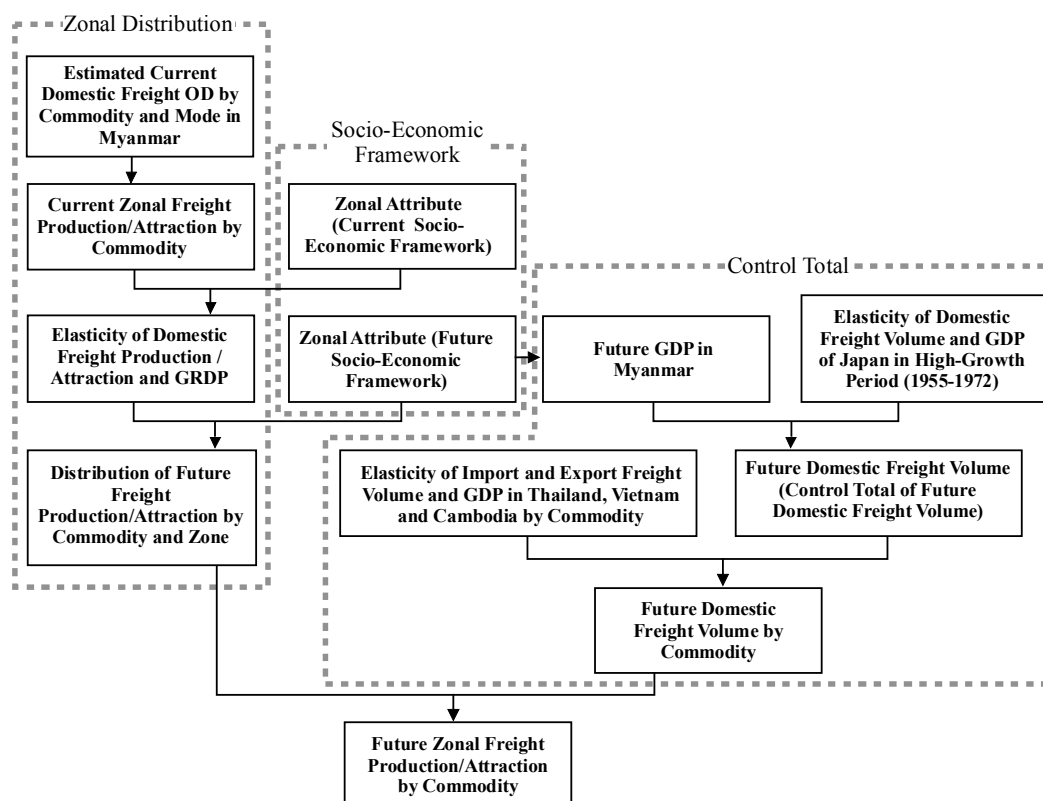
Household Income Category:

Class 1 ≤ 150,000 Kyat/ month, 150,000 < Class 2 ≤ 400,000, Class3 < 400,000

### 8.3.4 Freight Transport

#### (1) Trip Generation

Future cargo generation in the study area is estimated as shown in Figure 8.15. Future cargo generation modelling consists of two steps, namely: (i) estimation of a control total, which is the total domestic cargo generation of the entire study area by type of commodity; and (ii) zonal distribution, which is the cargo production and attraction by type of commodity and traffic analysis zone.



Source: JICA Study Team

Figure 8.14 Workflow of Future Zonal Cargo Generation

#### 1) Control Total

Control total is the total domestic cargo flow volume (between TAZs) of all transport modes and of all commodity types. This is estimated with existing total domestic cargo flow volumes and an expansion factor, calculated by future GDP growth rate and elasticity of domestic cargo volume to GDP.

The elasticity of domestic cargo volume to GDP is calculated by a regression model in Japan, during high-economic growth periods (1960 - 1972), which is 1.342 ( $R^2 = 0.993$ ).

Control total by type of commodity is also estimated by the elasticity of import/export volumes to GDP in Thailand, Vietnam and Cambodia. Defined elasticity is indicated in following table.



**Table 8.5 Elasticity of EXIM Volume by Type Commodities**

Commodity	Elasticity to GDP
1 Live Animal & Animal Products	1.22
2 Fish and Aquatic Products	1.76
3 Vegetable and Fruits	1.18
4 Grain and Grain Products	1.74
5 Other Agricultural Products (ex. Plantation Product)	2.13
6 Foodstuff, Beverage and Animal Food	1.30
7 Petroleum, Oil and Gas	1.84
8 Coal, Ore, Stone and Sand	2.21
9 Cement, Construction Material (incl. steel - frame)	1.93
10 Fertilizer (incl. Urea)	1.09
11 Garment, Textiles and fabric	1.24
12 Wood and Wood Products	1.14
13 Paper and Printed Matter	1.05
14 Metal and Metal Products (excl. construction material)	1.29
15 Industrial Material, Chemicals	1.33
16 Household articles, miscellaneous	1.80
17 Machinery and Parts, Transportation	1.40

Source: JICA Study Team

## 2) Zonal Distribution

The elasticity of cargo production/attraction by commodity to GRDP is shown in Table 8.6, based on the estimated current total cargo production/attraction and zonal attributes.

Future cargo production and attraction by zone is adjusted to control the total, after being computed by current cargo production and attraction, future GRDP by zone, elasticity of cargo production and attraction to GRDP.

**Table 8.6 Elasticity of Domestic Cargo Production and Attraction to GRDP**

Commodity	Cargo Production	Cargo Attraction
1 Live Animal & Animal Products	0.315	1.560
2 Fish and Aquatic Products	0.554	2.552
3 Vegetable and Fruits	0.803	0.819
4 Grain and Grain Products	1.274	0.771
5 Other Agricultural Products (ex. Plantation Product)	1.304	0.988
6 Foodstuff, Beverage and Animal Food	0.942	0.961
7 Petroleum, Oil and Gas	1.178	1.170
8 Coal, Ore, Stone and Sand	0.400	1.512
9 Cement, Construction Material (incl. steel - frame)	1.024	1.663
10 Fertilizer (incl. Urea)	1.663	1.831
11 Garment, Textiles and fabric	0.850	1.644
12 Wood and Wood Products	0.462	1.757
13 Paper and Printed Matter	0.858	0.579
14 Metal and Metal Products (excl. construction material)	1.621	0.384
15 Industrial Material, Chemicals	1.698	0.685
16 Household articles, miscellaneous	1.252	1.030
17 Machinery and Parts, Transportation	0.950	1.013

Source: JICA Study Team

## (2) Trip Distribution

The following formula uses the Fratar growth factor method to forecast future cargo OD by type of commodity.

$$T_{ij} = t_{ij} \cdot \frac{G_i}{g_i} \cdot \frac{A_j}{a_j} \cdot \frac{1}{2} \left( \frac{g_i}{\sum_j t_{ij} \cdot A_j / a_j} + \frac{a_j}{\sum_i t_{ij} \cdot G_i / g_i} \right)$$

where,  $T_{ij}$ : Future cargo distribution at zone i to j,

$G_i$ : Future cargo production at zone i,

$A_j$ : Future cargo attraction at zone j,

$t_{ij}$ : Current cargo distribution at zone i to j,

$g_i$ : Current cargo production at zone i, and

$a_j$ : Current cargo attraction at zone j.

## (3) Modal Split

The following logic model forecasts future cargo by type of commodity, and is divided into each transport mode, namely, costal, inland water transport, railway and truck.

$$P_i = \frac{\exp(U_i)}{\exp(U_i) + \exp(U_j)}$$

where,

$$U_i = a \cdot \text{time}_i + b \cdot \text{cost}_i$$

$$U_j = a \cdot \text{time}_j + b \cdot \text{cost}_j$$

$U_i$ : Utility of mode i,

$\text{time}_i$ : Travel time of mode i,

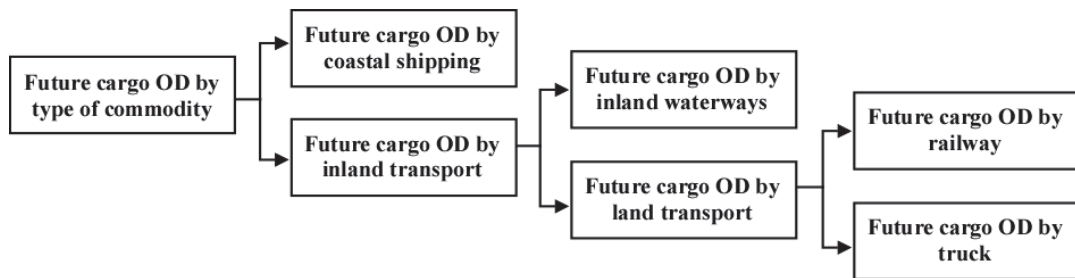
$\text{cost}_i$ : Cost of mode i,

$U_j$ : Utility of mode j,

$\text{time}_j$ : Travel time of mode j, and

$\text{cost}_j$ : Cost of mode j,

The modal split model is estimated by type of commodity and the following binary choice type, (i) coastal shipping - inland transport, (ii) inland waterways and land transport, and (iii) railway and truck.



Source: JICA Study Team

**Figure 8.15 Binary Choice Type Modal Split Model**

The following tables indicate estimated parameters for the modal split model, computed by current cargo OD, by commodity and by transport mode.

**Table 8.7 Parameters for Modal Split Model 1 (Coastal - Land Transport)**

Commodity	intercept	(Time_Land) -(Time_Coastal)	(Cost_Land) -(Cost_Coastal)	R <sup>2</sup>
1 Live Animals & Animal Products	-	-	-	-
2 Fish and Aquatic Products	-	-	-	-
3 Vegetables and Fruits	-	-	-	-
4 Grains and Grain Products	-4.5860	-0.2244	-0.0001	0.8504
5 Other Agricultural Products (ex. Plantation Product)	-	-	-	-
6 Foodstuffs, Beverages and Animal Food	0.8766	-0.0004	-0.0004	0.7852
7 Petroleum, Oil and Gas	-	-	-	-
8 Coal, Ore, Stone and Sand	-	-	-	-
9 Cement, Construction Material (incl. Steel - frame)	-10.8428	-0.2622	-0.0002	0.8223
10 Fertilizer (incl. Urea)	-	-	-	-
11 Garments, Textiles and fabric	-	-	-	-
12 Wood and Wood Products	-	-	-	-
13 Paper and Printed Matter	-	-	-	-
14 Metal and Metal Products (excl. Construction Material)	-	-	-	-
15 Industrial Material, Chemicals	-1.4294	-0.0858	-0.0004	0.5360
16 Household articles, miscellaneous	1.4364	-0.0355	-0.0004	0.5738
17 Machinery and Parts, Transportation	-9.1314	-0.0847	-0.0001	0.9584

Source: JICA Study Team

**Table 8.8 Parameters for Modal Split Model 2 (IWT - Land Transport)**

Commodity	intercept	(Time_Land) -(Time_River)	(Cost_Land) -(Cost_River)	R <sup>2</sup>
1 Live Animals & Animal Products	1.2754	-0.0314	0.0000	0.5787
2 Fish and Aquatic Products	2.3079	-0.0601	-0.0001	0.6536
3 Vegetables and Fruits	3.7516	-0.0142	0.0000	0.4659
4 Grains and Grain Products	1.6748	-0.0194	-0.0001	0.4280
5 Other Agricultural Products (ex. Plantation Product)	0.7821	-0.0158	-0.0001	0.6127
6 Foodstuffs, Beverages and Animal Food	-0.4133	-0.0387	-0.0004	0.6713
7 Petroleum, Oil and Gas	-1.2808	-0.0386	-0.0008	0.6969
8 Coal, Ore, Stone and Sand	0.5921	-0.0741	-0.0006	0.9647
9 Cement, Construction Material (incl. Steel - frame)	1.6728	-0.0087	-0.0003	0.5192
10 Fertilizer (incl. Urea)	2.9320	-0.0283	-0.0003	0.4003
11 Garments, Textiles and fabric	1.6906	-0.0219	-0.0004	0.5049
12 Wood and Wood Products	2.0427	-0.0169	-0.0004	0.9789
13 Paper and Printed Matter	3.9057	-0.0172	-0.0003	0.6502
14 Metal and Metal Products (excl. Construction Material)	-1.1756	-0.0412	-0.0001	0.5042
15 Industrial Material, Chemicals	-0.6727	-0.0732	-0.0006	0.7014
16 Household articles, miscellaneous	0.6300	-0.0173	-0.0001	0.5060
17 Machinery and Parts, Transportation	-0.1859	-0.0628	-0.0006	0.6602

Source: JICA Study Team

**Table 8.9 Parameters for Modal Split Model 3 (Railway - Truck)**

Commodity	intercept	(Time_Truck) -(Time_Rail)	(Cost_Truck) -(Cost_Rail)	R <sup>2</sup>
1 Live Animals & Animal Products	-	-	-	-
2 Fish and Aquatic Products	-	-	-	-
3 Vegetables and Fruits	-	-	-	-
4 Grains and Grain Products	-0.8966	-0.3892	-0.0008	0.5338
5 Other Agricultural Products (ex. Plantation Product)	-4.7785	-0.6994	-0.0015	0.5116
6 Foodstuffs, Beverages and Animal Food	-0.7408	-0.2078	-0.0003	0.6553
7 Petroleum, Oil and Gas	-14.4599	-1.2397	-0.0026	0.6679
8 Coal, Ore, Stone and Sand	2.8238	-0.0121	-0.0001	0.5394
9 Cement, Construction Material (incl. Steel - frame)	-3.0991	-0.1828	-0.0010	0.5839
10 Fertilizer (incl. Urea)	1.4067	-0.1803	-0.0006	0.5132
11 Garments, Textiles and fabric	-0.2128	-0.1772	-0.0010	0.5916
12 Wood and Wood Products	-16.5696	-0.5941	-0.0034	0.7840
13 Paper and Printed Matter	-1.3076	-0.1718	-0.0012	0.5996
14 Metal and Metal Products (excl. Construction Material)	-9.2513	-0.6487	-0.0022	0.5597
15 Industrial Material, Chemicals	-1.5760	-0.1760	-0.0008	0.5230
16 Household articles, miscellaneous	-1.9646	-0.5891	-0.0006	0.6127
17 Machinery and Parts, Transportation	2.5323	-0.0287	-0.0004	0.7430

Source: JICA Study Team

## 8.4 Demand Forecast

### 8.4.1 Passenger Transport

#### (1) Trip Generation

The Total Trip generation in 2013 is approximately 300 thousand persons per day. Trip generation in 2020 and 2030 is estimated at 0.55 million persons and 1.4 million persons, respectively.

**Table 8.10 Total Trip Generation, GDP and GDP Growth Ratio**

	Y2013	Y2015	Y2020	Y2030
Total Trip Generation (1,000 Persons / day)	300	347	555	1,397
GDP (Billion Kyat)	49,901	56,567	80,078	160,500
Annual Average GDP Growth Ratio (%)		6.5%	7.2%	7.2%

Source: JICA Study Team

**Table 8.11 Trip Generation by States / Region**

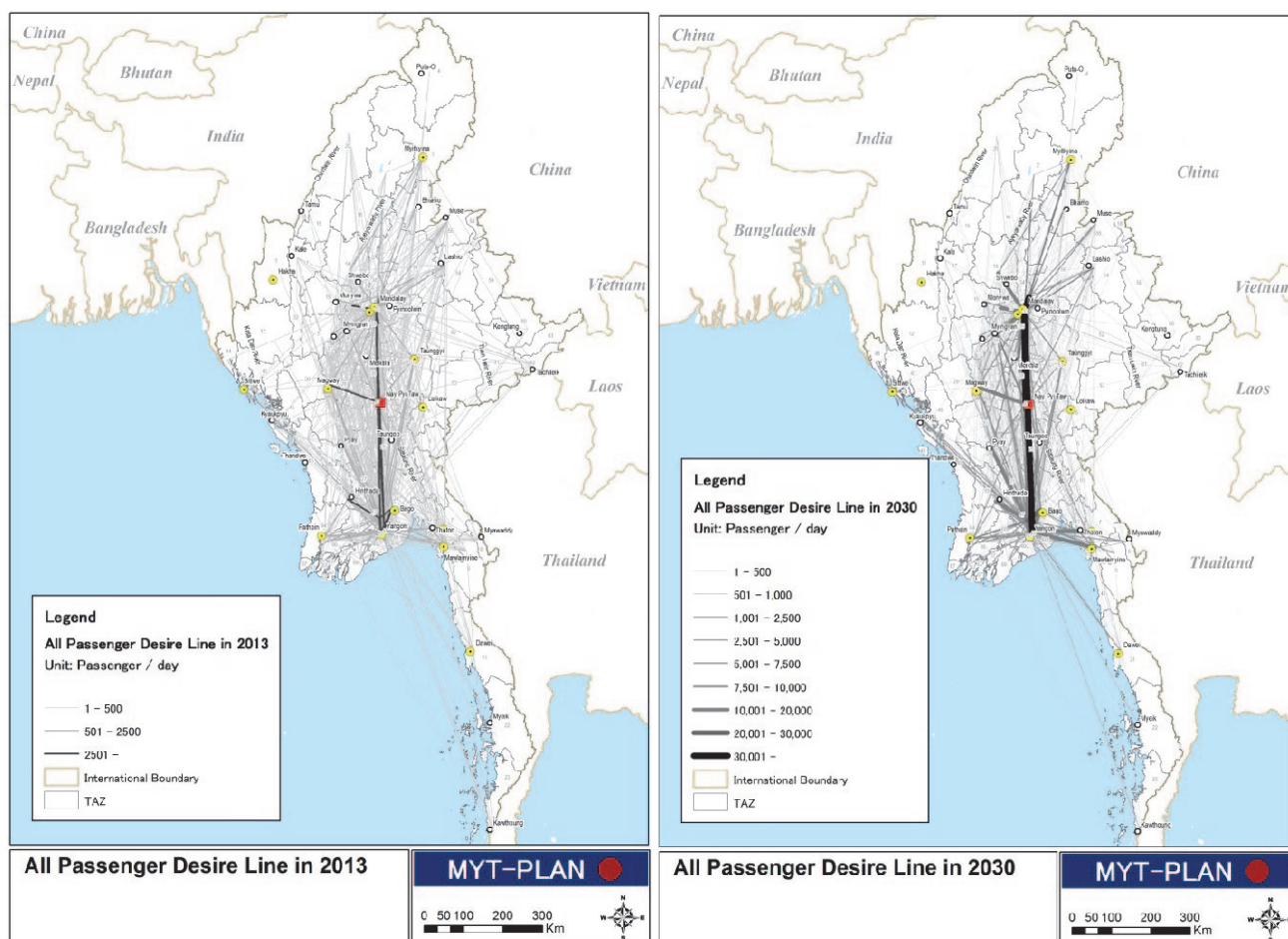
(Unit: Trip / day)

ST_CODE_rev	ST_NAME	2013	2015	2020	2030
1	Kachin	6,218	7,063	10,676	23,253
2	Kayah	544	656	1,110	2,572
3	Kayin	2,156	2,417	4,275	14,878
4	Chin	71	79	112	242
5	Sagaing	17,696	19,351	24,833	45,378
6	Tanintharyi	2,068	2,251	3,036	7,391
7	Bago	29,998	33,357	50,316	127,431
8	Magway	18,163	19,574	26,988	45,087
9	Mandalay	65,930	76,571	134,512	376,000
10	Nay Pyi Taw	21,546	26,898	46,344	142,404
11	Mon	11,933	13,575	20,674	50,944
12	Rakhine	3,587	4,079	6,727	17,950
13	Yangon	83,723	101,101	171,971	435,975
14	Shan	13,701	14,787	20,721	48,285
15	Ayeyarwady	23,110	25,365	33,012	59,909
Total		300,445	347,125	555,308	1,397,700

Source: JICA Study Team

## (2) Trip Distribution

Future trip distribution patterns are estimated using the Frater method. Figure 8.16 indicates the Desire Lines as of 2013 and 2030. Table 8.12 and Table 8.13 show estimated inter-state passenger OD in 2013 and 2030, respectively. As shown in the inter-state passenger tables, a significant increase of inner-state passenger trips in Mandalay region and Yangon region is estimated. The Tables show how both inter-state trips between National Growth Centers (i.e., Mandalay, Yangon, and Nay Pyi Taw) and trip volume between Mandalay region and Bago region increase dramatically.



Source: JICA Study Team

**Figure 8.16 Passenger Desired Line for All Transportation Modes (Left:2013, Right 2030)**

**Table 8.12 Estimated Inter-state Passenger OD in 2013**

(Unit: Person/day)

State Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	698				1,363		108	769	2,988	52			143	24		6,145
2					82		19	12	90	72			242	15	12	544
3						12	268	1	23	56	304	21	1,232	42	197	2,156
4													71			71
5	1,363	82			3,657		90	706	9,214	394	2	72	1,484	566	56	17,686
6			12			206	74		26		222	21	1,489		18	2,068
7	108	19	268		90	74	3,558	1,086	2,143	2,055	1,093	209	18,120	506	656	29,985
8	769	12	1		706		1,086	3,634	3,662	3,358	9	49	3,911	845	121	18,163
9	3,133	90	23		9,229	26	2,165	3,662	25,471	5,935	287	81	10,228	5,583	110	66,023
10	52	72	56		394		2,055	3,358	5,935		466	12	7,479	1,082	585	21,546
11			304		2	222	1,093	9	287	466	1,978		7,015	193	364	11,933
12			21		72	21	209	49	81	12		729	2,106	280	6	3,586
13	143	242	1,232	71	1,484	1,489	18,123	3,911	10,228	7,479	7,015	2,106	8,329	3,649	18,304	83,805
14	24	15	42		566		506	845	5,583	1,082	193	280	3,649	888	28	13,701
15		12	197		56	18	656	121	110	585	364	6	18,152	28	2,728	23,033
Total	6,290	544	2,156	71	17,701	2,068	30,010	18,163	65,841	21,546	11,933	3,586	83,650	13,701	23,185	300,445

Source: JICA Study Team

**Table 8.13 Estimated Inter-state Passenger OD in 2030**

(Unit: Person/day)

State Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	1,471				2,169		256	939	17,568	237			543	70		23,253
2			3		165		37	38	510	448			1,299	38	34	2,572
3		3				45	1,291	4	290	417	1,323	181	10,674	171	479	14,878
4													242			242
5	2,169	165			2,962		157	612	32,963	1,204	5	134	4,016	935	56	45,378
6			45			408	107		70		804	39	5,889		29	7,391
7	256	37	1,291		157	107	8,104	2,201	11,296	10,278	3,384	794	87,015	1,293	1,218	127,431
8	940	38	4		612		2,201	3,050	12,061	12,673	13	86	11,980	1,263	166	45,087
9	17,568	510	290		32,963	70	11,296	12,061	142,628	50,589	1,760	502	81,323	24,158	282	376,000
10	237	448	417		1,205		10,278	12,673	50,589		2,321	90	57,598	4,668	1,880	142,404
11			1,324		5	804	3,384	13	1,760	2,321	6,638		33,689	420	586	50,944
12			182		134	39	794	86	502	90		2,696	12,535	879	13	17,950
13	543	1,299	10,670	242	4,016	5,890	87,014	11,980	81,322	57,598	33,689	12,535	65,272	12,721	51,184	435,975
14	70	38	171		935		1,293	1,263	24,158	4,668	420	879	12,721	1,630	39	48,285
15		34	479		56	29	1,218	166	281	1,880	586	13	51,183	39	3,945	59,909
Total	23,254	2,572	14,876	242	45,379	7,392	127,430	45,086	375,998	142,403	50,943	17,949	435,979	48,285	59,911	1,397,700

Remarks: State Code in above tables is as follows;

1: Kachin, 2: Kayah, 3: Kayin, 4: Chin, 5: Sagaing, 6: Tanintharyi, 7: Bago, 8: Magway,

9: Mandalay, 10: Nay Pyi Taw, 11: Mon, 12: Rakhine, 13: Yangon, 14: Shan, 15: Ayeyarwady

Source: JICA Study Team

### (3) Modal Split

The following tables show the results of forecasted passenger ODs, in instances with no projects implemented and instances with all proposed projects implemented. In the case with all proposed projects, the modal share of railway will increase to 30 %.



**Table 8.14 Forecasted Modal Share (Without Case)**

	Number of Trip (1,000 Trip / day)						Share (%)					
	Air	Car	Bus	Rail	IWT	Total	Air	Car	Bus	Rail	IWT	Total
Y2015	11	78	182	64	11	347	3	23	53	18	3	100
Y2020	23	148	2833	89	12	555	4	27	51	16	2	100
Y2030	113	429	677	162	17	1,398	8	31	48	12	1	100

Source: JICA Study Team

**Table 8.15 Forecasted Modal Share (With Case)**

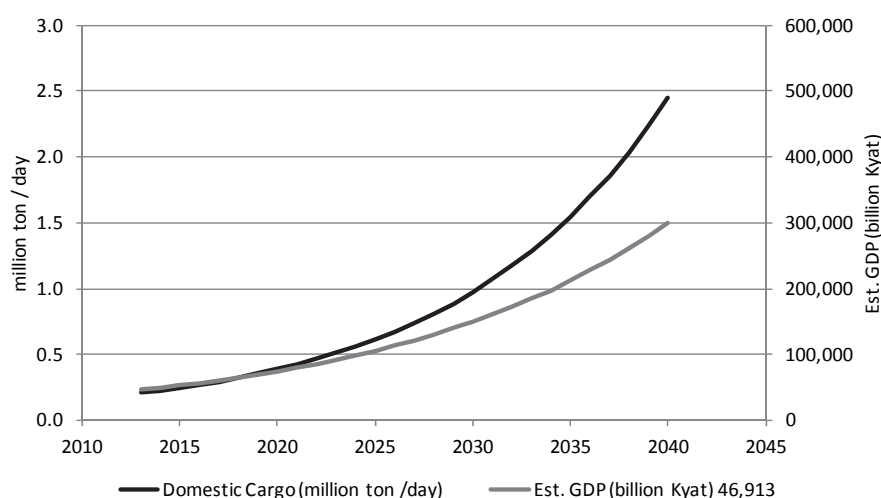
	Number of Trip (1,000 Trip / day)						Share (%)					
	Air	Car	Bus	Rail	IWT	Total	Air	Car	Bus	Rail	IWT	Total
Y2020	21	147	286	89	13	555	4	26	51	16	2	100
Y2030	87	374	499	423	15	1,398	6	27	36	30	1	100

Source: JICA Study Team

## 8.4.2 Freight Transport

### (1) Trip Generation

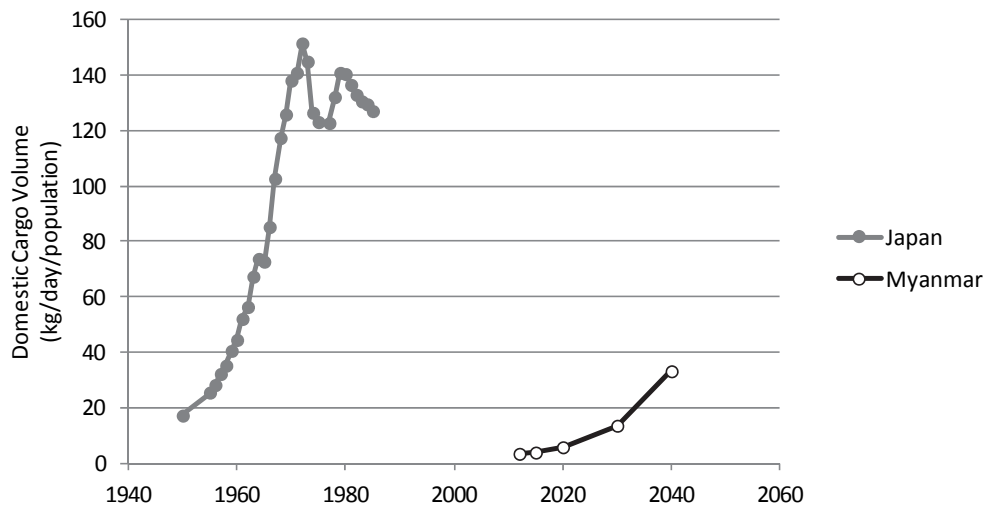
Based on forecasted future GDP and elastic factor of domestic cargo flow, future domestic cargo flow in Myanmar is forecast as shown in Table 8.17. In 2040, the total domestic cargo flow in Myanmar is expected to 11.7 times that of domestic cargo in 2013.



Source: JICA Study Team

**Figure 8.17 Estimated Future Domestic Cargo Flow in Myanmar**

Figure 8.18 indicates the average domestic cargo flow volume per population in Japan and in Myanmar. In 2040, Myanmar's average domestic cargo flow per capita is expected to be 33kg/day/population, which is almost equal to what Japan's flow per capita was in 1957.



Source: JICA Study Team

**Figure 8.18 Forecasted Domestic Cargo Volume per Population in Myanmar**

Based on the calculated control total of future domestic cargo flow volume and elasticity of each commodity, future domestic cargo flow volume by commodity is forecast in Table 8.16.

**Table 8.16 Forecasted Future Domestic Cargo Flow in Myanmar**

(Unit: 1,000 ton/day)

Commodity	2013	2015	2020	2030	2040
1 Live Animal & Animal Products	3.6	1.8	2.4	4.4	7.7
2 Fish and Aquatic Products	7.6	3.2	5.1	13.2	32.6
3 Vegetable and Fruits	14.5	6.7	8.9	15.7	26.5
4 Grain and Grain Products	84.1	41.0	65.7	167.0	408.1
5 Other Agricultural Products (ex. Plantation Product)	40.0	18.7	33.9	110.0	343.6
6 Foodstuff, Beverage and Animal Food	51.7	28.9	40.1	76.3	139.3
7 Petroleum, Oil and Gas	14.4	26.2	43.4	117.3	304.6
8 Coal, Ore, Stone and Sand	18.0	10.6	19.7	67.1	219.7
9 Cement, Construction Material (incl. steel - frame)	55.8	34.2	58.2	166.8	459.7
10 Fertilizer (incl. Urea)	41.1	15.6	20.3	33.7	53.9
11 Garment, Textiles and fabric	10.2	3.9	5.4	9.9	17.4
12 Wood and Wood Products	11.2	6.4	8.4	14.5	24.0
13 Paper and Printed Matter	4.5	1.6	2.1	3.3	5.2
14 Metal and Metal Products (excl. construction material)	5.0	2.6	3.7	7.0	12.7
15 Industrial Material, Chemicals	19.8	8.4	11.8	22.9	42.9
16 Household articles, miscellaneous	62.1	27.0	44.3	116.9	296.9
17 Machinery and Parts, Transportation	25.9	9.7	13.9	28.4	55.7
Total	208.9	246.5	387.3	974.2	2,450.4

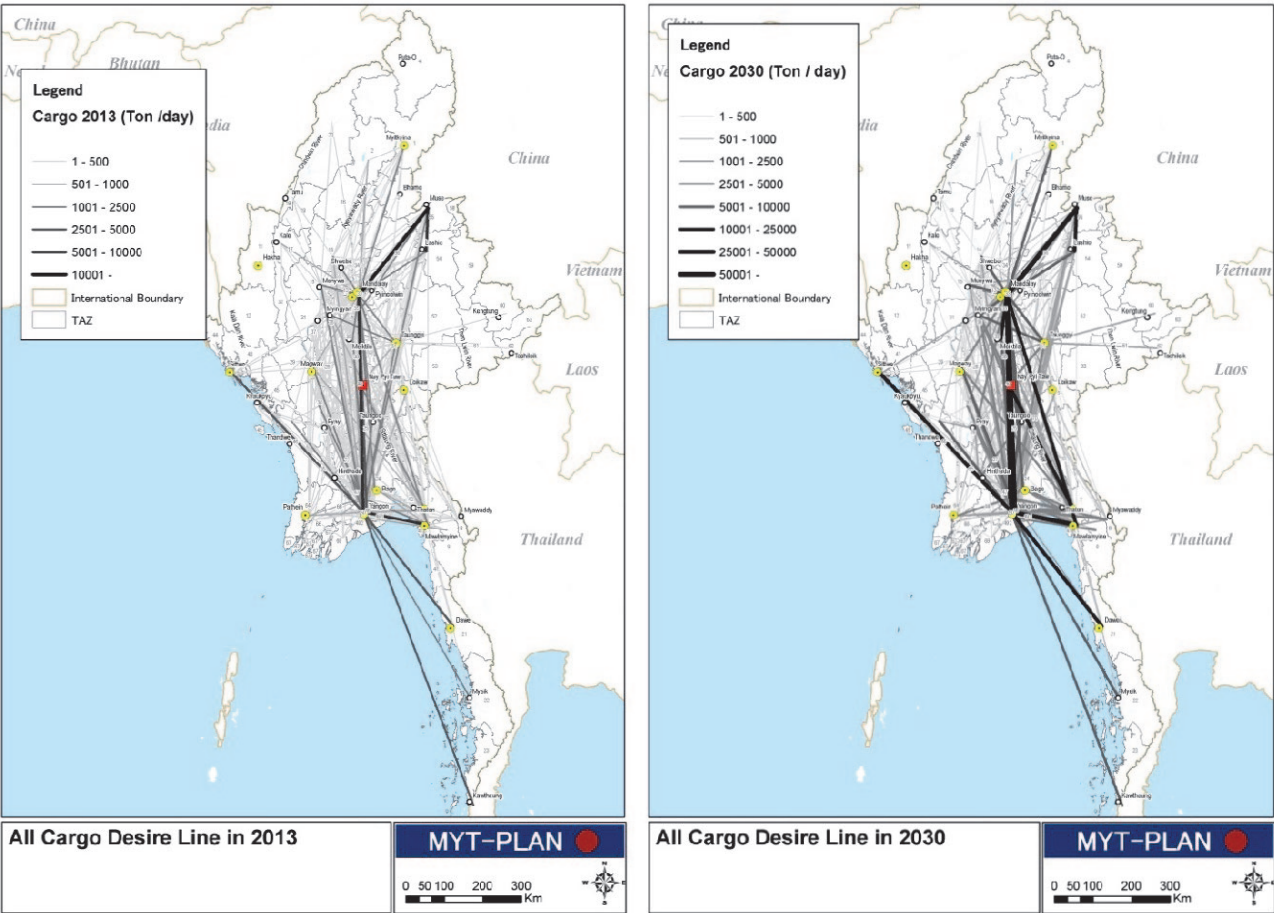
Source: JICA Study Team

## (2) Trip Distribution

Future trip distribution patterns are estimated using the Frater method. Figure 8.19 indicates the Desire Lines as of 2013 and 2030. Table 8.17 and Table 8.18 show estimated inter-state cargo OD in 2013 and 2030, respectively. The inter-state passenger tables indicate a significant increase of inner-state cargo flows in Mandalay region and Yangon region. In addition, the

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inter-state trips between National Growth Centers (i.e., Mandalay, Yangon, and Nay Pyi Taw) increase greatly.



Source: JICA Study Team

Figure 8.19 Cargo Desired Line for all Commodities (Left:2013, Right 2030)

**Table 8.17 Estimated Inter-state Cargo OD in 2013**

(Unit: Ton/day)

State Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	126	0	0	0	98	0	0	6	2,238	0	0	0	39	0	0	2,507
2	0	0	39	0	0	0	0	0	294	0	0	0	10	16	0	359
3	0	0	0	0	63	0	727	842	624	1,392	198	0	2,271	177	266	6,560
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	276	0	0	0	1,067	0	82	98	3,893	275	103	0	2,805	543	1	9,141
6	0	0	0	0	0	0	0	0	0	0	214	0	5,352	0	0	5,566
7	0	0	28	0	307	0	541	469	3,825	361	1,005	358	4,475	907	328	12,603
8	0	0	0	0	8	0	435	633	1,750	58	359	55	5,385	35	95	8,813
9	1,832	485	145	0	5,311	122	2,354	1,151	8,231	2,010	1,943	70	12,298	9,442	207	45,603
10	0	0	1,045	0	98	0	692	8	1,383	0	80	0	1,494	612	41	5,453
11	0	0	195	0	65	294	1,419	30	1,933	47	170	0	1,826	192	0	6,171
12	0	0	0	0	107	0	322	18	362	38	0	53	1,308	0	0	2,208
13	0	1,114	2,301	0	3,102	6,667	5,229	2,819	20,475	2,605	8,281	4,045	2,698	4,300	3,297	66,931
14	0	7	0	0	361	0	623	106	18,481	45	377	22	3,829	7,921	14	31,785
15	0	0	0	0	102	0	963	53	174	217	0	0	3,428	0	247	5,183
Total	2,234	1,606	3,753	0	10,690	7,082	13,387	6,233	63,662	7,047	12,728	4,602	47,218	24,143	4,496	208,884

Source: JICA Study Team

**Table 8.18 Estimated Inter-state Cargo OD in 2030**

(Unit: Ton/day)

State Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1	216	0	0	0	142	0	0	3	8,615	0	0	0	51	0	0	9,027
2	0	0	335	0	0	0	0	0	1,591	0	0	0	31	27	0	1,984
3	0	0	0	0	596	0	4,114	3,643	5,049	12,211	1,435	0	16,817	414	1,089	45,368
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	880	0	0	0	1,597	0	354	20	16,213	1,066	213	0	6,073	1,802	0	28,218
6	0	0	0	0	0	0	0	0	0	0	1,293	0	16,157	0	0	17,450
7	0	0	235	0	860	0	1,843	1,294	27,591	1,320	5,239	1,977	21,407	3,963	1,442	67,171
8	0	0	0	0	7	0	1,779	1,127	6,633	235	940	71	17,122	83	338	28,335
9	7,755	2,354	1,800	0	17,927	672	15,004	3,613	51,036	19,790	10,311	457	73,214	42,109	875	246,917
10	0	0	6,903	0	225	0	2,395	33	16,864	0	237	0	9,380	3,123	170	39,330
11	0	0	947	0	90	1,551	7,442	85	14,931	168	445	0	6,886	393	0	32,938
12	0	0	0	0	738	0	1,656	80	1,732	237	0	252	8,085	0	0	12,780
13	0	3,249	10,126	0	6,628	27,449	16,684	5,662	134,096	13,223	31,152	22,084	15,218	10,184	7,298	303,053
14	0	19	0	0	690	0	1,300	250	82,180	173	803	144	9,356	26,188	25	121,128
15	0	0	0	0	223	0	4,802	259	961	1,118	0	0	10,277	0	725	18,365
Total	8,851	5,622	20,346	0	29,723	29,672	57,373	16,069	367,492	49,541	52,068	24,985	210,074	88,286	11,962	972,064

Remarks: State Code in above tables is as follows;

1: Kachin, 2: Kayah, 3: Kayin, 4: Chin, 5: Sagaing, 6: Tanintharyi, 7: Bago, 8: Magway,

9: Mandalay, 10: Nay Pyi Taw, 11: Mon, 12: Rakhine, 13: Yangon, 14: Shan, 15: Ayeyarwady

Source: JICA Study Team

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### (3) Modal Split

The following tables indicate the results of forecasted future domestic cargo OD, with no projects implemented. The modal share is determined by transport time and cost between different modes. Therefore, modal share and OD by mode will change, depending on future transport network improvements.

**Table 8.19 Forecasted Future Cargo Volume in 2015**

(Unit: 1,000 ton/day)

Commodity	Truck	IWT	Railway	Coastal	Total
1 Live Animal & Animal Products	1.7	0.0	0.0	0.0	1.8
2 Fish and Aquatic Products	3.1	0.0	0.0	0.0	3.1
3 Vegetable and Fruits	6.6	0.0	0.0	0.0	6.6
4 Grain and Grain Products	38.7	0.5	0.2	1.5	40.9
5 Other Agricultural Products (ex. Plantation Product)	18.0	0.6	0.0	0.0	18.6
6 Foodstuff, Beverage and Animal Food	22.0	0.5	2.1	4.4	28.9
7 Petroleum, Oil and Gas	8.8	1.7	0.0	15.8	26.2
8 Coal, Ore, Stone and Sand	10.1	0.1	0.4	0.0	10.6
9 Cement, Construction Material (incl. Steel - frame)	30.9	0.7	1.1	1.4	34.1
10 Fertilizer (incl. Urea)	15.5	0.0	0.0	0.0	15.6
11 Garment, Textiles and fabric	3.9	0.0	0.0	0.0	3.9
12 Wood and Wood Products	5.9	0.2	0.2	0.0	6.3
13 Paper and Printed Matter	1.6	0.0	0.0	0.0	1.6
14 Metal and Metal Products (excl. Construction Material)	2.5	0.1	0.1	0.0	2.6
15 Industrial Material, Chemicals	7.6	0.3	0.1	0.4	8.4
16 Household articles, miscellaneous	25.3	1.0	0.4	0.3	27.0
17 Machinery and Parts, Transportation	9.5	0.0	0.1	0.0	9.7
Total	211.7	5.7	4.7	23.8	246.0
Share	86%	2%	2%	10%	100%

Source: JICA Study Team

**Table 8.20 Forecasted Future Cargo Volume in 2020**

(Unit: 1,000 ton/day)

Commodity	Truck	IWT	Railway	Coastal	Total
1 Live Animal & Animal Products	2.3	0.0	0.0	0.0	2.4
2 Fish and Aquatic Products	5.0	0.0	0.0	0.0	5.1
3 Vegetable and Fruits	8.8	0.0	0.0	0.0	8.9
4 Grain and Grain Products	62.7	0.6	0.3	2.1	65.7
5 Other Agricultural Products (ex. Plantation Product)	32.8	1.0	0.0	0.0	33.8
6 Foodstuff, Beverage and Animal Food	31.7	0.3	2.9	5.2	40.1
7 Petroleum, Oil and Gas	15.6	3.0	0.0	24.7	43.3
8 Coal, Ore, Stone and Sand	18.7	0.2	0.7	0.0	19.6
9 Cement, Construction Material (incl. Steel - frame)	53.5	0.7	2.0	2.0	58.2
10 Fertilizer (incl. Urea)	20.2	0.0	0.0	0.0	20.2
11 Garment, Textiles and fabric	5.3	0.0	0.0	0.0	5.3
12 Wood and Wood Products	7.9	0.3	0.2	0.0	8.4
13 Paper and Printed Matter	2.0	0.0	0.0	0.0	2.0
14 Metal and Metal Products (excl. Construction Material)	3.4	0.1	0.1	0.0	3.6
15 Industrial Material, Chemicals	10.4	0.1	0.2	0.5	11.2
16 Household articles, miscellaneous	41.9	1.3	0.6	0.4	44.2
17 Machinery and Parts, Transportation	13.7	0.0	0.1	0.1	13.9
Total	336.0	7.7	7.3	34.9	386.0
Share	87%	2%	2%	9%	100%

Source: JICA Study Team

**Table 8.21 Forecasted Future Cargo Volume in 2030**

(Unit: 1,000 ton/day)

Commodity	Truck	IWT	Railway	Coastal	Total
1 Live Animal & Animal Products	4.3	0.1	0.0	0.0	4.3
2 Fish and Aquatic Products	13.0	0.0	0.0	0.0	13.0
3 Vegetable and Fruits	15.5	0.0	0.0	0.0	15.6
4 Grain and Grain Products	161.1	0.8	0.6	4.4	166.9
5 Other Agricultural Products (ex. Plantation Product)	107.4	2.4	0.1	0.0	109.9
6 Foodstuff, Beverage and Animal Food	62.1	0.1	5.2	8.9	76.2
7 Petroleum, Oil and Gas	46.6	6.6	0.0	63.9	117.1
8 Coal, Ore, Stone and Sand	64.1	0.4	2.4	0.0	66.9
9 Cement, Construction Material (incl. Steel - frame)	158.2	0.4	4.0	4.2	166.7
10 Fertilizer (incl. Urea)	33.6	0.0	0.1	0.0	33.7
11 Garment, Textiles and fabric	9.8	0.0	0.0	0.0	9.8
12 Wood and Wood Products	13.9	0.4	0.1	0.0	14.4
13 Paper and Printed Matter	3.2	0.0	0.0	0.0	3.2
14 Metal and Metal Products (excl. Construction Material)	6.7	0.1	0.1	0.0	6.9
15 Industrial Material, Chemicals	21.1	0.0	0.4	0.9	22.3
16 Household articles, miscellaneous	113.0	1.5	1.5	0.8	116.8
17 Machinery and Parts, Transportation	28.1	0.0	0.1	0.1	28.3
Total	861.6	12.7	14.6	83.1	972.1
Share	89%	1%	2%	9%	100%

Source: JICA Study Team

### 8.4.3 Traffic Assignment

The following tables show the results of traffic assignment, in instances with no projects implemented and instances with all proposed projects implemented. In the case with all proposed projects, the modal share of railway will increase to 28 %.

**Table 8.22 Forecasted Modal Share (Without Case)**

	1,000 Person * km / day					
	Air	Car	Bus	Rail	IWT	Total
2015	6,469	21,628	65,278	15,879	2,737	111,992
2020	12,568	40,201	86,532	18,011	1,389	158,701
2030	57,151	112,688	244,665	33,920	3,560	451,983

	Modal Share				
	Air	Car	Bus	Rail	IWT
2015	6%	19%	58%	14%	2%
2020	8%	25%	55%	11%	1%
2030	13%	25%	54%	8%	1%

Source: JICA Study Team

**Table 8.23 Forecasted Modal Share (With Case)**

	1,000 Person * km per day					
	Air	Car	Bus	Rail	IWT	Total
Y2020	11,728	39,800	87,817	18,057	1,394	158,795
Y2030	44,957	96,736	178,314	125,684	3,139	448,830

	Modal Share (Person * km per day)				
	Air	Car	Bus	Rail	IWT
Y2020	7%	25%	55%	11%	1%
Y2030	10%	22%	40%	28%	1%

Source: JICA Study Team

## 8.5 International Air Passenger Forecast

### 8.5.1 Correlation between GDP and Air Passenger Volume in Myanmar

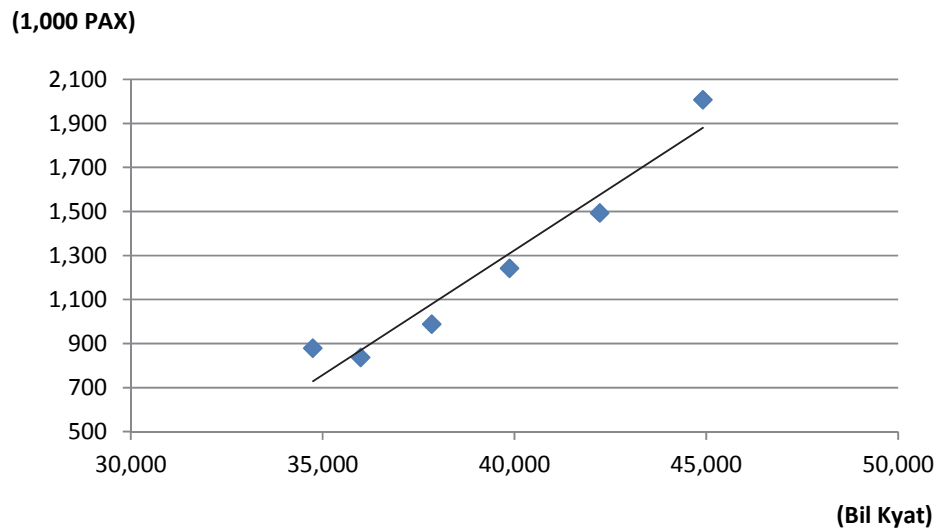
In general, the number of international passengers will increase or decrease in response to the degree of economic activity in the country. As seen in Figure 8.20, Myanmar is not an exception to this feature of economic growth. The horizontal axis (x-axis) represents Myanmar's GDP in billion Kyat (at 2005 constant prices) from 2007 to 2012, while the vertical axis (y-axis) represents the number of international air passengers in Myanmar.

The correlation coefficient between the two parameters is calculated at 0.94, which indicates a strong linier relation between the two. Accordingly, a simple liner regression model is developed as follows:

$$Y = 113.2 X - 324,909.3 \text{ ----- (1)}$$

Where, X: GDP in billion Kyat.

Y: International air passenger in Myanmar



Source: IMF (GDP), DCA (Passenger Volume)

**Figure 8.20 Relation between GDP and International Air Passenger in Myanmar**

### 8.5.2 International Air Passenger Forecast

By extrapolating the future GDP set by the Government of Myanmar into the formula (1) above, the number of future international air passengers in Myanmar is estimated. The existing number of international passengers was 2.0 million passengers per annum (MPA) in 2012, though this will increase to 14 MPA in 2030, according to the formula.

Assuming that Yangon International Airport's (YIA) existing share (96%) of total international passenger remains constant, the number of international passengers at YIA (or Yangon area) could be as much as 13.6 MPA, which exceeds the YIA airport terminal capacity, even after the proposed improvement (6.0MPA).



**Table 8.22 International Air Passenger Forecast in Myanmar**

(Unit: 1,000 Passengers)

	Y2012	Y2015	Y2020	Y2030
International Air Passenger	2,007	2,943	5,499	14,239
Annual Average Growth Ratio	-	14%	13%	10%

Source: JICA Study Team

**Table 8.23 Breakdown of Forecasted International Air Passenger in Myanmar**

(Unit: 1,000 Pax)

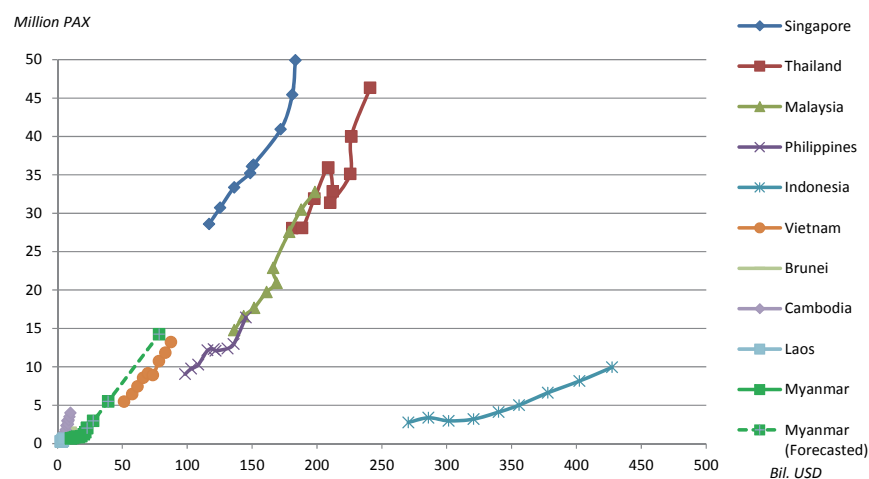
	Y2012	Y2015	Y2020	Y2030
Total International Air Passenger	2,007	2,943	5,499	14,239
Yangon Airport	1,929 (96%)	2,829	5,285	13,686
Mandalay Airport	78 (4%)	114	214	553

Source: JICA Study Team

### 8.5.3 International Air Passengers in other ASEAN Counties

Figure 8.21 shows GDP (x-axis) and international air passenger volume (y-axis) of ASEAN member countries from 2004 to 2012. The Figure shows how Singapore's share of international passengers is exceptionally high, while Indonesia's passenger numbers are lower than other countries, in terms of international air passenger ratio against the GDP.

Myanmar appears to be following the pattern of passenger numbers from Vietnam, Malaysia and Thailand, with Myanmar's estimated international air passengers in 2030 will be close to that of Vietnam and Philippines, as of 2012.



Source: JICA Study Team

**Figure 8.21 International Air Passenger Volume and GDP among ASEAN Countries**

## 8.6 International Cargo Movement

### 8.6.1 Boarder Trade between Thailand and Myanmar

Table 8.29 shows international cargo volumes as a result of cross-border trade between Thailand and Myanmar. The international cargo volume exported through the Three Pagodas Pass is significant, though the cargo imported through the Three Pagodas Pass is negligible. The primary exported commodities via the Three Pagodas Pass are “mineral fuels, oils, waxes and bituminous”. The volume of exports via other border trading points is marginal, in comparison with that of the Three Pagodas Pass.

By comparison, Mae Sot is the major importing point from Thailand and reaches more than 6 million tons per year.

**Table 8.26 Cargo Volume through Boarder Trade**

(Unit: 1,000 Ton)

Year	Import				Export			
	Mae Sot	Three Pagodas	Mae Sai	Total	Mae Sot	Three Pagodas	Mae Sai	Total
2008	379	8	145	533	98	10,751	41	10,891
2009	598	15	220	834	168	8,570	41	8,778
2010	618	47	305	969	97	8,913	72	9,083

Source: The Customs Department Thailand

**Table 8.27 Imported Cargo Volume by Commodity by Boarder Point in 2010**

(Unit: 1,000 Ton)

Mae Sot		Three Pagodas		Mae Sai	
Commodity	Volume	Commodity	Volume	Commodity	Volume
SALT, SULPHUR, EARTH & STONE, LIME & CEMENT	186	BEVERAGES, SPIRITS & VINEGAR	10	SALT, SULPHUR, EARTH & STONE, LIME & CEMENT	143
MINERAL FUELS, OILS, WAXES & BITUMINOUS SUB	90	PREPS OF VEGS, FRUITS, NUTS, ETC.	5	MINERAL FUELS, OILS, WAXES & BITUMINOUS SUB	45
IRON & STEEL	46	MINERAL FUELS, OILS, WAXES & BITUMINOUS SUB	5	BEVERAGES, SPIRITS & VINEGAR	33
BEVERAGES, SPIRITS & VINEGAR	43	ANIMAL OR VEGETABLE FATS, OILS & WAXES	4	IRON & STEEL	12
ANIMAL OR VEGETABLE FATS, OILS & WAXES	34	SALT, SULPHUR, EARTH & STONE, LIME & CEMENT	4	ARTICLES OF STONE, PLASTER, CEMENT, ASBESTOS, MICA OR SIMILAR MATERIALS	11
Others	219	Others	18	Others	60
Total	618	Total	47	Total	305

Source: The Customs Department Thailand

**Table 8.28 Exported Cargo Volume by Commodity by Boarder Point in 2010**

(Unit: 1,000 Ton)

Mae Sot		Three Pagodas		Mae Sai	
Commodity	Volume	Commodity	Volume	Commodity	Volume
WOOD & ARTICLES OF WOOD, WOOD CHARCOAL	52	MINERAL FUELS, OILS, WAXES & BITUMINOUS SUB	8,899	SALT, SULPHUR, EARTH & STONE, LIME & CEMENT	59
EDIBLE VEGETABLES	23	WOOD & ARTICLES OF WOOD, WOOD CHARCOAL	9	WOOD & ARTICLES OF WOOD, WOOD CHARCOAL	5
LIVE ANIMALS	5	VEGETABLE PLAITING MATERIALS	3	ED. FRUITS & NUTS, PEEL OF CITRUS/MELONS	3
FISH & CRUSTACEANS	4	ORES SLAG & ASH	1	EDIBLE VEGETABLES	2
FURNITURE, BEDDING, CUSHIONS, LAMPS & LIGHTING FITTINGS NESOI, ILLUMINATED SIGNS, NAMEPLATES & THE LIKE, PREFABRICATED BUILDINGS	4	LIVE ANIMALS	0	VEGETABLE PLAITING MATERIALS	1
Others	10	Others	0	Others	2
Total	97	Total	8,913	Total	72

Source: The Customs Department Thailand

## 8.6.2 International Sea Cargo Demand

A demand forecast of international sea cargo is available in “The Preparatory Survey for the Project for Expansion of Yangon Port in Thilawa Area” and “Preliminary Study on National Port Development Plan in Myanmar”.

The total cargo and container cargo throughput in 2030 is forecast to be 90 million tons and 8.1 million TEU, respectively.

**Table 8.27 Future Cargo Demand Forecast for Whole Myanmar**

(Unit: 1000 Ton)

Case	Y2011	Y2015	Y2020	Y2025	Y2030
High Case	25,696	29,607	42,999	62,221	90,000
Low Case	25,696	28,321	36,689	47,417	61,300

Source: JICA Study Team

**Table 8.28 Future Container Cargo Demand Forecast for Whole Myanmar**

(Unit: 1000 TEU)

Case	Y2010	Y2015	Y2020	Y2025	Y2030
High Case	335	892	1,986	4,014	8,100
Low Case	335	853	1,700	3,064	5,500

Source: Year 2010 – 2025: “The Preparatory Survey for the Project for Expansion of Yangon Port in Thilawa Area”, Year 2030: “Preliminary Study on National Port Development Plan in Myanmar”

### 8.6.3 Cargo Demand Forecast for Yangon Port

The existing share of cargo throughput in 2010 at Yangon Ports, including Thilawa, is 91.5 percent. Assuming this share continues in the future, the total cargo throughput at the Yangon Ports will be 57 million tons per year in 2025 (refer to Table 8.29).

Container cargo in 2025 is estimated at 41 million tons (74% of the total), which is equivalent to 3 to 4 million TEU, as shown in Table 8.28.

**Table 8.31 Future Cargo Demand Forecast for Yangon Port**

(Unit: 1,000 Ton)

Port	Category	Commodity	Y2010	Y2025
Yangon	Foreign	General Cargo	17,372	5,441
		Vehicle		396
		Grain		1,000
		Petroleum		7,285
		Container		41,063
		Total		55,185
	Coastal		1,067	2,000
	Sub-Total		18,439	57,185
Others			1,718	5,036
Total			20,157	62,221

Source: The Preparatory Survey for the Project for Expansion of Yangon Port in Thilawa Area

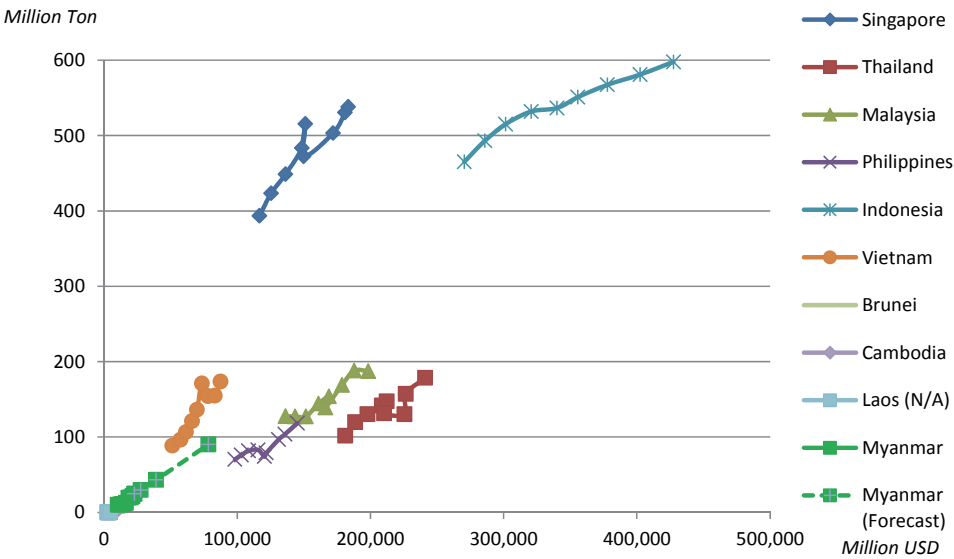
### 8.6.4 International Sea Cargo among ASEAN Counties

Figure 8.22 illustrates the GDP (x-axis) and the international cargo throughput (y-axis) of the ASEAN member countries, from 2004 to 2011. The Figure shows how Singapore's share of international cargo throughput is exceptionally high, while Indonesia's volume data is lower than other countries, in terms of international cargo throughput ratio against the GDP.

Myanmar appears to be following the pattern of international cargo throughput numbers from Vietnam and Malaysia, with Myanmar's estimated international sea cargo will be close to that of Vietnam, by 2015.

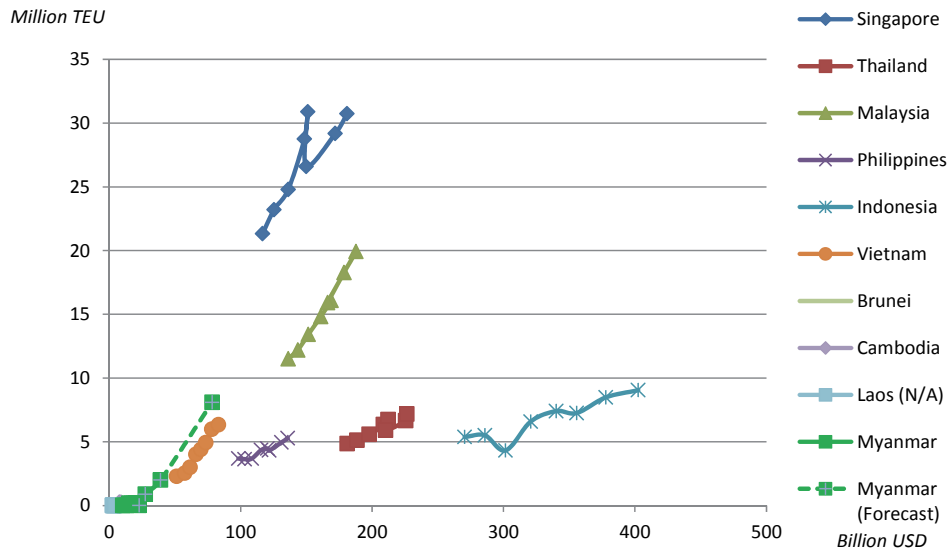
Figure 8.23 shows the comparison of container cargo volumes among ASEAN countries, from 2004 to 2012. It is forecast that the container cargo volume in Myanmar in 2030 will be close to that of Thailand, as of 2011.

Final Report



Source: JICA Study Team

**Figure 8.22 Comparison between International Sea Cargo Volume and GDP**



Source: JICA Study Team

**Figure 8.23 Comparison between Container Cargo Volume and GDP**

## **Chapter 9 Transport Vision, Policy, Strategy and Action**

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### **9.1 Existing Sub-sector Policy Statements**

This Chapter summarizes the important policy statements contained in government documents that are needed to formulate transport sub-sector policy in Myanmar.

During Myanmar's previous administration, the Committee for Safe and Smooth Transport Facilitation ensured policy integration and the development of related transport modes. However currently, there has been no explicit integration of transport policies and transport Ministries and departments are independently formulating sector policies and strategies.

#### **9.1.1 Overview of Existing Transport Policies**

##### **(1) MOT Policy**

Myanmar adopted a market-oriented economic development policy in 1989 to accelerate its national and regional economic growth. The Ministry of Transport (MOT), which is responsible for civil aviation and water transportation, established nine transport policy statements to support this economic development policy, as follows:

- To develop and fully utilize transport capacities to contribute towards the realization of an economically strong, modern and developed nation;
  - To fulfill transport requirements, and to extend and maintain the transport infrastructure to be able to fully support increased production from other economic sectors and meet growing public and social demands;
  - To ensure smooth and secure domestic and international transport systems as well as contribute towards the development of border areas and national races and the development of tourism;
  - To enable all-weather river transportation through the maintenance and preservation of natural resources;
  - To develop air and maritime transport infrastructures, in line with international standards for environmental protection;
  - To enhance the transport sector through human resources development and upgrade expertise in management and advancing modern technology;
  - To abide by international conventions, acts, laws, rules and regulations with respect to the transport sector;
  - To develop domestic and international transportation and actively take a key role in the implementation of a national multi-modal transport system; and
  - To plan for implementation of implement national, sub-regional and international transport networks.
-

### Civil Aviation Sector

In addition to the MOT policy, the Department of Civil Aviation adopted the following strategic objectives, to develop a better civil air transport environment, in line with the market-oriented economic vision:

- To ensure aviation safety and security are priorities;
- To promote infrastructure development;
- To allow the establishment of new air carriers, subject to demand and supply in the market;
- To allow the establishment of efficient air transport auxiliary services;
- To promote Public-Private Partnership (PPP) in the air transport industry;
- To develop fair competitions among air transport services;
- To encourage cooperation between air carriers;
- To enhance competitiveness of national air carriers;
- To foster air freight services;
- To support the development of tourism and trade;
- To continue pursuing gradual liberalization of air transport towards an open sky policy;
- To enhance the capacity of the aviation regulatory body;
- To create employment opportunities for nationals; and
- To develop environmentally-friendly air transport.

### **(2) MRT Policy**

The Ministry of Rail Transportation (MRT), which is responsible for railway and road transport administration, established seven transport policy statements as follows:

- To improve passenger and freight transport capability, in order to support the socio-economic development of the country in a sustainable and environmental friendly manner;
- To improve road and rail transport, including an urban transport network, so as to meet passenger and freight demand;
- To transform the state-owned road transport enterprise into a Public-Private Partnership, in a phased approach;
- To work with various stakeholders to improve traffic regulations and road safety;
- To regulate commercial licenses for passenger and freight transport services, so as to foster countrywide development;
- To enhance the capacity and ability of staff, by providing regular training for sustainable development; and
- To use all of the existing resources, including lands owned by MRT, in order to increase financial capacity of MRT.

### **Rail Sector**

Myanmar Railway adopted the following policy objectives to ensure safe, comfortable and punctual train operation:

- To ensure convenience for all passengers and to bring satisfaction to freighters;
- To keep the number of accidents at a minimum and to ensure total prevention of accidents;
- To have all trains running on time;
- To have all railways tracks constructed to required specifications and standards in order that they will withstand the stress and strain of constant traffic;
- To increase income and to keep expenses to a minimum;
- To promote efficiency in the management of existing staff, facilities and systems;
- To run all railways yards and workshops to full capacity;
- To keep locomotive and rolling stock break-downs to a minimum;
- To boost the design and production of machines, accessories and spare parts; and
- To never lose sight of staff privileges and welfare.

### **(3) MOC Policy for Road Sector**

The Department of Public Works adopted the following development directions, emphasizing that the extension of the road network will serve the entire country:

- Union Highway Network Master plan with 36 roads from north-south and 45 roads from east-west will cut-across 7 Regions and 7 States;
- Priorities are given to this development in each and every region, increasing contact and building relationships in these areas, and building reconciliation opportunities among national races;
- Extend and upgrade the existing roads, mostly running north to south, and construct new roads running from east to west across the Union; and
- Facilitate and promote economic activities, particularly trade and tourism, between Myanmar and other countries.

### **9.1.2 Initial Observation of Existing Transport Policies**

As noted above, Myanmar's transport-oriented ministries and agencies have prepared specific transport policies and objectives to help support Myanmar's long-term economic development. These transport policies provide sufficient policy cover within the Ministries to extend cover beyond infrastructure development to include private sector participation, environmental considerations, issues of international cooperation and the application of standards. However, while comprehensive, there are important initiatives that these policies do not cover as well as some weak statements in terms of neighboring country modern transport policies.

- This Report's analysis finds that there has been little coordination among the transport related ministries and agencies in developing transport policies or implementing related transport projects and actions. For example, the important role of multi-modal transport, which emphasizes connectivity and seamless transport between different modes of transport, is not addressed in existing transport policies.



- The existing transport policies have not been translated into concrete strategies and actions, with priority considerations or timeframes. In addition, the proposed transport projects have not tested their feasibility, in terms of efficiency or social and economic benefits to the country.
- Monitoring, post-evaluation and feed-back mechanisms on the completed or ongoing transport projects appear to be weak, likely due to there being no organization or authority assigned to monitor these projects, in a comprehensive manner. In addition, few numerical indicators have been set to permit authorities to understand if or how projects and action milestones are achieved.
- The government has clearly identified priorities within the transport sub-sectors, although these are not identified for all modes of transport. Since the government budget for transport infrastructure development is predictably limited, addressing all priorities across all modes in the sub-sector will require a consolidated or integrated approach.

## 9.2 Transport Sector Initial Assessment by ADB

The initial assessment of Myanmar's transport sector (October 2012) was prepared by the Asian Development Bank (ADB) and provides an overview of key challenges, opportunities and priority transport needs, as of 2012. This assessment was prepared to provide background information to support ADB's interim country partnership strategy in Myanmar. This assessment is also useful for the JICA Study Team to identify key strategic and priority issues and corresponding strategies and can be made more useful to JICA by including updated 2013 information and data, obtained through consultation with specialists from the transport sector in Myanmar.

ADB's assessment conducts a Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis of the transport sector in Myanmar, as shown in Table 9.1. Strengths and Weaknesses identify current conditions and issues in the sector, while Opportunities and Threats identify issues in the near future.

ADB's assessment summarizes the core issues in the Myanmar's transport sector, as follows:

- (i) *the fragmented and overlapping institutional structures for managing the sector;*
- (ii) *the lack of an overall transport sector strategy;*
- (iii) *the related lack of rigorous cost-benefit economic analysis in the decision-making process for prioritizing infrastructure investments;*
- (iv) *the need for capacity building using as a base the reasonably robust and committed institutions and officials at the subsector level;*
- (v) *the limited role of private sector; and*
- (vi) *the poor state and very low coverage of the lower level road network, resulting in local communities having inadequate access to the core road network and basic services.*

And in summary,

*"the principal sector issues are the fragmented and overlapping institutional management structure, the lack of an overall transport strategy and system for prioritizing infrastructure investment, the need for capacity building, and the serious inadequacy of the lower level road network."*

This SWOT analysis, together with the identified core issues, can help guide the development

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of MYT-Plan policies and strategies. The MYT-Plan can capitalize on the SWOT findings by using strengths to counter the threats and capture the opportunities, while addressing or remedying weaknesses, as shown in Table 9.2.

**Table 9.1 Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis of the Myanmar Transport Sector**

	PRESENT	FUTURE	
<b>STRENGTHS</b>	<ul style="list-style-type: none"> <li>• Sweeping political reforms are leading to resumption of multilateral and bilateral development assistance for Myanmar's transport sector;</li> <li>• Transport sector is expected to be a priority area of assistance for development partners;</li> <li>• Staff in the transport sector are committed and competent, and operate relatively effectively under difficult circumstances;</li> <li>• Transport systems are in a poor state, providing a relatively "clean slate" for formulating a sustainable transport strategy and policies to meet future transport demand;</li> <li>• National integration policy has resulted in primary road network extending to most areas of the country;</li> <li>• There is little encroachment on highway rights-of-way;</li> <li>• Existing rail network connects most regions of the country; and</li> <li>• There is an extensive navigable river network with inland water transport services.</li> </ul>	<ul style="list-style-type: none"> <li>• Political and economic environment is improving rapidly;</li> <li>• Basic subsectors structure are functional;</li> <li>• Staff resources of the responsible transport ministries and agencies are committed and work effectively;</li> <li>• Extensive assistance is required in all areas of the transport sector; and</li> <li>• Considerable scope exists for public-private-partnership initiatives.</li> </ul>	<b>OPPORTUNITIES</b>
<b>WEAKNESSES</b>	<ul style="list-style-type: none"> <li>• The institutional structure is fragmented and there is a lack of clarity in defining roles and responsibilities;</li> <li>• A comprehensive and integrated transport development strategy is lacking;</li> <li>• State enterprises operating on a non-commercial basis dominate the transport sector;</li> <li>• SOEs in civil aviation, ports, railways, and bus services are operating inefficiently;</li> <li>• Many transport prices are centrally set and controlled;</li> <li>• Budgetary subsidies compensate for low transport fares, distorting financial management; and</li> <li>• There is a lack of familiarity with international best practices for procurement, financial management, and environmental and social safeguards.</li> </ul>	<ul style="list-style-type: none"> <li>• Political reform fails to be sustained or occurs more slowly than envisaged;</li> <li>• Political reform occurs too quickly, creating a vacuum in policy and regulatory control;</li> <li>• Economic growth fails to materialize as quickly as expected;</li> <li>• Subsector agencies are unable or unwilling to transition from subsector operators to subsector regulators and managers;</li> <li>• Externally supported transport investments are uncoordinated, and</li> <li>• Institutional restructuring and capacity building is not addressed.</li> </ul>	<b>THREATS</b>

Source: Myanmar: Transport Sector Initial Assessment (ADB, Oct 2012)

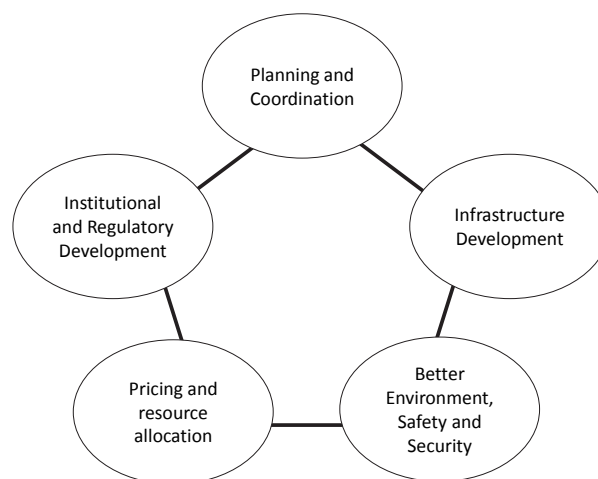
**Table 9.2 Indicative Strategies for MYT-Plan**

		In Response to Threats	To Capture Opportunities
Strategy Elements	Capitalizing on Strengths	<ul style="list-style-type: none"> <li>• Assemble a council of development partners to agree on a coordinated (and targeted) approach – for example, “Transport Sector Coordination Meeting”, initiated by JICA;</li> <li>• Identify and support reform champions in each transport sub-sector agencies in the adoption and execution of a comprehensive transport strategy and policies; and</li> <li>• Focus on upgrading road, rail and river networks, rather than expansion.</li> </ul>	<ul style="list-style-type: none"> <li>• Harness Official Development Assistance (ODA) in the formulation of a comprehensive transport strategy and policy, and in capacity building:MYT-Plan by JICA, YUTRA by JICA, Road Master Plan by KOICA, etc.; and</li> <li>• Finetune ongoing PPP initiatives, and apply these in a calibrated manner to other sectors.</li> </ul>
	Remedying Weaknesses	<ul style="list-style-type: none"> <li>• Formulate a comprehensive and integrated transport development strategy, to serve as the rallying point and common agenda for the different agencies;</li> <li>• Establish a Transport Coordinating Council, composed of the Ministers of transport and transport-related agencies;</li> <li>• Privatize SOEs engagement in service provisions, starting in areas with private sector competitors; and</li> <li>• Utilize PPP to rapidly infuse international best practices, and to regenerate privatized SOEs.</li> </ul>	<ul style="list-style-type: none"> <li>• Gradual adjustment in transport prices, to reflect factor costs and current conditions; and</li> <li>• Tap ODA grants for rapid capacity-building and training of reform champions.</li> </ul>

Source: JICA Study Team

### 9.3 Key areas of consideration and corresponding issues

In addition to ADB's overall assessment of the transport sector and additional review and analysis of existing conditions in key transport sectors (e.g. road and road transport, rail, air, maritime/inland waterway), this Report identifies a series of strategic or cross-sectoral issues in five key areas, as shown in Figure 9.1.



**Figure 9.1 Key Areas of Consideration**

(1) Planning and Coordination:

- Fragmented planning and poor coordination among transport infrastructure institutions, agencies and operators at national, regional and city/local levels lead to overlaps and/or shortfalls
- Integration of strategic transport and spatial development initiatives requires strengthening
- Efficient planning of transport infrastructure in rural regions is impacted by national security considerations

(2) Infrastructure Development:

- Coordination is lacking within and among the transport networks, this hinders efficient travel and modal transfer
- The lack of capacity and efficiency in most sectors is due to the low standard/quality of existing infrastructure and inadequate facilities and equipment

(3) Institutional and Regulatory:

- The roles of government and private sector in supply, management and maintenance of transport infrastructure and services needs clarifying
- Inadequate human resources and data at national, regional and city levels for transport planning and related land use development/spatial planning restricts implementation and enforcement
- Legislative and regulatory frameworks for transport infrastructure provision and operation need updating

(4) Pricing and Resource Allocation:

- Investment returns/cost recovery in the transport sector is exacerbated by a high proportion of poverty-level households, especially in rural and agricultural regions
- Impacts of transport investments on spatial development are not well understood,

including use of transport infrastructure to stimulate sustainable development.

**(5) Community, Society and the Environment:**

- Absence of social and environmental considerations in planning and design of transport infrastructure
- Safety standards and enforcement mechanisms, especially highway safety standards, need overhauling
- Use of inefficient transport technologies in transport sector exacerbates energy consumption
- Environmental assessment techniques, data and skills are not well developed, monitored or enforced

## **9.4 Overall Policy Priorities**

In order to frame appropriate policies to address these strategic issues, a number of policy priorities have been developed, taking into account the Government and transport sector's Ministry and Agency programs and commitments.

Identified priorities include:

- Improve coordination among transport sector ministries and agencies;
- Improve coordination among transport sector and spatial planning and development ministries and agencies;
- Enhance mechanisms for integrated planning of transport and other sector development Programs, projects and proposals;
- Enable integration of multi-modal transport networks and services in strategic corridors;
- Ensure efficient use, upgrading and maintenance of existing transport assets before major new investments are committed;
- Enhance opportunities for private sector involvement in the provision of transport infrastructure and services;
- Provide for the equitable use of investment funds to improve transport facilities and services in rural and agricultural regions, as well as cross-border locations;
- Prioritize safety and security of transport and transport services in all states and regions;
- Emphasize the importance of environmental considerations in transport planning processes to improve potential for successful implementation;
- Adapt appropriate technologies relative to the stage of development of the country to provide future sustainable transport solutions and help reduce carbon emissions;
- Institute long term training programs in transport sector planning, management and operations to improve human resource capabilities; and
- Adopt appropriate national and international regulatory frameworks consistent with Government social and economic aspirations and human resource capabilities for their implementation and enforcement.

## 9.5 Transport Sector Vision (MYT-Plan draft)

The Ministry of Transport (MOT) should begin to develop a set of transport policies to match the Government's Social and Economic Reform Program and its efforts to promote a market-oriented economy to accelerate national and regional economic growth.

The JICA Study Team has expanded the MOT's national transport policy to incorporate policies for the road and rail sub sectors, so it may address the full range of transportation issues and requirements in Myanmar and the wider ASEAN region. Based on this comprehensive policy framework, a Vision for the transport sector has been proposed by the JICA Study Team as follows:

*'To develop an efficient, modern, safe, and environmentally-friendly transportation system in a coordinated and sustainable manner that embraces all transport modes for the benefit of the country and people of Myanmar'.*

## **9.6 Updated Transport Policies (MYT-Plan draft)**

Myanmar's transport sector policies should incorporate the following five key elements: (1) better planning and coordination, (2) infrastructure development, (3) better environmental, safety and security considerations, (4) institutional and regulatory development, and (5) reasonable transport pricing and secure budgeting, for the benefit of the country and the people of Myanmar. The proposed (updated and expanded) list of transport policies are as follows:

### **(1) Better Planning and Coordination:**

- To prepare and periodically update the transport statistics for better planning work;
- To establish explicit and systematic coordination mechanisms among transport-related stakeholders and further strengthen these in order to achieve higher investment efficiency;
- To inform Myanmar's citizens and international societies of future transport development plans and corresponding actions in order to encourage the private sector's investment and to attract investors more widely;
- To enable community/public participation in transport planning and project design, as well as in environmental and social impact assessments; and
- To strengthen and increase human resources in the transport planning and administration sector in order to monitor, review and update integrated transport policies, strategies, and corresponding projects and actions needed to meet changing domestic and international transport needs.

### **(2) Infrastructure Development:**

- To maintain and improve the existing transport infrastructure, and to extend them in order to fully support increasing economic activities and meet growing public and social transport needs;
- To maximize the use of transport capabilities in the road, rail, air, maritime and inland waterway sectors to save costs in the transport infrastructure sector and achieve higher investment efficiencies;
- To strengthen connectivity along the designated development corridors and contribute to urban and regional development along the corridors.
- To ensure connectivity of higher capacity and faster speeds between major transport hubs and growth centres, providing robust transport infrastructure and reliable and cost-effective services.
- To upgrade trunk transport infrastructure and services to international standards, and conforming ASEAN transport agreements;
- To develop integrated domestic and international transportation networks in order to facilitate seamless multi-modal transport services; and
- To ensure smooth and secured rural and cross-border transport systems in order to contribute towards the development of designated border cities and rural regions.

### **(3) Better Environment, Safety and Security:**

- To encourage the use of environmentally-friendly transport systems (e.g. less noise, less vibration, less emission gases, and fuel-efficient), especially in built-up areas, including the progressive use of modern fuel-efficient (low carbon) technologies in the transport industry;

- To improve traffic safety significantly and reduce the growing number of traffic accidents on roads as soon as possible;
- To raise awareness in the population of the need to achieve environmentally friendly and safer transport behaviors;
- To upgrade the level of safety and security in transporting fuels and other hazardous goods along designated corridors;
- To develop all-weather and natural disaster preventive land transportation by programmed upgrading and maintenance of existing railway, road, bridge and drainage structures;
- To improve the level of security in the transport sector in order to ensure cross-border trade and other economic activities with neighboring countries; and
- To monitor and enforce national standards for security, safety and integrated emergency planning for all transport modes and operations.

(4) Institutional and Regulatory Development:

- To clearly define the role of each transport related agency in terms of assets (land and infrastructure) ownership, planning, development, operation, and maintenance;
- To remove barriers and update regulations and/or customs to international standards to enhance private sector's investment in transport sector infrastructure and service;
- To plan and define the role of the private sector in investing, operating and maintaining transport infrastructure;
- To provide accountable and fair investment opportunities for domestic and international investors in the transport industry by updating necessary regulatory framework (e.g. PPP law, etc.);
- To improve efficiency of State Owned Enterprise by reforming organizational structure and with Public-Private Partnership (PPP);
- To improve the knowledge and skills of civil servants and further increase human resources in transport planning, administration and management sector to achieve higher levels of transport system development; and
- To adhere to international conventions, acts, laws, rules and regulations with respect to the transport sector.

(5) Reasonable transport pricing and secured budgeting

- To implement a "Market-oriented Mechanism" that provides transport infrastructure and services, and further enhances efficiencies in the transport business and service;
- To apply a "Beneficially Pay Principle" to the transport market and industry;
- To apply "Affordable Pricing" to improve transport accessibility for all citizens; and
- To secure the needed funds in the annual budget for transport infrastructure development.



## 9.7 MYT-Plan Cross-sector Strategic Objectives, and corresponding Strategies and Actions (Draft)

To address the cross-sector issues, five strategic objectives and corresponding strategies and actions are proposed, as follows:

T-01 Statistics: Develop an initial mode of transport database, including databases for: a) road and road traffic (vehicle, passenger, and freight movement), b) rail (rail asset inventory, track condition, operation, passenger, and freight movement, etc.), c) maritime and inland water (vessel statistics, passenger and cargo movement data, maritime accidents, etc.), and d) civil aviation (air craft data, passenger and cargo movement, business performance of air lines, etc.) by the end of 2015.

Sector Strategy T-01: To develop an initial (preliminary) database urgently and develop it step-by-step

### Action T01

- Formulate a fully equipped special task force (unit) for data collection, data entry and analysis in each Ministry (MOT, MRT, MOC)
- Collect and update the transport infrastructure inventory, traffic data, etc., and build an initial database system and update it periodically
- Establish coordination / information exchange mechanisms (e.g. via optical cable, etc.) between the Ministries
- Use technical support from international donor agencies and other organizations, if necessary
- Publish transport statistics report regularly (e.g. monthly reports)

T-02 Enhanced Coordination Mechanism: Establish a high-level planning coordination mechanism by the end of 2014 to implement the Myanmar National Transport Master Plan (MYT-Plan), using 2015 as the base year.

Sector Strategy T-02: Effective use of the National Transport Master Plan (MYT-Plan)

The Myanmar National Transport Plan (MYT-Plan) is understood to be the only strategic plan for the development of the country's trunk (major) transport system.

### Action T02

- Formulate a planning coordination body for corridor development by inviting representatives from each Ministry and local government involved in the corridor development
- Establish coordination / information exchange mechanism between the coordination body and private investors

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T-03	<u>Participatory Planning</u> : Establish a mechanism for people and communities to join in the planning process.
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Sector Strategy T-03: Effective use of Strategic Environmental Assessment (SEA) procedure

People and communities are invited to a series of SEA meetings to express their concerns, share local knowledge, offer suggestions, etc. as a means to provide feedback into planning processes.

Action T03

- Enhance the existing EIA to cover SEA in the planning process
- Provide opportunities for the public to join the planning process through SEA

T-04	<u>Capacity building in the public sector</u> : Increase the number of high level experts in transport planning administration and management for better management of the transport sector.
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Sector Strategy T-04-1: Establishment of Planning Unit (or department)

Establish a special unit responsible for transport planning, and strengthen staff capability with technical support from external agencies.

Action T-04-1

- Implement a fully equipped planning unit
- Develop and utilize computer models in the national transport model (strategic model)
- Invite professional technical support to improve and increase staff capacity in the field of transport modeling and planning
- Monitor the progress of the Myanmar National Transport Master Plan's (MYT-Plan) implementation
- Review and update the MYT-Plan regularly

Sector Strategy T-04-2: Technical cooperation / exchange program

Establish a bilateral technical cooperation/exchange scheme (program) with corresponding agencies in advanced countries.

Action T-04-2

- Establish an international affairs department to manage international technical cooperation projects
- Dispatch select staff to those supportive countries to study advanced technologies, techniques, etc.
- Conduct joint research and development (R&D)

T-05	<u>Human Resources Development</u> : Increase the number of skilled people in the transport sector.
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Sector Strategy T-05-1: Vocational Training and Professional Certification

Increase the number of skilled workers in the transport sector to encourage efficient transport industries, increase safety, quality services and other issues of concern to the public.

Action T-05-1

- Identification of strategic fields that require a skilled workforce and professionals in the transport sector
- Provision of vocational training for designated sector professions
- Introduction of an ability-based grading system
- Introduction of professional certification, by type of job, in the transport industry

Sector Strategy T-05-2: Professional Engineer

By introducing a Professional Engineer's licensing system, the strategy will increase the number of professionals who can address public welfare and other interests. The professional status and practice of engineers is legally defined and protected by law.

Action T-05-2

- Designate the Ministry to be responsible for licensing Professional Engineers
- Establish Myanmar Professional Engineer (P.E. Myanmar) licensing system by 2020

T-06:	<u>Enhanced environmental management</u> : Increase public awareness of transport industry work to improve environmental sustainability, in the context of the transport system.
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Introduce environmentally-friendly technology in the transport sector, the industry and increase public awareness of environmental issues.

Sector Strategy T06-1: EIA Guideline

By introducing best practices from advanced countries, introduce practical and appropriate environmental protection measures.

Action T06-1: Develop EIA guideline in the transport sector

- Following the EIA guideline by MOECAP, develop responsible social and environmental guidelines in the transport sector
- Consultants and contractors would be required to follow the guideline
- Develop a traffic impact assessment manual and procedures for large-scale transport projects

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Sector Strategy T06-2: Increase Public Awareness

Action T06-2-1: Increase public awareness

- Prepare public awareness tools (e.g. communication tools, mass media, etc.)
- Organize public awareness campaigns, seminars, etc. in public gathering places

Action T06-2-2: Improve awareness of transport industries

- Review and revise the existing regulation on vehicle inspection from an aspect of environmental improvement (strict regulation on emission gases)
- Regulate and limit the use of older vehicles for commercial purposes (old trucks) and public transport (old buses) and encourage replacement with new vehicles by providing preferential treatment
- Introduce preferential treatment for use of environmentally friendly vehicles (e.g. favored import tax)
- Introduce preferential treatment for environmentally friendly technology research and development

T-07	<u>Sustainable funding</u> : Secure the needed funding to meet annual budget requirements and allocate to MOT, MORT, MOC and region/state government to improve and develop infrastructure.
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Sector Strategy T-07

Secure permanent funding sources for the development of road infrastructure and service.

Action T-07

- Carry out a comprehensive study to identify possible sources of financing for the transport sector including the establishment of a new taxation scheme targeted to transport infrastructure development.
- Develop and enact special a purpose taxation scheme (e.g. fuel levy law, development levy law) if applicable.
- Collect fees from transport users, according to the services they use.

T-08	<u>Research and Development</u> : Develop appropriate and cost-effective infrastructure development technologies, based on environmental and local conditions.
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Strategy T-08-1: Increase technical capacity in higher education systems

Action T-08-1: Improve national universities

- Increase the capacity of the national universities and institutes in the transport infrastructure sector through international exchange programs, technical assistance (TA) from advanced countries, etc.
- Increase the number of university students in the transport planning and engineering sector with incentives, such as scholarships, bursaries, etc.

Strategy T-08-2: Increase technical research and development

Action T-08-2: Improve the existing research and development capacity in ministries

Increase capacity in research and development on the relevant organizations, including:

- Department of Meteorology and Hydrology (DMH), MOT
- Department of Water Resources and Improvement of River Systems (DWIR), MOT
- Myanmar Shipyards (MS), MOT
- Myanmar Maritime University (MMU), MOT
- Institute of Marine Technology (IMT), MOT
- Road Research Laboratory, PW/MOC
- Central Institute of Transport and Communications, MRT

## 9.8 MYT-Plan Transport Sub-sector Vision, Strategic Objectives, and corresponding Strategies and Actions

### 9.8.1 Road Transport Sector

#### Sector Vision

*“Develop all-weather and safe road transport infrastructure in order to fulfill social and economic transport needs of the nation in a coordinated manner with other modes of transport; and build robust foundation for land transport industries in terms of road infrastructure and regulatory framework; and achieve environmentally-friendly land transport system development throughout the country.”*

#### Sector Issues

##### (1) Better Planning and Coordination:

- Road and bridge inventory data, traffic volume data, and other road related statistics have not been collected systematically, as such, the road and bridge asset management and road network planning is weak.
- Opportunities to improve knowledge and skill levels of MOC and MRT(RTAD) staff in the transport planning, administration and management and safety sector is limited.

##### (2) Infrastructure Development:

- Due to its geographic location, Myanmar has a number of strategic roads that form part of a broader regional transport network that must be developed, in coordination with international partners.
- Progress on improvements to the union highway network (ASEAN highways), suggested by the 2010 Brunei Action Plan, is behind schedule.
- Major projects in the transport and industrial sectors require planning coordination, as is the case with Hanthawaddy International Airport and Thilawa port and SEZ.
- There are bridges that need urgent rehabilitation or replacement. Planned new bridges should employ maintenance-free technologies to reduce the burden in the transport sector.
- The Highway truck transport services incur costs for excessive speed and accident damage, partly due to deteriorated road conditions on the union highways. Immediate maintenance or upgrading of these road segments is urgently needed.
- The existing Yangon-Mandalay Expressway is under-utilized, due to its restrictions on trucks.
- Space (right of way) for motorcyclists, cyclists and other vulnerable road users is limited and their needs should be specifically addressed.

##### (3) Better Environment, Safety and Security:

- Accident rates in Myanmar are about three times higher than those in Thailand and Vietnam. It should be noted that the expressway from Yangon to Mandalay is currently experiencing a number of accidents with fatalities.

- Although road safety measures have been implemented nationwide, total number of road accidents, injuries and death rate has been increasing.

**(4) Institutional and Regulatory Development:**

- Responsibilities for road development are split among several agencies, with unclear boundaries, thus exacerbating coordination and integration issues.
- The role of the private sector in developing the road infrastructure should be clearly defined.
- The existing BOT contracts require revision to meet international standards.
- Sustainable funding mechanisms in the public sector need to be developed in order to accelerate the union highway system as well as rural road development.
- Establishment of National Road Safety Council is behind schedule, accordingly, its monitoring and enforcement capability on road safety has not been fully implemented.

**(5) Reasonable transport pricing and secured budgeting:**

- The existing toll rates should be reviewed and adjusted to achieve maximum benefit for the public, while stimulating business development with the private sector.
- Lack of National Road Safety funding allocated for National Budget and other NGOs and INGOs is one of the most serious obstacles to implementing road safety measures effectively and efficiently.

**(6) Sector specific issues:**

- Safety devices that are below standard (unsafe) are widely used in the country. Many are locally produced and sold at a low cost; the majority of the motorcyclists do not buy or use high quality helmets because of the high price for this safety equipment.
- Almost 50% of all traffic accidents are associated with motorcyclists. It is critical that the transport sector devotes serious attention to this matter.
- Level of Service (LOS) and safety of public transport systems such as buses, taxis, and urban rail should be improved urgently.
- Issues of fluctuating demand together with low freight transport tariffs must be considered in order to stimulate the transport industry.

**Sector Strategic Objectives**

In order to address the identified sector issues, seven strategic objectives are suggested as follows:

- RD-01 Update and establish safe, environmentally-friendly and modern motorways, highways and bridge designs to international standards.
  - RD-02 Plan and build a hierarchical union highway and motorway network to support regional development along the designated transport corridors and major transport nodes, conforming to the ASEAN transport agreement.
  - RD-03 Develop an all-weather and disaster-free trunk road network along designated transport corridors.
  - RD-04 Develop cost-effective asset management measures and mechanisms.
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- RD-05 Reduce the number of road accidents to the level of advanced countries as soon as possible.
- RD-06 Establish clear institutional and organizational frameworks in the road transport planning administration and management sector, establishing lines of demarcation between the central government and the region / state governments.
- RD-07 Maintain and further encourage the participation of the private sector in developing road transport infrastructure and providing transport services.
- RD-08: Improve and enhance the road and land transport industry to increase business performance.

**Strategic objectives and corresponding strategies and actions**

RD-01: Improved Standards: Update and establish safe, environmentally-friendly and modern motorways, highways and bridge designs to international standards.

Sector Strategy RD-01-1: Urgent design standard updates

The existing design standards used in the road and bridge sector are reviewed by the end of year 2014, and consequently updated / improved with technical support from advanced countries.

Action RD-01-1

- Formulate a special task force in PW to review the existing road and bridge design standards.
- Invite specialists / senior engineers from advanced countries to support the task force.
- Update existing standards before starting a series of major works in the road and bridge sector.
- Establish a new road classification system urgently, including a new numbering system proposed by MYT-Plan, and corresponding geometric standards.
- Finalize a series of road designs, construction, and maintenance manuals.
- Establish a Road Safety Audit System (MRT).

RD-02: Road Network Development: Plan and build a hierarchical union highway and motorway network to support regional development along the designated transport corridors and major transport nodes, conforming to the ASEAN transport agreement.

Sector Strategy RD-02-1: Priority trunk road network development

Improve trunk road networks along the designated priority development corridors: the Central North-South Corridor (Yangon – Nay Pyi Taw – Mandalay), the East-West Corridor (Yangon – Hpa-An- Myawaddy), the Northern Corridor (Mandalay – Muse) and the Western North-South Corridor (Yangon – Pyay – Magway).



Action RD-02-1a: Effective use of the expressway

- Allow heavy vehicles (e.g. trucks) to use the expressway before 2018, based on the demand forecast.
- Provide more opportunities for drivers to stop and take rests to reduce accidents.
- Add more service areas along the expressway for the convenience of expressway users.

Action RD-02-1b: Improvement of the priority union highways

- Improve infrastructure (e.g. surface condition improvement, widening, etc.) on the union highway(s) along the priority corridors (e.g. Thaton – Eindu – Kawkareik – Myawaddy Road, etc.).
- Introduce the “Michi-no-eki” (roadside service areas) along the union highways to provide residents with business opportunities and road users (e.g. travelers) with opportunities to interact with local people and understand their products.
- Designate “heavy loaded highways” and improve these to appropriate standards, to support major freight movement that conforms to ASEAN Highway standards.

Sector Strategy RD-02-2: Strengthen connectivity between major traffic generators

Provide a high-speed and high-capacity road network and services to/from major dry ports, sea and river ports, and airports.

Action RD-02-2

- Extend the existing expressway to connect international airports to ports, and between major inland river ports (e.g. Yangon – Ywathargyi - Thilawa Port Expressway, Yangon City - Hanthawaddy Airport Expressway, etc.) (PW/MOC).
- Develop outer ring roads along designated urban growth boundaries of major growth centres, such as Yangon and Mandalay (MOC/YCDC/MCDC).
- Relocate the existing truck terminal near the Bayint Naung bridge to Ywathargyi, East Dagon township, together with relocation of MR facilities and development of a rail-based ICD (YCDC, MR/MORT).

Sector Strategy RD-02-3

Develop a high capacity road network and support regional development projects such as SEZs and Industrial Zones.

Action RD-02-3

- Support industrial development projects by providing direct and nearby access to highway on-and off ramp and expressway interchanges.

Sector Strategy RD-02-4

Develop cross border transport facilities and improve access to these facilities.

Action RD-02-4

- Improve access roads to international cross borders at Myawaddy and Three Pagodas Pass.
- Provide a single window service at international cross border points.

- Extend operational hours of cross border services.

#### Sector Strategy RD-02-5

Gradually upgrade the existing road infrastructure to conform to ASEAN transport agreements.

##### Action RD-02-5

- Complete a total of 3,000 km of ASEAN Highway Network in Myanmar (e.g. AH-1: Yangon- Mandalay- Tamu, AH-2: Mandalay-Taunggyi-Tachileik) by the year 2030.
- Install road signs and a route numbering system that are compatible with the ASEAN highway network.
- Identify freight movement patterns and volumes via ASEAN dry port network (e.g. dry ports in Yangon, Mandalay, Muse, Pyay, Monywa, Mawlamyine, Bago, and Tamu) and develop corresponding facilities.
- Develop an ICT and ITS master plan and introduce advanced technology to achieve higher efficiency in use of road infrastructure.
- Fully implement ASEAN Framework Agreements on Transport Facilitation.

#### Sector Strategy RD-02-6

Improve regional, state and township roads to access tourist attraction sites, such as Bagan and Taunggyi.

##### Action RD-02-6

- MOC and local governments to designate and improve major access roads to tourist attraction areas such as Bagan, Pyin Oo Lyin, Inle Lake, Kyaiktiyo.
- Install road signs in English and Myanmar language for visitors.
- Local governments to improve local access roads to tourist attraction areas, such as along the beach in Rakhine State.

RD-03: Safe trunk road network: Develop an all-weather and disaster-free trunk road network along designated development corridors.

#### Sector Strategy RD-03-1

The existing road infrastructure is not engineered to function in all weather conditions and is prone to damage from natural disasters. Economic growth in development corridors requires efficient, consistent and safe service from connected infrastructure.

##### Action RD-03-1

- Prepare a hazard map and identify road networks and other transport facilities that are likely to be damaged by natural disasters.
- Implement slope protection measures in landslide prone road sections.
- Implement measures to avoid flooding along the designated coarse ways.
- Carry out a series of disaster-resistant (cyclone and earthquake-resistant)

improvements of existing bridges.

- Develop an emergency transport plan, to be implemented during emergencies, such as a large-scale earthquake.

RD-04: Effective asset management: Develop cost-effective asset management measures and maintenance mechanism.

Sector Strategy RD-04-1

Properly design a maintenance mechanism for the existing road transport infrastructure and minimize the life cycle cost.

Action RD-04-1

- Carry out technical inspection of the existing road and bridge infrastructure and develop a database / inventory.
- Develop an asset management system, such as HDM, and a maintenance program.
- Implement preventive (proactive) measures before undertaking full-scale replacement or rehabilitation works.
- Conduct Research and Development (R&D) on cost-effective maintenance technologies.
- Provide trainings with regard to inspection, evaluation and implementation of the maintenance for transport infrastructures.
- Enforce regulations against overloading trucks.

RD-05: Reduction of traffic accidents: Reduce the number of road accidents to the level of advanced countries.

Sector Strategy RD-05-1      Controlled use of the existing expressway

In order to reduce the number of traffic accidents on the expressways, use of these roads should be controlled (limited) to permit only lower levels of road class users, until full-scale improvements can be completed.

Action RD-05-1

- Carry out a comprehensive road accident study on the expressway.
- Install necessary equipment to control behavior of drivers, such as speed limit notification devices.
- Provide crossing facilities for domestic animals.

Sector Strategy RD-05-2      Upgrade the existing expressway

Upgrade the existing expressway to international motorway standards and encourage economic activities that reduce the number of fatal accidents.

Action RD-05-2

- Establish a special task force team to improve safety on expressways.

- Inspect road conditions and identify critical locations/sections for improvement.
- Rehabilitate/replace expressway facilities to meet international motorway standards.

Sector Strategy RD-05-3 Upgrade the union highway

The union highways require urgent upgrading as industry standards are difficult to apply in some cases, due to physical constraints. However, it is suggested that the Government follow the improved design standard as much as possible.

Action RD-05-3

- Establish a special safety improvement task force team for union highways.
- Urgently implement safety measures (e.g. installation of guardrails, lighting, road signs, weight bridges, segregated pedestrian crossings, traffic signal installation at major intersections, etc.) at critical road sections.
- Develop highway design standards and a design manual.

Sector Strategy RD-05-4 Safety Improvement Plan and Programs

Develop a long-term plan for safety improvement in the road transport sector.

Action RD-05-4

- Develop a Road Transport Safety Improvement Master Plan.
- Develop National Road Safety Action Plan (2014 – 2020).
- Review and revise the existing laws/acts/regulations with regard to vehicle inspection/registration and introduce an advanced vehicle inspection system.
- Develop Road Safety Audit System.
- Introduce Intelligent Transport System (ITS).
- Upgrade public transport.

Sector Strategy RD-05-5 Public awareness and capacity development

Increase public awareness regarding road safety improvements and increase the capacity of experts/specialists in the field of road safety improvement.

Action RD-05-5

- Develop and disseminate road transport safety guidelines for bus and truck operators, drivers, pupil and students.
- Establish a Road Traffic Accident Research Center.
- Increase the number of road transport safety specialists.

RD-06	<u>Effective institutional set-up:</u> Establish clear institutional and organizational frameworks in the road transport planning administration and management sector, establishing lines of demarcation between the central government and the region / state governments.
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Sector Strategy RD-06-1 Decentralization of role of Public Works

PW region/state offices should be strengthened in terms of their institutional, organization and technical capacity and transformed into part of the region/state government body.

Action RD-06-1

- Conduct a comprehensive study on possible decentralization of road planning, administration, and management roles.
- Develop a road and road traffic database of region/state roads.
- Develop a fully computerized communication (data transfer) system between the central government (PW) and region/state PW offices.
- Increase road planning, administration and management capacity of region/state offices by providing training to central and local staff.

RD-07: Private sector participation: Maintain and further encourage participation of the private sector in developing and maintaining road transport infrastructure and providing transport services.

Sector Strategy RD-07-1

Promote fair and accountable business opportunities with the private sector by inviting them to partner on road infrastructure development, corresponding maintenance work and related service provision.

Action RD-07-1: Increase business opportunities

- Establish a special PW task force for toll road and bridge business operation.
- Review the existing procurement system and BOT contract documents, including specifications for road maintenance, and identify technical issues to be addressed.
- Update or improve the existing standard contract form for road operation and maintenance, used under the BOT scheme.
- Build a typical business model for a toll road construction project, using a PPP scheme.
- Provide business opportunities for road construction, operation, and maintenance to wider range of business entities through deregulation.

RD-08: Stimulate growth with infrastructure: Improve and enhance the road and land transport industry to increase business performance.

Sector Strategy RD-08-1: Core road transport business improvement

Action RD-08-1

- Establishment of a special business unit in MOC for public transport business development, based on YUTRA.
- Establish a JV or a similar partnership with the private sector (local and foreign) for both freight and passenger transportation at an initial stage, which can be transformed to a company (corporatization) and a Government Linked Company (GLC), with a phased approach.

Sector Strategy RD -08-2: Non-road transport business improvement

Encourage effective use of road transport opportunities for other types of business such as service areas and michi-no-eki and strategic use of lands owned by MOC.

Action RD -08-2

- Establish a special business unit in MOC for studying and implementing a series of non-road transport businesses, using road transport facilities and other MOC assets.
- MOC to run the real estate business jointly with private sector.
- Road Transport (MRT) work on the non-road transport business development jointly.

## 9.8.2 Railway Sector

### Sector Vision

*“Develop safe rail network and services along the designated major economic development corridors in order to fulfill social and economic transport needs of the nation in a coordinated manner with other modes of transport to achieve higher inter-modality; contribute to the environmental improvement through introduction of low carbon technologies, and build preferred business environment through provision of safe, punctual, comfort and high capacity rail transport services with affordable yet reasonable prices.”*

### Sector issues

#### (1) Better Planning and Coordination:

- The inventory data, passenger analysis and freight handling volume data for railways and bridges are not well prepared and are not digitized. As a result, asset management, service development and business planning capacity is weak.
- The human resources available for planning and business promotion sectors is very limited.
- The Government requires planning coordination with major projects in other transport and industrial sectors, such as Highway truck terminals in Yangon and Mandalay, Hanthawaddy International Airport and Thilawa port and SEZ and dry ports.

#### (2) Infrastructure Development:

- The railway is a valuable national asset that should be preserved and used to its maximum utility. Large investments, however, will be necessary to revitalize the system and make it competitive in the transport market.
- MR focused on line extensions in the past, even to areas with low traffic demand and areas ill-suited for railways as a principle mode of transport.
- There are several strategic railway lines that reach cities near international border areas, such as Myitkyina, Lashio, Kalay in the north, and Thanbyuzayat and Dawei in the south. Development of international inter-modal facilities in these areas must be considered in coordination with international partners.
- At the 13th Special Working Group Meeting on Singapore-Kunming Rail Link held in Myanmar in October 2011, both countries agreed to postpone off the construction of Namtok (Thailand) - Three Pagoda Pass (Border) - Thanbyuzayat (Myanmar) missing link. (MRT)
- The throughput of container and general cargo at the ports in the Yangon area have been increasing sharply, while the transport capacity of MR is limited.
- In Myanmar, Dawei Deep Seaport and the Special Economic Zone Project have been being implemented. A rail link from Dawei (Myanmar) to Kanchanaburi (Thailand) is scheduled for future construction, during the project's third phase. This would be a new spur line of the Singapore-Kunming Rail Link-SKRL.

- Progress of the cross-border railway network development (e.g. Thanbyuzayat – Three Pagoda Pass, 111 km by 2020 as part of Trans Asian Railway Line) is likely to be behind the schedule. Similarly, the rail network extension from the Three Pagodas Pass to Bangkok may not happen in a short-term.
- The quality of railway transport services is low because of deteriorated tracks, aging coaches and wagons as well as poor maintenance.
- There are many old rail bridges that need urgent rehabilitation or replacement to mitigate against large-scale accidents.
- The majority of existing rolling stocks is very old (over 30-years old), which is one of the obstacles for MR to improve train operation efficiency.
- The existing main railroads of Yangon-Mandalay, Yangon-Pyay, Yangon-Mawlamyine are not utilized effectively.
- MR plays a vital role in inter-city passenger and freight transport services. The service level of Yangon Circular Rail Line needs to be improved in order to accommodate the increasing travel demand in Yangon.
- The quality of railway transport services, in terms of speed and accident control, is low mainly because of deteriorated track conditions and aged and poorly maintained passenger coaches and freight wagons.
- In addition to the inter-city passenger and freight transport services, MR plays a vital role in Yangon as an urban rail passenger transport service provider. The service level of Yangon Circular Rail Line must be improved to accommodate the increasing travel demand in Yangon.
- Other important actions that MR should undertake include:
  - Upgrading of the Yangon Station Yard facilities and modernization of signaling system.
  - Establishing a modernized track maintenance system.
  - Upgrading the Insein Diesel Locomotive Workshop.
  - Moving RBE workshop to Ywarthagyi.
  - Constructing a new track maintenance workshop in Ywarthagyi.
  - Rehabilitating rail lines, including:
    - Bago – Mawlamyine rail line (Progress to 100 km/h running speed)
    - Yangon – Pyay – Bagan rail line
    - Bagan – Mandalay rail line
    - Ywahtaung – Khin U rail line (Progress to 100 km/h running speed)

**(3) Better Environment, Safety and Security:**

- Even though accidents are seldom serious (mainly because of low running speeds), actual accident rates in the rail sector are very high, as compared with Thailand and Vietnam, mainly because of poor track conditions and (mostly) primitive signaling system.
- Improvements are needed in terms of track rehabilitation and modernization of signaling systems, automatic level crossing, train control systems, and protection systems.

**(4) Institutional and Regulatory Development:**

- Myanmar Railways (MR) has the sole responsibility for rail infrastructure development
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and rail-related transport service production. Accordingly, there is no competition within the rail sector, though MR has been faced with tough competition with other modes of transport such as highway buses, inland water transport and highway trucks.

**(5) Reasonable transport pricing and secured budgeting**

- The business performance of MR has been very poor and MR's profit and loss statement has been negative since 2006, mainly due to increased fuel costs and other factors such as operation of non-profitable railways. Accordingly, about 20 % of MR's expenditure are typically subsidized by the central government. A critical due-diligence survey is needed before making additional investment in the rail sector.
- MR has been faced with poor business performance problems, that is, negative profit and loss statement recent years.

**(6) Sector Specific Issues**

- Unprofitable rail line have been subsidized by the Government.

**Sector Strategic Policies and Objectives**

In order to address the identified sector issues, seven strategic objectives are suggested as follows:

- RWY-01 Develop effective asset management measures and mechanisms to fully utilize the existing assets.
- RWY-02 Rehabilitate the existing rail infrastructure and associated systems along the designated development corridors and to/from major transport nodes to a higher standard.
- RWY-03 Develop all-weather and disaster-free trunk rail network and services along the designated development corridors.
- RWY-04 Reduce the number of rail accidents to the level of advanced countries, as soon as possible.
- RWY-05 Introduce environmentally-friendly technology in the rail infrastructure and rail transport industry.
- RWY-06 Increase participation of the private sector in developing rail and rail-related infrastructure and businesses such as ICD development and operation and rail-based freight forwarding business.
- RWY-07 Improve MR's business performance, focusing on market-driven freight transport services.
- RWY-08 Be prepared for early introduction of High Speed Railway (HSR) Passenger Service.
- RWY-09 Encourage and promote business and industrial activities along rail corridors, that can yield stable demand of both passenger and freight.
- RWY-10 Reduce operational and management costs by streamlining the institutions, the number of staffs, etc.

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## **Strategic objectives and corresponding strategies and actions**

RWY-01 <u>Asset Management System</u> : Develop effective asset management measures and mechanisms to fully utilize the existing assets.
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### Sector Strategy RWY-01-1

Establish a sustainable maintenance mechanism for the rail infrastructure and minimize life cycle costs.

#### Action RWY-01-1

- Carry out technical inspections of the existing rail infrastructure and develop a database/inventory of these by the end of 2015.
- Develop an asset management system and a maintenance program in 2015/2016.
- Implement preventive and proactive measures before doing full-scale replacement or rehabilitation works by 2016.
- Conduct Research and Development (R&D) on cost-effective maintenance technologies in 2015/2016, followed by establishment of a rail research centre.
- Provide training in inspection, evaluation and rail infrastructure maintenance in 2014.

RWY-02: <u>Cost-effective Rail Network Development</u> : Rehabilitate the existing rail infrastructure and associated systems along the designated development corridors and to/from major transport nodes to a higher standard.
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### Sector Strategy RWY-02-1: Priority Rail Corridor Development

Improve railway networks along the priority development corridors: the Central North-South Corridor, the East-West Corridor, the Northern Corridor and the Western North-South Corridor, Cross-border lines of Tamu – Kalay, Lashio – Muse, Dawei–Kanchanaburi.

#### Action RWY-02-1

- Improve railway infrastructure and enhance railway transport services along the priority corridors (e.g. Yangon – Mandalay Section, Yangon - Hanthawaddy / Bago Section, Bago-Mawlamyine Section, Yangon-Pyay Section).
- Develop logistics centres at major railway stations (e.g. Yangon and Mandalay ICD/Dry Ports) in conjunction with the Thilawa port development.

### Sector Strategy RWY-02-2: Strategic extension and new rail line construction

Provide high-speed and high-capacity railway network and service, connecting major ports and airports.

#### Action RWY-02-2

- Rehabilitate the existing rail line in the Yangon port area to accommodate increasing container volumes in 2015/2016.
- Increase the capacity of the Thilawa rail line to the Thilawa port and SEZ in

accordance with the increasing demand of international container cargo.

- Develop dry ports/ICDs in Yangon (Ywa Thar Gyi) and Mandalay (Myinge) area in conjunction with Thilawa port and SEZs development along the corridor.
- Construct an extension from Thanbyuzayat to Three Pagoda Pass where the State Railway of Thailand (SRT) confirms the connection and through-operation with Myanmar.
- Develop an airport rail access to the newly developed Hanthawaddy International Airport, as part of the future high speed rail (HSR: Yangon – NPT - Mandalay).
- Construct new rail infrastructure (LRT, MRT, subway) at Yangon Circular Line and Mandalay Circular Line and an LRT line, linking Mandalay to Mandalay International Airport.
- Rail network long-term plans include;
  - 1) Construct high speed train for the Ywa Thar Gyi-Nay Pyi Taw-Mandalay section
  - 2) Construct new double line for Yangon- Ywa Thar Gyi
  - 3) Set maximum speed of 100 km/h for Mawlamyine-Dawei section
  - 4) Set maximum speed of 100 km/h for Kalay-Tamu section
  - 5) Set maximum speed of 100 km/h for Patheingyi-Pakokku section
  - 6) Set maximum speed of 100 km/h for Okkalapa-Bago section
  - 7) Construct new circular line in Mandalay
  - 8) Construct subway systems in Yangon City
  - 9) Construct LRT system for Mandalay – Kyaukse
  - 10) Upgrade the Thazi-Shwepyithar section
  - 11) Construct double line for Yangon-Mogyoke
  - 12) Extend rail network of the Yangon and Mandalay Circular Rail Line

RWY-03: Safe rail transport service provision: Develop all-weather and disaster-free trunk rail network and services along the designated development corridors.

#### Sector Strategy RWY-03-1

Develop disaster-resistant rail infrastructure along the designated development corridors.

#### Action RWY-03-1

- Prepare a hazard map and designate rail sections and other transport facilities in 2014/2015 that are likely to be damaged by natural disaster.
- Implement slope protection measures in landslide prone railway sections by 2014.
- Implement measures such as truck level elevations to avoid flooding along the designated flooding sections in 2014/2015.
- Carry out a series of disaster-resistant (cyclone and earthquake-resistant) improvements (or replacement) of the existing bridges in 2014/2015.
- Develop an emergency transport plan, to be implemented during emergencies, such as a large-scale earthquake.

RWY-04 Safety First: Reduce the number of rail accidents down to the level of advanced countries, as soon as possible.

Sector Strategy RWY-04-1 Urgent rehabilitation

Carry out urgent rehabilitation of the critical railway sections in a practical manner. While it is understood there are cases in which design standards may be difficult to apply, due to physical constraints until full-scale improvements are complete, the Report recommends to follow design standards and develop improvement manuals, as much as possible.

Action RWY-04-1

- Establish a special task force team to examine safety improvements of the existing rail systems, mainly focusing on the rail and track condition and signals and communication in 2014/2015.
- Inspect the existing rail and track conditions and identify critical locations and sections during /2015/2016.
- Rehabilitate or replace existing rail and tracks to meet the MR standard during /2015/2016.
- Replacement of rolling stock, rehabilitation of the existing rolling stock and identification of the critical problems

Sector Strategy RWY-04-2 Safety Improvement Plan and Programs

Develop a long-term safety improvement plan, as a part of the MR modernization plan.

Action RWY-04-2

- Review, revise or develop laws/acts/regulations/manuals with regard to train operation, civil works, vehicle inspection and maintenance, etc. to improve safety.
- Develop a Rail Transport Safety Improvement Master Plan.
- Invite technical assistance to update skills and knowledge in the field of safety improvement.

RWY-05: Enhanced environmental consideration: Introduce environmentally-friendly technology in the rail infrastructure and rail transport industry.

Sector Strategy RWY-05-1: Low Carbon Tackle with global warming issues

By introducing best practices from advanced countries, introduce practical and applicable low carbon technologies in the rail sector.

Action RWY-05-1: Introduction of advanced low-carbon technologies

- Develop a plan for introduction of low-carbon technologies in the rail sector with technical support from external advisors in 2014/2015.
- Import environmentally-friendly and energy-saving locomotives, DEMU and other low-carbon technologies.
- Introduce renewable energy, where applicable (e.g. lighting at stations).

- Introduce electrification of the rail system or a hybrid system at circular line and other trunk lines by 2035.

RWY-06: Private sector participation: Encourage participation of the private sector in developing rail and rail-related infrastructure and business such as ICD facilities development and its operation and rail-based freight forwarding business.

Sector Strategy RWY-06-1

Encourage fair and accountable business opportunities with the private sector by inviting them into rail and non-rail business opportunities.

Action RWY-06-1: Increase business opportunities for private sector

- Establish a special task force in MR for PPP application and MR-private company joint operation in the rail sector in 2014.
- Review existing laws and acts that regulate MR's business activities with the private sector, and identify technical issues to be addressed in 2014/2015.
- Build a typical business model for a PPP project (e.g. Yangon station building and surrounding area development, ICD facilities building and operation project under PPP scheme).

RWY-07: Industry efficiency: Improve MR's business performance, focusing on market-driven freight transport services.

Sector Strategy RWY-07-1: Core rail business improvement

Action RWY-07-1

- Establish a special business unit for rail passenger and freight business improvement in 2014/2015.
- Develop a short- and mid-term business plan with technical support from external advisors, during 2014/2015.
- Develop a container train operation, based on the business plan.
- Conduct an urgent study on rail services and operations in the Ywar Thar Gyi area.

Sector Strategy RWY-07-2: Non-rail business improvement

Encourage effective use of MR/MRT assets and the strategic use of lands in prime locations.

Action RWY-07-2

- Establish a special business unit for carrying out a series of non-rail business, using MR/MRT assets like land and station buildings.
- Plan urban re-generation projects at or near major rail stations such as Yangon, Insein, Kyee Myint Daing, New Ma Hlwa Gone and Mandalay stations.
- MR/MRT to run the real estate business jointly with private sector.

RWY-08 Sector readiness: Be prepared for early introduction of High Speed Railway (HSR) Passenger Service

Sector Strategy RWY-08-1: Early Introduction of High Speed Railway (HSR) Service

Action RWY-08-1

- Establish a special project unit for HSR development.
- Study the development of HSR between the Yangon downtown and the Hanthawady airport, with possible extension to Nay Pyi Taw and Mandalay.

RWY-09 Stimulate economic growth: Encourage and promote business and industrial activities along rail corridors, that can yield stable demand of both passenger and freight.

Sector Strategy RWY 09 – 1: Business Environment Improvement

Action RWY 09 – 1

- Upgrade the stations and goods-sheds, which are located at the major city and main transportation nodes.
- Try to connect other modes of transport with business opportunities.
- Promote non-rail business development along the rail corridor such as shopping malls, recreation centers, hotels and restaurants with consideration to environmental issues.
- Improve transport capability and service provision to improve customer satisfaction.
- Introduce Public Private Partnerships in MR and joint operations with private companies, in the rail passenger and freight sector.
- Construct logistics hubs, logistics centers and dry ports near railway areas and try to enhance multi-modal transport capability.

RWY-10 Reduce operational and management costs by streamlining the institutions, the number of staffs, etc.

Sector Strategy RWY – 10 – 1: Reorganization

Action RWY – 10 – 1

- Modernize or reorganize the existing institute of Myanma Railways.
- Carry out rail operations streamlining, while maintaining skilled and experienced labor, staffs and supervisors.
- Modify the State-owned enterprise to a semi-public organization (Public Private Partnership sector) and reduce unnecessary costs.

### 9.8.3 Waterway Transport Sector

#### Sector Vision

*“Develop world-class international gateway port(s) as one of the hub seaports in Asia and all-weather and 24-hours inland waterway transport services along the designated development corridors in order to fulfill social and economic transport needs of the nation in a coordinated manner with other modes of transport to enable higher inter-modality; and build preferred business environment in the country through provision of safe, punctual, and high-capacity water transport services with competitive prices.”*

#### Sector issues

##### Maritime Transport and Ports

###### (1) Better Planning and Coordination:

- The maritime sector is expected to play a vital role in increasing the variety of industries in the country, with an emphasis on high-level inter-modality and accessibility at major ports.
- It is necessary to develop a port improvement master plan for each of the existing major ports to modernize port management and increase inter-modality.
- The sub-sector vision can be achieved with the development of new deep-sea ports at strategic locations, one of which should be close to the national development axis (the North-South Corridor).

###### (2) Infrastructure Development:

- The existing Yangon Ports (not including the Thilawa port) currently handle nearly 90% of international cargo and the dominance of the Yangon Ports (including Thilawa in future), as the country’s gateway port will likely remain in the future.
- It is projected that a total of international cargo throughput in Myanmar will be approximately 62 million tons by 2025, including containers and bulk cargo.
- Total container throughput in Myanmar will be close to 4 million TEU in 2025 (nearly 8 times the existing throughput).
- Existing ports in Myanmar, including the Yangon Port, are located on rivers and are constrained by shallow draft, high siltation, and variability in water depths. It is critical to have precise bathymetry data of the concerned areas as soon as possible for safe navigation, and to develop an electronic navigational chart (ENC) to an international standard.
- In addition, it is important to improve the navigation channel along the Yangon River and the Yangon port area by deepening and widening the existing channel and installing preventive measures for sedimentation in order to accommodate larger vessels.
- Should the Yangon ports continue to dominate and if handling volumes increase, these ports will become a bottleneck for the country’s industrial activities and may worsen traffic congestion in the city of Yangon. As such, port development in Thilawa should be accelerated.

- Cargo handling efficiency requires immediate improvement, in order to reduce cargo dwelling time.
- Current private sector development in Thilawa needs additional analysis, in terms of its location and connectivity with the newly developed SEZ in its hinterland.

**(3) Better Environment, Safety and Security:**

- Limited pilotage system and congested traffic in the Yangon Port area are resulting in a reduction of safety.
- With regard to port facilities, including private sector's facilities, a set of technical standard should be introduced to increase safety levels.

**(4) Institutional and Regulatory Development:**

- Efficiency improvements are needed for existing port management (reduction of paper works), including vessel entry procedure, cargo handling, accounting settlement between vessel owners, port master, port facility owners, cargo handling service providers, and custom clearance procedures. In addition, Electric Data Interchange (EDI) in port operation should be introduced.
- This Report recommends introducing bounded transportation from sea transport to inland water transport and land transport by developing inland / river ICDs at strategic locations to accommodate increasing container cargo transport demand and to enable faster intermodal transport.

**(5) Reasonable transport pricing and secured budgeting**

- The existing cargo handling tariff is relatively high in comparison with those of other major ports. A competitive and reasonable tariff structure should be established.

**Inland Water Transport and River Ports**

**(1) Better Planning and Coordination:**

- Statistics in the inland water transport sector are not well developed. Information from the private vessel owners or forwarders is limited or difficult to obtain, leading to difficulty in planning and marketing.
- Inter-modal facilities between water and land transport have not been well developed.
- There is no bounded transfer service between the inland water transport and the sea transport.

**(2) Infrastructure Development:**

- The unique characteristics of inland water transport (e.g. slow speed, cost differences between upstream and downstream movements, low carbon footprints per ton-km, pre-determined location, etc.) limit its competitiveness to specific market niches. In short, it is less flexible than road transport and is presently not an appropriate mode for all seasons. It is necessary to overcome such limitations technically, while fully taking advantage of its unique characteristics of low carbon footprints and competitiveness in specific market.
- The four major rivers are the natural assets of the country that should be conserved and maintained by the government for navigation and other purposes. However, the large differences in water levels between dry and wet seasons pose unique challenges. There



are many bottlenecks and dangerous sections for navigation, which is made worse by the limited navigation aid facilities. Hence, it is recommended to carry out a comprehensive study on these navigation channels.

- Hydrographic data about rivers is inadequate and oftentimes outdated. As such, there is no sound basis for issuance of navigation charts, restrictions, determination of maintenance and repair works, or formulation of future plans. Hence it is highly important that a comprehensive study be carried out on the navigation channels of these.
- The navigation channel along the Ayeyawaddy River is one of the major transport routes of the country (the Western North – South development corridor). Hence, it will be important to increase safety and transport capacity by improving the navigation channel, enabling 24-hour navigation and introducing new vessels.
- The navigation channel along the Chindwin River, as a spur line from the Ayeyawaddy River, plays a vital role to support socio-economic activities in Sagaing Region, and which is connected to India through Kalewa. The provision of water transport services along the Chindwin River may not be financially viable because of limited demand, but it is very important to provide such services, to maintain basic services for residents along the river.
- Aging and deteriorating vessels are a primary obstacle to achieving safe and fast water transport services.

**(3) Better Environment, Safety and Security:**

- Insufficient navigation aids and outdated navigation chart lead to deterioration of safety and service level (speed).

**(4) Institutional and Regulatory Development:**

- Role of Inland Water Transport (IWT) in the transport market needs to be revisited urgently, that is, as one of the semi-public organizations, IWT is expected to play a vital role in increasing welfare of the nation and developing the water transport industries. IWT needs to change its role of service provider to a supporting organization of the water transport industries.

**(5) Reasonable transport pricing and secured budgeting**

- Government-set tariffs are said to be excessively low and act as a disincentive to improve water transport business or for new investments in vessels, the majority of these are very old.

**Sector Strategic Objectives**

In order to address the identified sector issues, this Report recommends seven strategic objectives, as follows:

**Maritime Transport**

- WT-01 Enhance port capacity of Yangon port (including Thilawa area) to meet sharply increasing cargo demands and to reduce dwelling time of cargoes and ships in the port.
- WT-02 Develop a deep seaport that can accommodate mother vessels in trunk routes to support the further increasing import and export of goods, at reasonable cost to users in the Central North-South Development Corridor.

WT-03 Formulate a port master plan for each sea port and their hinterlands.

WT-04 Invest in effective and efficient port management.

### **Inland Water Transport**

WT-05 Establish key sections of the inland waterways as navigable throughout the year.

WT-06 Provide effective inland water transport network.

WT-07 Redefine the role of IWT and develop a corresponding business plan.

WT-08 Encourage the replacement of old vessels with safer and new environmentally-friendly vessels.

### **Strategic objectives and corresponding strategies and actions**

WT-01: Urgent Port Capacity Improvement for Yangon port: Enhance port capacity of Yangon port (including Thilawa area) to meet sharply increasing cargo demands and to reduce dwelling time of cargoes and ships in the port.

#### **Sector Strategy WT-01-1: Urgent Navigational Capacity and Safety Improvement in Yangon port**

##### **Action WT-01-1**

- Carry out a comprehensive bathymetry survey of the Yangon port area, and develop an electronic navigational chart (ENC) in line with international standards.
- Examine and implement effective measures to ease the constraints in inner-bar and outer-bar and to accommodate larger vessels, such as widening and/or deepening of the channel, civil structure to prevent the channel from sedimentation, effective maintenance dredging system.
- Examine and implement effective measures to secure safety navigation in the port, such as a navigational aid system, pilotage system including pilot fixed station and pilot boats.

#### **Sector Strategy WT-01-2: Effective and Efficient Terminal Improvement in Yangon port**

##### **Action WT-01-2**

- Improve capacity of the existing Yangon ports and cargo handling efficiency, considering development needs for waterfront area from urban side as well as constraints in urban traffic.
- Improve inter-modality with truck, inland water and railway operators with the development of warehouses and ICDs, and enable bounded transportation to/from the port.
- Develop and/or redevelop cargo-wise designated terminals such as oil, steel products, construction materials, in coordination with its hinterland (SEZ) development.

- Planning should emphasize improvements in inter-modality with MR and container truck operators, to secure the space for MR and container trucks.

Sector Strategy WT-01-3: Accelerated Development of Yangon Port in Thilawa Area

Action WT-01-3

- Develop multipurpose terminals, including container handling and cargo-wise specialized terminals such as oil, steel products, construction materials in a harmonized manner and in good coordination and linkages with hinterland (SEZ) development.
- Improve inter-modality between truck, inland water and railway operators, together with the development of warehouses and ICDs, and enable bounded transportation to/from the port.

WT-02	<u>New port infrastructure</u> : Develop a deep seaport that can accommodate mother vessels in trunk routes to support the further increasing import and export of goods, at reasonable cost to users in the Central North-South Development Corridor.
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Sector Strategy WT-02-1

By 2030, construct and begin operation of at least one deep seaport in the country, which can form part of the network of major ocean liners in order to make Myanmar one of the key players in the international supply-chain systems.

Actions WT-02-1

- Develop a maritime sector master plan that includes long-term strategies and corresponding action programs for port development, including deep seaports, by the end of 2015.
- Carry out a preliminary feasibility study to select a deep seaport area by the end of 2016, followed by a feasibility study in the selected location in 2017-2019. It is recommended that such a deep-sea port be positioned close to the national development axis, namely the Central North-South Development Corridor.

WT-03	<u>Port planning and development</u> : Formulate a port master plan for each sea port and their hinterlands.
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Sector Strategy WT-03-1: Port Development / Improvement Master Plans

Following the maritime sector master plan, a master development plan for each port should be developed. Basic directions of each port development are as follows:

Yangon Ports: As the most important international gateway port with the wide hinterland of Greater Yangon, Ayeyarwaddy Delta and Central North-South Development Corridor, the Yangon port capacity should be further improved through the channel and navigational improvement, and terminal development with appropriate role demarcation between Yangon area and Thilawa area.

- Dawei Port: This is one of the ideal locations for a deep-sea port development, especially as an industrial port in the Southern region of the country, with hinterland that includes Thailand and having a great potential as an international hub port connecting the Asian countries and the market in the western region including Europe, India and the Middle East.
- Kyaukpyu Port: The gas and oil pipeline is already developed from this port to Yunnan Province, China. The economic corridor starting from Kyaukpyu, passing through Mandalay to Yunnan is one of the major economic corridors of the country. This port and its hinterland can be developed further as a gateway port to Yunnan Province and an industrial activity center in Rakhine State, with SEZ development.
- Sittwe Port: The hinterland of this port includes the northeastern part of India including Assam State as well as Chin State and the northern part of Rakhine State. This port can be both a regional hub port for these states and development of this port will increase opportunity for Assam to trade through this port.
- Patheingyi Port: This is a regional hub in the Delta Area where inter-modal function should be further strengthened. Since the water depth in the Delta Area is shallow, it is difficult to develop this port as an international gateway, but it should be developed as the regional hub of the Delta Area.
- Mawlamyine Port: The existing port cannot be developed as an international gateway port, due to its physical constraints. However, its hinterland has great potential for further development as one of the transport nodes of the East-West Corridor and as an important regional hub for Mon and Kayah State.
- Myeik Port: As the port located at the south-end of the country, this port is expected to play a vital role as the regional hub of Tanintharyi region.

#### Actions WT-03-2

- Complete all of the port improvements and development master plans for the above major ports by the end of year 2017.
- Carry out feasibility studies on proposed components of each master plan during 2017-2019, followed by their implementation.

WT-04	<u>Strengthen administration:</u> Invest in effective and efficient port management.
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#### Sector Strategy WT-04-1: Port management and information system to reduce dwelling time of cargoes and ships in the port.

##### Action WT-04-1

- Simplify port-related procedures, in accordance with the FAL convention.
- Introduce port management and information systems, including Port EDI system (named Port-MIS in Myanmar), which is an initial EDI to be introduced in

2014/2015, in coordination with the customs system (MACCS).

Sector Strategy WT-04-2: Appropriate Port Tariff

Action WT-04-2

- Examine current tariffs, taking into account competitiveness with other ports in neighboring countries.
- Set the competitive and reasonable tariff for port users.

Sector Strategy WT-04-3: Unified Technical Standard and Regulation for Port Structures

Action WT-04-3

- Set a Unified technical standard and regulation for port structure to secure the safety of port facilities

WT-05    Expand navigation options: Establish key sections of the inland waterways as navigable throughout the year.

Sector Strategy WT-05-1: Navigation Improvement

Improve inland waterway networks along the priority development corridors, namely the Northern Corridor, the Western North-South Corridor / the Main River Corridor and the Delta Area Network.

Actions WT-05-01

- Carry out a comprehensive study on the navigation channels of the Ayeyarwaddy River and the Chindwin River, including river chart development with basic data such as water depth, water level and current velocity.
- Increase navigation capacity along the priority water transport corridors, including Yangon – Mandalay, Mandalay – Kalewa (– Homalin –Khamti), and Mandalay – Bhamo.
- Secure safe navigation by installing advanced navigation aid equipment, including facilities for night navigation.

WT-06    Modernize infrastructure: Provide effective inland water transport network.

Sector Strategy WT-06-1: Improvement and Modernization of River Ports

Improve and modernize major river ports along the Ayeyarwaddy River and the Chindwin River in order to achieve improved efficiency and cargo handling speed.

Actions WT-06-01

- Modernization of major river ports along the priority corridors (such as ports in Mandalay Bhamo, Kalewa, Monywa, Magway, Pyay and Yangon) will include a series of feasibility studies in 2014; Mandalay port has completed a feasibility study in 2014.

- Step-wise modernization of cargo handling equipment at major river ports should include transition time for port works to be accustomed to mechanized cargo handling from manual handling.
- Improve connectivity with other modes such as international shipping, truck and railway operators together with proper handling and storage facilities like warehouses in order to facilitate multi-modal transport.

#### Sector Strategy WT-06-2: Improvement of Inland Water Transport Service

##### Actions WT-06-02

- Maintain national minimum service in remote area with appropriate subsidy schemes.
- Note that international maritime transport has less-barriers, as compared to inland water transport. Supporting international transport will enable bounded transportation to/from sea ports and effective berth operation in the ports.

WT-07    Self-sustaining IWT: Redefine the role of IWT and develop a corresponding business plan.

#### Sector Strategy WT-07-1: Proactive change towards self-supportive IWT

Improve and change the nature of the organization from a government supported entity to a self-supportive organization.

##### Actions WT-07-01

- Examine carefully route-wise profitability.
- Develop a new business plan for IWT, in which the basic direction of IWT function will be focused into ship management in order to collaborate with the private sector.
- Replace IWT aged vessels and build new vessels with new technology (such as shallow draft vessel, environmentally-friendly vessel, etc.) jointly with private sector.
- Support replacement of aged vessels owned by the private sector by providing preferential treatment and/or advanced financial scheme such as “joint ship building”.
- Privatize IWT’s cargo transport services jointly with private sector.
- Ensure that IWT continues to provide passenger and cargo transport services in remote areas, where transport services are difficult to install and on routes that have no private sector provider.

WT-08    Upgrade equipment: Encourage the replacement of old vessels with safer and new environmentally- friendly vessels.

Sector Strategy WT-08-1: Encourage replacement of old and low capacity vessels

Vessel owners should be encouraged to replace their old and less economical vessels with new vessels, through preferential treatment schemes by the Government.

Actions WT-08-1

- Carry out a study on ages and condition of vessels owned by IWT and the private sector.
- IWT to build new vessels, and provide in the market with reasonable prices for the private sector.
- Increase capacity of existing shipyards and modernize associated facilities in order to provide better quality services.
- Examine effective measures (financial support, etc.) to encourage the private vessel owners to replace aged vessels with new vessels (leasing, joint ship building, etc.).

Sector Strategy WT-08-2: Development of vessel safety regulations/standards

Actions WT-08-2

- Develop vessel safety regulations/standards urgently.
- Deploy Technical Assistance (TA) for the planned vessel safety regulations/standards improvement.
- Develop enforcement mechanisms and effective vessel inspection systems.

Sector Strategy WT-08-3: Introduction of advanced low-carbon technologies

By introducing best practices from advanced countries, introduce practical and appropriate advanced low-carbon technologies in the water transport sector.

Action WT-08-3

- Develop a plan for the introduction of low-carbon technologies in the water transport sector.
- Import environmentally-friendly and energy-saving vessels and other low-carbon technologies, in the initial stage.
- Introduce early renewable energy where applicable (e.g. at ports, navigation system, etc.).

## 9.8.4 Civil Aviation Sector

### Sector Vision

*“Develop and strengthen the safe, secured, efficient, sustainable and environmentally friendly aviation industry in order to make Myanmar one of the major aviation hubs in Asia.”*

### Sector issues

#### (1) Better Planning and Coordination:

- Underutilization of Mandalay International Airport (a design capacity of 3.0 MPPA) and Nay Pyi Taw International Airport (a design capacity of 5.0 MPPA) means that forecasted demand for these airports is far below the design capacity – 1.9 MPPA for MIA in 2020 and 0.2 MPPA for NIA in 2020).
- There are possible risks of overinvestment and roles of demarcation between Yangon International Airport (6.0 MPPA in 2015) and Hanthawaddy International Airport (12.0 MPPA in 2017) are unclear. This leads to the ICAO demand forecast of 7.0 MPPA in total in 2018, which is far below the aggregated design capacity of the two airports (18.0 MPPA).
- Poor land transport accessibility to the Hanthawaddy International Airport results in there being no fast or reliable land transport access to reach the HIA as of today.

#### (2) Infrastructure Development:

- There is limited passenger capacity of the Yangon International Airport and DCA evaluates its capacity at most at 6.0 MPPA. Increased passenger demand can be accommodated by extending operation hours, shortening the aircraft turnaround time, and use of flight schedule, slot and spot.
- There are 69 airports in Myanmar, most of which are non-compliant with ICAO standards and requirements; 28 airports have unpaved runways.

#### (3) Better Environment, Safety and Security:

- There is a risk of having a multi-airport system in the Yangon / Bago region. Because this is a small area, complicated operations and corresponding control would be required, and could lead to double investment for airlines and other airport related business entities.
- Improvements to the sector will require updating of air navigation services with neighboring countries. This is necessary to implement Performance Based Navigation (PBN) which must be compliant with ICAO acceptable specifications, and accordingly to modernize Communications, Navigation, Surveillance (CNS) and Air Traffic Management (ATM).

#### (4) Institutional and Regulatory Development:

- The government has taken initial steps to commercialize aerodromes, privatize Myanma Airways, and restructure its aviation institutions in accordance with global best practices.
- The DCA is unlike other aviation institutions in other developing countries because it is still heavily centralized and combines regulatory and operational functions with built-in conflict of interests.



(5) Reasonable transport pricing and secured budgeting

- The use of PPP schemes is encouraged in developing airport related infrastructure.
- Joint operation with international airlines from other countries is expected.

**Sector Strategic Objectives**

In order to address the identified sector issues, five strategic objectives are suggested, as follows:

- CA-01: Strengthen regulatory functions of the Department of Civil Aviation, so as to monitor and regulate the increasingly influential roles and activities of other organizations.
- CA-02: Develop a safe and efficient airport system for the Yangon metropolitan area as the country's international prime gateway city to cope with increasing international and domestic air transport demand.
- CA-03: Develop a nationwide airport system in order to cope with increasing air traffic demand and contribute to balanced national socio-economic development.
- CA-04: Modernize Air Navigation Services in line with the ICAO GANP so as to provide seamless services and support safe and efficient air transport.
- CA-05: Allocate service provision functions currently under the Department of Civil Aviation to appropriate entities in order to improve effectiveness and efficiency of the service production and provision.

**Strategic objectives and corresponding strategies and actions**

CA-01: <u>Responsible industry oversight</u> : Strengthen regulatory functions of the Department of Civil Aviation, so as to monitor and regulate the increasingly influential roles and activities of other organizations.
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Sector Strategy CA-01-1: Scrutinize results of ICAO Universal Safety Oversight Audit Program and identify the areas where strengthening is required.

Action CA-01-1

- Scrutinize the results of the ICAO Universal Safety Oversight Audit Program and identify areas that requires improvement in 2014/2015.

Sector Strategy CA-01-2: Assessment on forthcoming changes in roles and activities of DCA and other organizations

Action CA-01-2

- Evaluate forthcoming changes in roles and activities of the DCA and other organizations, and identify the areas that require improvement to cope with such changes by the end of 2015.
- The assessment should include effects of allotting service provision function of DCA to several entities and creation of new SPCs for YIA, HIA and Mandalay International Airport.

Sector Strategy CA-01-3: Amend rules and regulations of licensing, audit, etc. for regulating civil aviation activities as necessary.

Action CA-01-3

- Amend rules and regulations of licensing, audit, etc. for regulating civil aviation activities in 2016/2017.
- In order to do this, DCA should establish an implementing mechanism in DCA, in line with the proposed amendment of rules and regulations.

CA-02: Plan for future growth: Develop a safe and efficient airport system for the Yangon metropolitan area as the country's international prime gateway city to cope with increasing international and domestic air transport demand.

Sector Strategy CA-02-1: Continue ongoing process of the projects for Yangon International Airport (YIA) and Hanthawaddy International Airport (HIA) with utmost care, and make adjustments as and when necessary.

Action CA-02-1

- Continue the ongoing selection process of the concessionaires who will implement the 30-year BOT projects for YIA and HIA with the utmost care so as to coordinate the 2 separate projects to achieve a single goal, i.e. to develop an efficient airport system for Yangon metropolitan area.

Sector Strategy CA-02-2: Coordinate with concerned organizations for provision of reasonable access to HIA at appropriate timing.

As HIA is located about 80km northeast of downtown Yangon, high-speed access will be required for successful utilization of HIA.

Action CA-02-2

- Coordinate with concerned organizations, such as Ministry of Construction, Ministry of Rail Transportation and Yangon City Development Committee in 2014/2015.

Sector Strategy CA-02-3: Establish effective means to encourage airlines to utilize both YIA and HIA.

In order to make these 2 projects viable, air services should be provided at both YIA and HIA, in equal share. However, it is natural that air operators will prefer to stay in YIA, because YIA is much closer to the demand center.

Action CA-02-3

- Establish effective means to encourage airlines to utilize both YIA and HIA, (e.g. exemption of Air Navigation Facility Charge for landing aircraft at HIA, application of preferential cooperative tax, etc.) in 2015/2016

Sector Strategy CA-02-4: Establish rules and regulations for monitor and control of various charges at the airports to avoid the abuse of monopoly positions.

There will be competition between YIA and HIA to attract air operators and air passengers.

Action CA-02-4

- Establish rules and regulations to monitor and control various charges at the airports to avoid the abuse of monopoly positions by the concessionaires in 2014/2015.

Sector Strategy CA-02-5: Monitor and check the performances of the Special Purpose Companies for YIA and HIA if they comply with the contracts.

Action CA-02-5

- Monitor and check the performances of the SPCs (Special Purpose Companies) formed by the successful tenderers for YIA and HIA, if they comply with the contracts throughout the 30-year BOT period (2014~).

Sector Strategy CA-02-6: Control and regulate operations of YIA and HIA to protect the interest of the travelling public.

Action CA-02-6

- Control and regulate operations of YIA and HIA in terms of safety and security of air transport and commercial aspects (based on rules and regulations established by Action 1-4) to protect the interest of the travelling public throughout the 30-year BOT period (2014~).

CA-03: Planning at a national level: Develop a nationwide airport system in order to cope with increasing air traffic demand and contribute to balanced national socio-economic development.

Sector Strategy CA-03-1: Identify strategic airports for international air services to promote regional socio-economic developments.

Four (4) international airports, including Hanthawaddy, may not be enough to support globalized socio-economic activities in Myanmar. For example, Thailand has 7 international airports, and Vietnam has 9 international airports.

Action CA-03-1

- Identify some airports from the existing domestic facilities that have the potential to be internationalized, most probably start with regional international charter operations, from a strategic viewpoint of formulating air transport network (such as Heho and Nyaung U, alternatively Pakokku) in 2014/2015.
  - Prepare a master development plan and conduct a feasibility study for each of the strategic airports for international services. Technical cooperation from a donor country/agency will probably be necessary in 2015/2016.
  - MOT to develop the strategic airports according to the master plans.
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Sector Strategy CA-03-2: Prepare a nationwide airport development master plan.

Action CA-03-2

- Prepare a nationwide airport development master plan for systematic and balanced development of the domestic airports. It must include a study on the necessity of some airports that have no traffic in the last few years (2014/2015).
- Produce a development plan for each individual airport, based on the priorities set in the nationwide airport development master plan (2015~).
- MOT to develop each airport according to its development plans.

Sector Strategy CA-03-3: Financial arrangement for development of the strategic airports for international services and priority domestic airports.

Development of a strategic airport for international services would cost several hundred million US dollars each, and DCA, in close coordination with the Ministry of Transport and other concerned ministries, should make advance financial arrangements for development of these strategic airports.

Action CA-03-3

- A soft loan, such as from Japan (0.01% interest rate, 40-year repayment period including 10-year grace period) can reduce the overall cost, including payment of interest.
  - \* It must be noted that even if the development were done with a BOT scheme, the overall cost would ultimately be borne by air passengers.

Sector Strategy CA-03-4: Monitor traffic growth and review airport development plans periodically.

Action CA-03-4

- Monitor traffic growth and review airport development plans, based on the actual trend of air transport periodically, e.g. at 5-year intervals.

CA-04: <u>Update industry services: Modernize Air Navigation Services in line with the ICAO GANP so as to provide seamless services and support safe and efficient air transport.</u>
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Sector Strategy CA-04-1: Develop a master plan for modernization of Air Navigation Services.

Action CA-04-1

- Develop a master plan for the modernization of Air Navigation Services, including air traffic forecasts for airports and air routes, roadmaps for implementation of Performance Based Navigation (PBN), air route plans, roadmaps for modernization of Air Traffic Management / Communications, Navigation and Surveillance (CNS) / Aeronautical Information Management, and phased implementation plans (2014/2015).
- Invite Technical Assistance on CNS/ATM improvement from international aid agencies (from the middle of 2014).

Sector Strategy CA-04-2: Establish rules and regulations for provision of the modern Air Navigation Services and aircraft operations under these services.

There is need to establish rules, regulations and procedures for the provision of modern Air Navigation Services and aircraft operations under these services.

Action CA-04-2

- Review the existing rules, regulations and procedures and make necessary updates in 2014.

Sector Strategy A-04-3: Improve CNS/ATM systems and provide modern Air Navigation Services based on the Master Plan

Action CA-04-3

- Improve CNS/ATM systems according to the master plan for modernization of Air Navigation Services.
- Implement PBN, and followed by a PBN Roadmap.
- Provide modern Air Navigation Services and maintain the modernized CNS/ATM equipment properly by 2015/2016.

Sector Strategy CA-04-4: Enhance capability of DCA officers for transition to the modern Air Navigation Services.

Action CA-04-4

- In order to provide modern Air Navigation services with modern CNS/ATM equipment, the capability of DCA staff, such as air traffic controllers, engineers and other technical staff who operate and maintain CNS/ATM equipment, should be enhanced through training. DCA should require instructors to carry out trainings at early stages of development.

CA-05: Strategic partnerships with the private sector: Allocate service provision functions currently under the Department of Civil Aviation to appropriate entities in order to improve effectiveness and efficiency of the service production and provision.

Sector Strategy CA-05-1: Conduct a comprehensive study, and produce plans for separation of service provision functions.

There are several ways to allocate service provision functions. For example, by creating (a) a single entity (civil aviation authority) for both airport and air navigation services, (b) separate entities for airport and air navigation services, or (c) further separation of entities for the major airports. In addition, there is a choice of the type of entity, including a budgetary unit of the Government, a 100% state-owned enterprise, a partially privatized corporation or a fully privatized corporation.

Action CA-05-1

- Conduct a comprehensive study to identify the best ways to separate service functions and produce detailed plans for separation in 2014/2015.

Sector Strategy CA-05-2: Amend laws/constitutions related to DCA and create new laws/constitutions related to establishment of service providers as necessary.

Action CA-05-2

- Initiate amendment of laws/constitutions related to DCA and create new laws/constitutions required for establishing the service providers.
- Implement actual separation of service provision functions by 2015/2016.



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## Chapter 10 Corridor-Based Transport Infrastructure Development

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### 10.1 Introduction

This Chapter describes an approach to develop Myanmar's corridor-based transport infrastructure and in doing so, it identifies priority corridors and necessary transport infrastructure and services, along designated corridors.

In order to identify priority corridors, the Study Team conducted numerical analysis for each transport corridor, based on the MYT-Plan's Socio-Economic Framework and passenger and freight demand forecasts. In addition, the characteristics and transport needs of each corridor are discussed in this Chapter, based on the National Spatial Development Framework. The corresponding transport infrastructure and services are also considered. Finally, a set component projects for each of the 10 priority corridors is proposed for further consideration by Joint Coordination Committee (JCC) members, using analysis from the budgetary framework and traffic demand forecast.

### 10.2 Background

#### Why is a corridor development approach important for Myanmar?

In Myanmar, multiple governmental agencies are responsible for developing and maintaining transport infrastructure and for providing transport services, including MOT, MRT, MOC, the Ministry of Border Affairs. Each of these Ministries establishes transport committees, such as the National Transport Coordination Committee under MOT, and the National Transport Facilitation Committee under MRT.

To date, there has been no comprehensive or definitive national level transport policy or strategy that can guide the country's transport sector and govern future development directions or corresponding investments. While each of the transport ministries is responsible for a long list of infrastructure projects as part of a long-term development plan, these projects are rarely tested analytically for potential benefits or how they address sector priorities. Corridor prioritization is a key issue that should be addressed in the transport sector, because the Government's ability to fund deep investment in transport infrastructure is severely hampered by a limited budget and competing priorities.

As a result, the Study Team recommends corridor-based transport infrastructure, to acknowledge the fiscal challenges while advancing infrastructure development as much as possible.

To support this finding, the ADB (2010)<sup>1</sup> proposed that the corridor development, once completed, would:

- (i) provide a spatial focus to transport improvement, connecting growth centers and catalyzing the development of surrounding locations;

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<sup>1</sup> Strategy and Action Plan for the Greater Mekong Sub-region North – South Corridor (ADB, 2010)



- (ii) open up many opportunities for various types of investment;
- (iii) promote synergy and enhance the impact on regional economy
- (iv) provide a mechanism for prioritizing and coordinating investments; and
- (v) generate tangible demonstration effects.

ADB suggested these advantages for the Greater Mekong sub-region, though it can also be applied to Myanmar. The Study Team concluded, therefore that a corridor based infrastructure development approach was most appropriate for Myanmar; this was presented at the 5th Joint Coordination Committee (JCC) Meeting, held on 25th November 2013; JCC voted in favor of this approach.

### **10.3 Development Corridors in Myanmar**

Chapter 4 of this final report proposes a National Spatial Development Framework, based on international, national, regional and city development policies and related transport networks and facilities. In this analysis, core development centers are grouped into a three level hierarchy: national, regional, agro-industrial/special function.

At the first hierarchy level, there are three national growth centers: Yangon, Mandalay and Nay Pyi Taw, where major concentrations of people, commerce, industry, and government activities exist. These national growth centers also perform the role of tourism hubs. At the second level, seven regional growth centers were identified, including: Myitkyina, Sittwe, Kyaukpyu, Patheingyi, Bago (Hanthawaddy), Mawlamyine, and Dawei. In these centers, clusters of commerce and industry are common and state/regional-level government administration, education and health and other social services are also provided. At the third level, major concentrations of agro-industry and commerce exist and are often related to the agricultural economic-base, border towns and other special function settlements.

The Study Team identified 10 development corridors that connect strategic activity hubs (corridor F and K may be combined into one). Selection was based on whether corridors embodied important city and economic activities, such as industrial zones, agro-industrial centers, strategic transport networks, international and national networks and major nodes for all transport modes. These development corridors include:

- A. Central North-South Corridor
- B. East - West Corridor
- C. Northern Corridor
- D. Mandalay - Tamu Corridor
- E. Second East - West Corridor
- F. Main River Corridor (part of the Western North-South Corridor)
- G. East - West Bridging Corridor
- H. Delta Area Network
- J. Southern Area Development Corridor
- K. Western North-South Corridor
- L. Eastern North - South Corridor



**Figure 10.1 National Spatial Development Framework and Development Corridors**

## **10.4 Planning Method Statement**

### **10.4.1 The Planning Principle**

The planning principle used to formulate the corridor-based transport infrastructure development plan, its evaluation and the prioritization of the development corridors, includes the following three prerequisites: 1) effective investment, 2) accountability, and 3) coordination among relevant agencies.

#### Effective Investment

As discussed in Chapter 2 of this final report, the Government of Myanmar is expected to invest fixed capital of 48 trillion Kyat (at year 2013 constant prices) in the transport sector between 2014 and 2030 to achieve the desired economic growth target of 7.2 % per annum. However, the Government should plan that a substantial proportion of this investment will come from international donors and the private sector, because the Government has limited budget capacity. If financed, the corridor development plan will act as a guide for investors to understand how funds are spent, to what extent the project will generate benefits, and which are the priority corridors.

#### Accountability

Investment in the development of transport corridors may contribute to positive economic impacts, such as reducing travel time and associated costs. The scale of these impacts may vary, depending on where investments are made. The corridor development plan should be prepared taking into account the scale and probability of impacts from transport projects. A corridor development plan designed with impact in mind will need to use computerized transport models and the database developed in the Study. Also, multi-criteria analysis, which normally is used to select the priority projects, should be applied to the corridor development plan, to ensure accountability in the planning process and achievement of the corridor development plan objectives.

#### Coordination Among Corresponding Agencies

All stakeholders should be informed and preferably involved in the planning process for the corridor-based transport infrastructure development plan. Contributions from these stakeholders in meetings is needed and is most profitable if each JCC member, representing his or her ministry, is fully informed of corridor issues and participates in the joint planning process. As such, a series of meetings and discussions were organized for the Study, and included the Joint Coordination Committee (JCC) for MYT-Plan, related agencies and the SEA. Each member was assigned a series of tasks, including preparing a long-list of projects with corresponding descriptions, a mapping of the projects, evaluation criteria (multi-criteria analysis), and confirmation of the priority projects.

### **10.4.2 Multi-Criteria Analysis**

As noted, the corridor-based transport infrastructure plan should be developed with the full and accountable participation of all key stakeholders. A multi-criteria analysis method is widely used to support decision-making processes in these meetings and as a tool to ensure the accountability in the planning process. For the MYT-Plan, a simple multi-criteria analysis method was established to determine priority corridors and set corresponding projects. The evaluation criteria include:

- (i) Connectivity between the growth centers;
- (ii) Contribution to the national and local economy;
- (iii) Investment impacts; and
- (iv) Investment efficiency.

## **10.5 Corridor analysis**

By combining the Main River Corridor (F) and the Western North – South Corridor (K) into one corridor, named K: Western North – South Corridor, the 10 development corridors include the following:

- A. Central North-South Corridor
- B. East - West Corridor
- C. Northern Corridor
- D. Mandalay - Tamu Corridor
- E. Second East - West Corridor
- G. East - West Bridging Corridor
- H. Delta Area Network
- J. Southern Area Development Corridor
- K. Western North-South Corridor (including Corridor F)
- L. Eastern North - South Corridor

### **10.5.1 Population and economic activities**

Corridor development impacts, in terms of the number of beneficiaries (represented by population) and concentration level of economic activities (represented by GDP) are important to include in this Study. Table 10.1 presents the 2012 population and the GRDP of the sphere of influence, for each corridor.

In 2012, Myanmar's population was 61 million and the country had a GDP of 47 trillion Kyat. Among the 10 development corridors, larger populations and associated economic activity can be seen along A: Central North-South Corridor (41% of total population and 50% of GRDP), followed by K: Western North-South Corridor (33% of total population and 42% of GRDP), B: East – West Corridor (28% of total population and 35% of GRDP), and H: Delta Area Network (21% of total population and 27% of GRDP).

**Table 10.1 2012 Population and GRDP by Development Corridor**

Development Corridor	Section	Code	2012 Population (,000)	% of National Population	2012 GRDP (Kyat billion)	% of National GDP
A. Central North-South Corridor	Yangon-Nay Pyi Taw	A1	11,714	41%	13,170	50%
	Nay Pyi Taw-Mandalay	A2	6,323		4,457	
	Mandalay - Myitkyna	A3	7,035		5,648	
B. East - West Corridor	Yangon - Hpa-An - Myawaddy	B1	14,052	28%	14,543	35%
	Mawlamyine - Dawei	B2	2,753		2,039	
C. Northern Corridor	Mandalay - Muse	C1	6,042	10%	4,503	10%
D. Mandalay - Tamu Corridor	Mandalay - Tamu	D1	8,722	14%	6,992	15%
E. Second East - West Corridor	Tachilek - Meiktila - Kyaukpyu	E1	10,636	17%	6,938	15%
G. East - West Bridging Corridor	Hpasawing - Pyay	G1	2,664	12%	1,727	11%
	Loikaw - Magway	G2	4,767		3,214	
H. Delta Area Network	Yangon - Patheingyi	H1	8,992	21%	10,076	27%
	Patheingyi - Hinthada	H2	3,766		2,651	
J. Southern Area Development Corridor	Thanbyuzayat - Hpayarhonesu	J1	2,537	8%	1,482	8%
	Dawai - Thai Border	J2	811		781	
	Dawei - Kawthaung	J3	1,756		1,679	
K. Western North-South Corridor	Yangon - Pyay - Magway	K1	12,810	33%	14,388	42%
	Magway - Mandalay	K2	7,096		5,468	
L. Eastern North - South Corridor	Bilin - Loikaw	L1	3,896	12%	2,550	9%
	Loikaw - Nawnghko	L2	3,247		1,900	

Source: JICA Study Team

### 10.5.2 Freight Transport Demand

Freight transport demands are an important indicator of corridor functionality and form a basis to understand project impacts. Investments made in building capacity and increasing infrastructure quality will generally lead to improvements in the freight transport industry. In addition, improvements in specific modes of transport can change the transport market along corridors, resulting in modal shift.

Table 10.2 shows 2013 freight demand (in million tonnage-kilometers) for each development corridor. Among the development corridors, A: Central North-South Corridor is shown to be the main freight transport corridor in Myanmar, because between Yangon and Mandalay, authorities measure 41 million ton-km of freight traffic per day; this accounts for 48% of all freight movement generated in Myanmar. In addition to this corridor, part of B: East-West Corridor (Yangon – Hpa – An- Myawaddy), C: Northern Corridor (Mandalay – Muse), part of K: Western North – South Corridor (Yangon – Pyay – Magway) are major freight transport corridors in the country.

**Table 10.2 2013 Freight Demand and Modal Share by Development Corridor**

Development Corridor	Section	Code	2013 Freight demand (million ton-km)	% of traffic demand along corridor	Modal Share (ton-km) in 2013		
					Road	Rail	River
A. Central North-South Corridor	Yangon-Nay Pyi Taw	A1	23.3	27%	93%	7%	0%
	Nay Pyi Taw- Mandalay	A2	15.4	18%	92%	8%	0%
	Mandalay - Myitkyna	A3	2.6	3%	67%	13%	20%
B. East - West Corridor	Yangon - Hpa-An - Myawaddy	B1	10.0	12%	95%	5%	0%
	Mawlamyine - Dawei	B2	0.4	0%	92%	8%	0%
C. Northern Corridor	Mandalay - Muse	C1	11.1	13%	98%	2%	0%
D. Mandalay - Tamu Corridor	Mandalay - Tamu	D1	1.4	2%	75%	7%	18%
E. Second East - West Corridor	Tachilek - Meiktila - Kyaukpyu	E1	2.4	3%	97%	3%	0%
G. East - West Bridging Corridor	Hpasawing - Pyay	G1	0.1	0%	100%	0%	0%
	Loikaw - Magway	G2	1.0	1%	100%	0%	0%
H. Delta Area Network	Yangon - Pathein	H1	1.4	2%	52%	0%	48%
	Pathein - Hinthada	H2	0.2	0%	97%	3%	0%
J. Southern Area Development Corridor	Thanbyuzayat - Hpayarthonesu	J1	0.0	0%	-	-	-
	Dawai - Thai Border	J2	0.0	0%	100%	0%	0%
	Dawei - Kawthaung	J3	0.1	0%	100%	0%	0%
K. Western North-South Corridor	Yangon - Pyay - Magway	K1	8.8	10%	61%	6%	33%
	Magway - Mandalay	K2	2.1	2%	12%	8%	80%
L. Eastern North - South Corridor	Bilin - Loikaw	L1	0.2	0%	100%	0%	0%
	Loikaw - Nawnghko	L2	0.1	0%	97%	3%	0%

Source: JICA Study Team

### 10.5.3 Passenger Transport Demand

The corridor-based transport infrastructure development also contributes to the improvement of passenger transport by reducing travel time and costs. It also provides opportunities for diversified transport businesses/services along the corridor and improved passenger comfort and safety. In order to gauge the likely impacts on passengers from the proposed corridor improvements, existing passenger demand for each development corridor was estimated, based on the transport model developed for MYT-Plan.

Table 10.3 shows passenger demand (in person-kilometers) by development corridor in 2013. Development corridor A: Central North-South Corridor, should be designated as the main passenger transport corridor in Myanmar, particularly between Yangon and Mandalay, which carry 44 million passenger-kilometers per day and accounts for 55% of all passenger demands (in terms of passenger-kilometers) generated in Myanmar. In addition to this corridor, B: East-West Corridor (Yangon ~ Hpa-An ~ Myawaddy) is another major passenger transport corridor.

**Table 10.3 2013 Passenger Demand and Modal Share by Development Corridor**

Development Corridor	Section	Code	2013 Traffic demand (million person-km)	% of traffic demand along corridor	Modal Share				
					Air	Car	IWT	Rail	Bus
A. Central North-South Corridor	Yangon-Nay Pyi Taw	A1	21.6	30%	1%	13%	0%	6%	80%
	Nay Pyi Taw- Mandalay	A2	14.4	20%	0%	15%	0%	14%	70%
	Mandalay - Myitkyna	A3	6.8	5%	8%	10%	10%	60%	13%
B. East - West Corridor	Yangon - Hpa-An - Myawaddy	B1	7.8	12%	0%	23%	0%	14%	64%
	Mawlamyine - Dawei	B2	0.5	1%	0%	22%	0%	10%	68%
C. Northern Corridor	Mandalay - Muse	C1	4.0	5%	0%	41%	0%	21%	38%
D. Mandalay - Tamu Corridor	Mandalay - Tamu	D1	1.9	4%	2%	22%	0%	11%	65%
E. Second East - West Corridor	Tachilek - Meiktila - Kyaukpyu	E1	4.1	6%	5%	26%	0%	10%	58%
G. East - West Bridging Corridor	Hpasawing - Pyay	G1	0.0	0%	0%	0%	0%	0%	100%
	Loikaw - Magway	G2	2.1	0%	17%	0%	0%	46%	37%
H. Delta Area Network	Yangon - Patheingyi	H1	3.9	5%	1%	24%	14%	0%	61%
	Patheingyi - Hinthada	H2	0.6	1%	0%	24%	0%	17%	59%
J. Southern Area Development Corridor	Thanbyuzayat - Hpaarthonesu	J1	0.0	0%	0%	100%	0%	0%	0%
	Dawei - Thai Border	J2	0.0	0%	0%	46%	0%	0%	54%
	Dawei - Kawthaung	J3	0.9	1%	87%	9%	0%	0%	4%
K. Western North-South Corridor	Yangon - Pyay - Magway	K1	6.2	5%	0%	22%	0%	23%	55%
	Magway - Mandalay	K2	1.8	2%	1%	9%	0%	45%	45%
L. Eastern North - South Corridor	Bilin - Loikaw	L1	0.0	0%	0%	0%	0%	0%	100%
	Loikaw - Nawnghko	L2	0.2	0%	0%	17%	0%	79%	4%

Source: JICA Study Team

#### 10.5.4 Capacity versus Demand

The importance and urgency of corridor development can be assessed by comparing the traffic volume (demand) with capacity (supply), or the so-called volume capacity ratio (V/C ratio). Where the corridor V/C ratio is close to or exceeds 1.0, transport capacity for this corridor should be increased, or demand should be limited so as to not excessively exceed capacity.

Future traffic demand for both passenger and freight traffic is projected, using a conventional four-step transport demand forecast model, as explained in Chapter 8. The future corridor-based traffic demand volume is estimated by aggregating the projected traffic volumes of transport links forming the corridor.

Road-based traffic capacity for passenger traffic is set to 40 % of the existing road design capacity (of typical cross section of the road to form the corridor), while the remaining 60% is allocated to freight, as a freight carrying capacity of the road segment.

Table 10.4 presents the volume capacity ratio for each corridor by comparing the year 2030 passenger and freight demand (volume) and existing road-based capacity (capacity) for the year 2013. These V/C ratios indicate how urgent improvement is required for capacity expansion. The corridors that require urgent capacity expansion include A: Central North-South Corridor

(Yangon – Nay Pyi Taw – Mandalay), B: East-West Corridor (Yangon – Hpa An – Myawaddy), K: Western North-South Corridor (Yangon – Pyay – Magway) for both passenger and freight, C: Northern Corridor (Mandalay – Muse) for freight traffic and H: Delta Area Network (Yangon – Pathein) for passenger traffic.

**Table 10.4 Volume Capacity Ratio by Development Corridor**

Development Corridor	Section	Code	Freight Volume Capacity Ratio	Passenger Volume Capacity Ratio
A. Central North-South Corridor	Yangon-Nay Pyi Taw	A1	1.09	1.30
	Nay Pyi Taw- Mandalay	A2	1.09	1.49
	Mandalay - Myitkyna	A3	0.42	0.81
B. East - West Corridor	Yangon - Hpa-An - Myawaddy	B1	1.81	1.98
	Mawlamyine - Dawei	B2	0.16	0.09
C. Northern Corridor	Mandalay - Muse	C1	2.14	0.87
D. Mandalay - Tamu Corridor	Mandalay - Tamu	D1	0.19	0.48
E. Second East - West Corridor	Tachilek - Meiktila - Kyaukpyu	E1	0.18	0.32
G. East - West Bridging Corridor	Hpasawing - Pyay	G1	0.03	0.01
	Loikaw - Magway	G2	0.12	0.51
H. Delta Area Network	Yangon - Pathein	H1	0.67	1.45
	Pathein - Hinthada	H2	0.08	0.31
J. Southern Area Development Corridor	Thanbyuzayat - Hpayarthonesu	J1	0.00	0.00
	Dawai - Thai Border	J2	0.00	0.00
	Dawei - Kawthaung	J3	0.01	0.09
K. Western North-South Corridor	Yangon - Pyay - Magway	K1	1.67	1.05
	Magway - Mandalay	K2	0.94	0.60
L. Eastern North - South Corridor	Bilin - Loikaw	L1	0.03	0.01
	Loikaw - Nawnghko	L2	0.02	0.02

Source: JICA Study Team

### 10.5.5 Selection of priority corridors

The multi-criteria analysis uses the best (and most current) numerical data available; this is adapted to assess the need and urgency of improvements for each development corridor. Ultimately, the analysis presents corridors of highest priority, in terms of investment needs.

The evaluation indicators of the multi-criteria analysis applied in the assessment include “connectivity” between growth centers (a corridor having connection with a larger growth center is given a high score), “contribution” to regional economy (a corridor having a larger existing and/or future GRDP generated in the sphere of influence along the corridor is given a high score), “traffic demand” (a corridor of higher traffic demand is given a high score) and “investment efficiency” (a corridor showing a higher volume capacity ratio is given a high score).

Each evaluation indicator ranges from 1 (low priority) to 5 (high priority) and a consolidated evaluation is made by averaging the score of each evaluation indicator.



Table 10.5 presents assessment results for each corridor and indicates development corridors of first priority, including:

- A: Central North-South Corridor (Yangon – Nay Pyi Taw – Mandalay)
- B: East-West Corridor (Yangon – Hpa An- Myawaddy)
- C: Northern Corridor (Mandalay – Muse)
- K: Western North-South Corridor (Yangon – Pyay – Magway)
- H: Delta Area Network

The average score for these first priority corridors exceeds 3.5.

**Table 10.5 Multi-criteria Analysis and Indicated Priority Development Corridors**

Development Corridor	Section	Code	Growth Center	Contribution (Economy)	Investment Impact (Traffic)	Investment Efficiency	Average Score
A. Central North-South Corridor	Yangon-Nay Pyi Taw	A1	5	5	5	5	5.0
	Nay Pyi Taw- Mandalay	A2	5	3	5	5	4.5
	Mandalay – Myitkyna	A3	4	4	2	2	3.0
B. East - West Corridor	Yangon - Hpa-An – Myawaddy	B1	4	5	4	3	4.0
	Mawlamyine – Dawei	B2	3	1	1	1	1.5
C. Northern Corridor	Mandalay – Muse	C1	4	3	3	4	3.5
D. Mandalay - Tamu Corridor	Mandalay – Tamu	D1	4	4	2	1	2.8
E. Second East - West Corridor	Tachilek - Meiktila – Kyaukpyu	E1	3	4	2	1	2.5
G. East - West Bridging Corridor	Hpasawing – Pyay	G1	3	1	1	1	1.5
	Loikaw – Magway	G2	3	2	1	1	1.8
H. Delta Area Network	Yangon – Pathein	H1	4	4	3	4	3.5
	Pathein – Hinthada	H2	3	1	1	1	1.5
J. Southern Area Development Corridor	Thanbyuzayat – Hpayarthonesu	J1	3	1	1	1	1.5
	Dawai - Thai Border	J2	3	1	1	1	1.5
	Dawei – Kawthaung	J3	3	1	1	1	1.5
K. Western North-South Corridor	Yangon - Pyay – Magway	K1	4	5	3	4	4.0
	Magway – Mandalay	K2	4	4	2	3	3.3
L. Eastern North - South Corridor	Bilin – Loikaw	L1	3	1	1	1	1.5
	Loikaw – Nawngghko	L2	3	1	1	1	1.5

First priority corridor

Second priority corridor

Source: JICA Study Team

## 10.6 Corridor-Based Transport Infrastructure Development Policy

### 10.6.1 Generic Policy in the Provision of Transport Services

Table 10.6 presents the characteristics of each identified corridor, in terms of demographic condition, dominant industrial activities, scale of socio-economic activities, and physical conditions (distance between neighboring centers, geographic conditions, etc.). These characteristics inform the generic requirements for transport services.

**Table 10.6 Transport Demand and Needs of Development Corridors and Desired Mode of Transport Provided along Development Corridors**

Development Corridor	Between National Growth Centers	Between National and Regional Growth Centers	Between Regional Growth Centers
Distance	300-600 km	100-400km	100-200km
Population of center city	1 - 8 million	200,000-500,000	100,000-300,000
Transport Demand and Characteristics	Over 100 mil pax-km per day	17 mil pax-km per day	3 mil pax-km per day
	Over 100 mil ton-km per day	20 mil ton-km per day	6 mil ton-km per day
	<ul style="list-style-type: none"> <li>Frequent business trip</li> <li>Frequent and large freight transport demand</li> <li>International freight movement (container)</li> <li>Visitors from overseas</li> <li>Exceed the existing traffic capacity along the corridor shortly</li> </ul>	<ul style="list-style-type: none"> <li>Frequent business trip (HQs and branch, etc.)</li> <li>Freight distribution to/from national centers (Dry port / ICD – and centers)</li> <li>Special purpose trip such as tourism (ex. Mandalay – Bagan)</li> </ul>	<ul style="list-style-type: none"> <li>Occasional business trip between neighboring regional centers</li> <li>Passenger and commodity movement within a limited sphere of influence.</li> </ul>
Transport Needs	<ul style="list-style-type: none"> <li>High speed (P)</li> <li>High capacity (F/P)</li> <li>High frequency (F/P)</li> <li>Redundancy (F/P)</li> <li>Dedicated network/service (F)</li> <li>Regular and punctual operation (F/P)</li> <li>Multimode (F/P)</li> </ul>	<ul style="list-style-type: none"> <li>Regular speed (P)</li> <li>Medium capacity (F/P)</li> <li>Regular frequency (F/P)</li> <li>Multimode (F/P)</li> <li>Regional terminal facility (F/P)</li> </ul>	<ul style="list-style-type: none"> <li>Regular speed (P)</li> <li>On-demand operation (F)</li> <li>Vehicular traffic dominant (F/P)</li> </ul>
Preferred transport services (Passenger)			
Expressway	A	B	B/C
Union Highway	B	A	A
High Speed Rail	A	C	D
Improved Railway	B	B/C	B/C
Inland Waterway	D	B/C	B/C
Air	A	B/C	D
Preferred transport services (Freight)			
Expressway	A	B	B/C
Union Highway	A	A	A
High Speed Rail	D	D	D
Improved Railway	A	B/C	B/C
Inland Waterway	A	B/C	B/C
Air	C	C	D

Note 1: A: Most appropriate, B: Appropriate, C: Slightly appropriate, D: Not appropriate

Note 2: P: for passenger movement, F: for freight movement

Source: JICA Study Team

By the year 2030, the development corridors that connect the National Growth Centers (i.e. Yangon, Nay Pyi Taw and Mandalay) will exhibit a high degree of traffic demand, exceeding 100 million passenger-kilometer per day and 100 million ton-kilometer of daily freight. Typical transport needs observed along this corridor are:

- Frequent business trips: A considerable number of business trips are observed between Yangon, Nay Pyi Taw, and Mandalay for business meetings and conferences. These travelers require fast, efficient and frequent transport services at a reasonable fare ) and they are willing to pay more for services of a higher level.
- Frequent and large freight transport demand: There is a high volume of freight movement including logs, construction materials, manufactured goods, food stuffs, and fuel mainly from/through Yangon and the Yangon Ports to Nay Pyi Taw, Mandalay and vice versa. It is a common requirement to provide reliable transport services (e.g. safety and regular operation) between shippers and consignees, yet the exact transport needs and means for freight transport do vary and are determined by commodity type and cargo volume.
- International freight movement: A considerable volume of international cargo, such as manufactured goods and petroleum, will be transported to/from Yangon/Thilawa Ports along the corridor towns. Transport infrastructure meeting international standards are required to carry international freight traffic as needed (e.g. reefer container/warehouse, container handling equipment, trailers, single-window border procedure).
- Visitors from overseas: Yangon/Nay Pyi Taw/Mandalay act as the gateways through which overseas business/commercial and tourism visitors travel; these travelers prefer fast and punctual transport services.
- Exceeding the existing traffic capacity: As the National Growth Centers' populations grow and economic activity results in traffic capacity exceeding limits along the corridor, the volume of passenger and freight traffic increases by over 10% per annum. Transport capacity should be expanded, maximizing the existing transport capacity and installing additional transport network surge capacity.

Along the corridors connecting the National Growth Centers, expressways, high-speed rail (HSR), and the air are suitable to carry passenger traffic. Freight transportation can take advantage of expressways, union highways (national highways), improved railways, and inland waterways in Myanmar.

Along the development corridors between the National and the Regional Growth Centers, the demand varies between corridors, and reaches at about 17 million passenger-kilometers per day and 20 million ton-kilometer per day by 2030, on average. Their travel distances are limited to a few hundreds kilometers and typical transport characteristics observed along these corridors include:

- Frequent business trips: A large number of trips observed between National and Regional Centers for business purposes. These travelers favor efficient, regular and frequent transport services by road and railway, due to limited travel distances.
  - Freight distribution to/from national centers: Multi-modal transport and trans-shipment facilities between different transport modes. Also, terminal facilities for consolidated cargos.
  - Special purpose trip such as tourism: Efficient, regular and reliable (safe) transport services.
-

- Along development corridors between National and Regional Growth Centers: Road and railway are desired modes of transport and suitable to carry passenger traffic; road and railway are also suitable for freight traffic, considering the transport demands and needs identified along the corridor.

#### 10.6.2 Basic policy in infrastructure provision

The required generic features of transport facilities (by type of corridor) are summarized in Table 10.7.

**Table 10.7 Transport Demand and Needs of Development Corridors and Desired Mode of Transport Provided along Development Corridors**

Development Corridor	Between National Growth Centers	Between National and Regional Growth Centers	Between Regional Growth Centers
<b>Proposed Infrastructure/Service</b>			
Expressway and Highway, and related facilities	<ul style="list-style-type: none"> <li>Expressway (4-8 lane, full-access controlled, toll)</li> <li>National Highway (4 -6 lane), heavy loaded road standard</li> <li>Bypass passing major cities</li> <li>Faster access to international nodes (ports and int'l airport)</li> <li>Logistics hub (dry port, ICD)</li> <li>Passenger terminal (mixed use building)</li> <li>Road monitoring and management system (ITS, etc)</li> <li>Road safety / emergency facilities</li> <li>Roadside station (Michi no Eki)</li> </ul>	<ul style="list-style-type: none"> <li>Expressway (spur line, toll)</li> <li>National Highway (4 – 6 lane), heavy loaded road standard</li> <li>Freight terminal (rail and truck ICD)</li> <li>Regional Roads (2 - 4 lane)</li> <li>Passenger terminal (bus)</li> <li>Cross boarder facilities (one-stop service)</li> <li>Roadside station (Michi no Eki)</li> </ul>	<ul style="list-style-type: none"> <li>National Highway (2 - 4 lane)</li> <li>Regional Roads (2 - 4 lane)</li> <li>Missing link improvement</li> <li>Passenger terminal (bus)</li> <li>Roadside station (limited)</li> </ul>
HSR and Rail	<ul style="list-style-type: none"> <li>High-speed Passenger Rail (HSR)</li> <li>Airport Rail Access</li> <li>Improved (faster) passenger rail</li> <li>Container Wagon (40ft high cube)</li> <li>Fuel Wagon</li> <li>Dry port / ICD and equipment</li> <li>International railway (SKRL Line)</li> <li>Modernized train operation and control system</li> <li>Multi-purpose station</li> </ul>	<ul style="list-style-type: none"> <li>Rail access to major nodes (city/port/airport/SEZ)</li> <li>Dry port</li> <li>Multi-purpose station</li> </ul>	<ul style="list-style-type: none"> <li>NA</li> </ul>
Maritime / Inland water Coastal	<ul style="list-style-type: none"> <li>Deep seaport and associated facilities</li> <li>Navigation channel improvement and maintenance</li> <li>River container / freight terminal</li> <li>River passenger terminal</li> <li>Navigation aid, security and safe improvement</li> <li>Ship building</li> </ul>	<ul style="list-style-type: none"> <li>Major ports improvement / modernization</li> <li>River passenger terminal improvement</li> <li>Navigation aid, security and safe improvement</li> <li>Ship building</li> </ul>	<ul style="list-style-type: none"> <li>NA</li> </ul>
Air	<ul style="list-style-type: none"> <li>New International airport</li> <li>Improvement of the existing international airports</li> <li>Logistics/passenger terminal improvement and development</li> <li>Upgrade of airport terminal security</li> <li>New air traffic control systems</li> <li>Upgrade of air navigation systems</li> <li>Introduction of Instrument Flight Rules (IFR)</li> <li>Meet Open Sky Policy (P)</li> </ul>	<ul style="list-style-type: none"> <li>Upgrade selected local airports to international airports</li> <li>Other local airport improvements/ expansion</li> <li>Upgrade of airport terminal security</li> <li>New air traffic control systems</li> <li>Upgrade of air navigation systems</li> <li>Introduction of Instrument Flight Rules (IFR)</li> </ul>	<ul style="list-style-type: none"> <li>NA</li> </ul>

Source: JICA Study Team

## 10.7 Proposed project component

### 10.7.1 Proposed project component along the priority development corridors

Section 10.6 identified the priority corridors, applying multi-criteria analysis as an evaluation method and socio-economic data and traffic demand to develop evaluation indicators. The priority development corridors include:

- A: Central North-South Corridor (Yangon – Nay Pyi Taw – Mandalay)
- B: East-West Corridor (Yangon – Hpa An- Myawaddy)
- C: Northern Corridor (Mandalay – Muse)
- K: Western North-South Corridor (Yangon – Pyay – Magway)
- H: Delta Area Network

The following discussion summarizes the project components for each priority corridor, highlighting the socio-economic conditions of the corridor, the existing and future transport demands and services and the list of priority projects for the corridor.

#### **A. Central North-South Corridor**

##### Socio-Economic Conditions of the Corridor

Most economic activities occur in highly populated cities and are located along the Central North-South Corridor. The city of Yangon, formerly the nation's capital, has a population of approximately 7.2 million people (2012). Other major cities along the corridor include Bago (population 2.1 million), Nay Pyi Taw (1.2 million) and Mandalay (1.5 million). The Central North-South Corridor accommodates 41% of the nation's population and generated 50% of the GDP in 2012, and this corridor ranks in the top 10 of development corridors, by population and GDP.

The production activities along the development corridor, mainly from the Industrial Zones in Yangon and Mandalay, produce Myanmar's majority of industrial products. According to the 2013 traffic demand forecast, detailed in the Study, Yangon produces 28% of Myanmar's manufactured goods and 28% of its foodstuffs, whereas Mandalay produces 27% of the manufactured goods and 20% of the foodstuffs. The Special Economic Zone project in Thilawa (Yangon) is in development and there are 21 Industrial Zone projects are under discussion or under development in Yangon. These two cities will remain major freight production nodes for the next decades.

##### Transport Demand and Service

All modes of transport along the Central North-South Corridor can carry passenger and freight traffic, including roads, expressways between Yangon and Mandalay, railway, inland water transport, and air transport. In 2013, the corridor was used for 43 million passenger-kilometers of passenger traffic and 41 million ton-kilometers of freight traffic. These figures account for 48% of all freight traffic and 55% of all passengers transported for all corridors. While all modes are used along the corridor, the road carries the majority of passenger and freight traffic. The modal distribution for freight is: road (91%), rail (8%), and water (1%), and the passenger distribution is: bus (66%), car (13%), rail (17%), air (2%) and water transport (2%). Linking all national growth centers along the corridor, this combined development contributes to rapid increases in both freight (maximum of 11% p.a. from 2013 to 2030) and passenger (11% p.a. during the same period) traffic demands. By 2030, the future traffic demand reaches nearly 100

million passenger-kilometer and 100 million ton-kilometer per day.

#### Proposed Major Project Component

Considering the corridor developments needs and demand data, and the proposed infrastructure and services for the transport corridor between National Growth Centers, the following development strategy is proposed for the Central North-South Corridor development.

- Provide high-speed, high capacity, safe and reliable transport network and services as the primary corridor element
- Enable multi-modal transport
- Make efficient use of existing transport facilities
- Segregate inter- and intra-city traffic

Table 10.8 and 10.9 and Figure 10.2 to Figure 10.5 summarize a range of priority transport projects along the Central North-South Corridor that will achieve the above corridor development strategies. These projects were developed using project assessments in ongoing transport studies.

**Table 10.8 Selected Major Priority Actions/Projects along Central North-South Corridor**

	Road	Rail	Inland Water
Selected Priority Actions / Projects			
Infrastructure	<ul style="list-style-type: none"> <li>• Upgrading Expressway, NH-1 and NH-2</li> <li>• Bypass (Circular Ring Road) at Yangon and Mandalay.</li> <li>• Extension of Expressway to Yangon, Thilawa Port and Hanthawaddy Airport</li> <li>• Heavy loaded roads/ bridges</li> <li>• Relocation (close to Rail ICD) /upgrading truck terminal in Yangon</li> </ul>	<ul style="list-style-type: none"> <li>• Rehabilitation and Modernization of the existing railway, including procurement of DEMU</li> <li>• New workshop in Ywa Thar Gyi area</li> <li>• Extension to Thilawa Port</li> <li>• Extension to Hanthawaddy Airport (spur line)</li> <li>• Dry port at Mandalay (Myntnge) and Yangon (Ywa Thar Gyi)</li> <li>• Airport Rail Access (HSR)</li> </ul>	<ul style="list-style-type: none"> <li>• Mandalay Port development</li> <li>• Yangon Port capacity improvement</li> <li>• River navigation channel improvement (Yangon River)</li> <li>• Replacement of old ships and barges</li> <li>• Navigation aid system in the Yangon Port area</li> </ul>
Service	<ul style="list-style-type: none"> <li>• Open Expressway to trucks</li> <li>• Roadside station (Michi no eki)</li> </ul>	<ul style="list-style-type: none"> <li>• MR Freight business improvement</li> </ul>	<ul style="list-style-type: none"> <li>• Navigation aid in the Yangon Port area</li> <li>• Introduction of EDI (Port-MIS)</li> </ul>
	Maritime	Air	
Selected Priority Actions / Projects			
Infrastructure	<ul style="list-style-type: none"> <li>• Capacity expansion of the existing ports in Yangon</li> <li>• Thilawa Port Development</li> <li>• Offshore Deep seaport at the Yangon River mouth</li> </ul>	<ul style="list-style-type: none"> <li>• Yangon Int'l Airport improvement</li> <li>• Hanthawaddy International Airport</li> <li>• Mandalay Int'l Airport improvement</li> </ul>	
Service	<ul style="list-style-type: none"> <li>• Introduction of EDI (Port-MIS)</li> </ul>	<ul style="list-style-type: none"> <li>• Airline development to/from Nay Pyi Taw</li> <li>• A series of navigation modernization such as IFR</li> </ul>	

Note: DEMU: diesel electric multiple unit, PTB: passenger terminal building, IFR: instrument flight rules

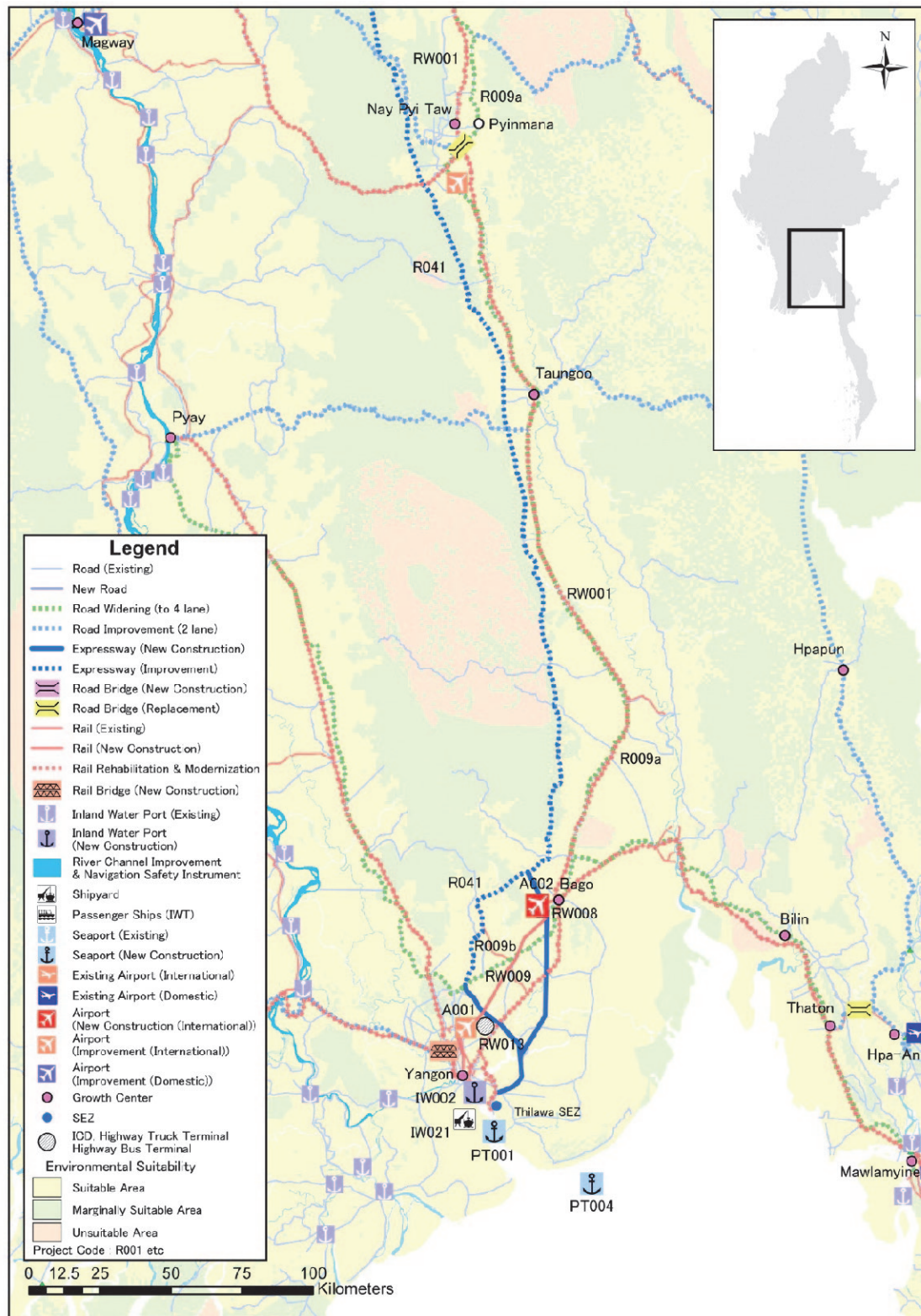
Source: JICA Study Team

**Table 10.9 List of Priority Infrastructure Projects along the Central North-South Corridor**

Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
A1,B1,H1,K1	Aviation	A001	Yangon International Airport	195.0
A1,B1	Aviation	A002	Hanthawaddy International Airport	1,403.0
A2,A3,C1,D1,K2	Aviation	A003	Mandalay International Airport	21.0
A3	Aviation	A008	Myitkyina Airport (major domestic)	24.0
A3	Aviation	A018	Bhamo Airport	9.0
A1, A2	Railway	RW001	Yangon - Mandalay	1,755.0
A3	Railway	RW002	Myohaung-Myitkyina	912.0
A1	Railway	RW008	Bago-Hanthawaddy	29.0
A1	Railway	RW009	Yangon - Hanthawaddy	2,000.0
A1	Railway	RW013	Yangon MR ICD, Workshop, etc.	40.0
A3	Railway	RW014	Mandalay MR ICD, truck terminal, etc.	10.0
A3	Road	R007	Shwebo – Myitkyina Road	462.0
A1, A2	Road	R009a	Bago – Mandalay Road	880.0
A1, A2	Road	R009b	Yangon (from toll gate) - Bago Road	84.0
A3	Road	R013	Mandalay – Thabeikkyin – Tagaung – Bhamo Road	274.0
A2	Road	R027	2 bridges on Yangon-Mandalay Road	10.0
A1	Road	R041	Yangon - Mandalay Expressway	676.0
A1	Road	R042	Yangon City - Thilawa Port Expressway	243.0
A1	Road	R043	Yangon City - Hanthawaddy - Existing Expressway	388.0
A2,A3	Road	R044	Mandalay Circular Expressway	340.0
A1,B1,H1,K1	Sea Port	PT001	Yangon Port in Thilawa (Phase 1)	223.0
A1,B1,H1,K1	Sea Port	PT001a	Yangon Port in Thilawa (Phase 2)	554.0
A1,B1,H1,K1	Sea Port	PT001b	Yangon Port in Thilawa (Phase 3)	194.0
A1,B1,H1,K1	Sea Port	PT002	Yangon Port Capacity and Connectivity Improvement	205.0
A1,B1,H1,K1	Sea Port	PT003	Yangon Port in Thilawa (Post Thilawa)	485.0
A1,B1,H1,K1	Sea Port	PT004	Offshore Yangon River (Deep Seaport)	2,427.0
				13,843

Source: JICA Study Team

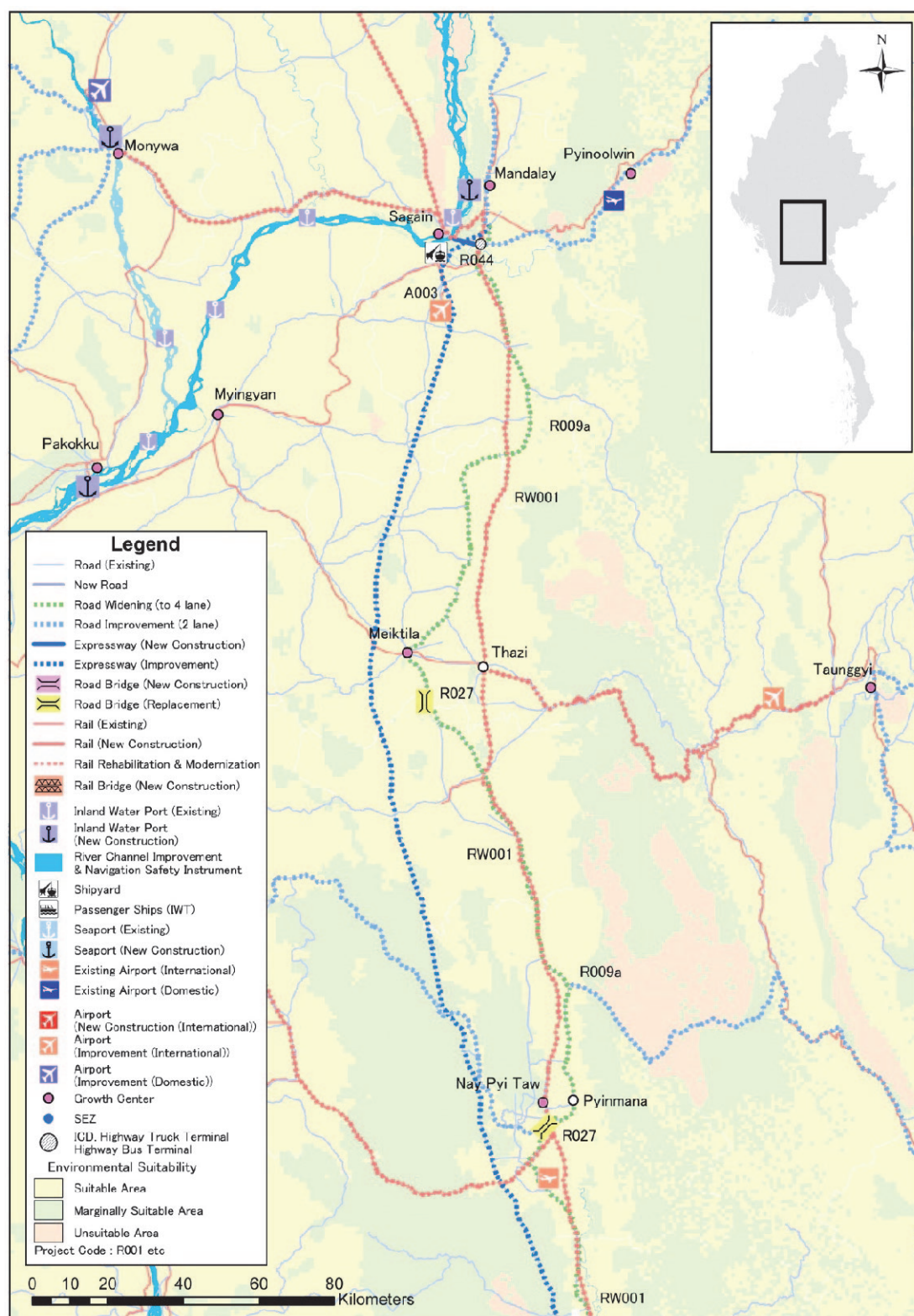
Note: Details of the project information are available in the technical notes.



Source: JICA Study Team

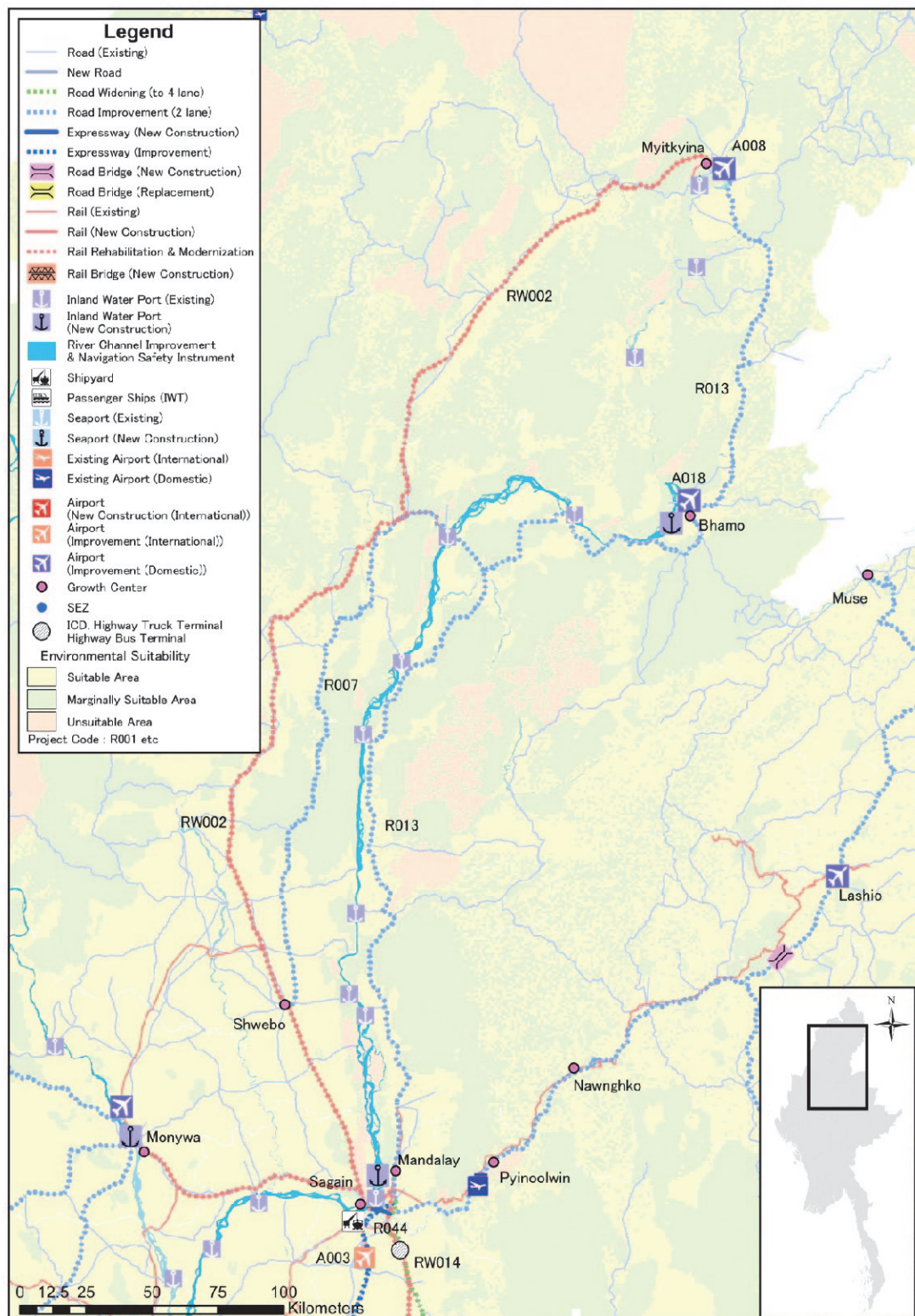
**Figure 10.2 Corridor-based Transport Infrastructure Development Plan  
– A. Central North-South Corridor (1/4)**





Source: JICA Study Team

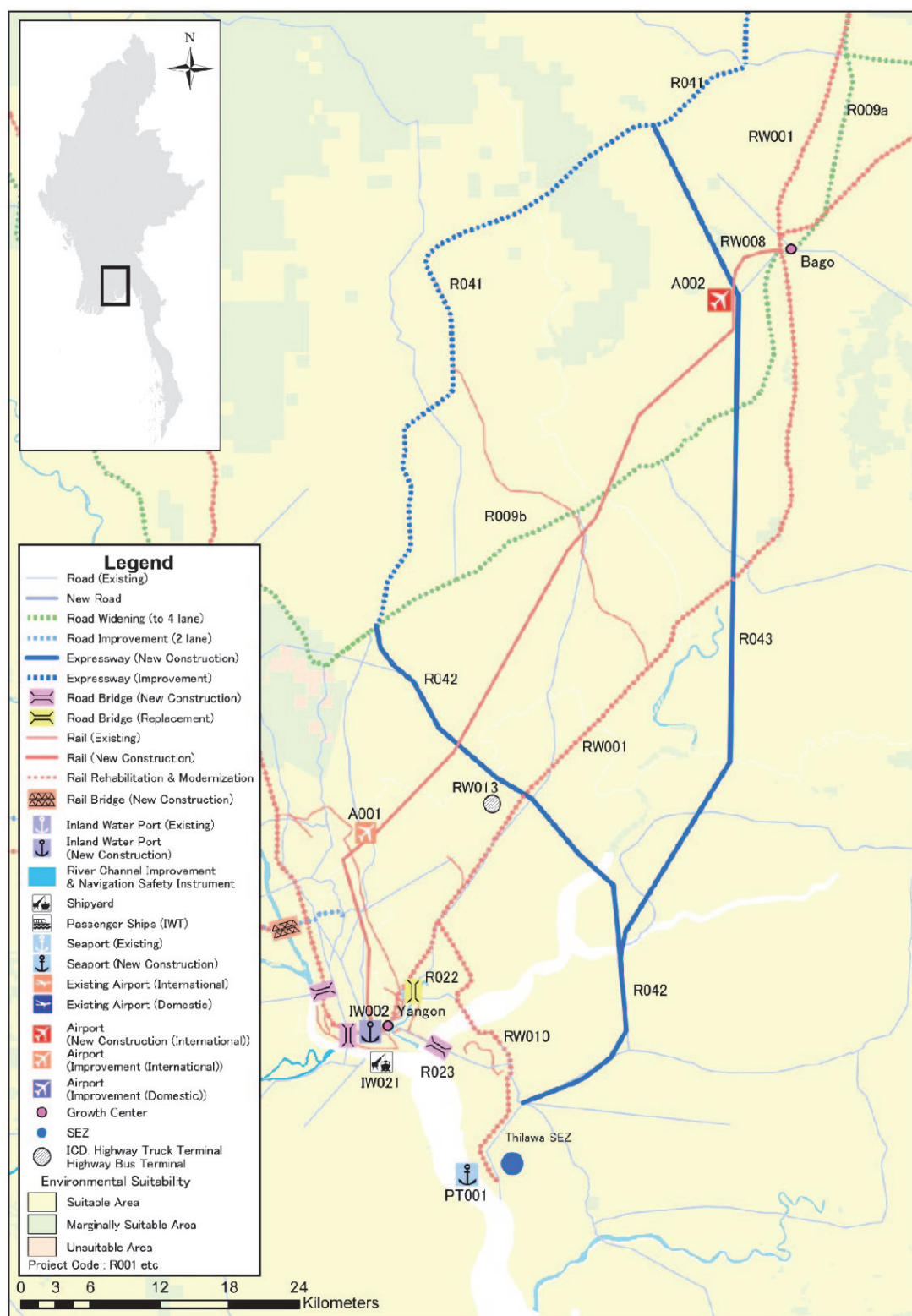
**Figure 10.3 Corridor-based Transport Infrastructure Development Plan  
– A. Central North-South Corridor (2/4)**



Source: JICA Study Team

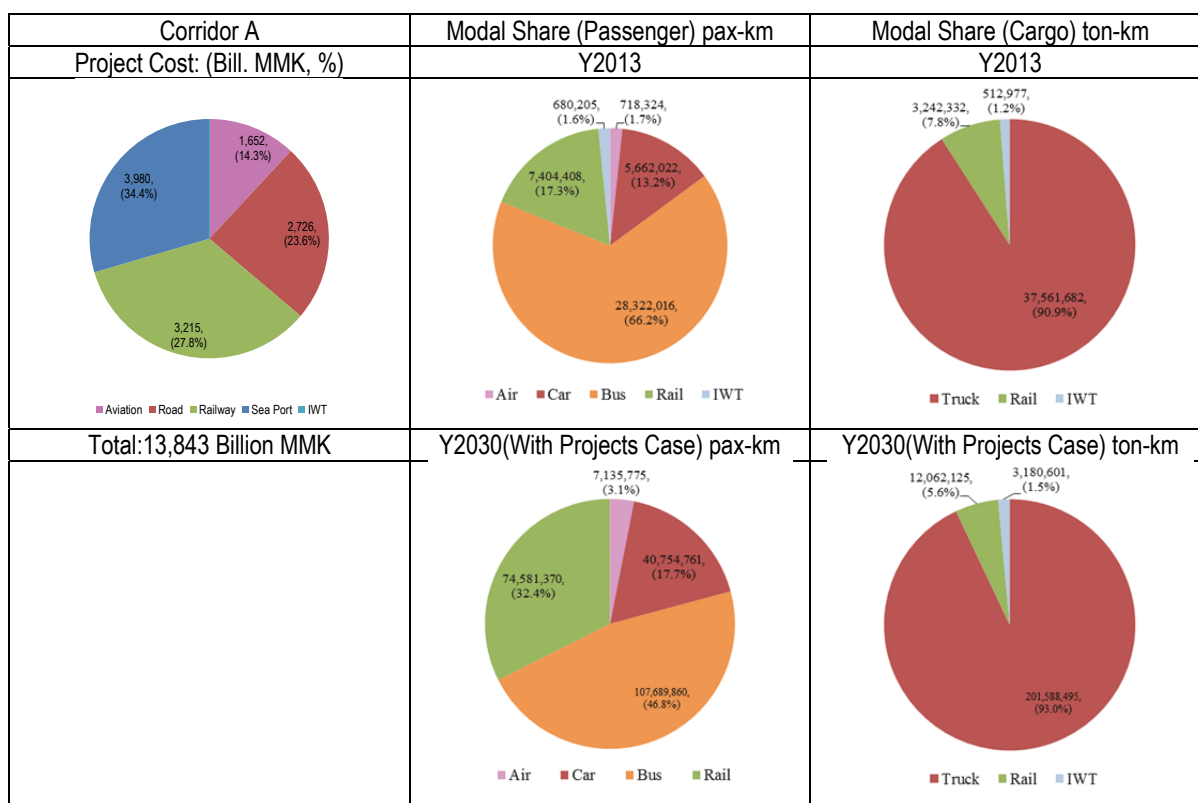
**Figure 10.4 Corridor-based Transport Infrastructure Development Plan  
– A. Central North-South Corridor (3/4)**





Source: JICA Study Team

**Figure 10.5 Corridor-based Transport Infrastructure Development Plan  
– A. Central North-South Corridor (4/4)**

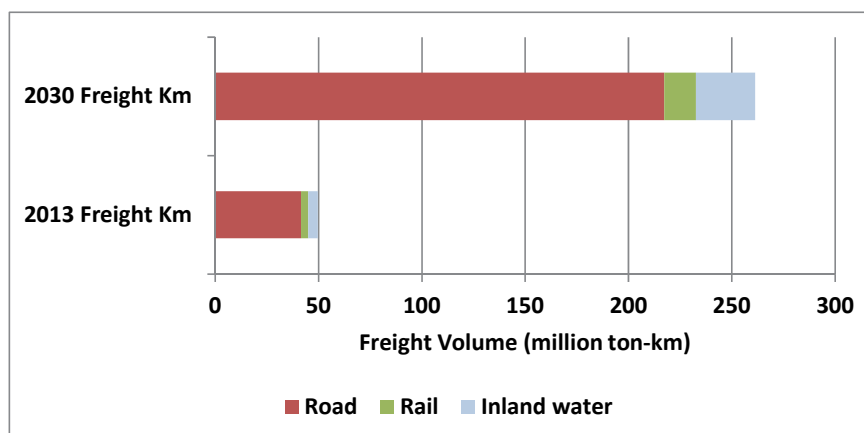


Source: JICA Study Team

**Figure 10.6 Proposed Project Cost and Modal Share – A. Central North-South Corridor**

**Box: Corridor Analysis on Central North-South Corridor: Yangon – Mandalay**

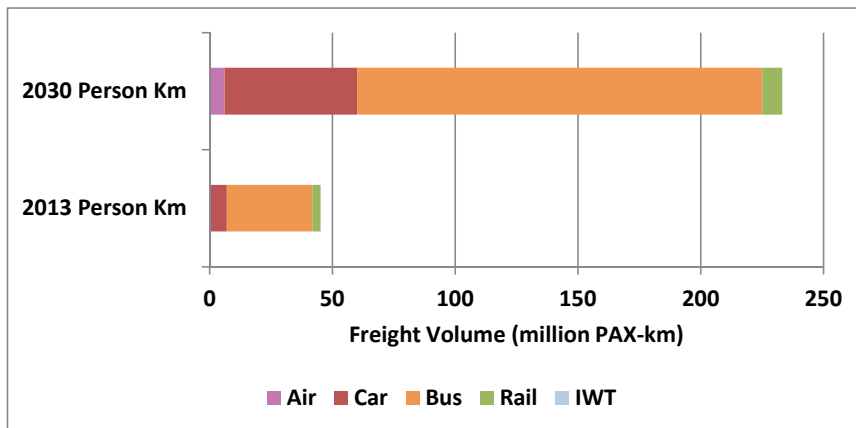
In 2013, the Central North-South Corridor between Yangon and Mandalay experiences 50 million ton-kilometers of daily freight traffic by: road (84% of freight traffic along the corridor), rail (7%) and inland water (9%). The freight traffic along the corridor is projected to increase by 10% p.a. until 2030.



Source: JICA Study Team

**Figure 10.7 2013 and 2030 Freight Demand by Transport Mode between Yangon and Mandalay**

Along the same corridor between Yangon and Mandalay, a total of 45 million passenger-kilometers of daily passenger trips travel by: bus (77% of passenger traffic along the corridor), car (15%), and rail (7%). Travel demand along the corridor is projected to increase by 10% per annum (p.a.) until 2030. The number of air and car passengers will increase significantly by 23% p.a. and 12% p.a., respectively.



Source: JICA Study Team

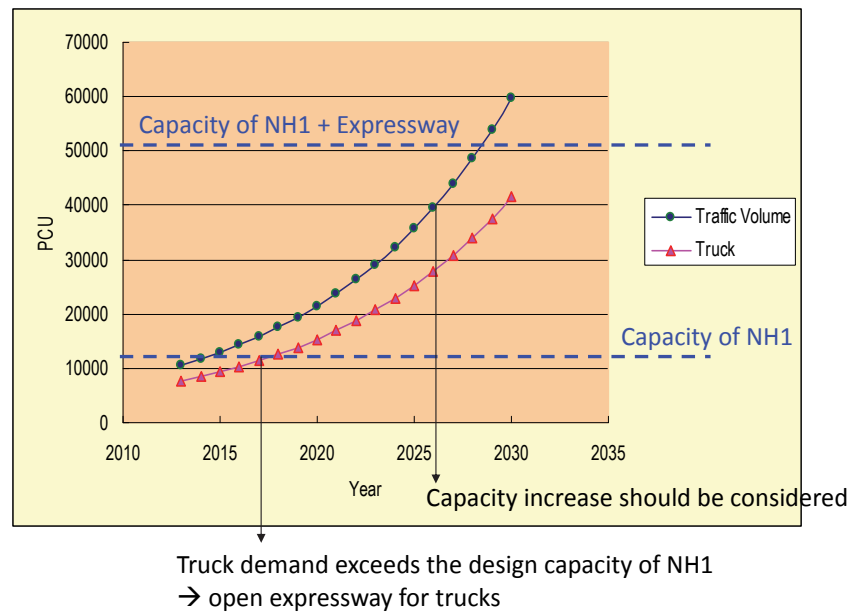
**Figure 10.8 2013 and 2030 Passenger Demand by Transport Mode between Yangon and Mandalay**

Along the same corridor between Yangon and Mandalay, the vehicular traffic volume on Expressway and National Highway No. 1 is estimated at 5,100 vehicles (10,500 PCUs) in 2013 and 31,000 vehicles (59,600 PCUs) in 2030. The road capacity (design capacity) of the Expressway (4 lane, double carriageway) is estimated at 28,800-43,200 PCUs/day and National Highway No. 1 (2 lane, single carriageway) at 9,600-12,000 PCUs/day. The following table and figure report vehicular traffic volume and volume capacity ratios between Yangon and Mandalay and indicate that the National Highway No. 1 will be oversaturated in a few years unless the Expressway is open to heavy vehicles. The table and figure also indicate that vehicular traffic demand along the same corridor will exceed the currently available road capacity (of both Expressway and National Highway No. 1) and the road improvement project(s) is unavoidable to increase road capacity by 2030.

**Table 10.10 Vehicular Traffic Volume and Volume Capacity Ratio between Yangon and Mandalay**

Year	Car	Bus	Truck	Total	Design Capacity (PCUs)	Volume / Capacity Ratio
2013 (Vehicle)	1,366	743	3,041	5,150	38,400 ~ 55,200	-
2013 (PCU)	1,366	1,486	7,603	10,455		0.19 - 0.27
2030 (Vehicle)	10,901	3,574	16,628	31,103		-
2030 (PCU)	10,901	7,148	41,571	59,619		1.08 - 1.55

Source: JICA Study Team



Source: JICA Study Team

**Figure 10.9 Vehicular Traffic Demand Forecast along the Yangon and Mandalay Corridor**

## **B. East - West Corridor**

### Socio-Economic Conditions of the Corridor

Like the Central North-South Corridor, intense economic activities and highly populated cities are situated along the East-West Corridor. The city of Yangon is home to 7.2 million residents in 2012. Other major cities along the corridor include Bago (population 2.1 million), Hpa-an (0.9 million), and Mawlamyine (1.9 million). The East-West Corridor accommodates 28 % of the national population and generated 35% of the nation's GDP in 2012.

The production activities along the development corridor, mainly from Yangon and Kayin, produce a considerable quantity of industrial products. According to the traffic demand forecast, described in the Study, for 2013, Yangon produced 28% of Myanmar's manufactured goods and 28% of food stuffs. Kayin State produced 12% of Myanmar's construction materials. Along the corridor, these two cities will remain as major freight production nodes for the next decades.

### Transport Demand and Service

A key feature of the East-West Corridor is that it includes a portion of the GMS East-West Corridor, which contributes to generating the cross border trade between Myanmar and Thailand. Along the East-West Corridor, highway, railway and air transport are available to carry passenger and freight traffic. In 2013, the corridor, mainly the section between Yangon and Myawaddy, transported 10 million passenger-kilometers of daily passenger traffic and 10 million ton-kilometers of daily freight traffic. These figures account for 10% of all freight traffic and 13% of all passengers transported along all corridors. The road carries a majority of the traffic along the corridor, and in terms of freight traffic, the modal share between Yangon and Myawaddy is road (95%) and rail (5%). For passenger traffic, the modal share is bus (64%), car (22%), rail (14%). Linking national and regional growth centers along the corridor, the corridor development will contribute to a rapid increase in both freight (maximum of 10% p.a. from 2013 to 2030) and passenger (10% p.a. during the same period) traffic demand and the future traffic demand reaches nearly 36 million passenger-kilometers and 53 million ton-kilometers per day by 2030. A potential risk along the corridor is the limited road capacity between Hpa-An and Myawaddy. Part of road section between Hpa-An and Myawaddy in mountainous area allows one-way traffic only, Hpa-an to Myawaddy direction on the odd days and Myawaddy to Hpa-an direction on the even days.

### Proposed Major Project Component

Considering the corridor developments needs and demand data, and the proposed infrastructure and services for the transport corridor between National and Regional Growth Centers, the following development strategy is proposed for the East-West Corridor development.

- Improve connectivity (land transport, freight movement) between Myanmar and Thailand
- Contribute to the coastal development between Yangon and Mawlamyine
- Integrate the corridor with the new transport hub (Hanthawady International Airport)
- Use the existing transport facilities efficiently
- Provide safe/reliable transport network/service, particularly for freight transport

Figures 10.11 and 10.12 and Figures 10.10, 10.11 and 10.12 summarize a range of priority transport projects along the East-West Corridor that will achieve the above corridor development strategies. These projects were developed using project assessments in ongoing transport studies.

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**Table 10.11 Selected Major Priority Actions/Projects along East-West Corridor**

	Road	Rail
Selected Priority Actions		
Infrastructure	<ul style="list-style-type: none"> <li>Upgrading and widening of roads along the EW Corridor</li> <li>Bypass at major cities along the EW corridor</li> <li>Heavy loaded roads/ bridges</li> <li>Dry port at Myawaddy</li> </ul>	<ul style="list-style-type: none"> <li>Rehabilitation between Bago and Mawlamyine</li> </ul>
Service	<ul style="list-style-type: none"> <li>Trade facilitation between Thailand and Myanmar (One-stop cross border facility and service, transit terminal)</li> <li>Roadside station (Michi no eki)</li> </ul>	
	Inland water / maritime	Air
Selected Priority Actions		
Infrastructure	<ul style="list-style-type: none"> <li>Yangon Port in Thilawa Area Development</li> <li>Off-shore deep seaport at the Yangon River mouth</li> <li>Mawlamyine port improvement</li> <li>Kalegauk port development</li> <li>Dawei port development</li> </ul>	<ul style="list-style-type: none"> <li>Yangon Int'l Airport improvement</li> <li></li> <li>Dawei Airport improvement (major domestic airport)</li> <li>Mawlamyine Airport improvement (domestic airport, PTB, TRW, TWY)</li> </ul>
Service	<ul style="list-style-type: none"> <li>Introduction of EDI (Port-MIS)</li> </ul>	<ul style="list-style-type: none"> <li>A series of navigation modernization such as IFR</li> </ul>

Note: PTB: passenger terminal building, IFR: instrument flight rules, TWY: taxiway, TWR: Aerodrome Control Tower or Aerodrome Control

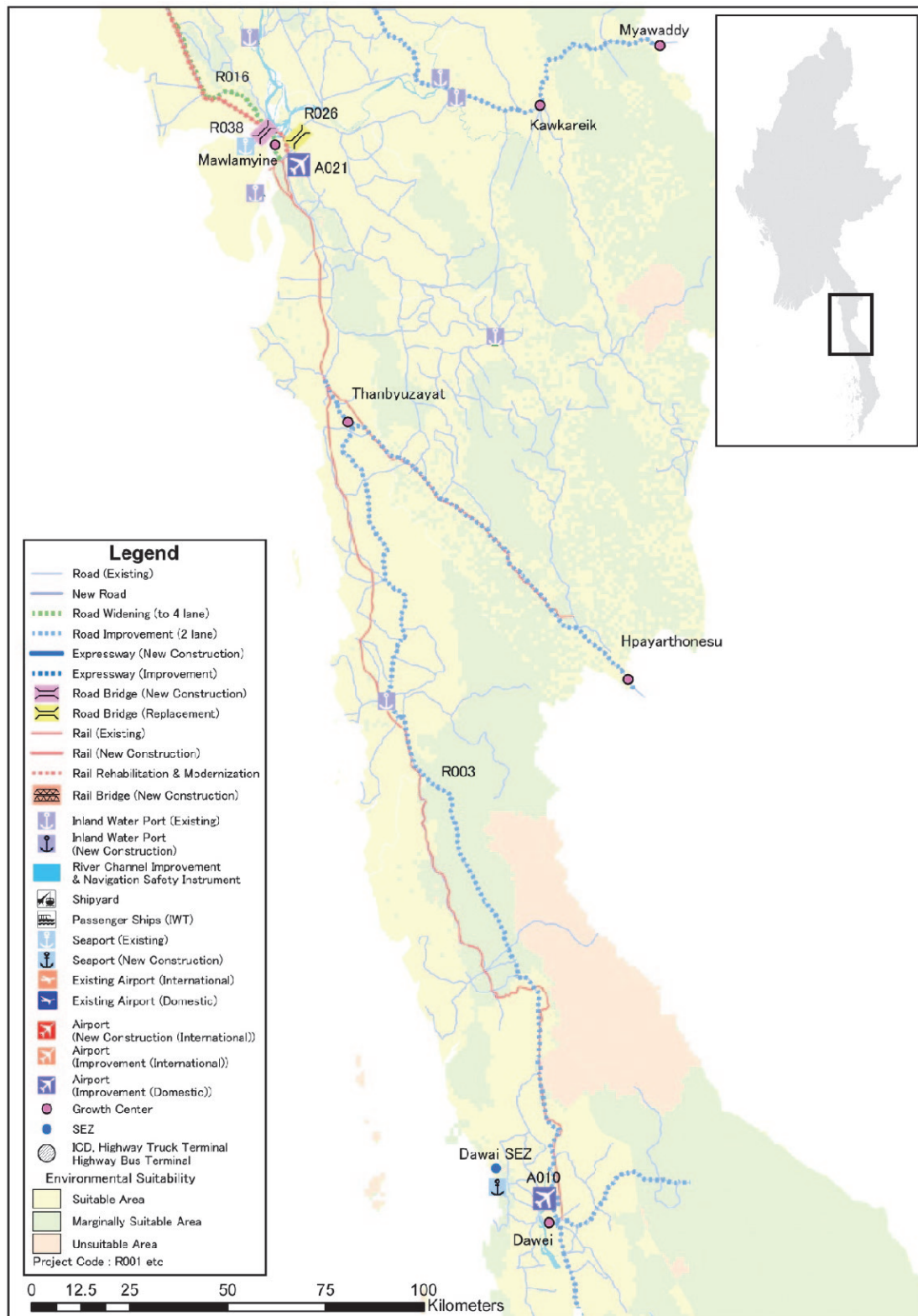
Source: JICA Study Team



**Table 10.12 List of Major Priority Projects along East-West Corridor**

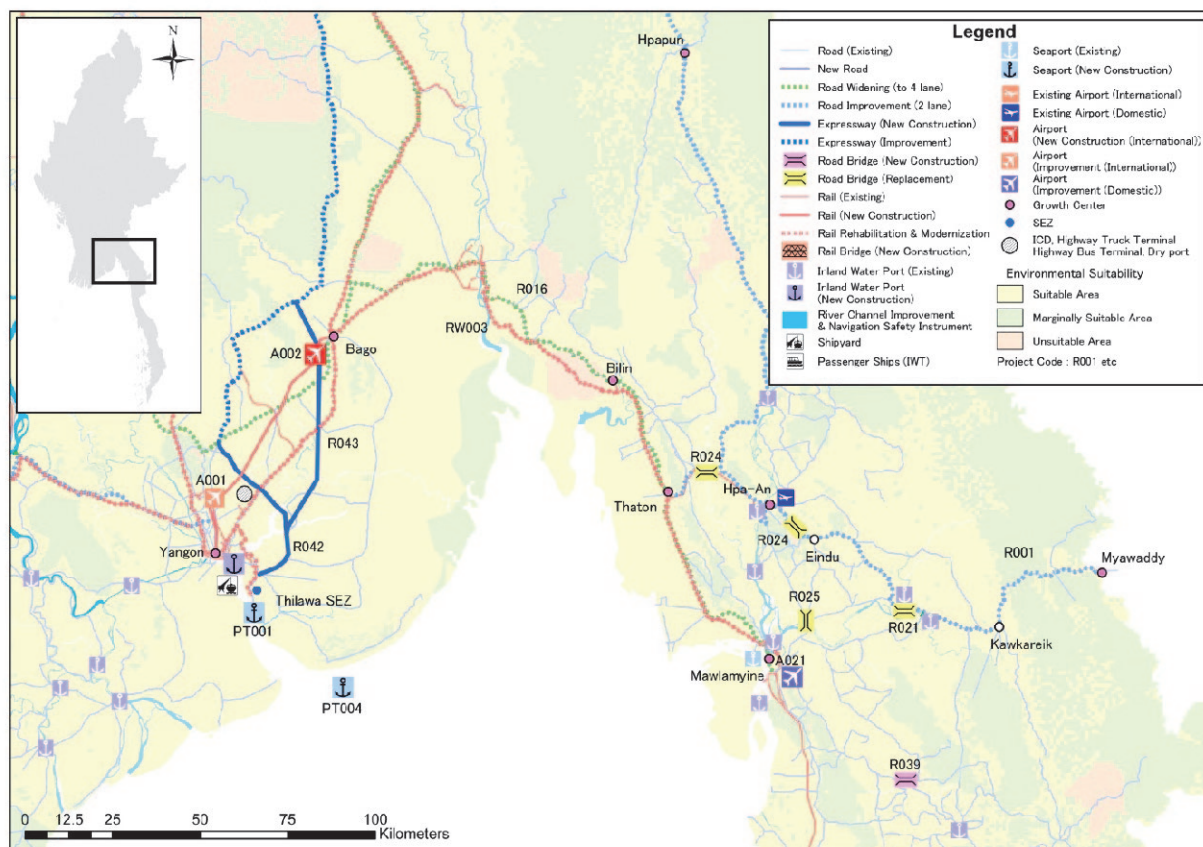
Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
A1,B1,H1,K1	Aviation	A001	Yangon International Airport	195.0
A1,B1	Aviation	A002	Hanthawaddy International Airport	1,403.0
B2,J2,J3	Aviation	A010	Dawei Airport (major domestic)	37.0
B1,B2,J1	Aviation	A021	Mawlamyine Airport	2.0
B1	Railway	RW003	Bago-Mawlamyine	366.0
B1	Road	R001	Thaton – Eindu – Kawkareik – Myawaddy Road	192.0
B2,J3	Road	R003	Thanbyuzayat – Dawei – Myeik – Kawthonng Road	907.0
B1,B2	Road	R016	Payagyi – Mawlamyine – Thanbuzayat Road	393.0
B1	Road	R021	Gyaing (Kawkarik) Bridge	21.0
B1	Road	R024	Don Tha Mi and Naung Lon Bridge	16.0
B1	Road	R025	Gyaing (Zarthapyin) Bridge	34.0
B2	Road	R026	Atran Bridge	17.0
B2	Road	R038	Thanlwin (Chaungsone) Bridge	23.0
B1	Road	R039	Chaungnitkwa Bridge	14.0
B1	Road	R042	Yangon City - Thilawa Port Expressway	243.0
B1	Road	R043	Yangon City - Hanthawaddy - Existing Expressway	388.0
A1,B1,H1,K1	Sea Port	PT001	Yangon Port in Thilawa (Phase 1)	223.0
A1,B1,H1,K1	Sea Port	PT001a	Yangon Port in Thilawa (Phase 2)	554.0
A1,B1,H1,K1	Sea Port	PT001b	Yangon Port in Thilawa (Phase 3)	194.0
A1,B1,H1,K1	Sea Port	PT002	Yangon Port Capacity and Connectivity Improvement	205.0
A1,B1,H1,K1	Sea Port	PT003	Yangon Port in Thilawa (Post Thilawa)	485.0
A1,B1,H1,K1	Sea Port	PT004	Offshore Yangon River (Deep Seaport)	2,427.0
B2, J2, J3	Sea Port	PT006	Dawai Port	2,000.0
B1,B2, J1	Sea Port	PT008	Mawlamyain Port	49.0
				10,388

Source: JICA Study Team



Source: JICA Study Team

**Figure 10.10 Corridor-based Transport Infrastructure Development Plan  
– B. East-West Corridor (1/2)**



Source: JICA Study Team

**Figure 10.11 Corridor-based Transport Infrastructure Development Plan  
– B. East-West Corridor (2/2)**

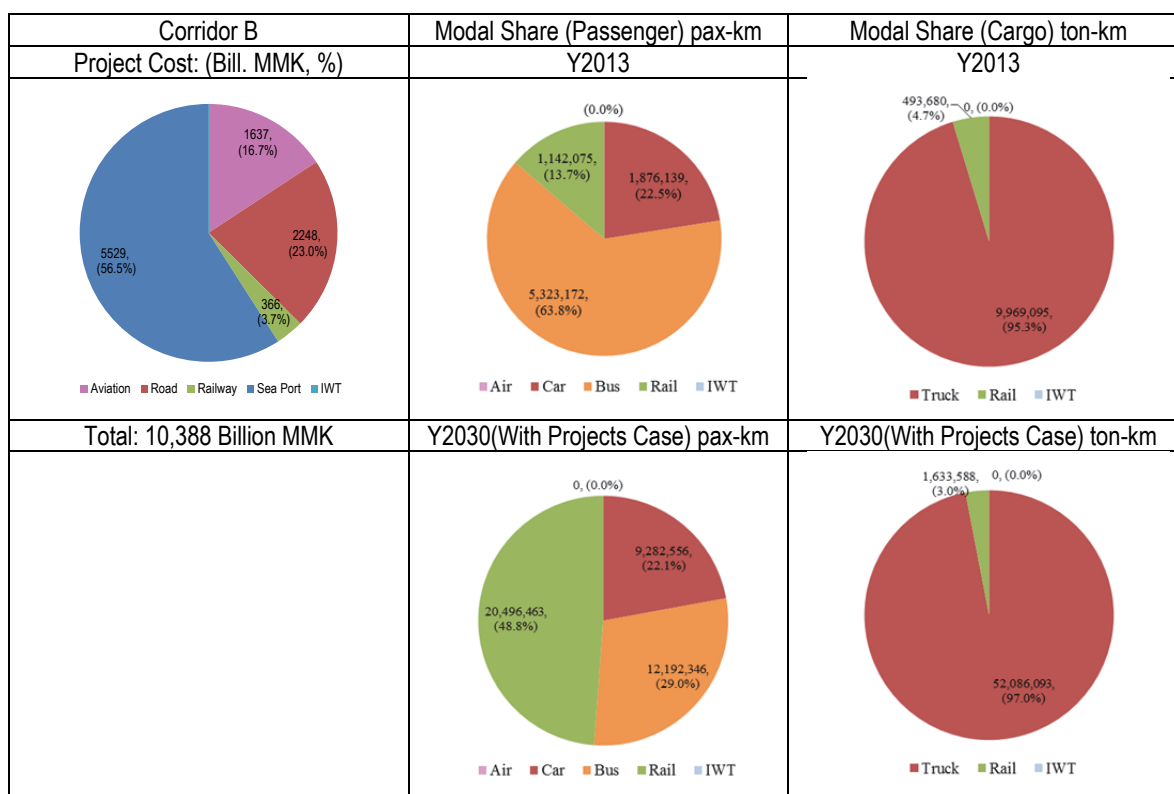


Figure 10.12 Proposed Project Cost and Modal Share – B. East-West Corridor

### C. Northern Corridor

#### Socio-Economic Conditions of the Corridor

Along the Northern Corridor, most economic activities and populations are situated in Mandalay. The city of Mandalay is home to 1.4 million residents in 2012 and no other major cities are present along the corridor. Other major cities located near the corridor include Sagaing (0.8 million) and Monywa (1.8 million), which also enjoy benefits of development of the Northern Corridor. The Northern Corridor accommodates 10 % of the national population and 10 % of the nation's GDP in 2012.

The production activities along the development corridor, mainly from Mandalay, produce a considerable quantity of industrial products. According to the traffic demand forecast, described in the Study, for 2013, Mandalay produces 20% of Myanmar's food stuffs, 26% of construction materials and 27% of manufactured goods. Also, Shan produces 11% of the nation's food stuffs, 14% of construction materials and 26% of manufactured goods, which are sourced mainly from China.

#### Transport Demand and Service

The Northern Corridor functions as the major trade corridor between Myanmar and China. It also includes a portion of the GMS Northern Corridor. Along the Northern Corridor, highway, railway and air transport are available to carry passenger and freight traffic. In 2013, the corridor transported 4 million passenger-kilometers of daily passenger traffic and 11 million ton-kilometers of daily freight traffic. These figures account for 13% of all freight traffic and 5% of all passengers transported along the corridors. The road carries a majority of traffic along

the corridor, and in terms of freight traffic, the modal share is road (98%) and rail (2%). For passenger traffic, the modal share is bus (38%), car (41%) and rail (21%). Linking national and agro-industrial growth centers along the corridor, the corridor development will contribute to a rapid increase in both freight (maximum of 9% p.a. from 2013 to 2030) and passenger (8% p.a. during the same period) traffic demand and the future traffic demand reaches nearly 17 million passenger-kilometer and 44 million ton-kilometer per day by 2030.

#### Proposed Infrastructure Project Component

Considering the corridor developments needs and demand data, and the proposed infrastructure and services, the following development strategy is proposed for the Northern Corridor.

- Improve connectivity (land transport, freight movement) between Myanmar and Yunnan Province
- Contribute to the industrial development in Muse, Lashio, Mandalay / Sagin area
- Integrate the corridor with the new transport hub (Mandalay and Muse Dry port)
- Use the existing transport facilities efficiently
- Provide safe/reliable transport network/service, particularly for freight transport.

Tables 10.13 and 10.14 and Figures 10.13 and 10.14 summarize selected road and railway sectors that will achieve the above corridor development strategies. These projects were developed using project assessments in ongoing transport studies.

**Table 10.13 Selected Major Priority Actions/Projects along East-West Corridor**

	Road	Rail
Selected Priority Actions		
Infrastructure	<ul style="list-style-type: none"> <li>• Improvement of Mandalay – Lashio – Muse Road</li> <li>• Dry port at Muse</li> <li>• A series of bridge improvement</li> </ul>	<ul style="list-style-type: none"> <li>• Mandalay Dry Port / ICD</li> </ul>
Service	<ul style="list-style-type: none"> <li>• Trade facilitation between China/Myanmar and associated infra/service development (One-stop cross border facility and service, transit terminal)</li> </ul>	
	Inland water / maritime	Air
Selected Priority Actions		
Infrastructure	<ul style="list-style-type: none"> <li>• NA</li> </ul>	<ul style="list-style-type: none"> <li>• Lashio Airport Improvement (domestic: PAPI, PTB, TWR, TWY)</li> <li>• Mandalay Airport Improvement (international)</li> </ul>
Service		<ul style="list-style-type: none"> <li>• A series of navigation modernization such as IFR</li> </ul>

Note: PTB: passenger terminal building, IFR: instrument flight rules, TWY: taxiway, TWR: Aerodrome Control Tower or Aerodrome Control

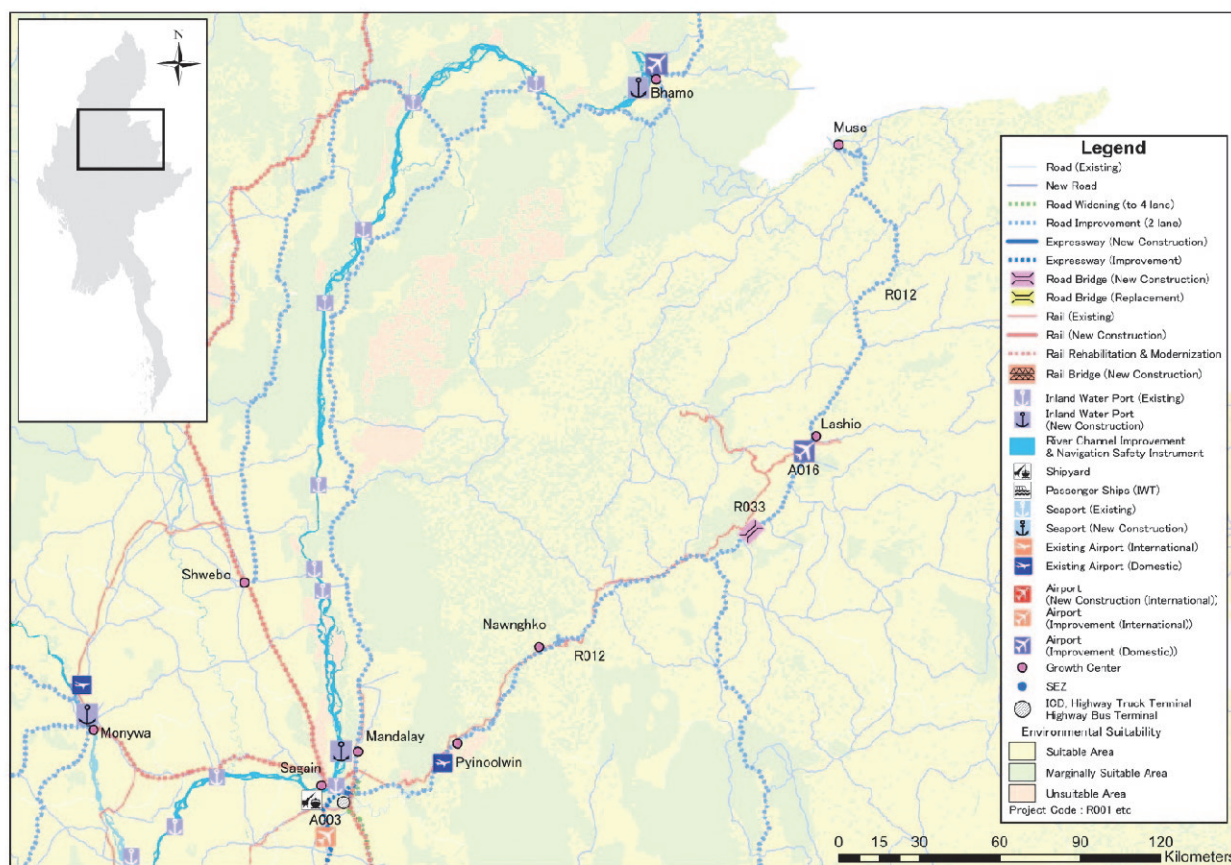
Source: JICA Study Team



**Table 10.14 List of Priority Projects along Northern Corridor**

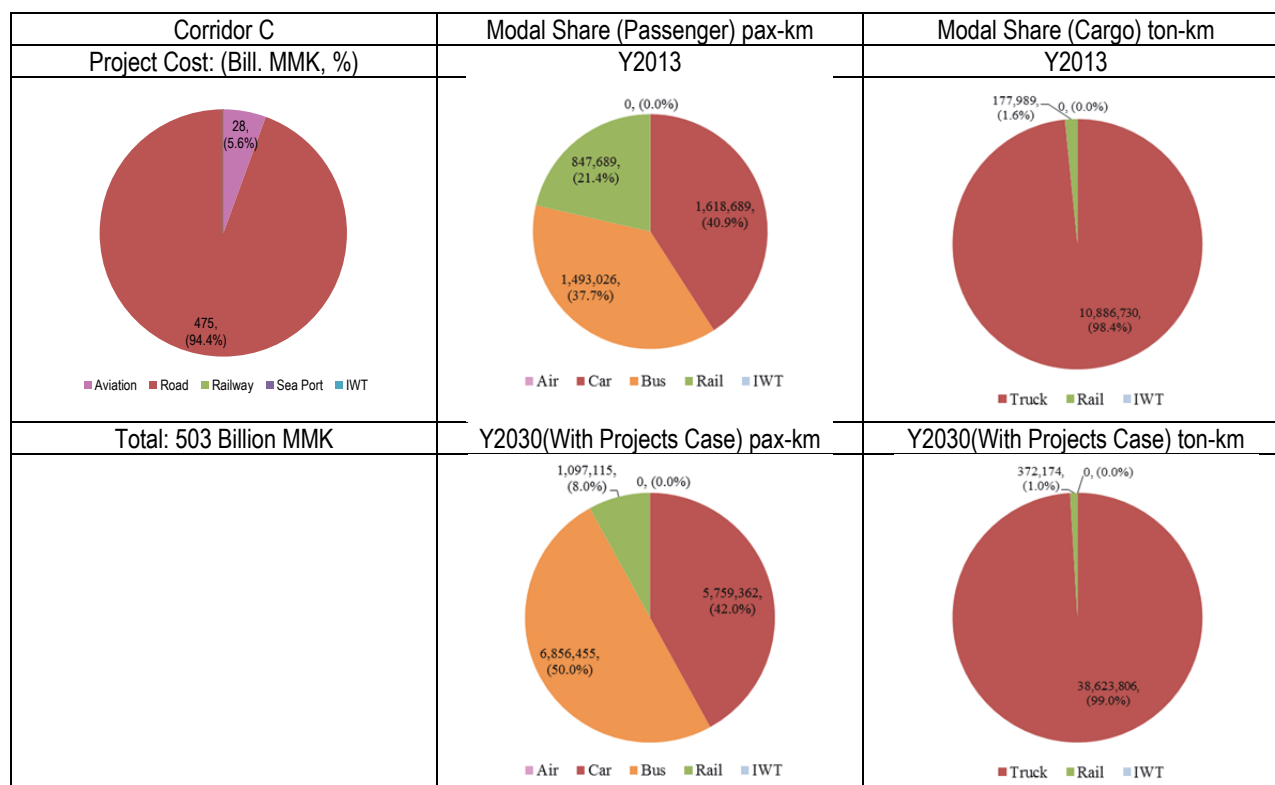
Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
A2,A3,C1,D1,K2	Aviation	A003	Mandalay International Airport	21.0
C1	Aviation	A016	Lashio Airport	7.0
C1	Road	R012	Mandalay – Lashio – Muse Road	440.0
C1	Road	R033	New Goat twin Viaduct	35.0
				503

Source: JICA Study Team



Source: JICA Study Team

**Figure 10.13 Corridor-based Transport Infrastructure Development Plan  
– C. Northern Corridor**



**Figure 10.14 Proposed Project Cost and Modal Share – C. Northern Corridor**

## **F. Main River Corridor**

The socio-economic conditions and traffic features along the Main River Corridor are described as part of K: Western North-South Corridor, the following section. The section includes priority actions and projects for the selected transport sub-sector, through the assessment of the planned transport projects and proposed projects by ongoing transport studies.

## **K. Western North-South Corridor**

### **Socio-Economic Condition of the Corridor**

Like the Central North-South Corridor, economic activities and populations of the Western North-South Corridor are situated in Yangon and Mandalay. Other major cities located along the corridor include Pyay (1.2 million) and Magway (1.9 million). The Western North-South Corridor is home to 33 % of Myanmar's population and 42 % of GDP in 2012. The production activities along the development corridor, mainly from Yangon and Mandalay, produce a high quantity of industrial products, as described earlier.

### Transport Demand and Service

In terms of transport infrastructure and service, a key feature of the Western North-South Corridor is the river transport by the Ayeyarwaddy River. In 2013, the corridor transported 6 million passenger-kilometers of daily passenger traffic and 11 million ton-kilometers of daily freight traffic. These figures account for 12% of all freight traffic and 10% of all passengers transported along the corridors. Unlike other corridors, the inland water transport carries the majority of traffic along the corridor, and in terms of freight traffic, the modal share is road (52%), rail (6%) and inland water transport (42%), and for passenger traffic, the share is bus (53%), car (19%) and rail (28%). Linking national and regional growth centers along the corridor, the corridor development will contribute to a rapid increase in both freight (maximum of 11% p.a. from 2013 to 2030) and passenger (9% p.a. during the same period) traffic demand; future traffic demand reaches nearly 32 million passenger-kilometers and 52 million ton-kilometers per day by 2030.

### Proposed Infrastructure Project Component

The following development strategy is proposed for the development of the Western North-South Corridor.

- Provide high-speed, high capacity, safe and reliable transport network and services as the primary corridor element
- Alternative routes for the central north-south corridor (to form two primary elements in the North-South network)
- Enable multi-modal transport
- Make efficient use of the existing transport facilities
- Segregate inter- and intra-city traffic

Tables 10.15 and 10.16 and Figures 10.15 ~ 10.20 summarize selected projects that will achieve the above corridor development strategies along the Western Northern Corridor. These projects were developed using project assessments in ongoing transport studies.

**Table 10.15 Selected Priority Actions/Projects along Western North-South Corridor**

	Road	Rail
Selected Priority Actions		
Infrastructure	<ul style="list-style-type: none"> <li>• Yangon – Pyay road improvement</li> <li>• Pyay – Magway road improvement</li> <li>• Magway – Mandalay road improvement</li> <li>• Monywa – Patheingyi road</li> </ul>	<ul style="list-style-type: none"> <li>• Yangon – Pyay railway improvement</li> <li>• Yangon – Hlawga urban rail improvement</li> <li>• Procurement of DEMU</li> </ul>
Service	<ul style="list-style-type: none"> <li>• Roadside station (Michi no eki)</li> </ul>	
	Inland water / maritime	Air
Selected Priority Actions		
Infrastructure	<ul style="list-style-type: none"> <li>• Mandalay Port</li> <li>• Yangon Port</li> <li>• Pakokku Port</li> <li>• Magway Port</li> <li>• Monywa Port</li> </ul>	<ul style="list-style-type: none"> <li>• Yangon International Airport</li> <li>• Mandalay International Airport</li> <li>• Nyaung U Airport (regional international airport) (Alternative as a regional international airport : Pakokku airport)</li> </ul>
Service	<ul style="list-style-type: none"> <li>• A series of vessel procurement</li> </ul>	<ul style="list-style-type: none"> <li>• A series of navigation modernization such as IFR</li> </ul>

Note: PTB: passenger terminal building, IFR: instrument flight rules, TWY: taxiway, TWR: Aerodrome Control Tower or Aerodrome Control

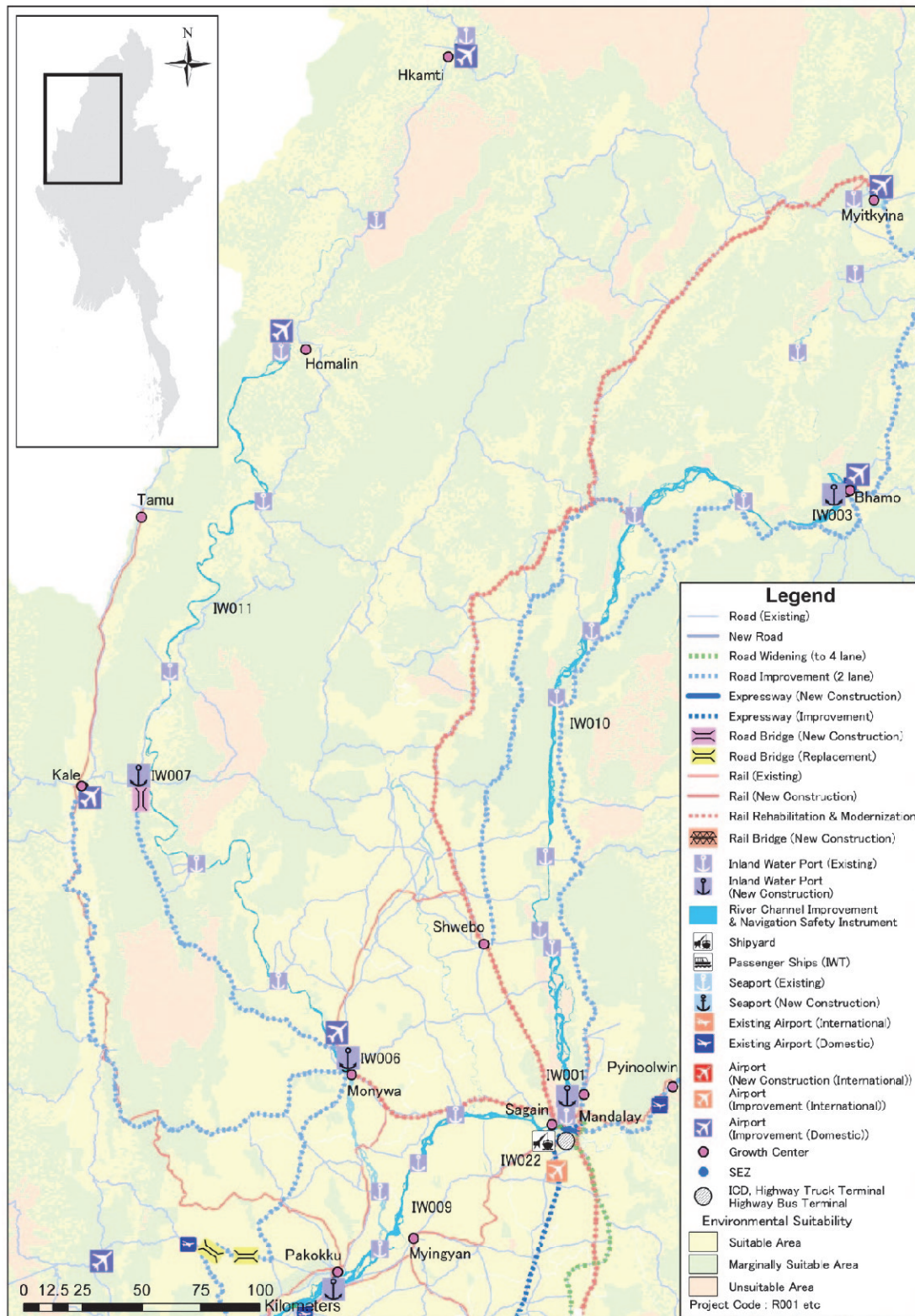
Source: JICA Study Team



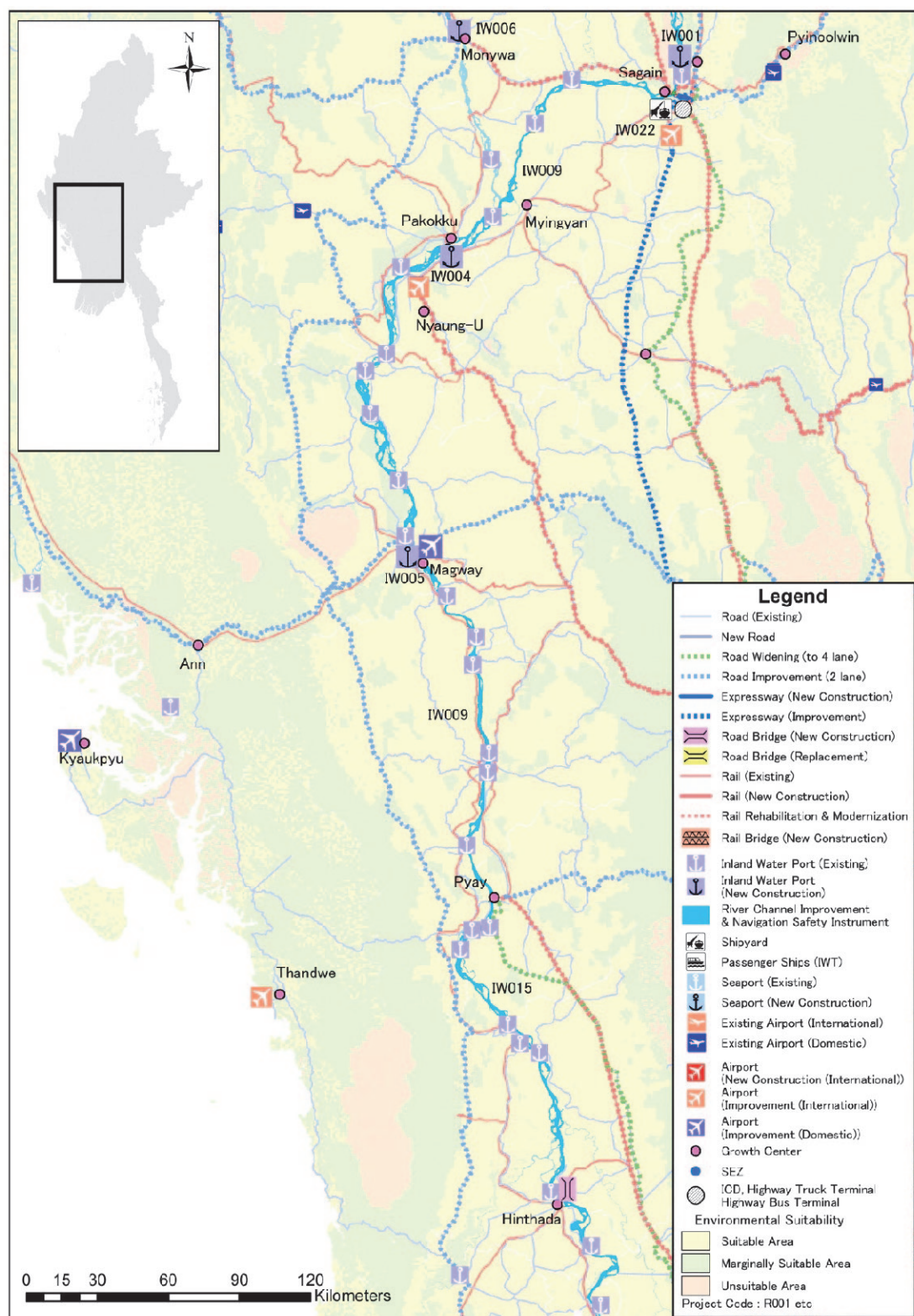
**Table 10.16 List of Priority Projects along Main River Corridor and Western North-South Corridor**

Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
A1,B1,H1,K1	Aviation	A001	Yangon International Airport	195.0
A2,A3,C1,D1,K2	Aviation	A003	Mandalay International Airport	21.0
K2,D1	Aviation	A005	Nyaung U International Airport (Alt. Pakokku)	107.0
E1,G2,K1,K2	Aviation	A028	Magway Airport	2.0
K1,K2,D1	Aviation	A029	Kyauktu Airport	2.0
F1,F2	IWT	IW001	Mandalay Port	123.0
F1, H1	IWT	IW002	Yangon Port (Including Connectivity)	303.0
F1	IWT	IW003	Bhamo Port	93.0
F1,F2	IWT	IW004	Pakokku Port	22.0
F1	IWT	IW005	Magway Port	22.0
F2	IWT	IW006	Monywa Port	21.0
F2	IWT	IW007	Kalewa Port	21.0
F1,H1	IWT	IW009	Yangon - Mandalay channel improvement	187.0
F1	IWT	IW010	Mandalay - Bhamo channel improvement	130.0
F2	IWT	IW011	Monywa - Upstream channel improvement	36.0
F1,H1	IWT	IW012	Ayeyawady Delta channel improvement	54.0
F1,H1	IWT	IW015	Yangon - Mandalay Navigation safety improvement	20.0
F1	IWT	IW016	Mandalay - Bhamo Navigation safety improvement	20.0
F2	IWT	IW017	Monywa - Upstream Navigation safety improvement	20.0
F1,H1	IWT	IW018	Ayeyawady Delta Navigation safety improvement	20.0
F1,F2	IWT	IW022	Mandalay Shipyard modernization	30.0
F1,H1	IWT	IW025	Ayeyawady Delta IWT vessels	20.0
K1	Railway	RW004	Yangon-Pyay	432.0
K1	Road	R010	Yangon - Pyay - Mandalay Road	1,139.0
D1,K1,H1	Road	R011	Monywa - Patheingyi Road	700.0
A1,B1,H1,K1	Sea Port	PT001	Yangon Port in Thilawa (Phase 1)	223.0
A1,B1,H1,K1	Sea Port	PT001a	Yangon Port in Thilawa (Phase 2)	554.0
A1,B1,H1,K1	Sea Port	PT001b	Yangon Port in Thilawa (Phase 3)	194.0
A1,B1,H1,K1	Sea Port	PT002	Yangon Port Capacity and Connectivity Improvement	205.0
A1,B1,H1,K1	Sea Port	PT003	Yangon Port in Thilawa (Post Thilawa)	485.0
A1,B1,H1,K1	Sea Port	PT004	Offshore Yangon River (Deep Seaport)	2,427.0
H1,H2,F1	Sea Port	PT009	Patheingyi Port	49.0
				7,877

Source: JICA Study Team



**Figure 10.15 Corridor-based Transport Infrastructure Development Plan  
– F. Main River Corridor (1/3)**

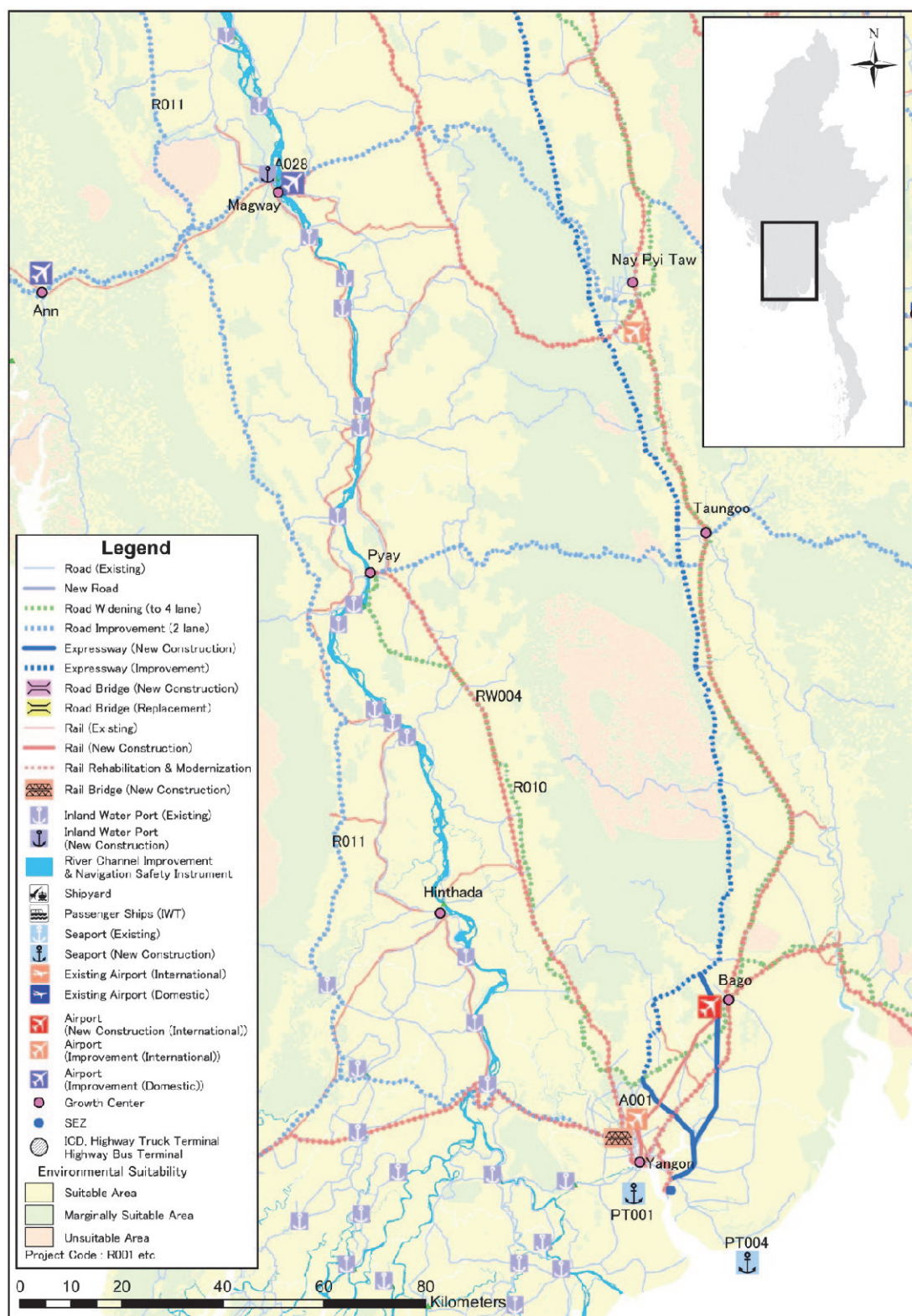


**Figure 10.16 Corridor-based Transport Infrastructure Development Plan  
– F. Main River Corridor (2/3)**





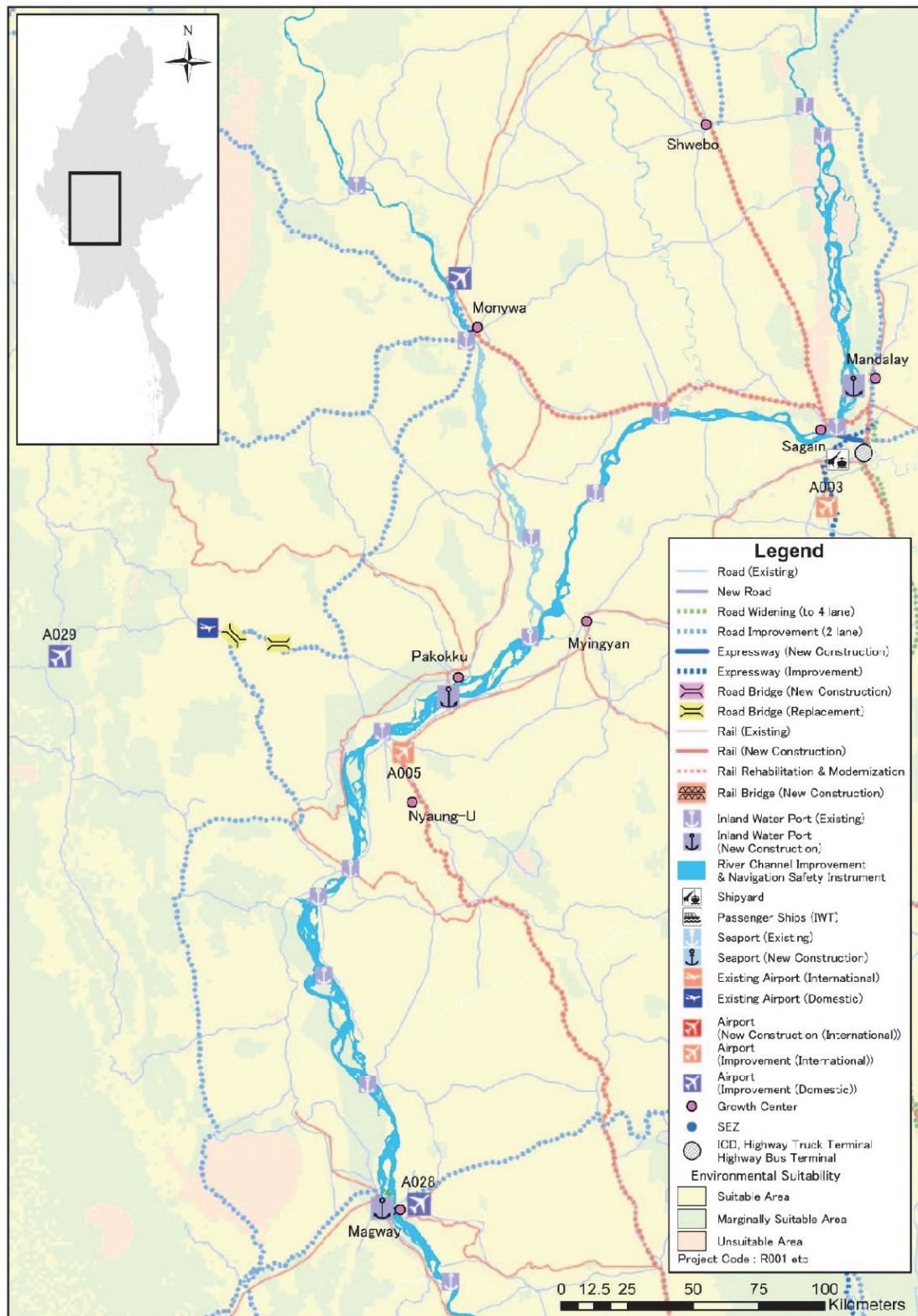
10-37



Source: JICA Study Team

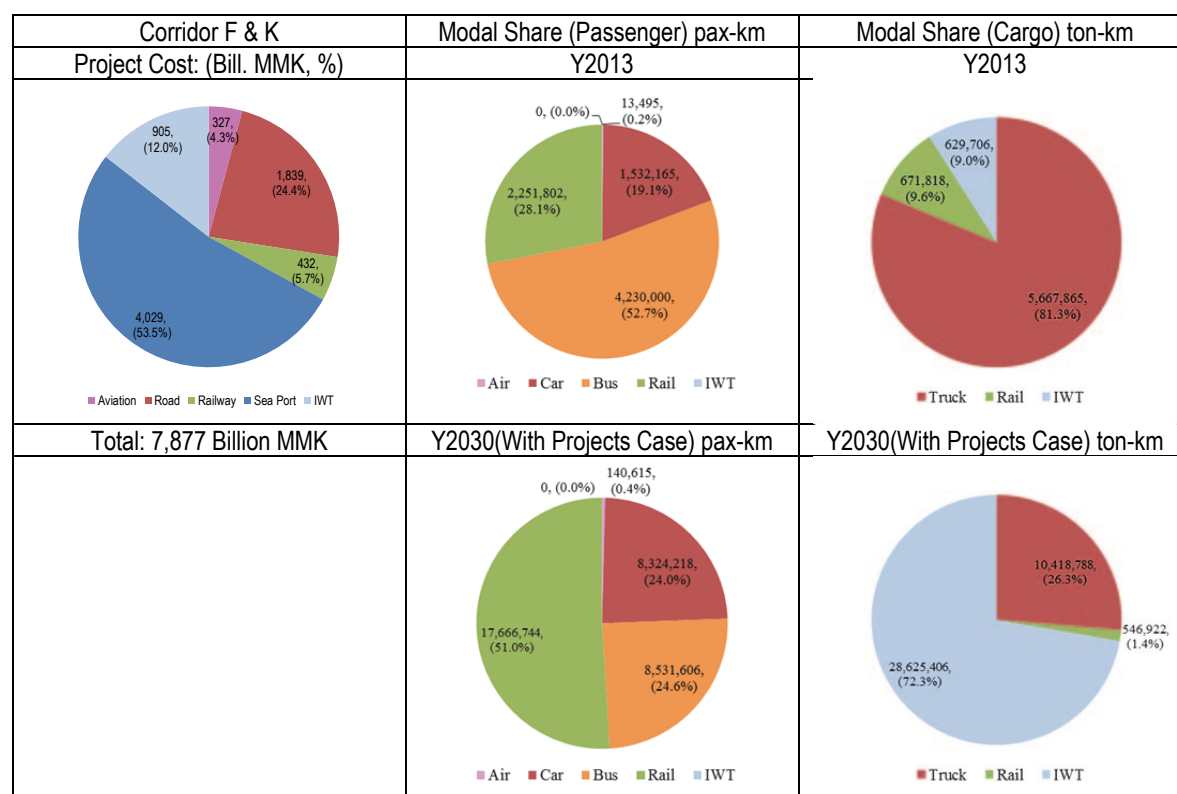
**Figure 10.18 Corridor-based Transport Infrastructure Development Plan  
– K. Western North-South Corridor (1/2)**





Source: JICA Study Team

**Figure 10.19 Corridor-based Transport Infrastructure Development Plan  
– K. Western North-South Corridor (2/2)**



**Figure 10.20 Proposed Project Cost and Modal Share – K. Western North-South Corridor**

## **H. Delta Area Network**

### **Socio-Economic Conditions, Transport Demands and Services of the Corridor**

In 2012, the Delta Area Network's population represented 21% of the national total and economic activities account for 27% of the nation's GDP. In 2013, the corridor saw 4.6 million passenger-kilometers of daily passenger traffic and 1.6 million ton-kilometers of daily freight traffic. These figures account for 2% of all freight traffic and 6% of all passengers transported for all corridors. The Delta Area's modal distribution for freight traffic is road (56%), rail (1%) and water transport (43%). The passenger distribution is bus (61%), car (24%) and rail (2%), and water transport (12%). In the future, corridor development will contribute to an increase in both freight (maximum of 8.9% p.a. from 2013 to 2030) and passenger (6.3% p.a. during the same period) traffic demand as future traffic demand reaches 12.7 million passenger-kilometers and 6.7 million ton-kilometers per day by 2030.

### **Proposed Infrastructure Project Component**

Given current corridor developments needs and demand data, and the proposed infrastructure and services for the transport corridor between the Yangon metropolitan area and the Delta area, the following development strategy is recommended for the Delta Area development.

- Provide a safe and reliable transport network and related services, as the primary corridor element
- Enable intermodal-modal transport between water and land transport

- Make efficient use of existing water transport routes
- IWT to play a vital role in providing the water transport services

Tables 10.17 and 10.18 and Figures 10.21 and 10.22 summarize selected projects that will achieve the above corridor development strategies along the Western Northern Corridor. These projects were developed using project assessments in ongoing transport studies.

**Table 10.17 Selected Priority Actions/Projects in the Delta Area**

	Road	Rail
Selected Priority Actions		
Infrastructure	<ul style="list-style-type: none"> <li>• Hinthada Bridge construction</li> <li>• Hlaing Bridge construction</li> <li>• Yangon – Patheingyi Road</li> <li>• etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Yangon – Patheingyi railway improvement</li> </ul>
Service	<ul style="list-style-type: none"> <li>• Improve highway truck services</li> </ul>	<ul style="list-style-type: none"> <li>• Intermodal transfer between rail and inland water transport</li> </ul>
	Inland water / maritime	Air
Selected Priority Actions		
Infrastructure	<ul style="list-style-type: none"> <li>• Procurement of new vessels</li> <li>• Connectivity improvement</li> <li>• River channel improvement</li> <li>• A series of river port improvements</li> <li>• Navigation safety improvement</li> </ul>	<ul style="list-style-type: none"> <li>• Patheingyi airport minor improvement</li> </ul>
Service	<ul style="list-style-type: none"> <li>• Improve passenger and freight transport service by new vessels (IWT)</li> </ul>	<ul style="list-style-type: none"> <li>• A series of navigation modernization such as IFR</li> </ul>

Note: IFR: instrument flight rules

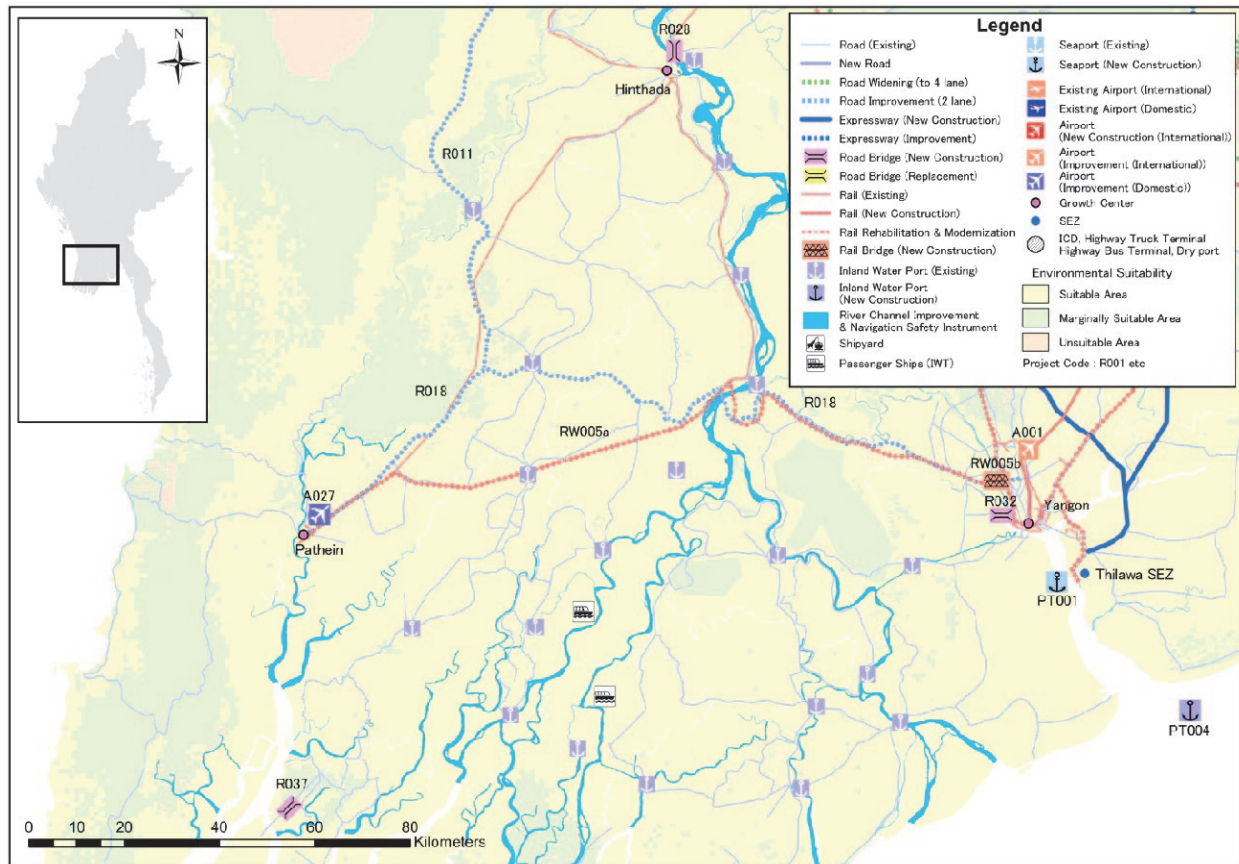
Source: JICA Study Team



**Table 10.18 List of Priority Projects along Delta Area Network**

Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
A1,B1,H1,K1	Aviation	A001	Yangon International Airport	195.0
H1	Aviation	A027	Patheingyi Airport	2.0
F1, H1	IWT	IW002	Yangon Port (Including Connectivity)	303.0
F1,H1	IWT	IW009	Yangon - Mandalay channel improvement	187.0
F1,H1	IWT	IW012	Ayeyarwady Delta channel improvement	54.0
F1,H1	IWT	IW015	Yangon - Mandalay Navigation safety improvement	20.0
F1,H1	IWT	IW018	Ayeyarwady Delta Navigation safety improvement	20.0
F1,H1	IWT	IW025	Ayeyarwady Delta IWT vessels	20.0
H1	Railway	RW005a	Yangon-Patheingyi	239.0
H1	Railway	RW005b	Bridge	29.0
D1,K1,H1	Road	R011	Monywa – Patheingyi Road	700.0
H1	Road	R018	Yangon – Patheingyi Road	124.0
H2	Road	R028	Hinthada Bridge	141.0
H1	Road	R032	Hlaing River Bridge	58.0
H1	Road	R037	Thetkale Thung Bridge	29.0
A1,B1,H1,K1	Sea Port	PT001	Yangon Port in Thilawa (Phase 1)	223.0
A1,B1,H1,K1	Sea Port	PT001a	Yangon Port in Thilawa (Phase 2)	554.0
A1,B1,H1,K1	Sea Port	PT001b	Yangon Port in Thilawa (Phase 3)	194.0
A1,B1,H1,K1	Sea Port	PT002	Yangon Port Capacity and Connectivity Improvement	205.0
A1,B1,H1,K1	Sea Port	PT003	Yangon Port in Thilawa (Post Thilawa)	485.0
A1,B1,H1,K1	Sea Port	PT004	Offshore Yangon River (Deep Seaport)	2,427.0
H1,H2,F1	Sea Port	PT009	Patheingyi Port	49.0
				6,258

Source: JICA Study Team



Source: JICA Study Team

**Figure 10.21 Corridor-based Transport Infrastructure Development Plan  
– H. Delta Area Network**

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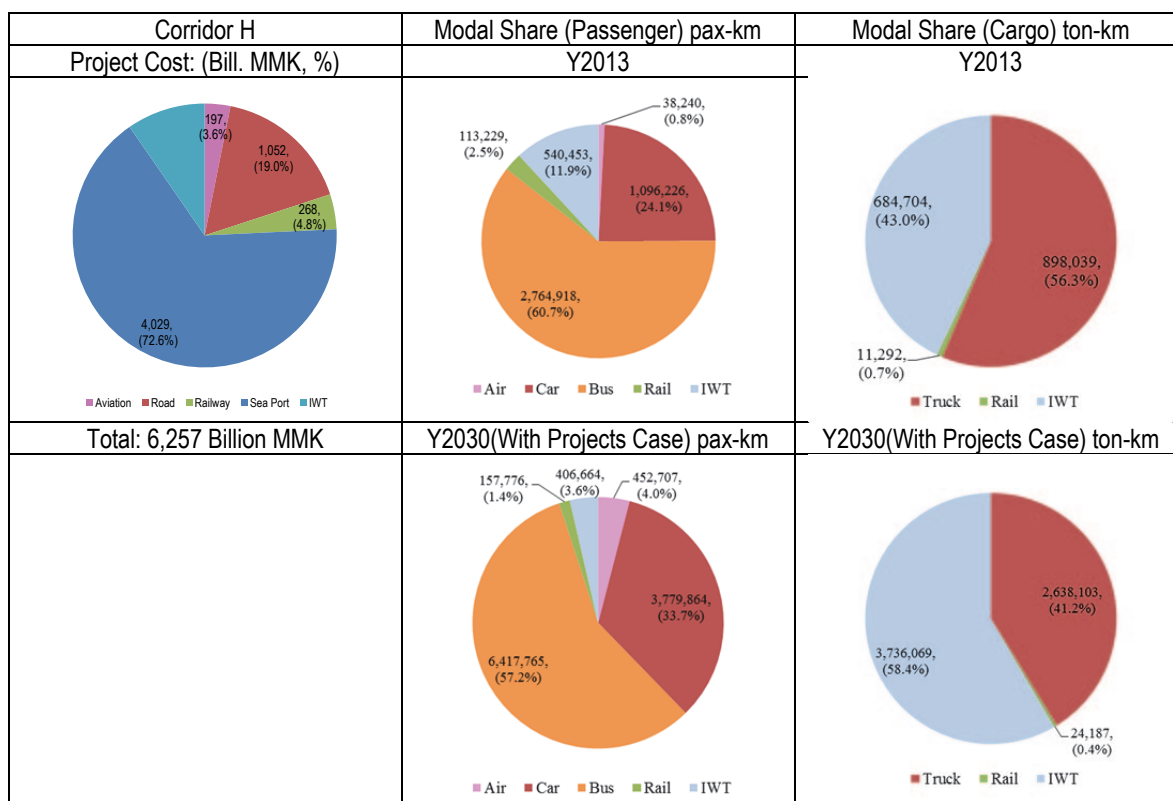


Figure 10.22 Proposed Project Cost and Modal Share – H. Delta Area Network

### **10.7.2 Proposed project component along other development corridors**

The following discussion summarizes the project components of other development corridors, listing the priority projects of the corridor.

#### **D. Mandalay - Tamu Corridor**

##### **Socio-Economic Condition, Transport Demand and Service of the Corridor**

In 2012, Mandalay-Tamu Corridor's population represented 14% of national total and economic activities accounted for 15% of national GDP; these figures are from Mandalay alone. In 2013, the corridor saw 3.0 million passenger-kilometers of daily passenger traffic and 1.4 million ton-kilometers of daily freight traffic. These figures account for 2% of all freight traffic and 2% of all passengers transported along the corridors. The modal share for the freight traffic is road (75%), rail (7%) and inland water transport (18%). The modal share for passenger traffic is bus (65%), car (22%) and rail (11%). The corridor development will contribute to an increase in both freight (6.7% p.a. from 2013 to 2030) and passenger (6.4% p.a. during the same period) traffic demand and the future traffic demand will reach 8.5 million passenger-kilometers and 5.4 million ton-kilometers per day by 2030.

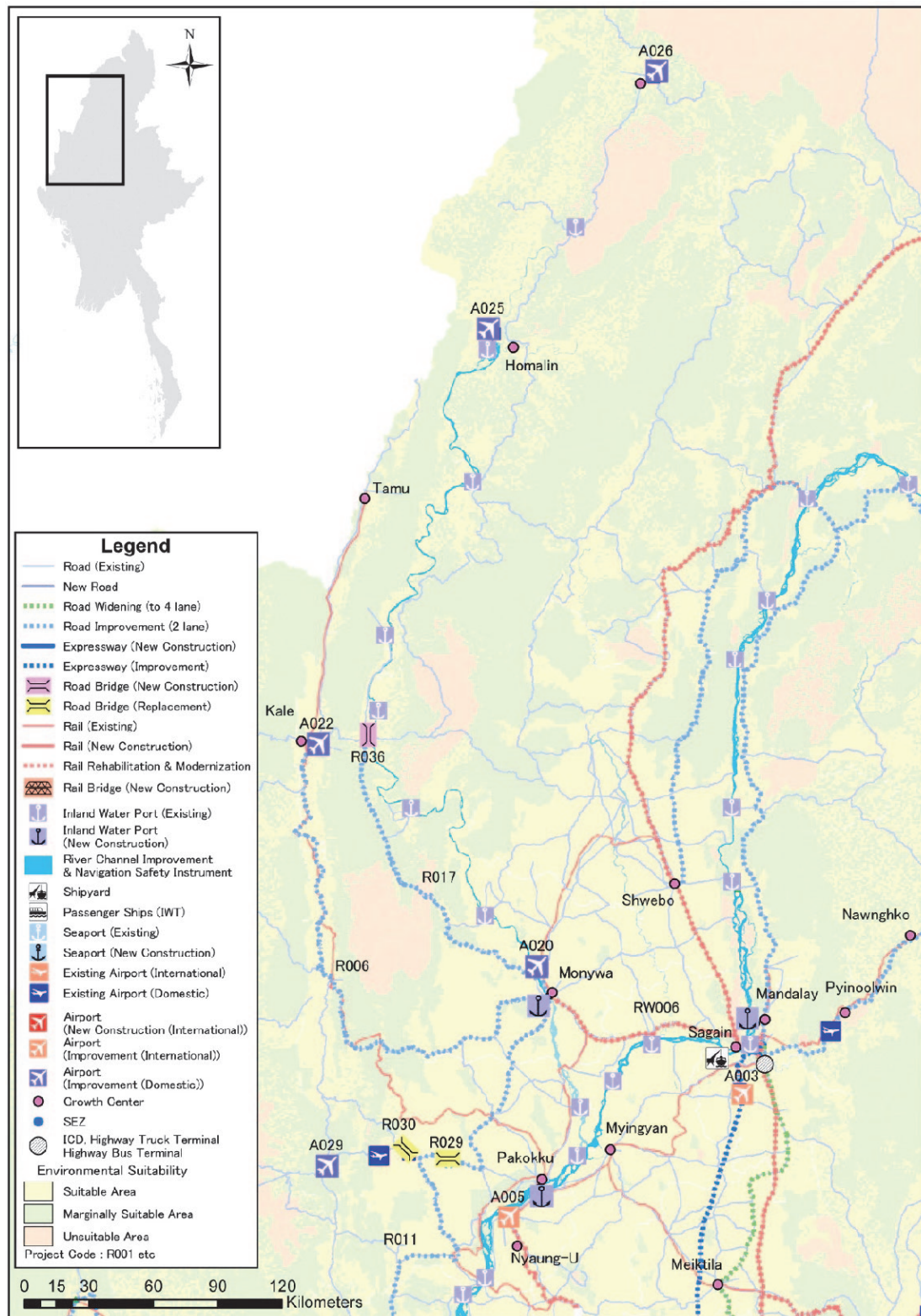
##### **Proposed Major Project Component**

Tables 10.19 and Figures 10.23 and 10.24 summarize a range of priority transport projects along the Mandalay - Tamu Corridor that will achieve the above corridor development strategies. These projects were developed using project assessments in ongoing transport studies.

**Table 10.19 List of Priority Projects along Mandalay – Tamu Corridor**

Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
A2,A3,C1,D1,K2	Aviation	A003	Mandalay International Airport	21.0
K2,D1	Aviation	A005	Nyaung U International Airport (Alt. Pakokku)	107.0
D1	Aviation	A020	Monywar Airport	7.0
D1	Aviation	A022	Kalay Airport	4.0
D1	Aviation	A025	Hommalin Airport	5.0
D1	Aviation	A026	Kanti Airport	5.0
K1,K2,D1	Aviation	A029	Kyauktu Airport	2.0
F1,F2	IWT	IW001	Mandalay Port	123.0
F2	IWT	IW006	Monywa Port	21.0
F2	IWT	IW007	Kalewa Port	21.0
F2	IWT	IW011	Monywa - Upstream channel improvement	36.0
F2	IWT	IW017	Monywa - Upstream Navigation safety improvement	20.0
D1	Railway	RW006	Myohaung-Monywa	128.0
D1	Road	R006	Monywa - Pale - Gangaw – Kalaymyo Road	302.0
D1,K1,H1	Road	R011	Monywa – Pathein Road	700.0
D1	Road	R017	Monywa – Yargyi – Kalewa Road	181.0
D1	Road	R029	Yaw Chaung (Yepyay) Bridge	39.0
D1	Road	R030	Yaw Chaung (Ohn Taw) Bridge	29.0
D1	Road	R036	Chindwin (Kalaywa) Bridge	23.0
				1,774

Source: JICA Study Team



Source: JICA Study Team

**Figure 10.23 Corridor-based Transport Infrastructure Development Plan  
– D. Mandalay-Tamu Corridor**



Final Report

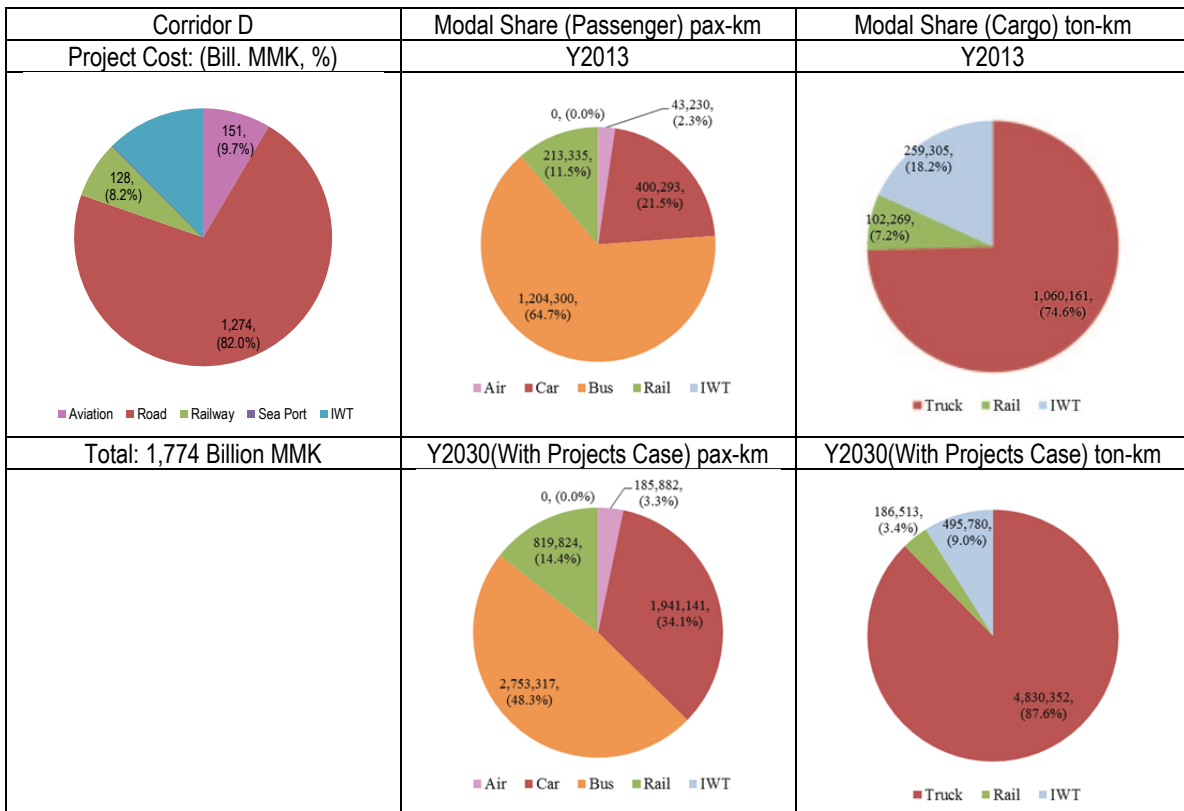


Figure 10.24 Proposed Project Cost and Modal Share – D. Mandalay-Tamu Corridor

### E. Second East - West Corridor

#### Socio-Economic Conditions, Transport Demand and Services of the Corridor

In 2012, the Second East - West Corridor population represented 17% of the national total and economic activities accounted for 15% of the nation's GDP. In 2013, the corridor saw 4.1 million passenger-kilometers of daily passenger traffic and 2.4 million ton-kilometers of daily freight traffic. These figures account for 3% of all freight traffic and 6% of all passenger transported for all corridors. The modal distribution for freight is: road (97%) and rail (3%), and the passenger distribution is: bus (58%), car (26%), rail (10%) and air (5%). The corridor development will contribute to an increase in both freight (6.8% p.a. from 2013 to 2030) and passenger (7.2% p.a. during the same period) traffic demand and the future traffic demand will reach 13 million passenger-kilometers and 9.9 million ton-kilometers per day by 2030.

#### Proposed Major Project Component

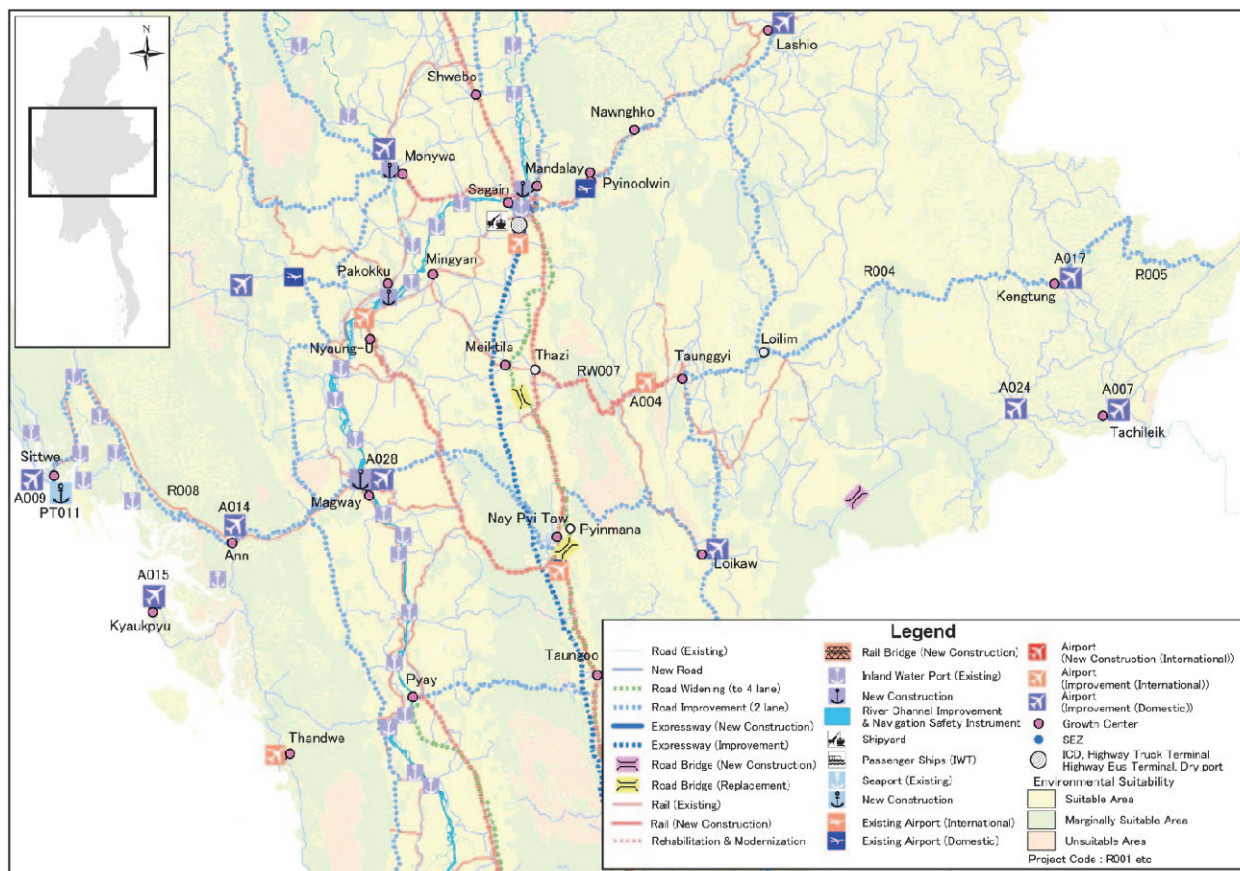
Table 10.20 and Figure 10.25 and 10.26 summarize a range of priority transport projects along the Second East - West Corridor.

**Table 10.20 List of Priority Projects along Second East - West Corridor**

Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
E1,L2	Aviation	A004	Heho International Airport	146.0
E1	Aviation	A007	Tachileik Airport (major domestic)	76.0
E1	Aviation	A009	Sittwe Airport (major domestic)	21.0
E1	Aviation	A014	Ann Airport	7.0
E1	Aviation	A015	Kyaukphyu Airport	8.0
E1	Aviation	A017	Kengtung Airport	5.0
E1	Aviation	A024	Mong-Hsat Airport	2.0
E1,G2,K1,K2	Aviation	A028	Magway Airport	2.0
E1	Railway	RW007	Pyawbwe-Shwenyaung	386.0
E1	Road	R004	Taunggyi – Loilim – Kyaington Road	658.0
E1	Road	R005	Kyaington – Mongla Road	90.0
E1	Road	R008	Minbu – Ann – Kyauktaw – Sittwe Road	463.0
E1	Sea Port	PT011	Sittwe Port	209.0
				2,073

Source: JICA Study Team





Source: JICA Study Team

**Figure 10.25 Corridor-based Transport Infrastructure Development Plan  
– E. Second East-West Corridor**

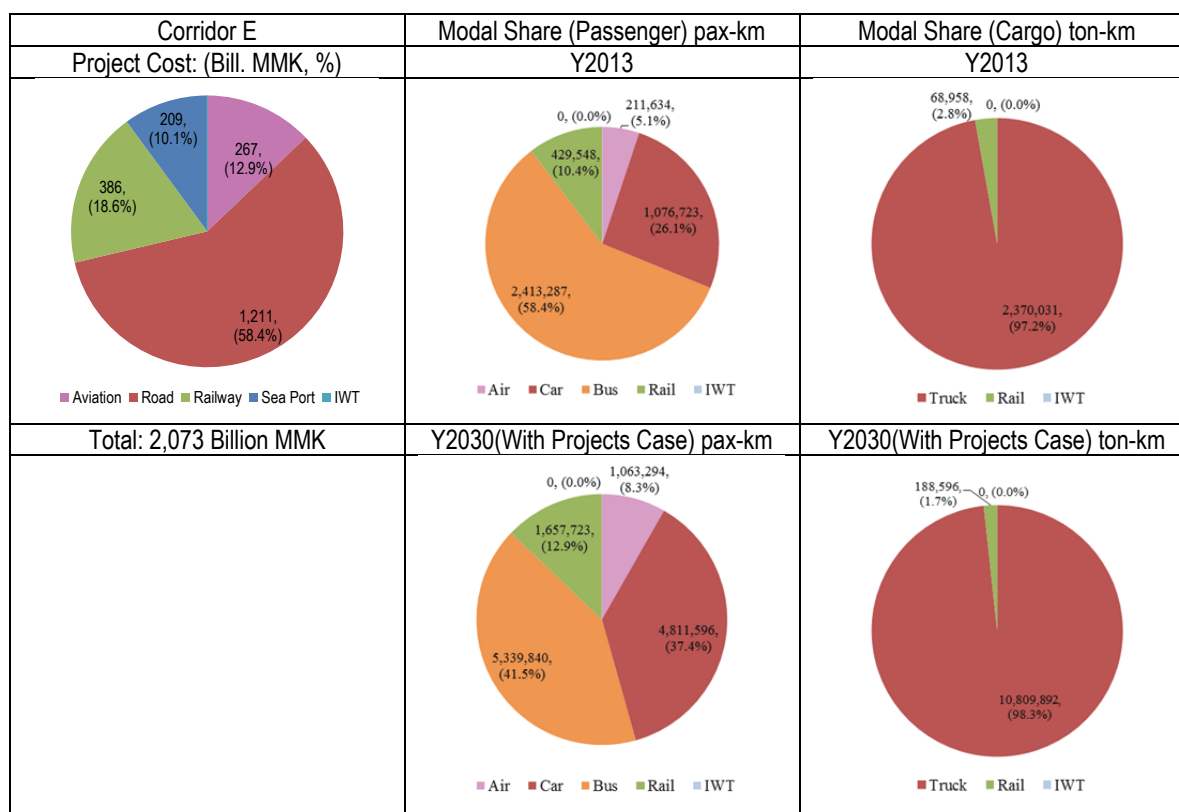


Figure 10.26 Proposed Project Cost and Modal Share – E. Second East-West Corridor

### G. East - West Bridging Corridor

#### Socio-Economic Conditions, Transport Demands and Services of the Corridor

In 2012, the East-West Bridging Corridor's population represented 12% of the national total and economic activities accounted for 11% of the nation's GDP. In 2013, the corridor saw 2.1 million passenger-kilometers of daily passenger traffic and 1.1 million ton-kilometers of daily freight traffic. These figures account for 1% of all freight traffic and 3% of all passengers transported for all corridors. The corridor's freight traffic relies on roads for 100% of its freight transport, and the modal distribution for passenger traffic is bus (38%), car (17%) and rail (45%). The corridor development will contribute to an increase in both freight (maximum of 6.9% p.a. from 2013 to 2030) and passenger (7.8% p.a. during the same period) traffic demand and the future traffic demand will reach 7.5 million passenger-kilometers and 3.1 million ton-kilometers per day by 2030.

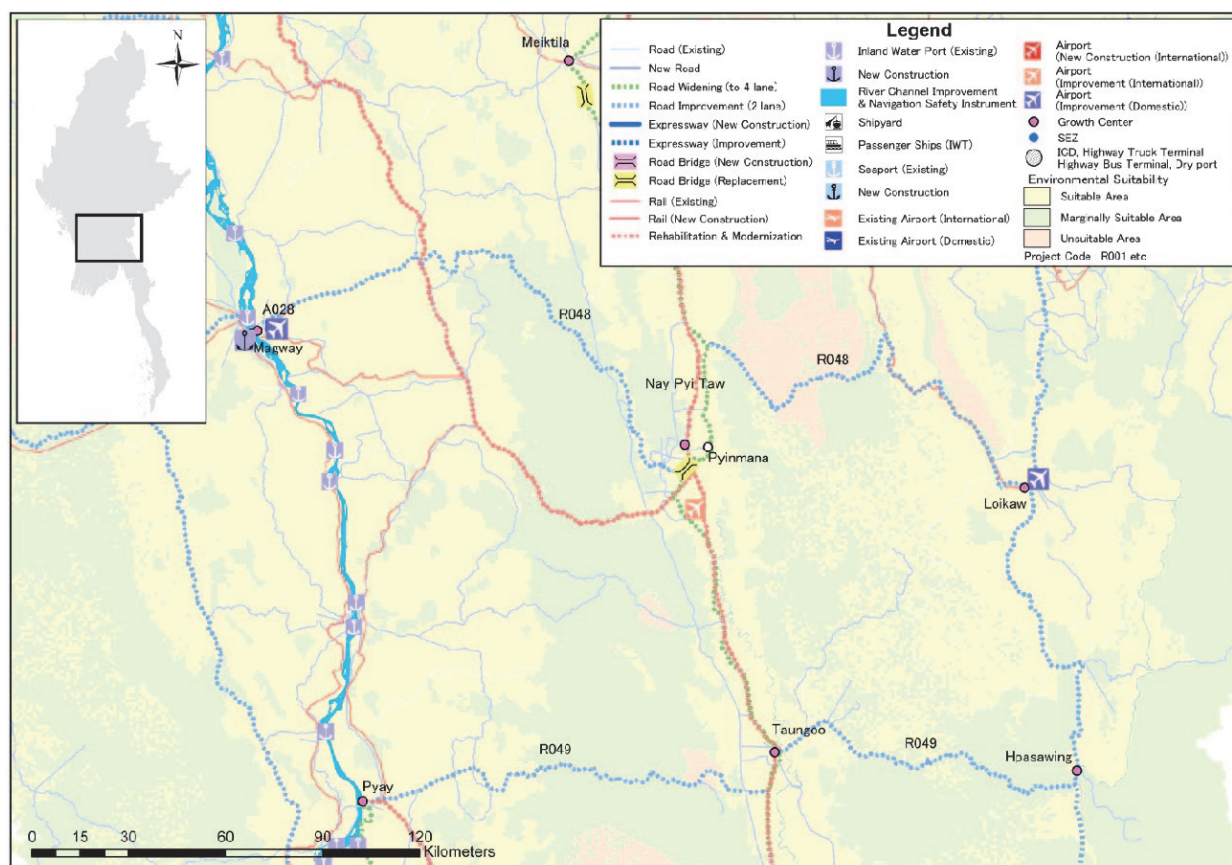
#### Proposed Project Component

Table 10.21 and Figure 10.27 and 10.28 summarize a range of priority transport projects along the East - West Bridging Corridor.

**Table 10.21 List of Priority Projects along East - West Bridging Corridor**

Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
E1,G2,L1,L2	Aviation	A019	Loikaw Airport	7.0
E1,G2,K1,K2	Aviation	A028	Magway Airport	2.0
G2	Road	R048	Loikaw - Magway Road	363.0
G1	Road	R049	Hapasawing - Pyay Road	283.0
				655

Source: JICA Study Team



Source: JICA Study Team

**Figure 10.27 Corridor-based Transport Infrastructure Development Plan  
– G. East-West Bridging Corridor**

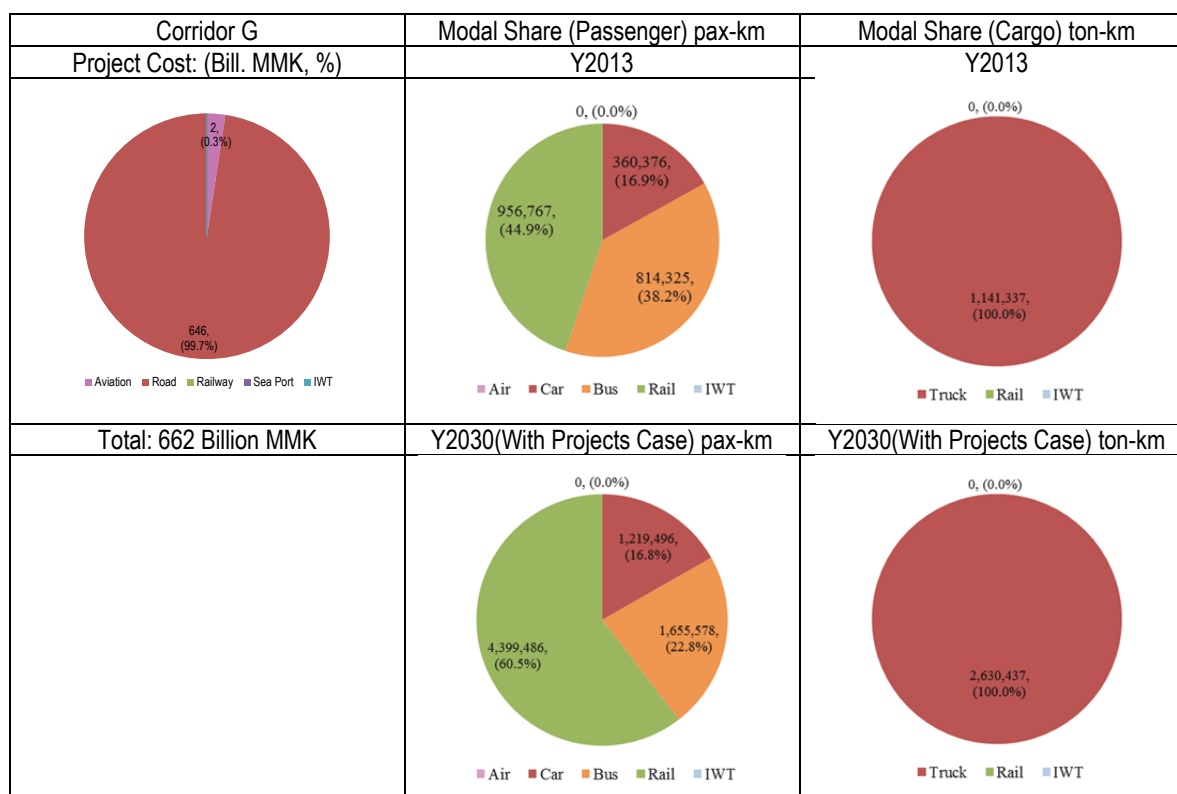


Figure 10.28 Proposed Project Cost and Modal Share – G. East-West Bridging Corridor

## J. Southern Area Development Corridor

### Socio-Economic Conditions, Transport Demands and Services of the Corridor

In 2012, the Southern Area Development Corridor's population accounted for 8% of the national total and economic activities represented 8% of the nation's GDP. In 2013, the corridor saw 0.9 million passenger-kilometers of daily passenger traffic and 0.1 million ton-kilometers of daily freight traffic. These figures account for less than 1% of all freight traffic and 1% of all passengers transported for all corridors. The corridor's freight traffic relies on roads for 100% of its freight transport. The corridor development will contribute to an increase in both freight (maximum of 10.0% p.a. from 2013 to 2030) and passenger (5.3% p.a. during the same period) traffic demand and the future traffic demand will reach 2.2 million passenger-kilometers and 0.4 million ton-kilometers per day by 2030.

### Proposed Major Project Component

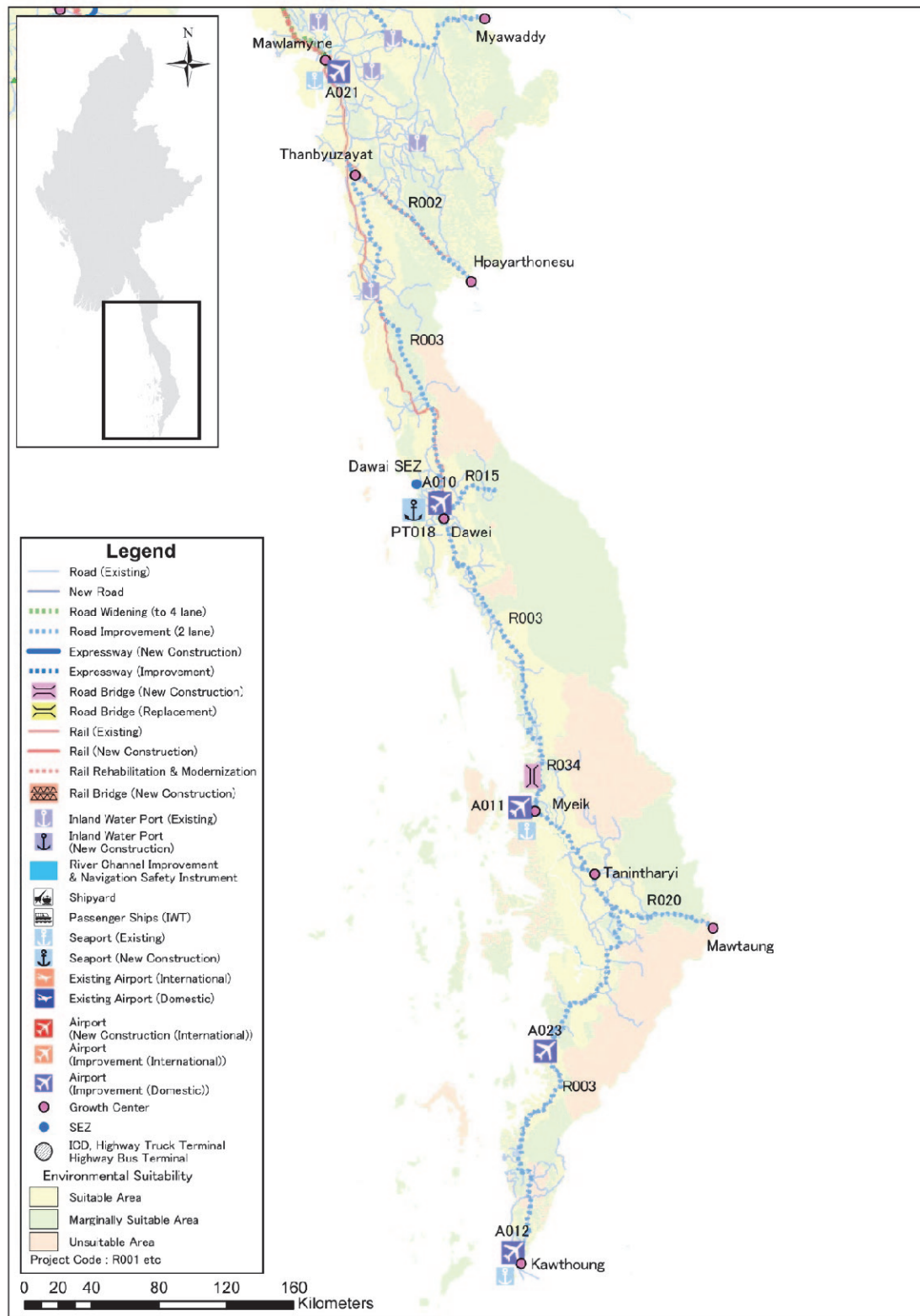
Table 10.22 and Figures 10.29 and 10.30 summarize a range of priority transport projects along the Southern Area Development Corridor.

**Table 10.22 List of Priority Projects along Southern Area Development Corridor**

Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
B2,J2,J3	Aviation	A010	Dawei Airport (major domestic)	37.0
J2,J3	Aviation	A011	Myeik Airport (major domestic)	45.0
J3	Aviation	A012	Kawthoung Airport	9.0
B1,B2,J1	Aviation	A021	Mawlamyine Airport	2.0
J3	Aviation	A023	Bokpyinn Airport	7.0
J1	Road	R002	Three Pagoda Pass	101.0
B2,J3	Road	R003	Thanbyuzayat – Dawei – Myeik – Kawthoung Road	907.0
J2	Road	R015	Dawei – Phunamron Road	128.0
J3	Road	R020	Tanintharyi – Mawtaung Road	107.0
J3	Road	R034	Tha Mouk Bridge	14.0
B1,B2, J1	Sea Port	PT008	Mawlamyaing Port	49.0
B2, J2, J3	Sea Port	PT006	Dawai Port	2,000.0
				3,406

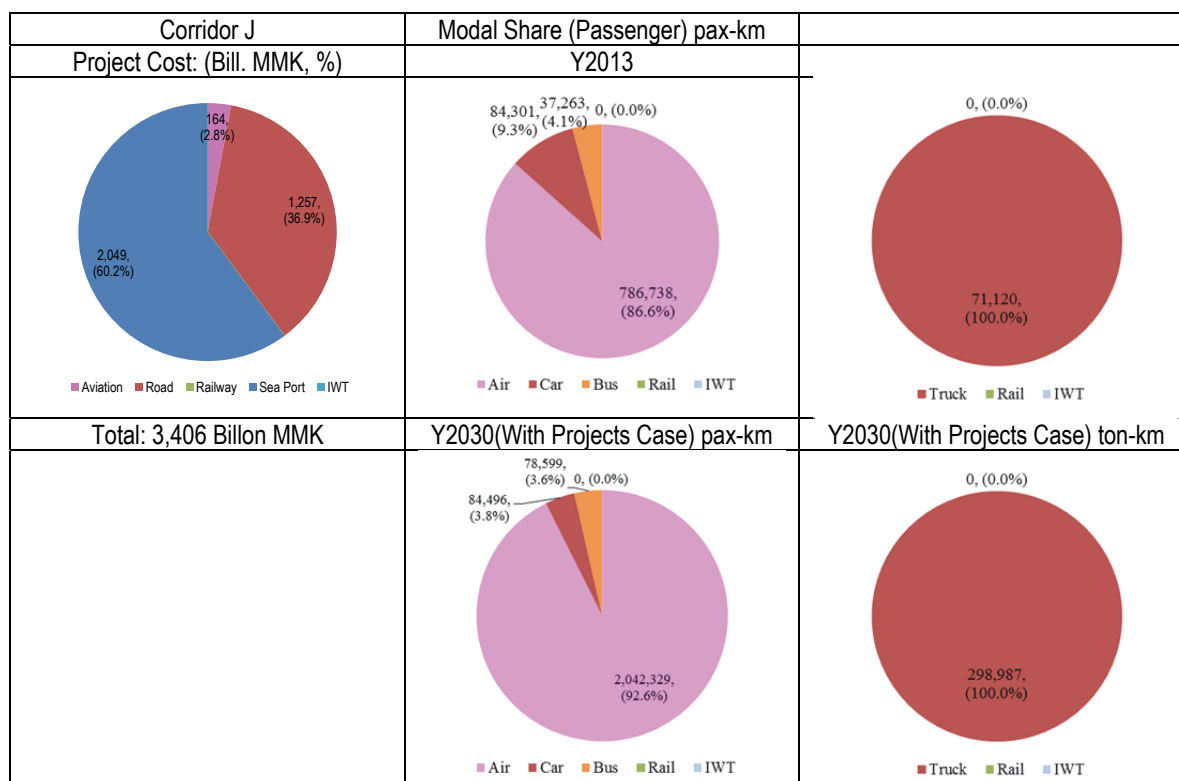
Source: JICA Study Team





Source: JICA Study Team

**Figure 10.29 Corridor-based Transport Infrastructure Development Plan  
– J. Southern Area Development Corridor**



**Figure 10.30 Proposed Project Cost and Modal Share  
– J. Southern Area Development Corridor**

### **L. Eastern North - South Corridor**

#### **Socio- economic Condition, Transport Demand and Service of the Corridor**

In 2012, the Eastern North - South Corridor's population accounted for 12% of the national total and economic activities represented 9% of the nation's GDP. In 2013, the corridor saw 0.2 million passenger-kilometers of daily passenger traffic and 0.3 million ton-kilometers of daily freight traffic. These figures account for less than 1% of all freight traffic and 1% of all passengers transported for all corridors. The modal distribution of freight traffic is road (99%) and rail (1%). The corridor development will contribute to an increase in both freight (maximum of 7.2% p.a. from 2013 to 2030) and passenger (4.6% p.a. during the same period) traffic demand and the future traffic demand will reach 0.5 million passenger-kilometers and 0.3 million ton-kilometers per day by 2030.

#### **Proposed Project Component**

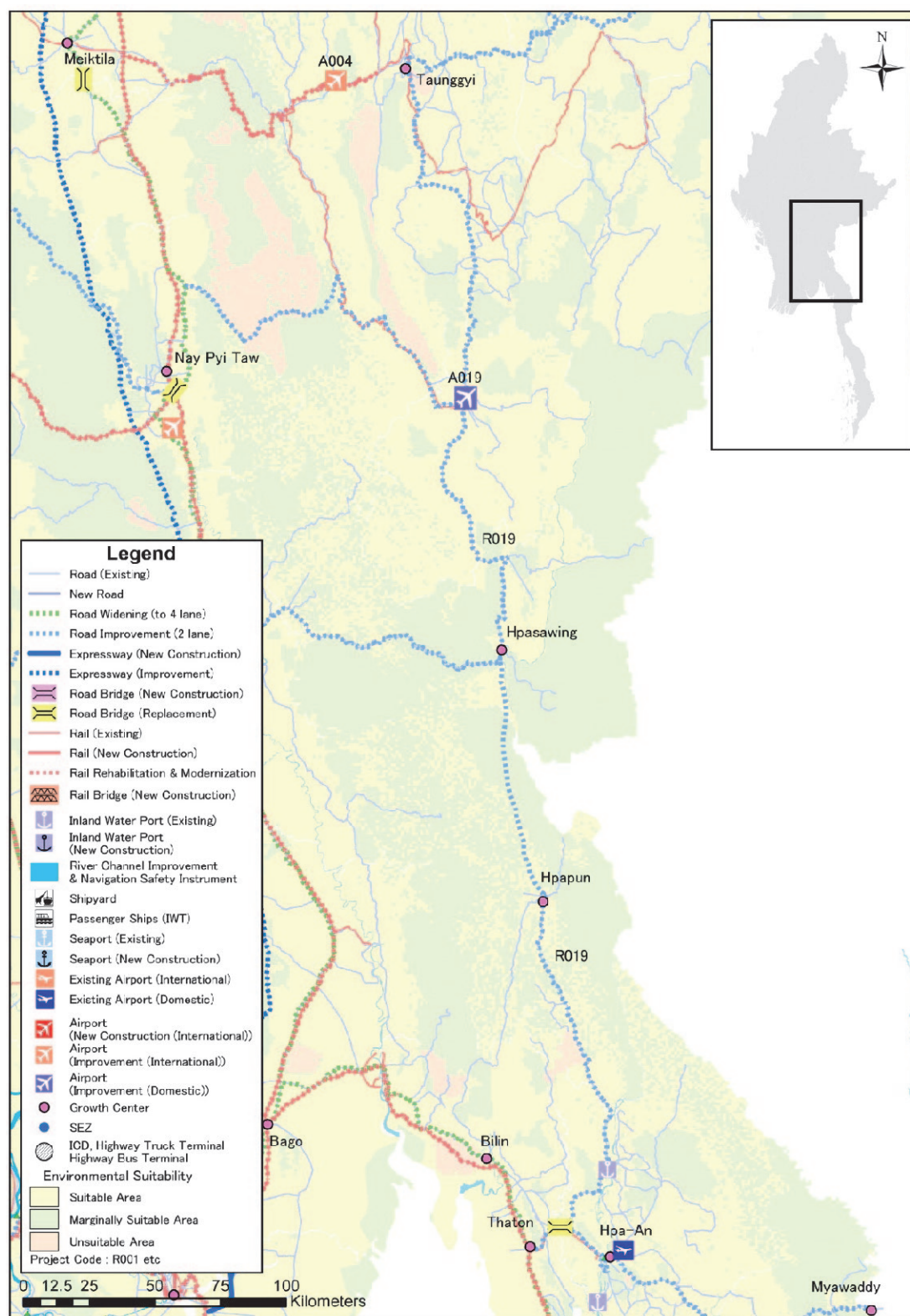
Table 10.23 and Figures 10.31 to 10.33 summarize a range of priority transport projects along the Eastern North - South Corridor.

**Table 10.23 List of Priority Projects along the Eastern North - South Corridor**

Corridor	Sector	Project ID	Project	Total Project Cost (Bil. MMK)
E1,L2	Aviation	A004	Heho International Airport	146.0
E1,G2,L1,L2	Aviation	A019	Loikaw Airport	7.0
L2	Road	R014	Thibaw – Loilem Road	232.0
L1	Road	R019	Taunggyi – Loikaw – Hpapun – Pha an Road	660.0
				1,045

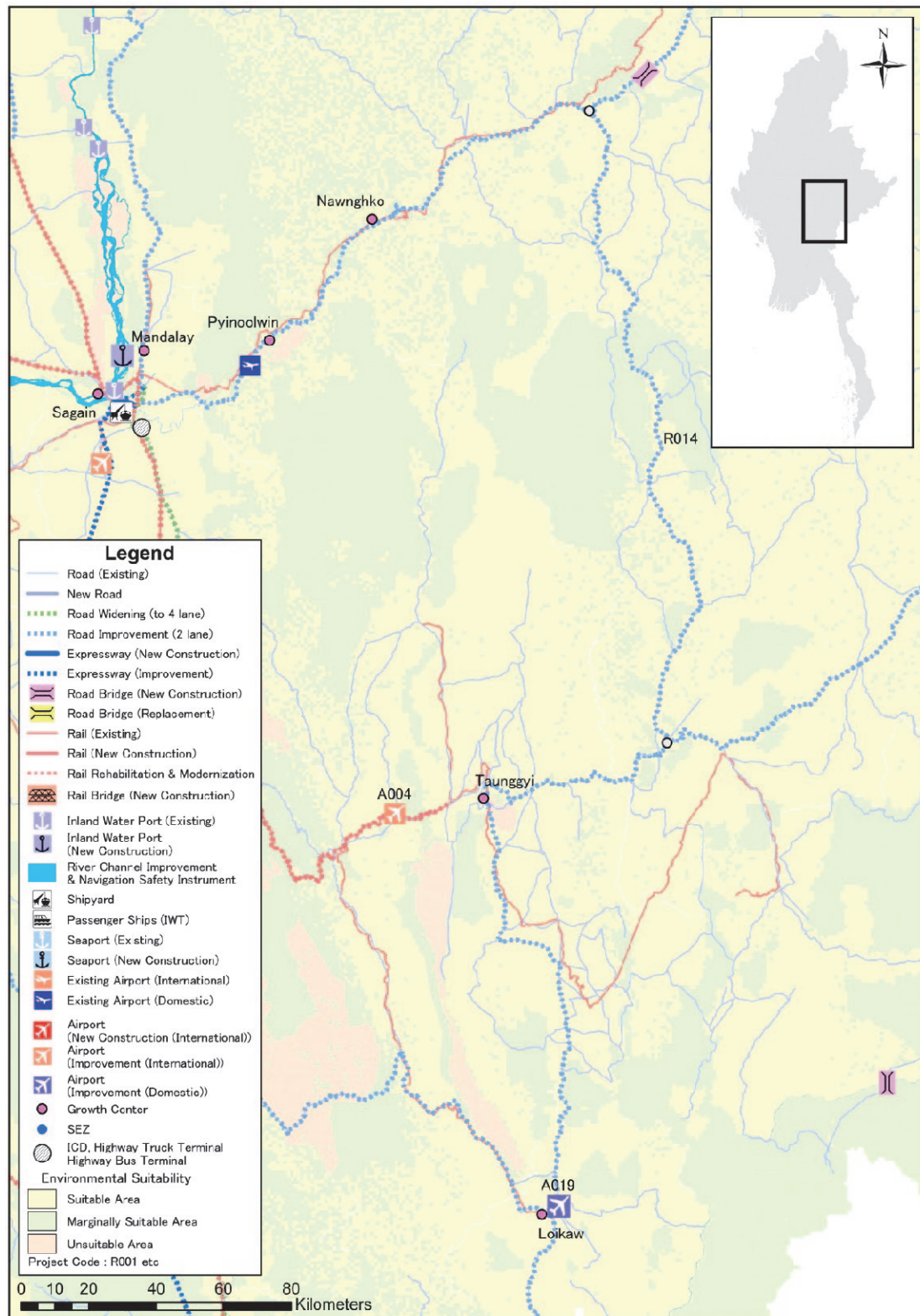
Source: JICA Study Team





Source: JICA Study Team

**Figure 10.31 Corridor-based Transport Infrastructure Development Plan  
– L. Eastern North - South Corridor (1/2)**



Source: JICA Study Team

**Figure 10.32 Corridor-based Transport Infrastructure Development Plan  
– L. Eastern North - South Corridor (2/2)**

Final Report

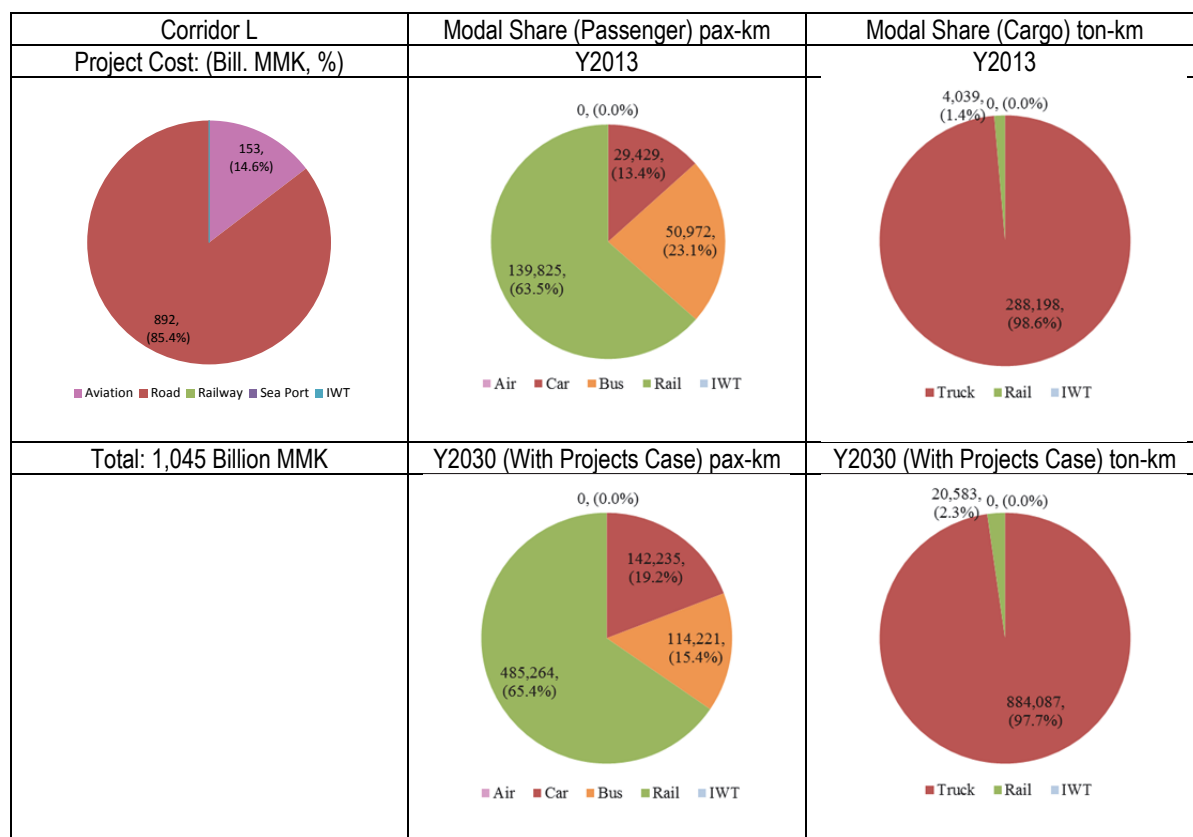


Figure 10.33 Proposed Project Cost and Modal Share – L. Eastern North - South Corridor

## Chapter 11 Implementation Plan

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### 11.1 Introduction

This Chapter summarizes priority investments in the transport sector over the next fifteen years (until 2030) and includes recommended actions to implement the MYT-Plan.

While many of these investments may be implemented within the next five years, several are high priority actions that, if not acted upon very soon, would mean that Myanmar will miss opportunities to stimulate domestic growth, either by not taking advantage of favorable trade agreements with neighboring countries or by failing to catalyze domestic growth opportunities.

As well, these initiatives must be supported by capable and well-resourced government stakeholders, at the national level and state/region levels. Ministries and Departments will require improved capacity to plan and implement coordinated activities. A framework for this type of support is described in this Chapter, both to implement the short-term investments as well as to launch studies for longer-term capacity activities.

### 11.2 Implementation Plan

As discussed in Chapter 10, corridor-based transport projects are based on analysis that includes three frameworks, namely: financial, environmental and special.

Implementation of these projects will require two programs: a six year nationally-focused plan (2014/2015 to 2020) and a ten-year balanced national and urban/rural plan (2021 to 2030). Due to the intensity of the projects, especially during the six-year program, a number of related investments and “soft components” should be made, including:

- Prioritize strategic infrastructure development and asset maintenance and management
  - Identify key capacity building requirements in the public sector, at the national and state/regional levels
  - Calculate detailed capital costs for all elements of programs, including air, road, rail, seaport and inland water; see Table 11.1 for a preliminary cost breakdown summary
  - Identify needed policy changes to improve sector regulation and technical guidelines
  - Identify strategies to encourage new partnerships and investment with aid agencies, the private sector and regional bodies like the Association of Southeast Asian Nations (ASEAN)
  - Identify important industry investments that will help sustain the improved transport sector
  - Develop a communications plan to describe a business case for sector development and outreach/promotional materials to present the value of these projects and spin off benefits to investors. This must confirm the financial feasibility of projects and
-

prioritize them, according to their economic, social and environmental outcomes

- Identify needed environmental assessment analysis for each initiative within the programs

### 11.3 Overall Capital Investment

The MYT-Plan analysis concludes that 48 trillion Kyat of Gross Fixed Capital Formation (GFCF) will be required to fund the needed transport sector investments, through to 2030, as described in Chapter 2 of this Report. This investment is allocated to two programs: 1) a five-year program (2014 – 2020) that will see 87% of the program funding for national-level transport systems; and 2) a ten-year program (2020 – 2030) that includes an investment allocation (pattern) that is “well-balanced” between national systems and urban/rural systems.

The five-year program (2014 – 2020) will cost 11.678 trillion Kyat and the program focus is on national systems, hence 10.144 trillion Kyat (87%) is designated to national level trunk and related infrastructure while 1.53 trillion Kyat (13%) is slated for urban/rural transport systems. The ten-year plan (2020 – 2030) will cost 36.390 trillion Kyat and will invest 16.544 trillion Kyat (45%) in trunk transport systems to encourage economic activities in other industrial and 19.85 trillion Kyat (55%) to increase quality of life of the nations through investment to the urban and rural transport systems. Table 11.1 illustrates the investment in national level transport systems against transport sector capital formation.

**Table 11.1 Gross Fixed Capital Formation in the Transport Sector and the Investment to the National Level Transport Systems**

Unit: Billion Kyat at 2013 constant prices

	2014-2020	2020-2030	2014-2030
Investment in the national level transport systems	10,144	16,544	26,688
	87%	45%	56%
Transport Sector Capital Formation	11,678	36,390	48,068

Source: JICA Study Team

Tables 11.1 through 11.3 and Figure 11.1 identify projects by transportation sector within the two program timeframes. While some infrastructure projects will be implemented within five years, most of the projects will be completed between 2020 and 2030.

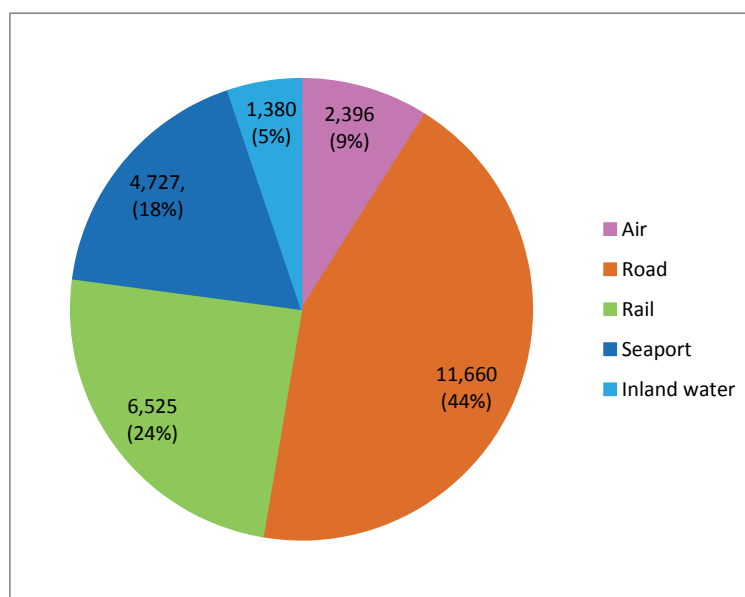
**Table 11.2 Summary of the Proposed Investment by Sectors**

Unit: Billion Kyat at 2013 constant prices

Sector	Investment				2014 - 2030 (Bil. MMK)	2014 - 2030 + over 2030 (Bil. MMK)
	- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030		
Air	319	1,155	922	0	2,396	2,396
Road	588	2,788	8,285	2	11,660	11,662
Rail	327	1,994	4,204	413	6,525	6,938
Seaport	501	1,872	2,354	1,796	4,727	6,523
Inland water	39	562	779	372	1,380	1,752
Total	1,774	8,371	16,544	2,582	26,688	29,271

**Table 11.3 Summary of the Proposed Investment by Sectors (% of Total Project Cost)**

Sector	Investment				2014 - 2030 (Bil. MMK)	2014 - 2030 + over 2030 (Bil. MMK)
	- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030		
Air	18%	14%	6%	0%	9%	8%
Road	33%	33%	50%	0%	44%	40%
Rail	18%	24%	25%	16%	24%	24%
Seaport	28%	22%	14%	70%	18%	22%
Inland water	2%	7%	5%	14%	5%	6%
Total	100%	100%	100%	100%	100%	100%



Source: JICA Study Team

**Figure 11.1 Investment by transport sub-sector  
between 2013 and 2030 (billion MMK at 2013 constant process)**



Table 11.4 Investment Program (Air Sector)

Sector	Corridor	Project ID	Project	Implementation Schedule																				Budget				Total	Contents							
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037		2038	2039	2040	- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030
Aviation	A1,B1,H1,K 1	A001	Yangon International Airport																												49.0	146.0	0.0	0.0	195.0	Improvement by PPP concessionaire On-going
	A1,B1	A002	Hanthawaddy International Airport																												263.0	439.0	701.0	0.0	1,403.0	Construction by PPP concessionaire
	A2,A3,C1,D 1,K2	A003	Mandalay International Airport																												0.0	21.0	0.0	0.0	21.0	Improvement by PPP concessionaire
	E1,L2	A004	Heho International Airport																												0.0	119.0	27.0	0.0	146.0	Runway pavement, TWY, PTB, Apron, Control Tower, Administration building, AGL, Rescue and Fire-fighting, Utilities
	K2,D1	A005	Nyaung U International Airport (Alt. Pakokku)																												0.0	88.0	19.0	0.0	107.0	Runway pavement, TWY, PTB, Apron, Control Tower, Administration building, AGL, Rescue and Fire-fighting, Utilities
	Other	A006	Thandwe International Airport																												0.0	46.0	11.0	0.0	57.0	Runway pavement, TWY, PTB, Apron, Control Tower, Administration building, AGL, Rescue and Fire-fighting, Utilities
	E1	A007	Tachileik Airport (major domestic)																												0.0	54.0	22.0	0.0	76.0	Runway, PTB, Apron, TWY, RWY Renewal of PAPI, SALS
	A3	A008	Myitkyina Airport (major domestic)																												0.0	17.0	7.0	0.0	24.0	Installation of PAPI, SALS Expansion of PTB, Renewal of RWY, TWY, Apron Lights
	E1	A009	Sittwe Airport (major domestic)																												0.0	15.0	6.0	0.0	21.0	Extension of runway and apron, fire-fighting, renewal of SALS/PAPI/TWY/Apron lights
	B2,J2,J3	A010	Dawei Airport (major domestic)																												0.0	26.0	11.0	0.0	37.0	Relocation of apron, TWY, fire-fighting engine, expansion of apron, renewal of RWY lights
	J2,J3	A011	Myeik Airport (major domestic)																												0.0	32.0	13.0	0.0	45.0	Expansion of Apron and PTB Renewal of PAPI, RWY, TWY, Apron Lights
	J3	A012	Kawthoung Airport																												0.0	6.0	3.0	0.0	9.0	PTB. Apron, Taxiway
	Other	A013	Putao Airport																												0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway
	E1	A014	Ann Airport																												0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, SALS
	E1	A015	Kyaukphyu Airport																												0.0	6.0	2.0	0.0	8.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	C1	A016	Lashio Airport																												0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, SALS
	E1	A017	Kengtung Airport																												0.0	4.0	1.0	0.0	5.0	PTB. Apron, Taxiway
	A3	A018	Bhamo Airport																												0.0	6.0	3.0	0.0	9.0	PTB. Apron, Taxiway
	E1,G2,L1,L 2	A019	Loikaw Airport																												0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	D1	A020	Monywar Airport																												0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	B1,B2,J1	A021	Mawlamyine Airport																												0.0	1.0	1.0	0.0	2.0	Minor improvement
	D1	A022	Kalay Airport																												0.0	3.0	1.0	0.0	4.0	PTB. Apron, Taxiway SALS
	J3	A023	Bokpyinn Airport																												0.0	5.0	2.0	0.0	7.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	E1	A024	Mong-Hsat Airport																												0.0	1.0	1.0	0.0	2.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	D1	A025	Hommalin Airport																												0.0	4.0	1.0	0.0	5.0	PAPI, RTIL, SALS
	D1	A026	Kanti Airport																												0.0	4.0	1.0	0.0	5.0	PTB. Apron, Taxiway PAPI, RTIL, SALS
	H1	A027	Pathein Airport																												0.0	1.0	1.0	0.0	2.0	Minor improvement
	E1,G2,K1,K 2	A028	Magway Airport																												0.0	1.0	1.0	0.0	2.0	Minor improvement
	K1,K2,D1	A029	Kyauktu Airport																												0.0	1.0	1.0	0.0	2.0	PAPI, RTIL, SALS
	Other	A030	Coco Island Airport																												0.0	1.0	1.0	0.0	2.0	PAPI, RTIL, SALS
	Common	A031	Soft Component																												5.0	80.0	75.0	0.0	160.0	A series of projects for improvement of CNS/ATM systems (refer to the technical note on the aviation sector)
	Common	A032	Soft Component																												2.0	3.0	0.0	0.0	5.0	A series of TA and other actions for DCA reorganization (refer to the technical note on the aviation sector)
Total																														319	1,155	922	0	2,396		
Projects in the first priority corridor																																				
Projects outside the priority corridor, but of higher priority (projects in the regional centers, etc.)																																				
Projects in the second priority corridor																																				

Table 11.5 Investment Program (Road Sector)

Table 11.3 Investment Program (Road Sector)																																							
Sector	Corridor	Project ID	Project	Implementation Schedule																	Budget				Total Project Cost (Bil. MMK)	Contents													
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033			2034	2035	2036	2037	2038	2039	2040	- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030		
Road	B1	R001	Thaton – Eindu – Kawkaeik – Myawaddy Road																													0.0	192.0	0.0	0.0	192.0	L: 198km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	J1	R002	Three Pagoda Pass																													0.0	101.0	0.0	0.0	101.0	L: 104km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	B2,J3	R003	Thanbyuzayat – Dawei – Myeik – Kawthong Road																													0.0	907.0	0.0	0.0	907.0	L: 934km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	E1	R004	Taunggyi – Loilim – Kyaington Road																													110.0	548.0	0.0	0.0	658.0	L: 677km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	E1	R005	Kyaington – Mongla Road																													0.0	90.0	0.0	0.0	90.0	L: 93km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	D1	R006	Monywa - Pale - Gangaw – Kalaymyo Road																													0.0	0.0	302.0	0.0	302.0	L: 311km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	A3	R007	Shwebo – Myitkyina Road																													0.0	0.0	462.0	0.0	462.0	L: 476km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	E1	R008	Minbu – Ann – Kyauktaw – Sittwe Road																													0.0	0.0	463.0	0.0	463.0	L: 477km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	A1, A2	R009a	Bago – Mandalay Road																													0.0	0.0	880.0	0.0	880.0	L: 604km, 4-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	A1, A2	R009b	Yangon (from toll gate) - Bago Road																													0.0	0.0	84.0	0.0	84.0	L: 50 km, 4-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	K1	R010	Yangon – Pyay - Mandalay Road																													0.0	0.0	1,139.0	0.0	1,139.0	L: 782km, 4-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	D1,K1,H1	R011	Monywa – Patheingyi Road																													0.0	0.0	700.0	0.0	700.0	L: 721km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	C1	R012	Mandalay – Lashio – Muse Road																													0.0	0.0	440.0	0.0	440.0	L: 459km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	A3	R013	Mandalay – Thabeikkyin – Tagaung – Bhamo Road																													0.0	0.0	274.0	0.0	274.0	L: 282km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	L2	R014	Thibaw – Loilem Road																													0.0	0.0	232.0	0.0	232.0	L: 239km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	J2	R015	Dawei – Phunamron Road																													0.0	0.0	128.0	0.0	128.0	L: 132km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	B1,B2	R016	Payagyi – Mawlamyaine - Thanbuzayat Road																													0.0	0.0	393.0	0.0	393.0	L: 270km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	D1	R017	Monywa – Yargyi – Kalewa Road																													0.0	0.0	181.0	0.0	181.0	L: 186km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	H1	R018	Yangon – Patheingyi Road																													0.0	0.0	124.0	0.0	124.0	L: 128km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	L1	R019	Taunggyi – Loikaw – Hpapun – Pha an Road																													0.0	0.0	660.0	0.0	660.0	L: 680km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	J3	R020	Tanintharyi – Mawlaikun Road																													0.0	0.0	107.0	0.0	107.0	L: 110km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)		
	B1	R021	Gyaing (Kawkaeik) Bridge																													0.0	21.0	0.0	0.0	21.0	Replacement L: 450m		
	Urban	R022	New Thaketa Bridge																													0.0	15.0	0.0	0.0	15.0	Replacement L: 190m		
	Urban	R023	Bago Bridge																													24.0	121.0	0.0	0.0	145.0	Replacement L: 3000m		
	B1	R024	Don Tha Mi and Naung Lon Bridge																													0.0	16.0	0.0	0.0	16.0	Replacement L: 200+120m		
	B1	R025	Gyaing (Zarhapyin) Bridge																													0.0	34.0	0.0	0.0	34.0	Replacement L: 870m		
	B2	R026	Atran Bridge																													0.0	17.0	0.0	0.0	17.0	Replacement L: 433m		
	A2	R027	2 bridges on Yangon-Mandalay Road																													0.0	10.0	0.0	0.0	10.0	Replacement L: 100+100m		
	H1, H2	R028	Hinthata Bridge																													0.0	141.0	0.0	0.0	141.0	Replacement L: 3620m		
	D1	R029	Yaw Chaung (Yepyar) Bridge																													0.0	0.0	39.0	0.0	39.0	Replacement L: 1000m		
	D1	R030	Yaw Chaung (Ohn Taw) Bridge																													0.0	0.0	29.0	0.0	29.0	Replacement L: 760m		
	Urban	R031	Dala Bridge																													0.0	121.0	0.0	0.0	121.0	New bridge L: 1210		
	H1	R032	Hlaing River Bridge																													0.0	0.0	58.0	0.0	58.0	New bridge L: 1200m		
	C1	R033	New Goat twin Viaduct																													0.0	0.0	35.0	0.0	35.0	New bridge L: 910m		
	J3	R034	Tha Mouk Bridge																													0.0	0.0	14.0	0.0	14.0	New bridge L: 350m		
Urban	R035	Wataya Bridge																													0.0	0.0	30.0	0.0	30.0	New bridge L: 500m			
	Projects in the first priority corridor																																						
	Projects outside the priority corridor, but of higher priority (projects in the regional centers, etc.)																																						
	Projects in the second priority corridor																																						



Table 11.5 Investment Program (Road Sector)(Cont.)

Sector	Corridor	Project ID	Project	Implementation Schedule																				(Cont.) Budget				Total	Contents								
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037		2038	2039	2040	- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030	Project Cost (Bil. MMK)
Road	D1	R036	Chindwin (Kalaywa) Bridge																													0.0	0.0	23.0	0.0	23.0	New bridge L: 600m
	H1	R037	Thetkal Thoung Bridge																													0.0	0.0	29.0	0.0	29.0	New bridge L: 760m
	B2	R038	Thanlwin (Chaungsone) Bridge																													0.0	0.0	23.0	0.0	23.0	New bridge L: 600m
	B1	R039	Chaungnitkwa Bridge																													0.0	0.0	14.0	0.0	14.0	New bridge L: 360m
	Urban	R040	Thanlwin (Tarsotpha) Bridge																													0.0	0.0	12.0	0.0	12.0	New bridge L: 305m
	A1	R041	Yangon - Mandalay Expressway																													193.0	483.0	0.0	0.0	676.0	Improvement (surface, alignment, safety facilities, lighting, etc.) L: 50km
	B1	R042	Yangon City - Thilawa Port Expressway																													0.0	243.0	0.0	0.0	243.0	New expressway L: 50km
	B1	R043	Yangon City - Hanthawaddy - Existing Expressway																													0.0	0.0	388.0	0.0	388.0	New expressway L: 80km
	A2,A3	R044	Mandalay Circular Expressway																													0.0	0.0	340.0	0.0	340.0	New expressway L: 70km
	Other	R045	Road Asset Management Improvement																													1.0	5.0	10.0	1.0	17.0	Database development, survey, training
	Other	R046	Road Sector Administration Improvement																													0.5	2.5	5.0	0.5	8.5	Technical assistance (TA) and training, procurement of PC etc.
	G2	R048	Loikaw - Magway Road																													0.0	0.0	363.0	0.0	363.0	L: 380km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)
	G1	R049	Hapasawing - Pyay Road																													0.0	0.0	283.0	0.0	283.0	L: 300km, 2-lane single carriageway Improvement (roughness, pavement, scholder, etc.)
Total																															329	3,068	8,264	2	11,662		

- Projects in the first priority corridor
- Projects outside the priority corridor, but of higher priority (projects in the regional centers, etc.)
- Projects in the second priority corridor

Table 11.6 Investment Program (Rail Sector)

Sector	Corridor	Project ID	Project	Implementation Schedule																	Budget				Total Project Cost (Bil. MMK)	Contents													
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033			2034	2035	2036	2037	2038	2039	2040	- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030		
Railway	A1, A2	RW001	Yangon - Mandalay																												219.0	1,097.0	439.0	0.0	1,755.0	Railway improvement and modernization (rail track, signal and communication, level crossing, trains, etc.)			
	A3	RW002	Myohaung-Myitkyina																												91.0	456.0	365.0	0.0	912.0	Railway improvement and modernization (rail track, signal and communication, level crossing, trains, etc.)			
	B1	RW003	Bago-Mawlamyine																												0.0	183.0	183.0	0.0	366.0	Railway improvement and modernization (rail track, signal and communication, level crossing, trains, etc.)			
	K1	RW004	Yangon-Pyay																												0.0	162.0	270.0	0.0	432.0	Railway improvement and modernization (rail track, signal and communication, level crossing, trains, etc.)			
	H1	RW005a	Yangon-Pathein																												0.0	30.0	209.0	0.0	239.0	Railway improvement and modernization (rail track, signal and communication, level crossing, trains, etc.)			
	H1	RW005b	Bridge																												0.0	4.0	25.0	0.0	29.0	New rail bridge crossing the Hlaing River.			
	D1	RW006	Myohaung-Monywa																												0.0	0.0	37.0	91.0	128.0	Railway improvement and modernization (rail track, signal and communication, level crossing, trains, etc.)			
	E1	RW007	Pyawbwe-Shwenyaung																												0.0	0.0	64.0	322.0	386.0	Railway improvement and modernization (rail track, signal and communication, level crossing, trains, etc.)			
	A1	RW008	Bago-Hanthawaddy																												12.0	17.0	0.0	0.0	29.0	Spur line from Bago to Hanthawaddy International Airport (single track)			
	A1	RW009	Yangon - Hanthawaddy																												0.0	0.0	2,000.0	0.0	2,000.0	New Airport Rail Access Project			
	Other	RW010	Togyang-Thilawa																												0.0	0.0	56.0	0.0	56.0	Railway improvement and modernization (rail track, signal and communication, level crossing, trains, etc.)			
	Other	RW011	Naypyitaw - Bagan																												0.0	0.0	556.0	0.0	556.0	Railway improvement and modernization (rail track, signal and communication, level crossing, trains, etc.)			
	A1	RW013	Yangon MR ICD, Workshop, etc.																												3.0	37.0	0.0	0.0	40.0	DEMU, Locomotive workshop in Ywathargyi area New Inland Container Deport (ICD), YCDC truck terminal, etc.			
	A2, A3	RW014	Mandalay MR ICD, truck terminal, etc.																												2.0	8.0	0.0	0.0	10.0	New Inland Container Deport (ICD), truck terminal, etc.			
Total																														327	1,994	4,204	413	6,938					
	Projects in the first priority corridor																																						
	Projects outside the priority corridor, but of higher priority (projects in the regional centers, etc.)																																						
	Projects in the second priority corridor																																						

Projects in the first priority corridor

Projects outside the priority corridor, but of higher priority (projects in the regional centers, etc.)

Projects in the second priority corridor

Table 11.7 Investment Program (Maritime Sector)

Sector	Corridor	Project ID	Project	Implementation Schedule																	Budget				Total	Contents													
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034		2035	2036	2037	2038	2039	2040	- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030	Project Cost (Bil. MMK)		
Sea Port	A1,B1,H1,K 1	PT001	Yangon Port in Thilawa (Phase 1)																													223.0	0.0	0.0	0.0	223.0	New port construction in Thilawa area.		
	A1,B1,H1,K 1	PT001a	Yangon Port in Thilawa (Phase 2)																													10.0	500.0	44.0	0.0	554.0	New port construction in Thilawa area.		
	A1,B1,H1,K 1	PT001b	Yangon Port in Thilawa (Phase 3)																													0.0	0.0	194.0	0.0	194.0	New port construction in Thilawa area.		
	A1,B1,H1,K 1	PT002	Yangon Port Capacity and Connectivity Improvement																													5.0	200.0	0.0	0.0	205.0	Capacity expansion of the existing Yangon port including and connectivity improvement between inland water transport and sea transport.		
	A1,B1,H1,K 1	PT003	Yangon Port in Thilawa (Post Thilawa)																													0.0	0.0	388.0	97.0	485.0	New port construction in Thilawa area (south of the Thilawa SEZ).		
	A1,B1,H1,K 1	PT004	Offshore Yangon River (Deep Seaport)																													0.0	0.0	728.1	1,698.9	2,427.0	New deep seaport construction at the river mouth of the Yangon River.		
	B2, J2, J3	PT006	Dawai Port																													0.0	1,000.0	1,000.0	0.0	2,000.0	New deep sea port construction in Dawai.		
	B1,B2, J1	PT007	Kalegauk Port																													10.0	39.0	0.0	0.0	49.0	New seaport construction in Kalegauk.		
	B1,B2, J1	PT008	Mawlamyaing Port																													10.0	39.0	0.0	0.0	49.0	Improvement of the existing port in Mawlamyaing.		
	H1,H2,F1	PT009	Patheingyi Port																													10.0	39.0	0.0	0.0	49.0	Improvement of the existing port in Patheingyi.		
	E1	PT011	Sittoung Port																													209.0	0.0	0.0	0.0	209.0	Port and facility improvement of the Sittoung port.		
	Common	PT013	Yangon Port Channel Navigation																													5.0	20.0	0.0	0.0	25.0	Navigation safety facilities installment		
	Common	PT015	Law & Regulation update and TA																													2.0	10.0	0.0	0.0	12.0	Review and update the existing laws and regulations and TA		
	Common	PT016	Statistics development and TA																													2.0	10.0	0.0	0.0	12.0	Statistics development, procurement of equipment and TA		
	Common	PT017	EDI : Yangon Port & Other ports																													15.0	15.0	0.0	0.0	30.0	EDI (Port-MIS) installation, including river ports		
Total																															501	1,872	2,354	1,796	6,523				
	Projects in the first priority corridor																																						
	Projects outside the priority corridor, but of higher priority (projects in the regional centers, etc.)																																						
	Projects in the second priority corridor																																						

Projects in the first priority corridor

Projects outside the priority corridor, but of higher priority (projects in the regional centers, etc.)

Projects in the second priority corridor

Table 11.8 Investment Program (Inland Water Transport Sector)

Sector	Corridor	Project ID	Project	Implementation Schedule																				Budget				Total	Contents								
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037		2038	2039	2040	- Y2015	Y2016 - Y2020	Y2021 - Y2030	Over Y2030	Project Cost (Bil. MMK)
IWT	F1,F2	IW001	Mandalay Port																												2.0	39.0	43.0	39.0	123.0	New river port construction in Mandalay.	
	F1,H1	IW002	Yangon Port (Including Connectivity)																												2.0	99.0	103.0	99.0	303.0	Port expansion for river transport including backyard facilities	
	F1	IW003	Bhamo Port																	Extension											0.0	41.0	26.0	26.0	93.0	New port construction in Bhamo.	
	F1,F2	IW004	Pakkokku Port																												0.0	12.0	10.0	0.0	22.0	New port construction in Pakkoku.	
	F1	IW005	Magway Port																												0.0	12.0	10.0	0.0	22.0	New port construction in Magway.	
	F2	IW006	Monywa Port																												0.0	0.0	21.0	0.0	21.0	New port construction in Monywa.	
	F2	IW007	Kalewa Port																												0.0	0.0	21.0	0.0	21.0	New port construction in Kalewa.	
	Other	IW008	Other 10 Ports construction																												0.0	0.0	87.0	58.0	145.0	New port construction in other 10 locations.	
	F1,H1	IW009	Yangon - Mandalay channel improvement																												4.0	61.0	61.0	61.0	187.0	Comprehensive navigation channel improvement for future container transport.	
	F1	IW010	Mandalay - Bhamo channel improvement																												0.0	0.0	65.0	65.0	130.0	Navigation channel improvement for all seasons.	
	F2	IW011	Monywa - Upstream channel improvement																												0.0	0.0	22.0	14.0	36.0	Navigation channel improvement for all seasons.	
	F1,H1	IW012	Ayeyarwady Delta channel improvement																												2.0	32.0	10.0	10.0	54.0	Navigation channel improvement for all seasons.	
	Other	IW013	Rakhaing River channel improvement																												0.0	13.0	41.0	0.0	54.0	Navigation channel improvement for all seasons.	
	Other	IW014	Thanlwin River channel improvement																												0.0	13.0	41.0	0.0	54.0	Navigation channel improvement for all seasons.	
	F1	IW015	Yangon - Mandalay Navigation safety improvement																												0.0	10.0	10.0	0.0	20.0	Navigation channel improvement for all seasons.	
	F1	IW016	Mandalay - Bhamo Navigation safety improvement																												0.0	8.0	12.0	0.0	20.0	Navigation channel improvement for all seasons.	
	F2	IW017	Monywa - Upstream Navigation safety improvement																												0.0	4.0	16.0	0.0	20.0	Navigation channel improvement for all seasons.	
	F1,H1	IW018	Ayeyarwady Delta Navigation safety improvement																												0.0	8.0	12.0	0.0	20.0	Installment of navigation safety systems	
	Other	IW019	Rakhaing River Navigation safety improvement																												0.0	0.0	20.0	0.0	20.0	Installment of navigation safety systems	
	Other	IW020	Thanlwin River Navigation safety improvement																												0.0	0.0	20.0	0.0	20.0	Installment of navigation safety systems	
	F1,H1	IW021	Dalla Shipyard modernization																												24.0	24.0	0.0	0.0	48.0	Capacity development of the existing Dalla Shipyard and modernization	
	F1,F2	IW022	Mandalay Shipyard modernization																												0.0	18.0	12.0	0.0	30.0	Capacity development of the existing Mandalay Shipyard and modernization	
	F1,H1	IW025	Ayeyarwady Delta IWT vessels																												0.0	20.0	0.0	0.0	20.0	Procurement of IWT vessels	
	F1	IW026	Mandalay - Upstream IWT vessels																												0.0	12.0	0.0	0.0	12.0	Procurement of IWT vessels	
	F2	IW027	Chindwin River IWT vessels																												0.0	3.0	2.0	0.0	5.0	Procurement of IWT vessels	
	Other	IW028	Rakhaing River IWT vessels																												0.0	3.0	2.0	0.0	5.0	Procurement of IWT vessels	
	Other	IW029	Thanlwin River IWT vessels																												0.0	3.0	2.0	0.0	5.0	Procurement of IWT vessels	
	Other	IW030	IWT barge and tugs																												0.0	100.0	100.0	0.0	200.0	Procurement of IWT barge and tugs.	
	Common	IW031	Vessel safety improvement and TA																												0.0	10.0	0.0	0.0	10.0	Vessel safety related systems installment and TA.	
	Common	IW032	Navigation safety improvement and TA																												3.0	7.0	0.0	0.0	10.0	Navigation safety systems installment and TA.	
	Common	IW033	Statistics Development																												1.0	4.0	0.0	0.0	5.0	River transport statistics development and TA.	
	Common	IW034	Port operation and management improvement and TA																												1.0	4.0	0.0	0.0	5.0	River port operation and management improvement and TA.	
	Common	IW035	Container transport system install and TA																												0.0	2.0	10.0	0.0	12.0	Systems for river container transport and TA.	
	Total																														39	562	779	372	1,752		
	Projects in the first priority corridor																																				
Projects outside the priority corridor, but of higher priority (projects in the regional centers, etc.)																																					
Projects in the second priority corridor																																					