



The Republic of the Union of Myanmar Ministry of Construction

The Republic of the Union of Myanmar **Urban Development Plan for Regional Cities** - Mandalay, Patheingyi and Mawlamyine -



Data Collection Survey on Urban Development Planning for Regional Cities

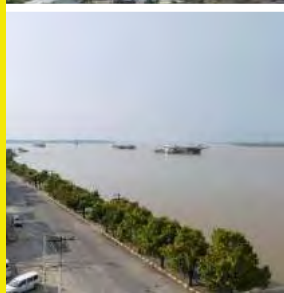
FINAL REPORT

August 2016

JICA Study Team: Nippon Koei Co., Ltd.

Nine Steps Corporation

International Development Center of Japan Inc.



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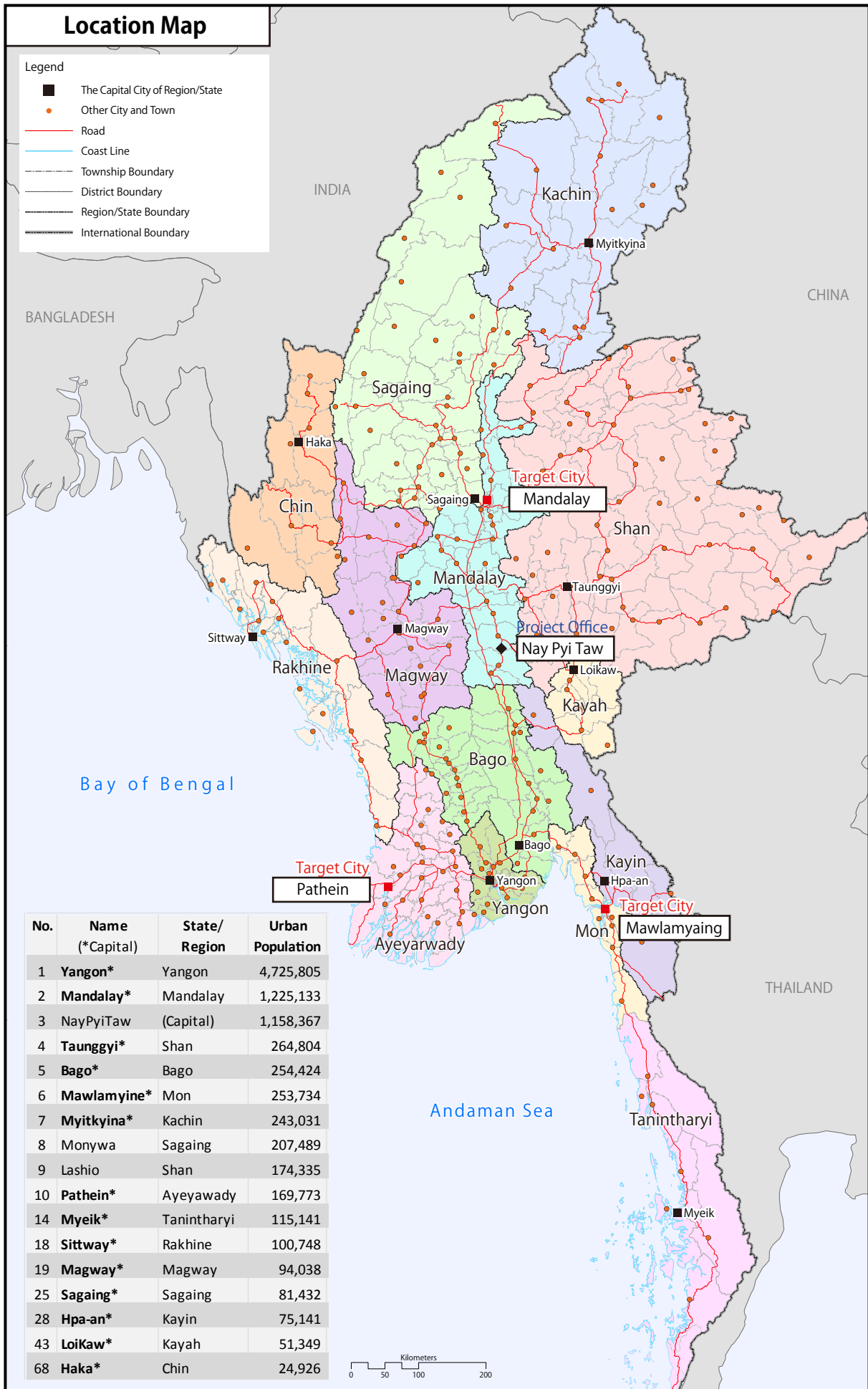
JR

16-047

Location Map

Legend

- The Capital City of Region/State
- Other City and Town
- Road
- Coast Line
- Township Boundary
- District Boundary
- Region/State Boundary
- International Boundary



The Republic of the Union of Myanmar
Ministry of Construction (MOC)

The Republic of the Union of Myanmar

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on Urban Development Planning
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-Mandalay, Patheingyi, and Mawlamyine-

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Data Collection Survey on Urban Development Planning for Regional Cities -Mandalay, Patheingyi, and Mawlaikine-

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CONVERSION RATE (AT MARCH 2016)

1 MMK = 0.092 JPY, 1 JPY = 10.870 MMK

1 USD = 114.01 JPY, 1 JPY = 0.00877 USD

1 USD = 1239.45 MMK, 1 MMK = 0.000807

Source: JICA HP

LIST OF ABBREVIATIONS

| | |
|--------|--|
| ASEAN | Association of Southeast Asian Nations |
| ADB | Asia Development Bank |
| BCR | Building Coverage Ratio |
| BOT | Build Operate Transfer |
| BRT | Buss Rapid Transit |
| CBD | Central Business District |
| CDC | City Development Committee |
| C/P | Counterpart |
| DAO | Development Affairs Organization |
| DDG | Deputy Director General |
| DEM | Digital Elevation Model |
| DEPP | Department of Electric Power Planning |
| DEPTSC | Department of Electric Power Transmission & Control and System Control |
| DHPI | Department of Hydropower Implementation |
| DIG | Delta Industrial Group |
| DUHD | Department of Urban and Housing Development |
| ECFA | Engineering Firms Association |
| EIA | Environmental Impact Assessment |
| EPGE | Electric Power Generation Enterprise |
| ESE | Electricity Supply Enterprise |
| FASEP | Fonds d'Études et d'Aide au Secteur Privé |
| FAR | Floor Area Ratio |
| FMB | Farmland Management Body |
| FY | Fiscal Year |
| GAD | General Administration Department |
| GCP | Ground Control Point |
| GDP | Gross Domestic Products |
| GIS | Geographic Information System |
| GMS | Greater Mekong Subregion |
| GOM | Government of Myanmar |
| GPS | Global Positioning System |
| GRDP | Gross Regional Domestic Product |
| ICD | Inland Container Depot |

| | |
|----------|--|
| IPP | Independent Power Producer |
| ITS | Intelligent Transport Systems |
| IWT | Inland Water Transport |
| JETRO | Japan External Trade Organization |
| JICA | Japan International Cooperation Agency |
| JPY | Japanese Yen |
| JV | Joint Venture |
| LDC | Load Dispatch Center |
| LRT | Light Rail Transit |
| LTMC | Lorry and Truck Management Committee |
| MBMC | Mini Bus Management Committee |
| MCDC | Mandalay City Development Committee |
| MESC | Mandalay Electricity Supply Corporation |
| MIA | Mandalay International Airport |
| MIDV | Myanmar Industrial Development Vision |
| MIP | Myotha Industrial Park |
| MIMU | Myanmar Information Management Unit |
| MMID | Mandalay Myotha Industrial Development Public Co.,Ltd |
| MMK | Myanmar Kyat |
| MNBC | Myanmar National Building Code |
| MNPED | Ministry of National Planning and Economic Development |
| MOECAP | Ministry of Environmental Conservation and Forestry |
| MOEPE | Ministry of Electric Power and Energy |
| MOC | Ministry of Construction |
| MOHA | Ministry of Home Affairs |
| MHLW | Ministry of Health, Labour and Welfare. Japan |
| MIA | Mandalay International Airport |
| MOT | Ministry of Transport |
| MPA | Myanmar Port Authority |
| MPBND | Ministry for Progress of Border Areas and National Races and Development Affairs |
| MR | Myanmar Railways |
| MRT | Mass Rapid Transit |
| MSWM | Municipal Solid Waste Management |
| MYT Plan | The Survey Program for the National Transport Development Plan |
| NGO | Non-Governmental Organization |
| NCC | National Control Center |

| | |
|--------|--|
| NCDP | National Comprehensive Development Plan |
| NMT | Non-motorized Transport |
| NPT | Nay Pyi Taw |
| NRW | Non-revenue water |
| PCCD | Pollution Control and Cleansing Department |
| PGM | Phy Gyi Mingalar (Truck Terminal) |
| PLC | Power Line Carrier |
| PPP | Public Private Partnership |
| PPTA | Project Preparatory Technical Assistance |
| RTAD | RTAD |
| SEZ | Special Economic Zone |
| SHM | Stakeholder Meeting |
| SMP | Semeikhon Port |
| SWM | Solid Waste Management |
| TA | Technical Assistant |
| TDC | Township Development Committee |
| TDAC | Township Development Affairs Committee |
| TDSC | Township Development Support Committee |
| TMC | Township Management Committee |
| TMuC | Township Municipal Committee |
| TOD | Transit Oriented Development |
| TPIC | Township Planning and Implementation Committee |
| UAGO | Union Attorney General Office |
| UK | United Kingdom |
| UFW | Un-accounted For Water |
| UNDP | United Nations Development Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| URDD | Urban Regional Development Division |
| USD | US Dollar |
| VMC | Vehicle Management Committee |
| WHO | World Health Organization |
| WTP | Water Treatment Plant |
| WWTP | Waste Water Treatment Plant |
| YESC | Yangon Electricity Supply Corporation |
| YUTRA | Yangon Urban Transportation Master Plan |



PART 1

Survey & Preparation

Part 1: Survey & Preparation

1.1 Introduction

1.1.1 Background

Myanmar has been promoting economic deregulation after shifting the policy to emphasize reforms on international relations and economy since 2011. Along with this context, the position of Myanmar has been more powerful as new investment frontier in Asia as well as worldwide. Although Myanmar was one of the poorest countries in the Association of Southeast Asian Nation (ASEAN) before, now it can be said it has the highest growth potential. Myanmar's gross domestic product (GDP) per capita is estimated to reach to the level of middle-income countries by 2030 in case economic reforms and foreign direct investment continue steadily.

The Government of Myanmar formulated the "National Comprehensive Development Plan (NCDP)" in 2014 by Ministry of National Planning and Economic Development, which indicates the development policies of the whole country, and presents the guidelines of comprehensive development of all sectors and strategic national development goals. The "National Spatial Development Plan" and the "National Transportation Master Plan" were also formulated in 2014, by the Ministry of Construction and the Ministry of Transportation, respectively. Additionally, with respect to target cities of this project (hereafter referred to as "the Study"), there are "Urban Infrastructure Service Improvement Study (Asian Development Bank: Mandalay)" and "Comprehensive Development Plan Project for Southeast Region (Japan International Cooperation Agency: Mawlamyine)".

To accelerate economic development continuously, not only in Yangon but also in other regional cities such as Mandalay, Patheingyi, and Mawlamyine also have important role as regional hub. To promote the required roles of these cities, it is urgent to clarify the future development images and to formulate comprehensive urban development master plans. Based on these works, structured infrastructure development plans are also necessary to realize and implement the development potential of each city.

1.1.2 Objective

The objective of the Study is to support the Government of Myanmar in planning works of urban development master plans through conducting the following works:

- i) Review of Relevant Policies and Plans, and Current Conditions;
- ii) Proposal of Development Visions and Spatial and Structure Plans; and
- iii) Proposal of a Roadmap of Prioritized Projects.

1.1.3 Study Period

The study started at the end of December 2015 and completed in August by the submission of the Final Report 2016 lasting 7-8 months. The deliverables of the Study are shown in Table 1.1.1.

Table 1.1.1: Menu of Deliverables

| Status | Deliverable | Delivery Time | Language |
|--------------------|---------------------|---|--|
| <i>(Completed)</i> | Inception Report | January 2016 | English, Japanese |
| <i>(Completed)</i> | Progress Report | April 2016 (initially March 2016) | English, Japanese (Summary) |
| <i>This Report</i> | Final Report | August 2016 (initially June 2016) | English (Full and Summary), Japanese (Summary), Myanmar (Summary) |

Source: JICA Study Team

1.1.4 Study Target

The targets of the Study are the three cities, namely; Mandalay, Patheingyi, and Mawlamyine (hereafter referred to as the target three cities). The main project office is situated in the building of the Ministry of Construction in Nay Pyi Taw.

All target three cities are the capital of regions and states government, playing a role of regional cores in commercial, business, and logistic activities in general. As described in the location map the next of cover page, Mandalay has a population of more than 1 million, which are second largest city in Myanmar. Additionally Mawlamyine and Patheingyi are ranked as top 10 in population volume, which are 254 thousands and 170 thousands respectively.

Although Yangon seems to become one strong primate city rapidly in Myanmar, it may increase risk when unanticipated problems occur. To promote balanced development of Myanmar, such regional cores must lead economical development further. Mandalay, Patheingyi, and Mawlamyine are expected to play said function at center, west, and east of Myanmar.

In details of the target areas of the three cities will be probably set as shown in Table 1.1.2, through the discussions with counterpart and in the workshops held. The target areas are also explained in detail with maps.

Table 1.1.2: Target Areas of the Three Cities (Tentative)

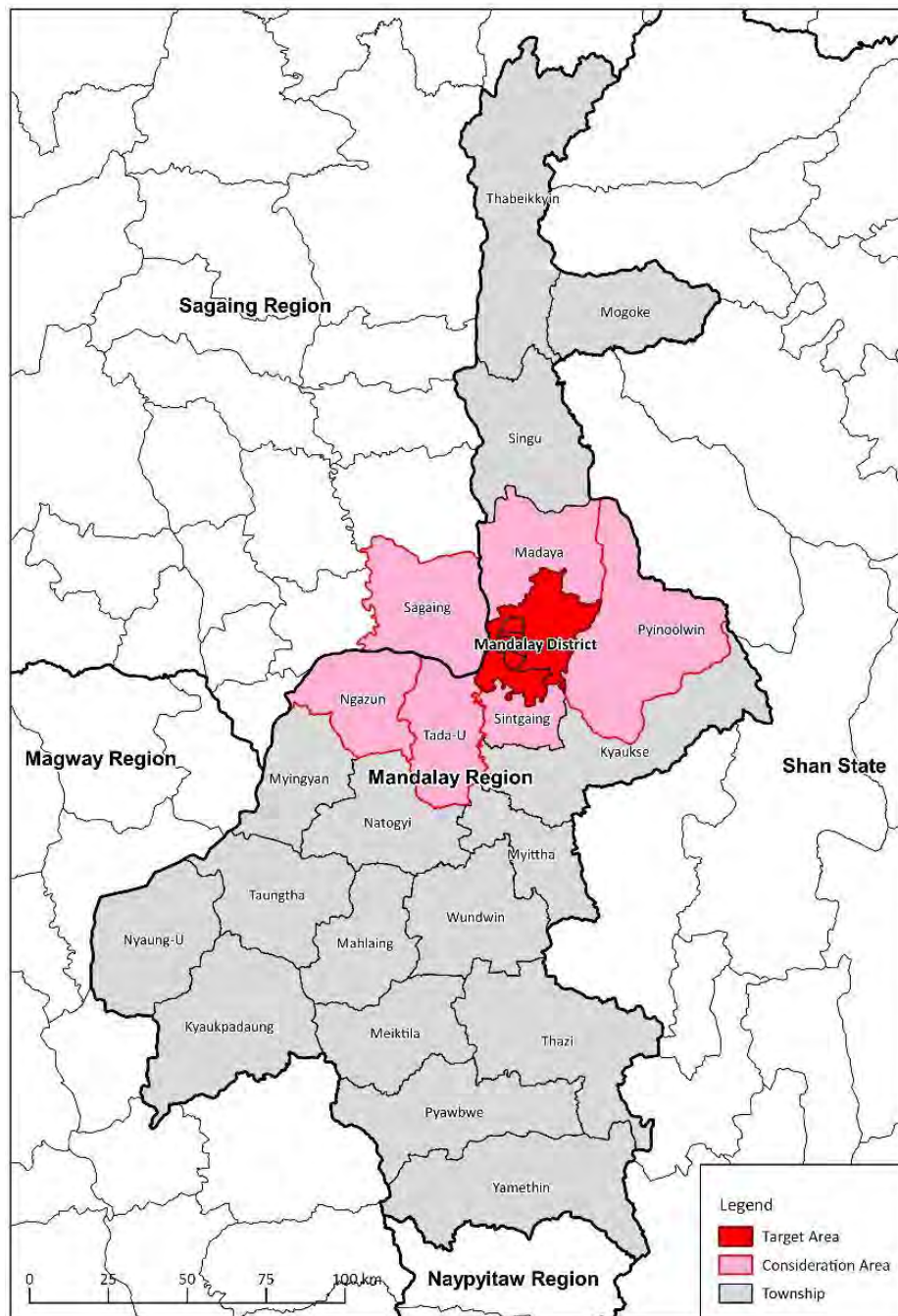
| City | Outline (Name of Township, District, Region) |
|------------|---|
| Mandalay | Seven townships (whole area of seven townships), namely: Aungmyethazan, Chanayethazan, Mahaaungmye, Chanmyathazi, Pyigyidagun, Amarapura, and Patheingyi. All belong to Mandalay District in Mandalay Region. |
| Patheingyi | Part of Patheingyi Township (urban area and surrounding seven villages of Patheingyi Township), namely; urban area (15 wards) and villages of Shwe Myin Tin, Zin Pyun Kone, Koe Su, Ma Yan Chaung, Myo Chaung, Pyin Ka Doe Kone, and Pauk Kone. It belongs to Patheingyi District in Ayeyawady Region. |
| Mawlamyine | The whole area of Mawlamyine Township. It belongs to Mawlamyine District in Mon State. |

Source: JICA Study Team

(1) Mandalay

Mandalay is located in the middle of Myanmar, which district is about 390 km north of Nay Pyi Taw and about 700 km north of Yangon. Mandalay District, corresponding to MCDC management area, is about 900 km², which stretches 46 km east and west, and 40 km north and south. The district consists of seven townships, namely: Aungmyetharzan, Chanayetharzan, Mahaaungmye, Chanmyatharzi, Pyigyidagun, Amarapura, and Patheingyi. The district belongs to Mandalay Region, which region shares border with Sagaing Region, Shan State, Kayah State, Bago Region, and Magway Region.

The red area in Figure 1.1.1 shows the planning area of this project, the whole Mandalay District, and the pink area shows the consideration area in which the planning area will be considered.



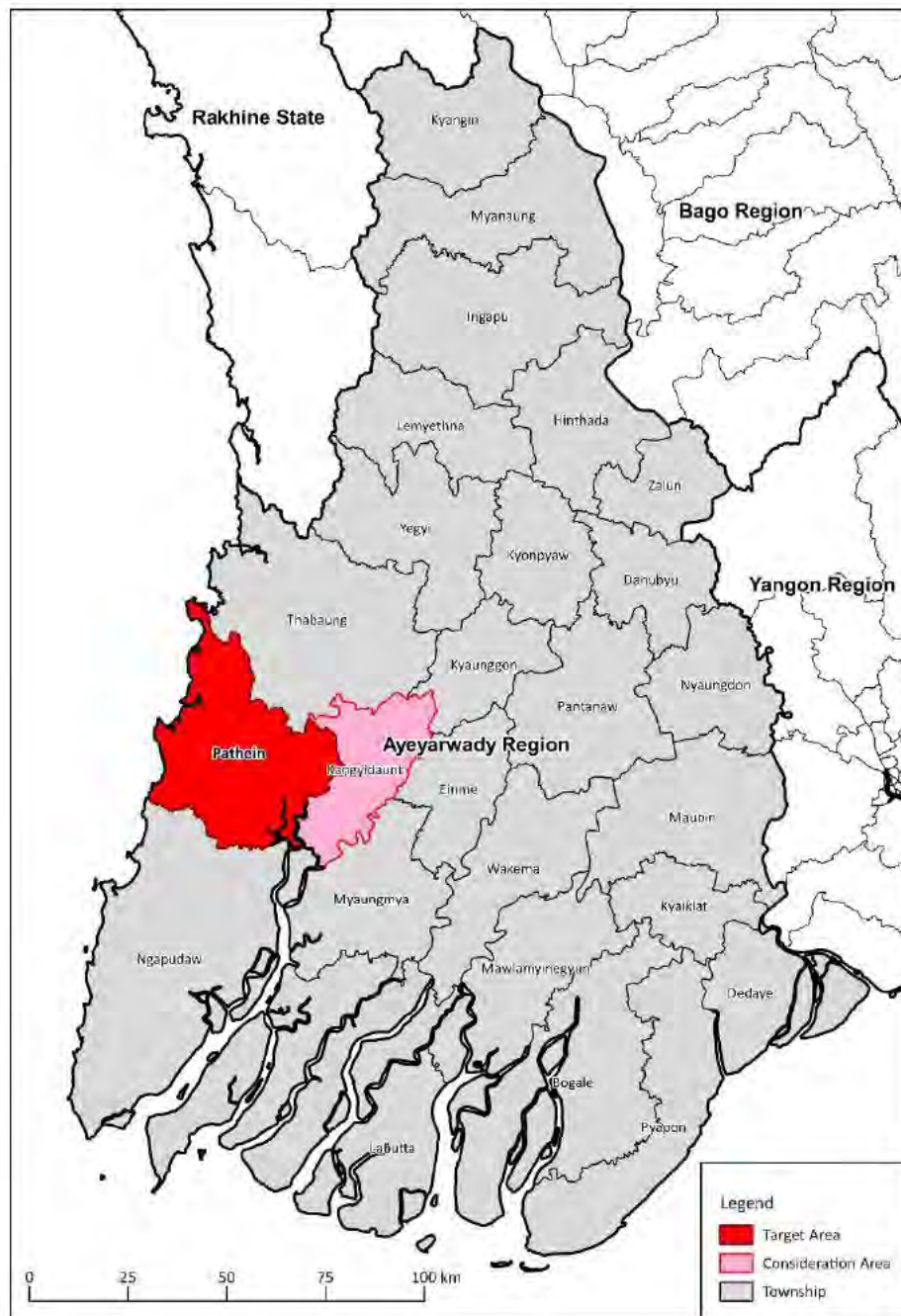
Source: JICA Study Team

Figure 1.1.1: Location Map of Mandalay District

(2) Pathein

Pathein is located in the south-west area of Myanmar, which is about 150 km west of Yangon and 40 km east from coast line. Pathein Township is about 1,450 km², which stretches 50 km east and west, and 68 km north and south. The township belongs to Pathein District and Ayeyawady Region, which region shares border with Rakhine State, Bago Region, and Yangon Region.

The red area in Figure 1.1.2 shows Pathein Township, which includes the planning area of this project shown in Part 2 of this report, and the pink area shows the consideration area in which the planning area will be considered.



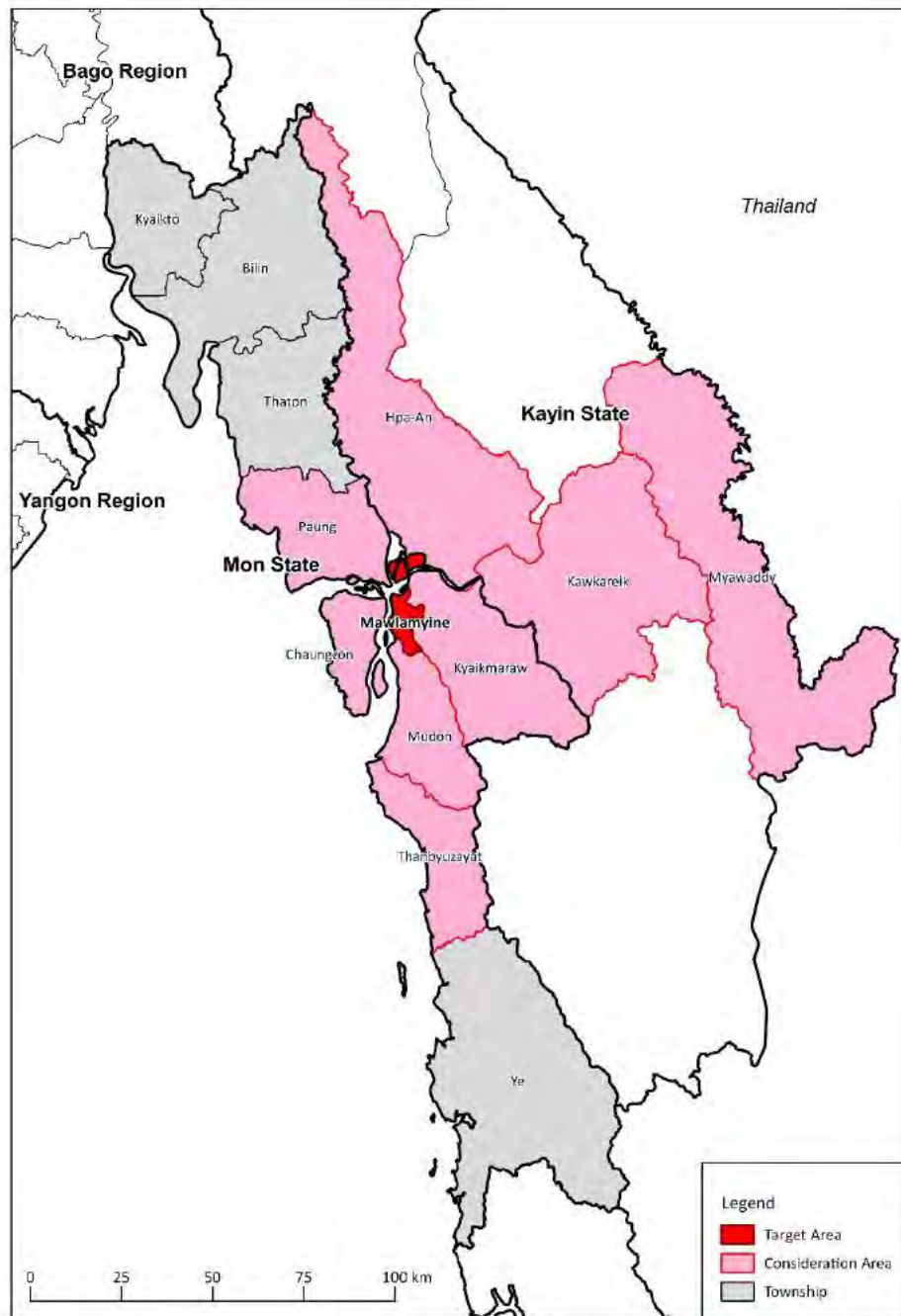
Source: JICA Study Team

Figure 1.1.2: Location Map of Pathein Township

(3) Mawlamyine

Mawlamyine is located in the south-east area of Myanmar, which is about 160 km north-east of Yangon. Mawlamyine Township is about 219 km², which stretches 11 km east and west, and 18 km north and south. The township belongs to Mawlamyine District and Mon State, which state shares border with Bago Region, Kayin State, and Tanintharyi Region.

The red area in Figure 1.1.3 shows the planning area of this project, the whole Mawlamyine Township, and pink area shows the consideration area in which the planning area will be considered.

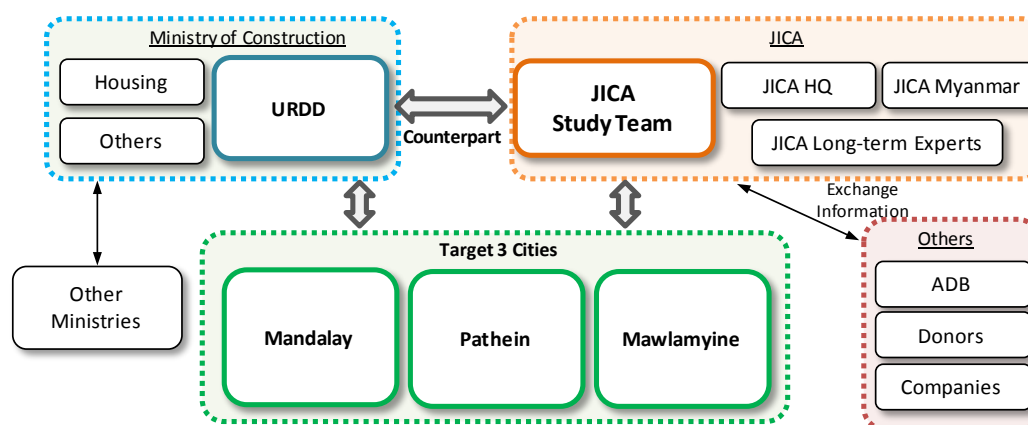


Source: JICA Study Team

Figure 1.1.3: Location Map of Mawlamyine Township

1.1.5 Study Implementation

The counterpart organization (hereinafter referred to as the “C/P”) of the Study is the Urban Regional Development Division, Department of Urban and Housing Development, Ministry of Construction (hereafter referred to as the “URDD”, “DUHD”, “MOC”, respectively). The main contact organizations of the three cities are the DUHD Branch Office in each region/state, and region/state governments. Additionally, Mandalay City Development Committee (hereafter referred to as the “MCDC”) is also the main consultative body in Mandalay. The Study also cooperates with the main relevant organizations, such as General Administration Department (hereinafter referred to as the “GAD”) and Township Development Committee (hereinafter referred to as the “TDC”) in each city as shown in Figure 1.1.4.



Source: JICA Study Team

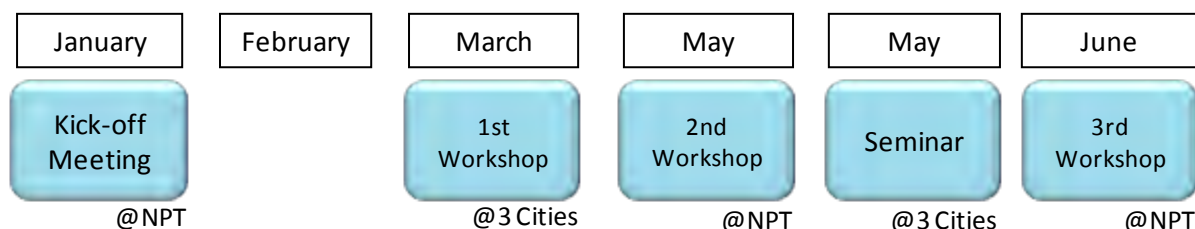
Figure 1.1.4: Main Relevant Organizations

1.1.6 Formulation Methodology

In the Study, it is necessary to conduct field survey, data collection, public involvement, and consensus building efficiently in distant target three cities. Under current movement toward democratization, the Study put more emphasis on public involvement in the process of urban development planning. The Study set two types of meetings in the Study:

- Workshop Meeting: to discuss with C/P and related organizations; and
- Seminar: to collect opinions of various stakeholders such as representatives of local communities.

Planned work process and schedule is shown in Figure 1.1.5 and Table 1.1.3, respectively.



Source: JICA Study Team

Figure 1.1.5: Work Proposal of Meetings and Surveys

Table 1.1.3: Work Process and Schedule of Field Surveys and Stakeholder Meetings

| Month | Event | Venue | Main Contents |
|-------|----------------------|-------------|---|
| Jan | Kick-off Meeting | Nay Pyi Taw | - Explanation and basic approval of the outline of the Study - Establishment of a Planning Team with the C/P |
| | Field Survey (1) | 3 cities | - Field survey in the field of urban, industry, environment, and social. |
| Feb | Field Survey (2) | 3 cities | - Field survey in the field of infrastructure. |
| Mar | 1st Workshop Meeting | 3 cities | - Discussion and analysis of current conditions and issues - Additional survey by the JICA experts |
| Apr | 2nd Workshop Meeting | Nay Pyi Taw | - Discussion of directions of target three cities - Discussion of visions, socio-economic frameworks, and policies |
| May | Seminar | 3 cities | - Opinion collection of visions, frameworks, and policies - Proposals and selection of alternatives (SEA process) |
| Jun | 3rd Workshop Meeting | Nay Pyi Taw | - Discussion of draft spatial and structure plans - Advices and recommendations |

Source: JICA Study Team

(1) Kick-Off Meeting

The Kick-off Meeting was held on 19 January 2016 (Tue) in Nay Pyi Taw (the Meeting Room of MOC), chaired by Director General of DUHD and participated by MOC, relevant ministries, and representatives from the target three cities. Summary result and pictures of the kick-off meeting are shown in Table 1.1.4 and Figure 1.1.6, respectively.

Through the discussions after the opening remarks and explanation of the project outline, all participating organizations basically agreed on the methodology and contents of the Study.

Table 1.1.4: Summary Result of Kick-off Meeting

| | |
|------------------------------|--|
| Title of the Meeting | Kick-off Meeting |
| Date and Time | 19 January 2016 (Tue) 13:00-14:15 |
| Venue | Nay Pyi Taw (the Meeting Room of MOC) |
| Chairperson | Director General, DUHD |
| Total Number of Participants | 39 participants |
| Participated Organizations | Ministry of Construction, Department of Urban Housing Development, General Administration Department, MCDC, JICA |
| Agenda | 1. Opening Remarks (Chairperson) 2. Explanation of the Study Outline (JICA Study Team) 3. Discussion |
| Minutes | (See attached file) |

Source: JICA Study Team



Source: JICA Study Team

Figure 1.1.6: Pictures of Kick-off Meeting

(2) 1st Workshop Meetings

A series of 1st workshop meetings was held in the target three cities from 18 to 25 March. Representatives of DUHD from Nay Pyi Taw were accompanied by the JICA Study Team. Deputy Director General of DUHD attended for Mandalay, and Deputy Director of URDD attended for Mawlamyine and Patheingyi. All meetings were completed successfully. Details are shown in the later section.

1) Mandalay

The 1st workshop meeting of Mandalay, summarized in Table 1.1.5 and shown in Figure 1.1.7, was held on 18 March 2016 (Fri) in Mandalay (Mandalay Hill Resort), chaired by Deputy Director General of DUHD, and participated by MOC, relevant organizations, and the JICA Study Team.

Table 1.1.5: Summary Result of the 1st Workshop in Mandalay

| | |
|------------------------------|---|
| Title of the Meeting | Urban Development Planning Workshop |
| Date and Time | 18 March 2016 (Friday) at 13:00 – 17:30 |
| Venue | Mandalay Hill Resort Hotel |
| Chairperson | Deputy Director General, DUHD |
| Total Number of Participants | 36 participants |
| Participated Organizations | DUHD, MCDC, MORT, DOA, DMH, DLMS, DISI, DOH, DORD, ECD, Forest Department, DOP, Transport Division, GAD |
| Agenda | <ol style="list-style-type: none"> 1. Opening <ul style="list-style-type: none"> • Opening Remarks (Chairperson) • Presentation of the Study Outline • Presentation of the Stakeholder's Consultation Plan 2. Session 1: Review on Current Status <ul style="list-style-type: none"> • Presentation • Presentation • Question and Answer 3. Session 2: Planning Framework <ul style="list-style-type: none"> • Presentation • Q&A • Coffee Break 4. Session 3: Spatial Planning <ul style="list-style-type: none"> • Presentation • Group discussion 5. Closing <ul style="list-style-type: none"> • Up-coming schedule • Closing |
| Minutes | (See attached file) |

Source: JICA Study Team



Opening Remarks



Presentation of the Study Outline



Source: JICA Study Team

Figure 1.1.7: Pictures of the 1st Workshop of Mandalay

2) Pathein

The 1st workshop meeting of Pathein, summarized in Table 1.1.6 and shown in Figure 1.1.8, was held on 25 March 2016 (Fri) in Pathein (Pathein Hotel), chaired by Deputy Director of URDD, and participated by MOC, relevant organizations, and the JICA Study Team.

Table 1.1.6: Summary Result of the 1st Workshop in Pathein

| | |
|------------------------------|--|
| Title of Meeting | Urban Development Planning 1 st Workshop in Pathein |
| Date and Time | 25 March 2016 (Friday) 13:00–17:30 |
| Venue | Pathein Hotel, Pathein City |
| Chairperson | Deputy Director of URDD, MOC |
| Total Number of Participants | 21 participants |
| Participated Organizations | DUHD, GAD, Forest, MOI, TDC, ECD, DRD, Planning Department |
| Agenda | Introduction (Deputy Director General, DUHD) <ul style="list-style-type: none"> Opening Speech on behalf of MOC (DUHD) Presentation <ul style="list-style-type: none"> Outline of the Study Stakeholder's Consultation Process Current Status of Pathein in General Current Status of Transportation of Pathein Planning Framework Spatial Planning |
| Minutes | (See attached file) |

Source: JICA Study Team





Source: JICA Study Team

Figure 1.1.8: Pictures of the 1st Workshop of Patheingyi

3) Mawlamyine

The 1st workshop meeting of Mawlamyine, summarized in Table 1.1.7 and shown in Figure 1.1.9, was held on 22 March 2016 (Tue) in Mawlamyine (Shwe Myint Mo Tun Hotel), chaired by Deputy Director of URDD, and participated by MOC, relevant organizations, and the JICA Study Team.

Table 1.1.7: Summary Result of the 1st Workshop in Mawlamyine

| | |
|------------------------------|--|
| Title of the Meeting | Urban Development Planning Workshop |
| Date and Time | 22 March 2016 (Tue) 13:00 – 17:30 |
| Venue | Shwe Myint Mo Tun Hotel, Mawlamyine City |
| Chairperson | Deputy Director, URDD, MOC |
| Total Number of Participants | 27 participants |
| Participated Organizations | Forest, DUHD, GAD, Health, DRD, DMH, DISI, SDA, Planning Department, ECD, Archaeology Department, Education, TDC |
| Agenda | <ol style="list-style-type: none"> 1. Opening <ul style="list-style-type: none"> • Opening Remarks (Chairperson) • Presentation of the Study Outline • Presentation of the Stakeholder's Consultation Plan 2. Session 1: Review on Current Status <ul style="list-style-type: none"> • Presentation • Presentation • Question and Answer 3. Session 2: Planning Framework <ul style="list-style-type: none"> • Presentation • Q&A • Coffee Break 4. Session 3: Spatial Planning <ul style="list-style-type: none"> • Presentation • Group discussion 5. Closing <ul style="list-style-type: none"> • Up-coming schedule • Closing by MOC (Chairperson) |
| Minutes | (See attached file) |

Source: JICA Study Team



Source: JICA Study Team

Figure 1.1.9: Pictures of the 1st Workshop of Mawlamyine

(3) Courtesy Call to Region/State Government

Target 3 cities visit at same time of the workshops above, courtesy calls to each Region/State Government, summarized in Table 1.1.8 and shown in Figure 1.1.10, were done by JICA Study Team and C/P (MOC).

Table 1.1.8: Summary Result of Courtesy Call in Target 3 Cities

| | | |
|------------|----------------------------------|---|
| Mandalay | Title of the Meeting | Courtesy Call to Mandalay Region Government |
| | High Ranking Official Attendance | Commissioner, Deputy Director General, GAD, Mandalay Region |
| | Date and Time | 18 March 2016 (10:00 – 11:00) |
| | Venue | Meeting Room, GAD office, Mandalay |
| | Total Number of Participants | 9 participants |
| | Participated Organizations | GAD, DUHD |
| Patheingyi | Title of the Meeting | Courtesy Call to Patheingyi Region Government |
| | High Ranking Official Attendance | Secretary, Ayeyarwaddy Regional Government Office |
| | Date and Time | 25 March 2016 (10:00 -10:30) |
| | Venue | Meeting Room (2), GAD office, Pathien |
| | Total Number of Participants | 13 participants |
| | Participated Organizations | DUHD, MNPED, TDC |
| Mawlamyine | Title of Meeting | Courtesy Call to Mawlamyine Region Government |
| | High Ranking Official Attendance | Minister of Mon State |
| | Date and Time | 22 March 2016 (10:00 – 10:30) |
| | Venue | Meeting Room, GAD office, Mawlamyine |

| | | |
|--|------------------------------|--|
| | Total Number of Participants | 32 participants |
| | Participated Organizations | CDC, GAD, INPD, RD, NPD, Forest, MOEP, ECD, MPT, Marine, Aviation, Railway, DUHD, Irrigation, Water resource, DLMS |

Source: JICA Study Team



Source: JICA Study Team

Figure 1.1.10: Pictures at the Courtesy Calls to Region/State Government

(4) 2nd Workshop Meeting

The 2nd workshop meeting of Nay Pyi Taw, summarized in Table 1.1.9 and shown in Figure 1.1.11, was held on 3rd May 2016 (Tue) in Nay Pyi Taw (Office 40, Ministry of Construction, Meeting Room), chaired by Deputy Director General of DUHD, and participated by MOC, relevant organizations, and the JICA Study Team.

Table 1.1.9: Summary Result of the 2nd Workshop in Nay Pyi Taw

| | |
|------------------------------|--|
| Title of the Meeting | Urban Development Planning Workshop |
| Date and Time | 3 May 2016 (Tuesday) at 13:00 – 17:30 |
| Venue | Office 40, Ministry of Construction, Meeting Room |
| Chairperson | Deputy Director General, DUHD |
| Total Number of Participants | 40 participants |
| Participated Organizations | DUHD, DAN, DH, MORAC, MOTC, Planning Department, GAD, TDC, MCDC, MES, ECD, DALMS |
| Agenda | Introduction (Deputy Director General, DUHD) <ul style="list-style-type: none"> Opening Speech on behalf of MOC (DUHD) Presentation <ul style="list-style-type: none"> Current status of the study and Planning Framework (JICA Study Team) Socio-economic Framework (JICA Study Team) Development Visions (JICA Study Team) Industrial Development for 3 cities (JICA Study Team) Urban Development Policy (JICA Study Team) Options for spatial planning (JICA Study Team) Future Next step of Project (JICA Study Team) Discussion |
| Minutes | (See attached file) |

Source: JICA Study Team





Source: JICA Study Team

Figure 1.1.11: Pictures of the 2nd Workshop

(5) Seminars

A series of seminar meetings was held in the target three cities from 9 to 19 May. Representatives of DUHD from Nay Pyi Taw were accompanied by the JICA Study Team, Deputy Director General of DUHD attended for Mandalay, and Deputy Director of URDD attended for Mawlamyine and Patheingyi. All seminar meetings were completed successfully. Details are shown in the later section.

1) Mandalay

The seminar meeting of Mandalay, summarized in Table 1.1.10 and shown in Figure 1.1.12, was held on 9 May 2016 (Mon) in Mandalay (Mandalay Hill Resort), chaired by Deputy Director General of DUHD and participated by MOC, relevant organizations, JICA and the JICA Study Team.

Table 1.1.10: Summary Result of the seminar in Mandalay

| | |
|------------------------------|--|
| Title of the Meeting | Urban Development Planning Seminar |
| Date and Time | 9 May 2016 (Monday) at 13:00 – 17:30 |
| Venue | Mandalay Hill Resort Hotel |
| Chairperson | Deputy Director General, DUHD |
| Total Number of Participants | 67 participants |
| Participated Organizations | DUHD, MCDC, TDC, Planning Department, DAR, DAN, Forest Department, ECD, DMH, MTU, MU, MGH, Companies, Merchants, ChinDwin College |
| Agenda | Introduction <ul style="list-style-type: none"> Opening Speech by Representative of JICA Myanmar Office Opening Speech by Deputy Director General, DUHD Presentation <ul style="list-style-type: none"> Planning Framework and Development vision (JICA Study Team) Socio-economic Framework (JICA Study Team) Industrial Development (JICA Study Team) Urban Development Policy (JICA Study Team) Infrastructure: Road and Transportation (JICA Study Team) Infrastructure: Water Supply, Sewage, Drainage and Solid Waste (JICA Study Team) Infrastructure: Electricity (JICA Study Team) Discussion |
| Minutes | (See attached file) |

Source: JICA Study Team



Source: JICA Study Team

Figure 1.1.12: Pictures of the Seminar Meeting of Mandalay

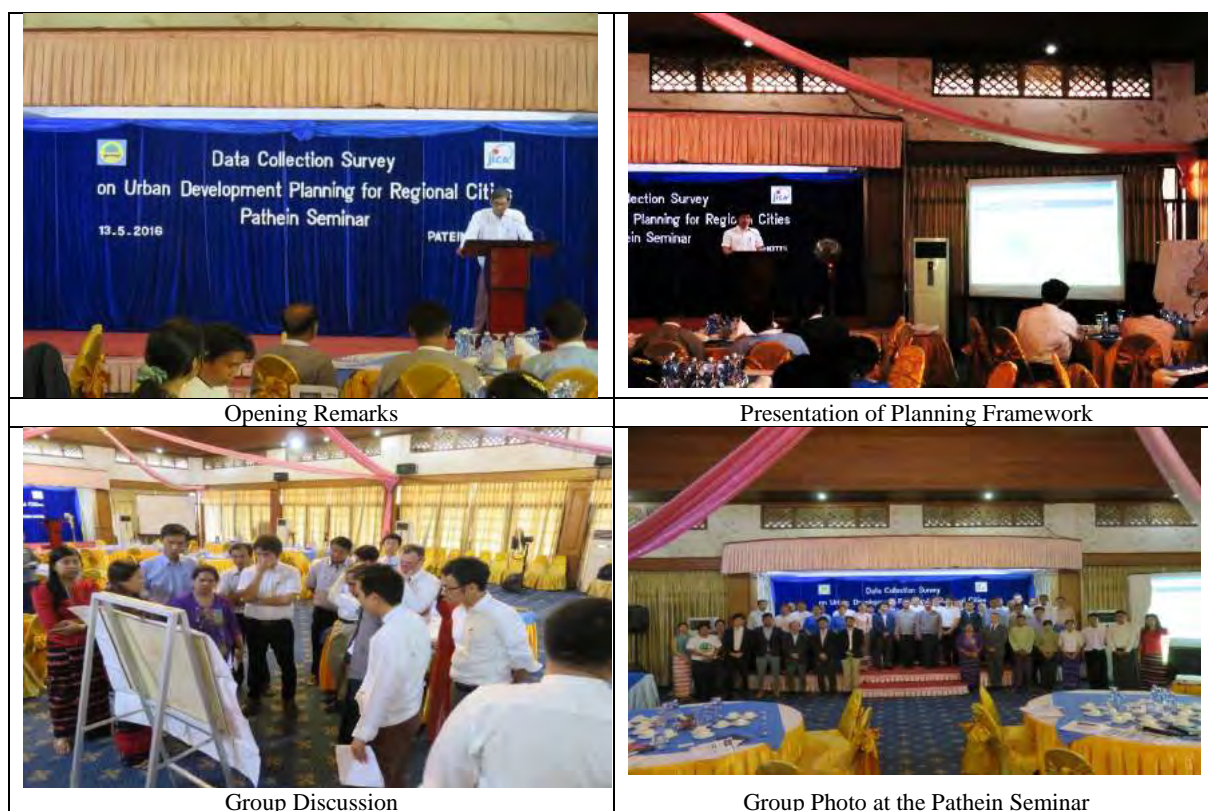
2) Pathein

The seminar meeting of Pathein, summarized in Table 1.1.11 and shown in Figure 1.1.13, was held on 13 May 2016 (Fri) in Pathein (Pathein Hotel), chaired by Deputy Director of URDD and participated by MOC, relevant organizations, JICA and the JICA Study Team.

Table 1.1.11: Summary Result of the seminar in Pathein

| | |
|------------------------------|--|
| Title of the Meeting | Urban Development Planning Seminar |
| Date and Time | 13 May 2016 (Friday) at 13:00 – 17:30 |
| Venue | Pathein Hotel |
| Chairperson | Deputy Director, URDD |
| Total Number of Participants | 48 participants |
| Participated Organizations | DUHD, GAD, TDC, DOC, DTAA, DMH, DISI, Planning Department, Forest Department, ARCCI, University, Companies, Merchants, Hotels |
| Agenda | Introduction <ul style="list-style-type: none"> Opening Speech (JICA) Opening Speech (URDD) Presentation <ul style="list-style-type: none"> Planning Framework and Development vision (JICA Study Team) Socio-economic Framework (JICA Study Team) Industrial Development (JICA Study Team) Urban Development Policy (JICA Study Team) Infrastructure: Road and Transportation (JICA Study Team) Infrastructure: Water Supply, Sewage, Drainage and Solid Waste (JICA Study Team) Infrastructure: Electricity (JICA Study Team) Discussion |
| Minutes | (See attached file) |

Source: JICA Study Team



Source: JICA Study Team

Figure 1.1.13: Pictures of the Seminar Meeting of Patheingyi

3) Mawlamyine

The seminar meeting of Mawlamyine, summarized in Table 1.1.12 and shown in Figure 1.1.14, was held on 18 May 2016 (Wed) in Mawlamyine (Ngwe Moe Hotel), chaired by Deputy Director of URDD and participated by MOC, relevant organizations, JICA and the JICA Study Team.

Table 1.1.12: Summary Result of the seminar in Mawlamyine

| | |
|------------------------------|--|
| Title of the Meeting | Urban Development Planning Seminar |
| Date and Time | 18 May 2016 (Wednesday) at 13:00 – 17:30 |
| Venue | Ngwe Moe Hotel |
| Chairperson | Deputy Director, URDD |
| Total Number of Participants | 54 participants |
| Participated Organizations | DUHD, DRD, GAD, TDC, DAN, DMH, MOSBA, Planning Department, LF, CSO, DISI, DAAS, Finance Department, ECD, Hotels, ADB, TU, UNHCR |
| Agenda | Introduction <ul style="list-style-type: none"> • Opening Speech (JICA) • Opening Speech (URDD) Presentation <ul style="list-style-type: none"> • Planning Framework and Development vision (JICA Study Team) • Socio-economic Framework (JICA Study Team) • Industrial Development (JICA Study Team) • Urban Development Policy (JICA Study Team) • Infrastructure: Road and Transportation (JICA Study Team) • Infrastructure: Water Supply, Sewage, Drainage and Solid Waste (JICA Study Team) • Infrastructure: Electricity (JICA Study Team) Discussion |
| Minutes | (See attached file) |

Source: JICA Study Team



Source: JICA Study Team

Figure 1.1.14: Pictures of the Seminar Meeting of Mawlamyine

(6) Courtesy Call to Region/State Government in May

Target 3 cities visit at same time of the seminars above, courtesy calls to each Region/State Government, summarized in Table 1.1.13 and shown in Figure 1.1.15, were done by JICA Study Team and C/P (MOC).

Table 1.1.13: Summary Result of Courtesy Call in Target 3 Cities

| | | |
|------------|----------------------------------|---|
| Mandalay | Title of the Meeting | Courtesy Call to Mandalay Region Government |
| | High Ranking Official Attendance | Chief Minister, Mandalay Regional Office |
| | Date and Time | 9 May 2016 (10:00 – 12:30) |
| | Venue | Meeting Room, GAD office, Mandalay |
| | Total Number of Participants | 14 participants |
| | Participated Organizations | MRO, MCDC, MOEP, MOC, MOEA, MOEP, MOC |
| Patheingyi | Title of the Meeting | Courtesy Call to Patheingyi Region Government |
| | High Ranking Official Attendance | Chief Minister, Ayeyarwaddy Regional Office |
| | Date and Time | 13 May 2016 (10:00 -12:30) |
| | Venue | Meeting Room , GAD office, Pathien |
| | Total Number of Participants | 12 participants |
| | Participated Organizations | ARO, MOEP, MOTC, ARA, DUHD |
| Mawlamyine | Title of Meeting | Courtesy Call to Mawlamyine Region Government |
| | High Ranking Official Attendance | Chief Minister, Mawlamyine Regional Office |
| | Date and Time | 18 May 2016 (10:00 – 12:30) |
| | Venue | Meeting Room, GAD office, Mawlamyine |
| | Total Number of Participants | 14 participants |
| | Participated Organizations | MRO, MOBEA, MOKEA, MOPEA, MOSBA, MOALT, DUHD |

Source: JICA Study Team



Source: JICA Study Team

Figure 1.1.15: Pictures at the Courtesy Calls to Region/State Government

(7) 3rd Workshop Meeting

The 3rd workshop meeting of Nay Pyi Taw, summarized in Table 1.1.14 and shown in Figure 1.1.16, was held on 16th June 2016 (Thurs) in Nay Pyi Taw (Office 40, Ministry of Construction, Meeting Room), chaired by Director General of DUHD and participated by MOC, relevant organizations, and the JICA Study Team.

Table 1.1.14: Summary Result of the 3rd Workshop in Nay Pyi Taw

| | |
|------------------------------|--|
| Title of the Meeting | Urban Development Planning Workshop |
| Date and Time | 16 June 2016 (Thursday) at 13:00 – 17:30 |
| Venue | Office 40, Ministry of Construction, Meeting Room |
| Chairperson | Director General, DUHD |
| Total Number of Participants | 40 participants |
| Participated Organizations | DUHD, MORAC, MOTC, MONPF, MOHT, ECD, GAD, MCDC, TDC, The Asia Foundation |
| Agenda | Introduction (Deputy Director General, DUHD) <ul style="list-style-type: none"> Opening Speech on behalf of MOC (DUHD) Presentation <ul style="list-style-type: none"> Study outline, Progress and Planning Framework (JICA Study Team) Vision & Strategies (JICA Study Team) Spatial Plan (JICA Study Team) Prioritized Projects (JICA Study Team) Urban Development Management (JICA Study Team) Closing Speech by Director General, DUHD |
| Minutes | (See attached file) |

Source: JICA Study Team





Source: JICA Study Team

Figure 1.1.16: Pictures of the 1st Workshop of Mandalay

(8) Meeting with Mandalay Mayor

Courtesy call meeting with Mandalay Mayor in Mandalay, summarized in Table 1.1.15 and shown in Figure 1.1.17, were done by JICA Study Team and MCDC.

Table 1.1.15: Summary Result of Courtesy Call Meeting with Mandalay Mayor

| | | |
|----------|----------------------------------|--|
| Mandalay | Title of the Meeting | Courtesy Call Meeting with Mandalay Mayor |
| | High Ranking Official Attendance | Mayor, Mandalay City Development Committee |
| | Date and Time | 20 June 2016 (10:30 – 12:15) |
| | Venue | MCDC office, Meeting Room |
| | Total Number of Participants | 19 participants |
| | Participated Organizations | MCDC, DUHD |

Source: JICA Study Team



Source: JICA Study Team


Figure 1.1.17: Pictures at the Courtesy Call Meeting with Mandalay Mayor in Mandalay

(9) Other Activities

1) Workshop on Myanmar Industrial Development Vision (MIDV) and the Next Five-Year Plan

A workshop was held on 2 February 2016 in Mandalay regarding industrial development and the next Five-year Plan hosted by the Ministry of National Planning and Economic Development (MNPED), Mandalay Region Government, and JICA. The JICA Study Team was requested to participate in the workshop as one of the speakers to share the outline of the study focusing on industrial development in Mandalay. Results of the MIDV workshop are summarized in Table 1.1.16.

Table 1.1.16: Summary Result of MIDV Workshop

| | | |
|----------------------------|--|--|
| Title of Activity | Workshop on Myanmar Industrial Development Vision (MIDV) and the Next Five-year Plan |  |
| Date and Time | 2 February 2016 (Tue) 9:00 – 17:30 | |
| Venue | Sedona Hotel, Mandalay | |
| Participated Organizations | MNPED, Mandalay Region Government, JICA, Professor of GRIPS, JICA Study Team, Embassy of Japan, Ministry of Agriculture of Japan, DICA /MNPED, Ministry of Industry of Myanmar, other ministries | |

Source: JICA Study Team

2) ADB Workshop, Establishing the Future Cities Program in the Asia-Pacific Region

A workshop was held on 3 February 2016 in Mandalay to introduce the inception report of the program supported by ADB. The objective of this TA program is to enhance operational knowledge and long-term sector engagement, areas identified under the mid-term review of ADB's Strategy 2020 (MTR), for the implementation of ADB strategic priorities in the urban sector. The seven target cities, 1) Tbilisi, 2) Colombo, 3) Mandalay, 4) Ho Chi Minh, 5) Ulaan Baatar, 6) Suva, 7) Bandung, are selected by ADB and Mandalay City is one of the target cities.

According to the introduction of the inception report, the “core project sector” of the program for Mandalay City will be WSS (water supply system) and SWM (solid waste management).

In the workshop, general information on ongoing and planned infrastructures in multi sectors in Mandalay was collected from the participants to acquire the basic information for the program. Results of the UK-Japan Seminar are summarized in Table 1.1.10.

Table 1.1.17: Summary Result of ADB Workshop

| | |
|----------------------------|---|
| Title of Activity | ADB Workshop, Establishing the Future Cities Program in the Asia-Pacific Region |
| Date and Time | 3 February (Wed.) 09:00 – 17:30 |
| Venue | Mandalay Hill Resort, Mandalay |
| Participated Organizations | ADB, FASEP Study Team, and Myanmar private and public sectors. |



Source: JICA Study Team

3) Seminar on UK-Japan Supporting Infrastructure Development in Myanmar

A seminar was held on 11 March 2016 in Yangon regarding infrastructure development discussion hosted by the British Embassy. The JICA Study Team was requested to participate in the seminar as

one of the speakers and panelists from the viewpoint of regional urban development. Results of the UK-Japan seminar are summarized in Table 1.1.18.

Table 1.1.18: Summary Result of UK-Japan Seminar

| | |
|----------------------------|--|
| Title of Activity | Seminar on UK-Japan Supporting Infrastructure Development in Myanmar |
| Date and Time | 11 March 2016 (Fri) 13:00 – 17:30 |
| Venue | Park Royal Hotel, Yangon |
| Participated Organizations | British Embassy, JICA, JICA Study Team, MOC of Myanmar, British private and public sectors, Japanese private and public sectors, and Myanmar private and public sectors. |



Source: JICA Study Team

1.2 Legal and Regulatory Framework

1.2.1 Urban and Regional Development Planning Law

Since the urban development plan to be formulated in the Study shall be defined in the currently being prepared law, namely; “Urban and Regional Development Planning Law”, the review of this law is the most important aspect of the Study.

(1) Current Status of the Law

Drafts of the law have been submitted from MOC to the Union Attorney General Office (hereinafter referred to as “UAGO”) thrice so far, and MOC received comments on it and modified it each time. Currently, MOC is under work for the modification of the 3rd comment from UAGO. The 3rd draft submission is shown in the attachment of the report. Afterward if the procedure goes smoothly, the draft will be sent to the Presidential Office. According to MOC’s prospect, the draft law will proceed to the Parliament after June 2016.

(2) Framework of the Law

The focal aim of the law can be said to define the urban development plan which direct future urban image and framework. According to the draft, the objectives of the law are:

- To formulate the development plans within the country systematically and to have management systems powerful enough to implement the development plans;
- To reduce the development gap among the regions within the country;
- To support the security of the State, health, safety, economic development, culture, and higher living standards of the people;
- To harmonize the land use appropriation in urban areas with policies related to the use of land resources of the country effectively for future development and conservation;
- To implement the land use based regional plans systematically incorporating sector-wise plans formulated for socio-economic development; and
- To become land use based that can support sustainable economic development of the country.

The chapter frame of the law is shown in Table 1.2.1.

Table 1.2.1: Chapter Frame of the Draft Law

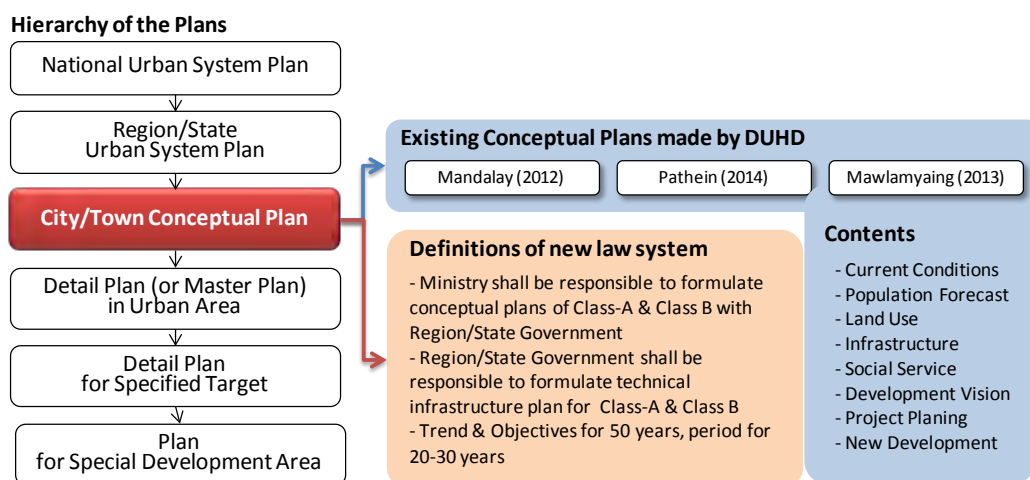
| Item | Contents |
|------------|---|
| Contents | 17 Chapters and 85 Articles |
| Chapter 1 | Name and Definition |
| Chapter 2 | Objectives |
| Chapter 3 | Framework of Development Plan |
| Chapter 4 | Organization of National Urban and Housing Development Central Committee |
| Chapter 5 | Organization of Urban and Housing Development Region/State Committee Self-administered Division |
| Chapter 6 | Task of Department |
| Chapter 7 | Classification of the Types of Cities or Towns and Development Plans |
| Chapter 8 | Formulating, Evaluating and Approving Urban Plans |
| Chapter 9 | Review and Modification of Development Plans |
| Chapter 10 | Specify Zone and Change in Land Use |
| Chapter 11 | Budget Resources |

| | |
|------------|---|
| Chapter 12 | Reception of Planning Permit and Implementation |
| Chapter 13 | Taking Action using Management Method |
| Chapter 14 | Appeal |
| Chapter 15 | Prohibition |
| Chapter 16 | Offenses and Penalties |
| Chapter 17 | Miscellaneous |

Source: JICA Study Team

(3) Definition of the Law

According to the draft law, regulated urban development plans are categorized into six plans from the national level to district level as hierarchy of the plans. The plans to be formulated in the Study shall correspond to “City/Town Conceptual Plan” regulated in the law as shown in Figure 1.2.1.



Source: JICA Study Team

Figure 1.2.1: Hierarchy of the Plan in the Draft Law

The law classifies 367 cities and towns into five grades, from Grade A to Grade E, depending on those population volumes or regional roles. As per classification, Mandalay is Grade A, and Pathein and Mawlamyaine are Grade B as shown in Table 1.2.2.

Table 1.2.2: City Grade in the Draft Law

| Grade | Definition | Target 3 Cities |
|---------|---|-------------------------|
| Grade A | CDC – 3 cities | Mandalay |
| Grade B | District Level >20,000 pop, Township 40,000-100,000 pop (70 no) | Pathein and Mawlamyaine |
| Grade C | District Level < 20,000 pop, Township 20,000-40,000 pop (66 no) | |
| Grade D | Township 10,000-20,000 pop (68 no) | |
| Grade E | Township <10,000 pop (160 no) | |

Source: JICA Study Team based on MOC Material

Based on the grade of cities and towns, required planning frame is also different as shown in Table 1.2.3.

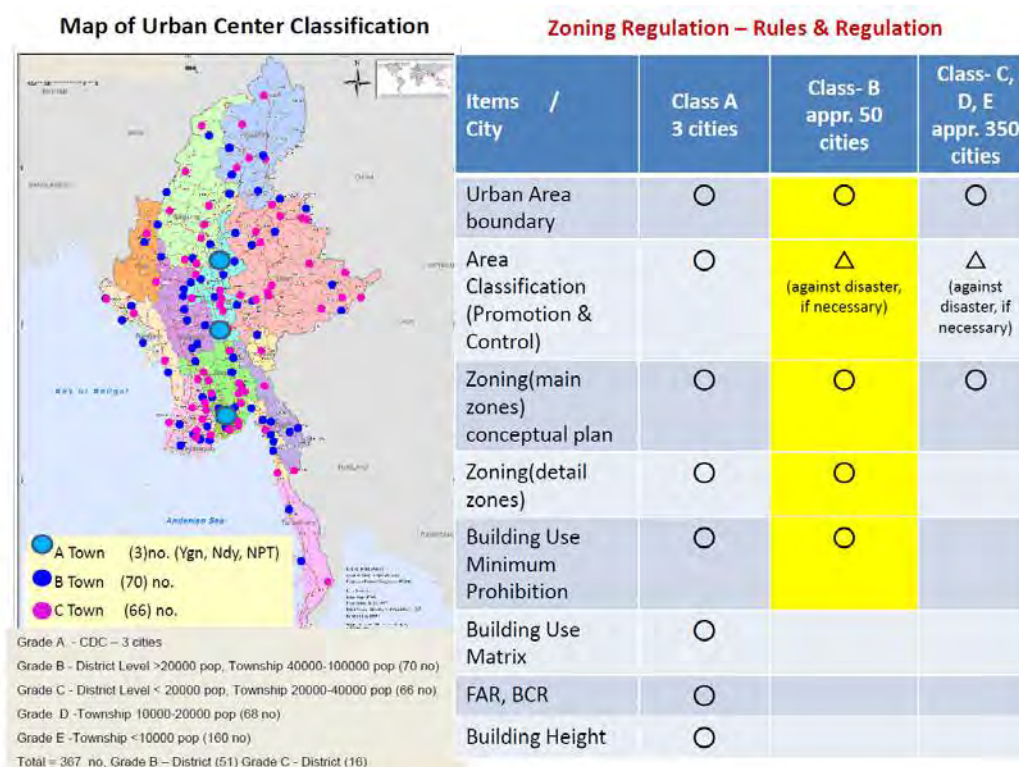
Table 1.2.3: Contents of the Plan by City/Town Grade

| Grade A: | Grade B, C, D, and E |
|--|--|
| 1. Development status of inner areas and outskirt areas of the town and city, urban structure, urban landscaping, security and administration inside the city or town, service, trading, culture, education, health and training, green area and parks, physical | 1. Description mentioned in Section 19 (a) of this law shall be included in this Plan. 2. Areas that will promote development activities, areas that will be controlled, preserved areas, reserved areas for urban development, buffer areas, |

| | |
|--|--|
| <p>training and sports related facilities, technical infrastructures inside the town or city territory, including the development objectives of a town or city, major propulsions and constraints, population, area, social and technical infrastructure standards, underground areas and water body areas shall be incorporated in one framework. Environmental impact assessment, prioritized investment plans in implementing urban development activities, and exploitation measures of natural resources shall also be included.</p> <p>2. Areas that will promote development activities, areas that will be controlled, preserved areas, reserved areas for urban development, buffer area, and open space shall be clearly mentioned in the development plan.</p> <p>3. That plan is formulated for the coming 50 years including trend and objectives of the town or city and its period can be specified from 10 to 30 years.</p> <p>4. Approved Urban Conceptual Plan shall serve as a basic framework for formulating the Technical Infrastructure Plan, Urban Zoning Plan and Detailed Plan, and implementing prioritized investment plans for that town or city.</p> | <p>and open space shall be clearly mentioned in the development plan.</p> <p>3. That plan is formulated for the coming 50 years including trend and objectives of the town or city and its period can be specified from 10 to 30 years.</p> <p>4. Approved Urban Conceptual Plan shall serve as a basic framework for formulating the Technical Infrastructure Plan, Urban Zoning Plan and Detailed Plan, and implementing prioritized investment plans for that town or city.</p> |
|--|--|

Source: MOC (Draft of Urban and Regional Development Planning Law)

Additionally, MOC also intends to regulate the contents of the plans based on the grade of the cities and towns in “Rules and Regulations” which is under preparation as shown in Figure 1.2.2. According to the proposal, Mandalay’s Plan, Grade A, shall be required to include all contents, namely; urban area boundary, area classification, zoning, building use prohibition, building use matrix, floor area ratio (FAR), building coverage ratio (BCR), and building height. On the other hand, building use matrix, FAR, BCR, and building height are not necessary to be included in Patheingyi and Mawlamyine plans.



Source: MOC (Presentation Material)

Figure 1.2.2: Proposal of Zoning Regulation by City Grade

1.2.2 Other Related Laws

(1) Condominium Law

Condominium Law has been enacted, which defines to regulate the classification ownership of condominium, including foreigner's ownership, in February 2016. Target in the law is the condominium with more than six stories and/or has site area of more than 20,000 ft² (approximately 1,858 m²). Foreigners are allowed to dominate up to 40% of the number of households in the target condominium. The supervisory authority of the law is the Housing Development Division, DUHD, MOC.

Since this law defines individual buildings and those ownerships, it may not be affected by the law in the urban development plan. On the other hand, this law shall encourage urban development projects by foreign investors and high-rise building construction. These should be taken into account in the planning work.

(2) National Housing Development Law

The National Housing Development Law is being prepared in similar schedule with the Urban and Development Planning Law. Current status of the law is in the phase of finalizing the draft with UAGO. The law, which consists of 15 chapters and 67 articles, aims at sustainable housing development to contribute to economic growth and living improvement. The draft law is expected to proceed to the Parliament after June 2016. The supervisory authority of the law is the Housing Development Division, DUHD, MOC, same as Condominium Law.

This law must be close relationship with the urban development plan, especially in housing supply. Because a sort of housing supply master plan may be formulated under the law, relevant information should be collected in the planning work.

(3) Myanmar National Building Code

The Myanmar National Building Code (called "MNBC") was made as its "Provisional" in 2012 supported by UN-Habitat. As the provisional consists of seven parts in total, Part 1 regulates "Planning, Environment, Administration and Legislation", including zoning classification and planning permission. Current status of the law is in the phase of public hearing to collect opinions of stakeholders. MOC intends to enact the law within 2016. The supervisory authority of the law is the Department of Building, MOC.

Since this law covers zoning and planning permission, it should be referred more in detail urban design to realize urban spatial plan. In the implementation stage after planning stage, the law will have necessary power to control individual building shape and location.

(4) Myanmar Construction Industry Development Board Law

The Myanmar Construction Industry Development Board Law has commenced its drafting work. The objective of the law is to identify building and development permission and its procedure and criteria in order to control the quality of buildings. The supervisory authority of the law is the Department of Building, MOC.

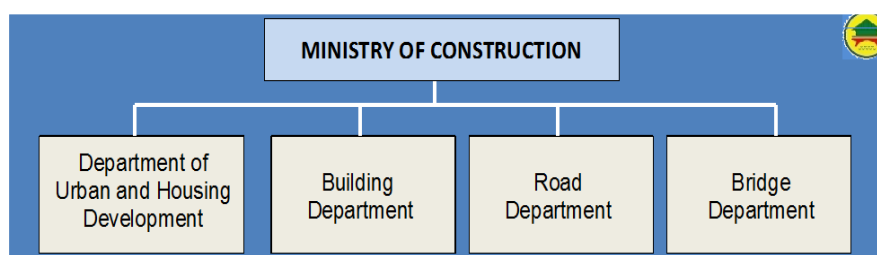
This law should be referred more in implementation stage rather than planning stage. In the plan, this law will be mentioned as one of necessary law for urban management for realizing the urban spatial plan.

1.3 Organization Framework

1.3.1 National Level

(1) Overview of MOC

The Ministry of Construction consists of four departments, namely; the Department of Urban and Housing Development (hereinafter referred to as “DUHD”), Building Department, Road Department, and Bridge Department. Formerly the name of DUHD was the Department Human Settlement and Housing Development (DHSHD). The other three departments used to be the Public Works Department. Figure 1.3.1 shows the organizational structure of MOC.



Source: MOC

Figure 1.3.1: Organization Structure of MOC

DUHD consists of six divisions as shown below. Urban and Regional Development Division (URDD) which is one of the divisions is in charge of making city/town conceptual plan as described in the next section.

< Divisions of DUHD >

1. Administrative Division
2. Finance Division
3. Land and Housing Division
4. Urban and Regional Planning Division
5. Housing Development Division
6. Urban Infrastructure Division

Currently, DUHD has a total of 2,280 officers and staffs, whose breakdown is 234 officers and 2,046 staffs. DUHD has a plan to increase the number of officers and decrease the number of staffs in the future.

Table 1.3.1: Number of Officers and Staffs of DUHD

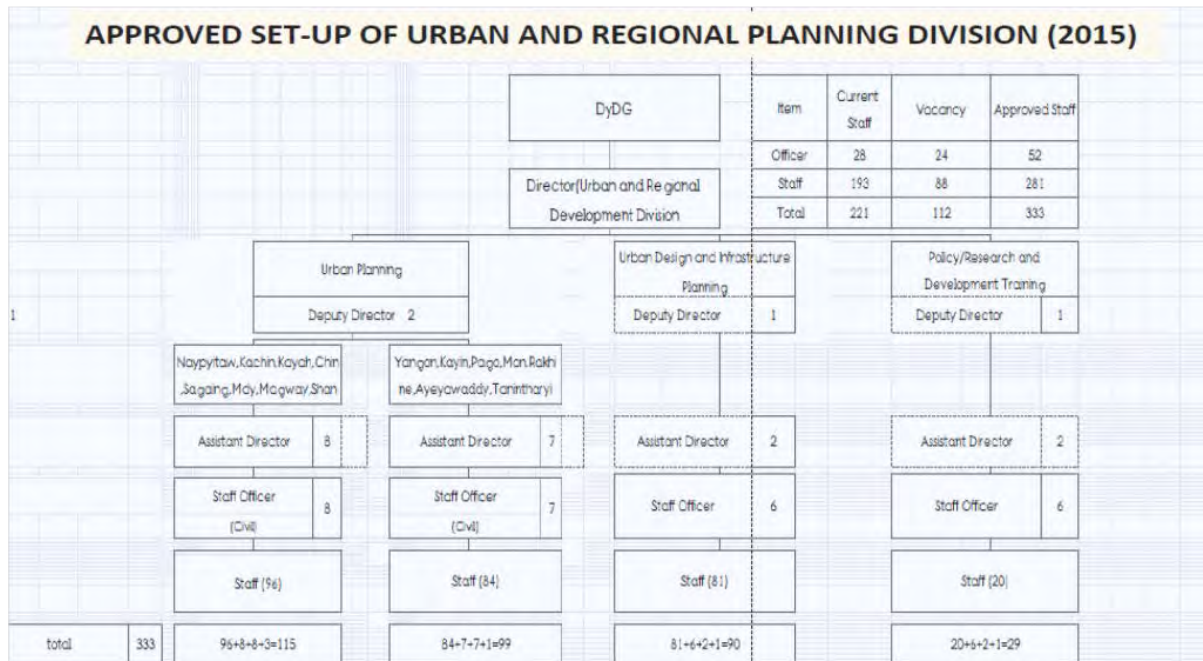
| Position | Current | Proposed | Increase/ Reduce |
|----------|---------|----------|------------------|
| Officer | 234 | 383 | 149 |
| Staff | 2,046 | 1,781 | -265 |
| Total | 2,280 | 2,164 | -116 |

Source: JICA Study Team based on MOC Material

(2) Urban and Regional Development Division (URDD)

URDD has a total of 221 officers and staffs, 28 officers and 193 staffs, as shown in Figure 1.3.2. But as of the end of 2015, actual figures are about 20 officers and 90 staffs according to the director information. The work breakdown of 90 staff is 30 surveyors, 20 PC operators, 20 landscape keepers,

and 20 administration officers. It was approved to increase the number of officers and staffs to a total of 333 in the future (no specific time schedule).



Source: MOC

Figure 1.3.2: Organizational Structure of URDD (Current and Future)

(3) Formation of Planning Teams

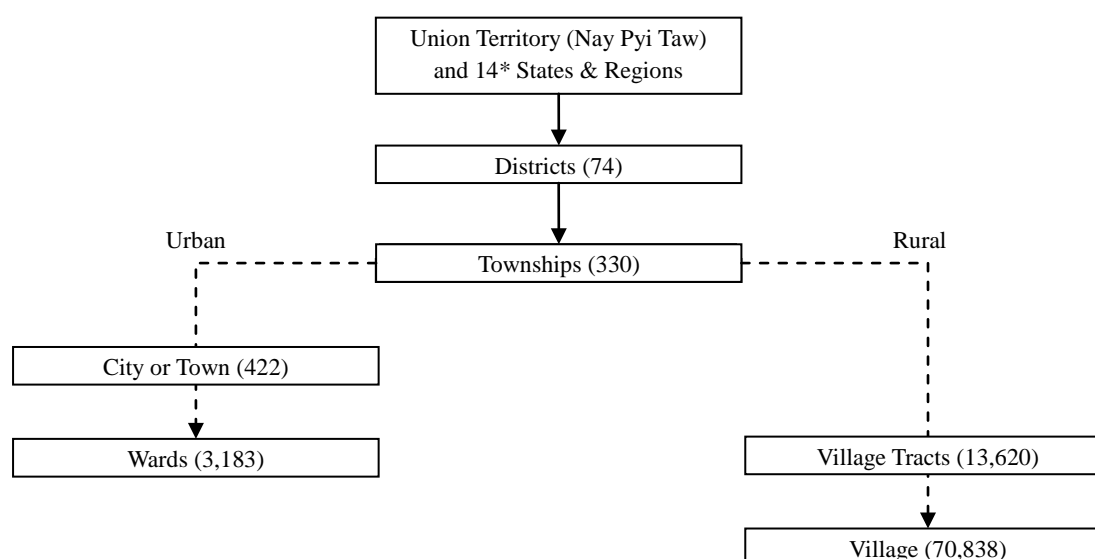
According to an interview with URDD, there are seven team leaders who can lead the planning teams to make a city/town conceptual plan in URDD. URDD's planning teams have so far formulated 56 city/town plans. As the members of planning teams are not fixed, the team is organized when necessary under the team leaders.

In ordinary case, the planning team consists of around ten members; which includes 2 planners, 7 surveyors, and 1 PC operator. Google Map is used for planning the base map. The planning period usually takes six weeks; one week for the preparation in NPT, two weeks for field survey in the target city, and three weeks for planning and reporting in NPT. In the field survey, information collection and exchange opinion with the General Administrative Department (GAD), Township Development Committee (TDC), and other related organizations are thoroughly conducted by the planning team. Stakeholder meeting is also held, usually twice, in the target city. The figure of the growth rate for population forecast is referred from one of the Migration Department, Ministry of Migration and Population.

1.3.2 Target Three Cities

Myanmar's administrative structure, shown in Figure 1.3.3, has three major layers; Union Territory (Nay Pyi Taw) and 14 regions and states as the first layer, 74 districts as the second layer, then 330 townships as the third layer. Townships are separately administrated; consisting of wards in urban area and village tracts in rural area.

The 2008 Constitution, implemented since 2011, is the current primary legal reference framework for governance of Myanmar. As stipulated in Schedule II, the municipal management and development affairs fall in the autonomous area of the region and state government. However, all other areas of governance of sub-national level are still based on the function of the union ministries which maintain offices at the state/region, district, and township levels.

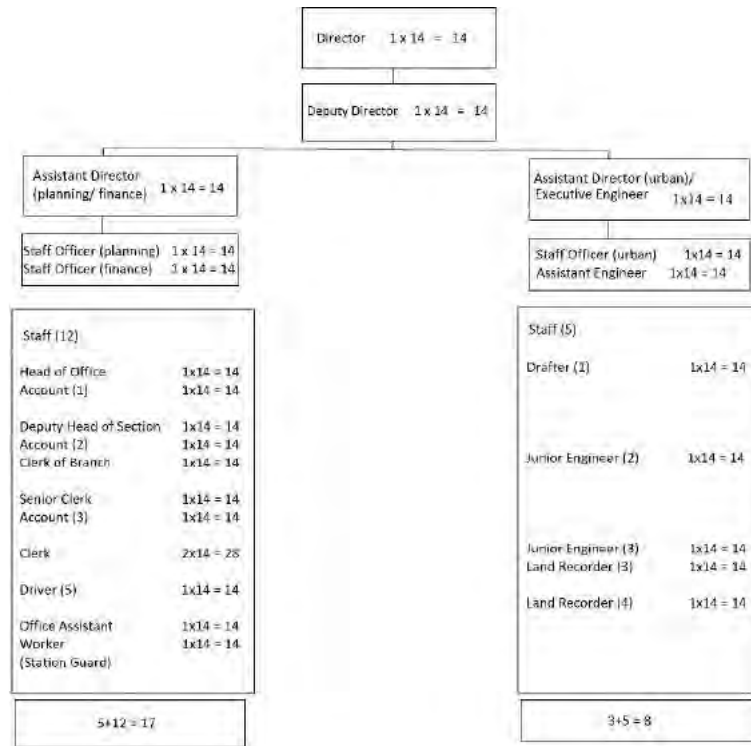


Source: General Administration Department, Ministry of Home Affairs, March 2015

Figure 1.3.3: Myanmar Administrative Structure

DUHD structure has 14 local DUHD branches distributed at seven regions and seven states, which were established and started operating since April 2015 (neither in districts nor townships). The branch office in each region and state has specific assignment on new housing development for government employees and for poor community as a public service. Hence, DUHD branch offices have only limited involvement on urban development planning, apart from the land use for housing purpose. The state or region office normally consists of i) one director, ii) two deputy directors, iii) two assistant directors, and iv) one staff officer and staffs, as shown in Figure 1.3.4.

The size of the branch office is different from the region and state, due to some vacancies in the needed posts. At Patheingyi office, total of 12 people (7 officers and 5 staffs), and at Mawlamyine office total of 17 (9 officers and 8 staffs) are taking responsibility.



Source: MOC

Figure 1.3.4: Myanmar DUHD Administrative Structure



Source: JICA Study Team

Figure 1.3.5: Pictures of DUHD Office Room in Pathein

(1) General Governance Structure in Regions and States

The autonomy of the region and state government, established by series of reforms in Myanmar legislation since 2011 as shown in Table 1.3.2, was the ex-President H.E.U. Thein Sein government priority to avert international sanctions and to fix Myanmar's relationship with the international community. A gradual shift of responsibilities from the union level to region and state governance has taken place since then, but not yet fully extended the transfer of responsibilities to local-level institutions. As mentioned in Section (i), it is the uniqueness of the Myanmar's sub-national governance that the chief minister and his/her supporting nine ministers at the region and state level do not have their own bureaucracy independently functioning from the Union Government as shown in Figure 1.3.6. Only exception is the municipal management and development affairs under the Ministry of Development Affairs, which are allowed to prepare a local developing plan independently. The nine ministers at the sub-national level (region and state level) are appointed by the State of Region Chief Minister, who himself/herself is appointed by the Chief Minister of the State, conditioned to the

approval of the respective state or region *Hluttaw* (parliament), whereas the public administration at the sub-national level is conducted by civil servant, in the 2008 Constitution.

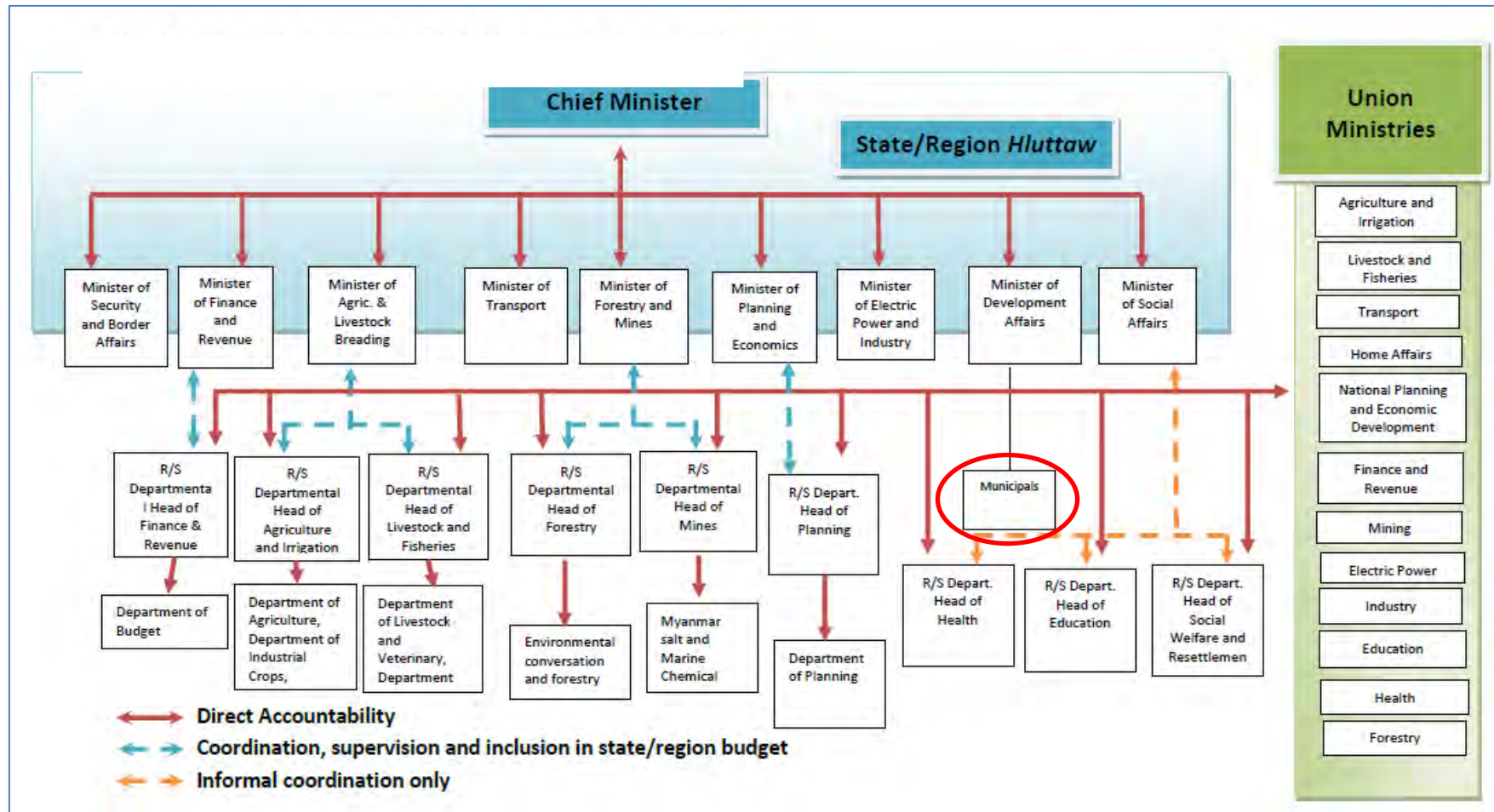
To further advance the decentralization in local municipal service and exercise legislative powers, followed by the Presidential Notification and new municipal laws in 2013, the sub-national government formed four committees: Township Management Committee (TMC), Township Development Support Committee (TDSC), Township Development Affairs Committee (TDAC) (in some articles, this committee is translated as Township Municipal Committee (TMuC)), and Farmland Management Body (FMB).

Parallel to the decentralization movement in sub national governance, the regions and states obtained separate budgets from the Union, though the union budget continues to include significant transfers to these local budgets. This is the second driver of public financial management reform, and intended to allow more bottom-up input to budgeting. Though the state and region budget is subjected to the approval by the Union government, the state/region does have enhanced control over certain components of the budget, notably locally-raised revenue, from activities stipulated in the Schedule II.

Table 1.3.2: Reforming Local Governance (Key Events between 2011 – 2013)

| | |
|----------------------|---|
| February 2012 | Amendment of Ward and Village Tract Act |
| March 2012 | President sets up Poverty Reduction Fund |
| December 2012 | VT/WA elections |
| February 2013 | Presidential Notification 27/2013 |
| March 2013 | Establishment of TDSCs, W/VTDCs through elections |
| 2013 | Pyidaungsu Hluttaw sets up Constituency Development Fund |
| Mar 2013 – Jan. 2014 | Adoption of “Municipal Laws” in 14 states and regions, formation of TMuCs through elections |

Source: JICA Study Team



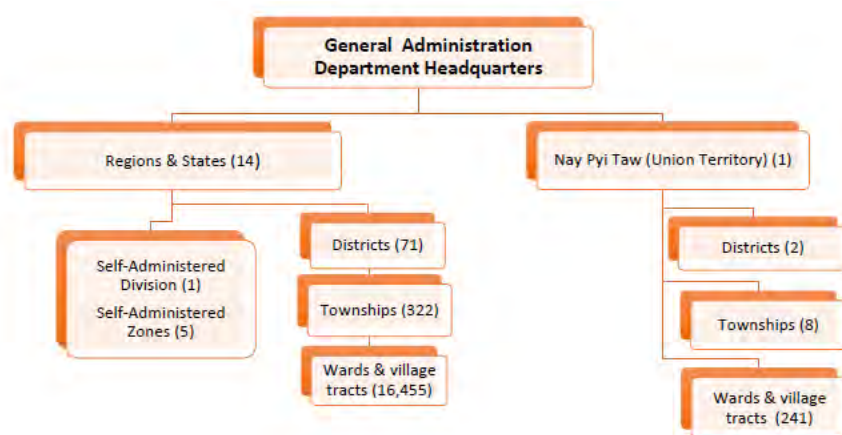
Source: Arnold M., Saw K.P.C., “Adminitrating the State in Myanmar; An Overview of General Administration Department”, October 2014

Figure 1.3.6: Region and State Government Structure

(2) GAD and Its Role at the Subnational Level Governance

The 2008 Constitution stipulates in Section 260 that the General Administration Department (GAD) from the Ministry of Home Affairs (MOHA) of the region or state is the office of the region or state government, and the head of GAD of the region or state is the secretary of the respective region or state government. The township and district GAD administrators play a primary role in the assorted management and development committees. GAD at the township and district spends large part of their time on township administration, as they must focus on prioritizing and implementing local development projects.

GAD plays a central role, vertically and horizontally, in convening, coordinating, and communicating the discussions, recommendations, and decisions of these assorted committees within the state administration, and particularly up to the region and state governments. GAD's role is strongest in the district and township management committees, where district and township administrators act as chairpersons. GAD township deputy administrators are involved as members of other committees such as the township development support and development affairs committees. Figure 1.3.7 shows GAD offices and staff chart.



Source: Arnold M., Saw K.P.C., "Administering the State in Myanmar; an overview of General Administration Department", Oct. 2014

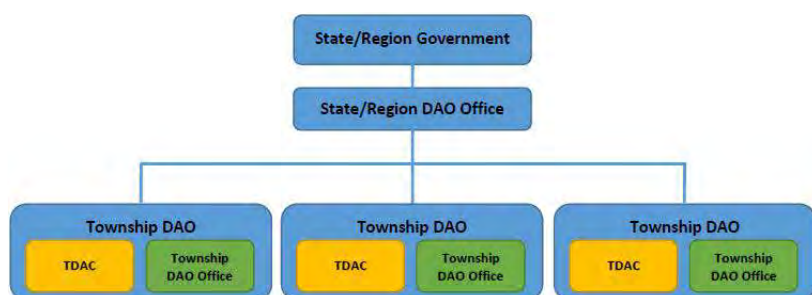
Figure 1.3.7: GAD Offices and Staff

(3) Planning Process at the Township Level¹

The townships are not elected level of government but are local administrative divisions of the states and regions, as well as of the Union Territory, and it is the administrative unit covering the entire national territory.

The working body for the state or region minister of development affairs is the Development Affairs Organizations (DAOs). All of Myanmar's townships, outside of Yangon City, Mandalay City, and Nay Pyi Taw Union Territory, have a Township DAO Office that is under the full control of their respective state or region government. Township DAOs have two complementary entities: a Township Development Affairs Committee (TDAC) and a Township DAO Office. DAOs manage local municipal affairs at the township level. The State/Region DAO Office in the state/region capital is, in turn, mainly responsible for coordination and staff management for the whole state/region. In contrast, at the township level, TDAC and Township DAO Office work together to prioritize public works and municipal management. Figure 1.3.8 shows DAO positioning within sub-national governance.

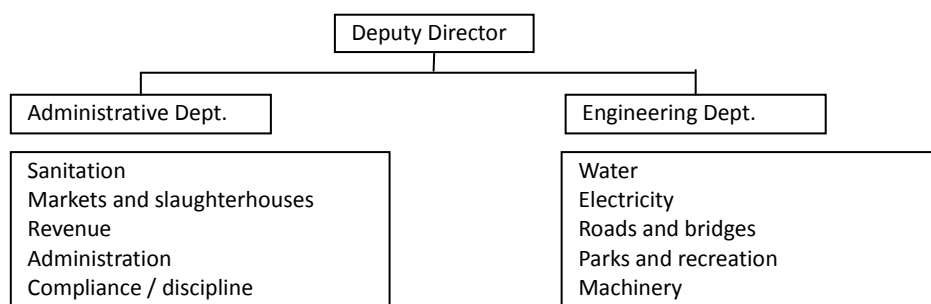
¹ Arnold M, "Municipal Governance in Myanmar", July 20015



Source: Arnold M., Aung Y T., Kempel S., et al., "Municipal Governance in Myanmar, An Overview of Development Affairs Organizations", July 2015

Figure 1.3.8: DAO Positioning within Subnational Governance

Township DAO Offices will have at least two departments (administration and engineering) as shown in Figure 1.3.9. Though larger township DAO offices may have up to five departments, having just two departments is common.



Source: JICA Study Team, based on "Municipal Governance in Myanmar, An Overview of Development Affairs Organizations" (Arnold M., Aung Y T., Kempel S., et al, July 2015)

Figure 1.3.9: General Structure of DAO

TDAC is formed under the development law of each region and state, together with three other committees; Township Management Committee (TMC), Township Development Support Committee (TDSC), and Farmland Management Body (FMB). In collaboration with Township DAO Offices, TDACs play a key role in setting priorities for annual planning and budgeting of township DAO funds and funds from the Union Government within the DAO's area of responsibility.

Budget prepared by township DAO and TDAC is sent to the state and region DAO for further integration into the state and region budget, and then, via state and region "hluttaw" decision, into the union budget with potentially alternations. After approval of the budget by union level and state and region level, Township budget becomes final. In 2013 fiscal year, 3.6% of the union budget was transferred to state and regions. Apart from the transferred union budget, township DAO has full is fully self-funded, by collected revenue.

(4) Governance in Mandalay

Municipal affairs in Yangon and Mandalay cities are organized differently than the rest of the country, as described in the previous Section (3).

Mandalay, consists of seven townships, is managed by the Mandalay City Development Committees (MCDC), which are responsible for municipal service delivery and public works (waste management, water supply, roads and bridges, parks and sports grounds, street lighting, funeral services and firefighting), city planning, urban land administration, tax collection (including business licensing and registration), public health, and urban development. The current responsibility and power belonging to municipality is routed in the 1898 Municipal Law, which introduced provisions of new

electrification, expanded collection of fees for the urban services to the Municipal, as well public works listed above.

These objectives are being implemented by the following 14 departments:

1. Administration Development
2. Motor Transport and Workshop Department
3. Market and Slaughter House Department
4. Finance Department
5. Revenue Department
6. Cleaning Department
7. Playgrounds, Parks and Gardens Department
8. Building and Central Stores Department
9. Roads and Bridges Department
10. Water and Sanitation Department
11. City Planning and Administration Department
12. Public Relation and Information Department
13. Inspection Department
14. Agriculture and Livestock Breeding Department

The MCDC have delegated administrative functions under the authority of the Mandalay Region Governments (MRG). Thus, they are not fully autonomous local governments. MCDC is now managed by committees consisting of nine members that are partly elected by the public. The head of MCDC is a Mayor of Mandalay city, acting as a chairman of the committees. The Mayor also has a seats as the Minister of Development Affairs in the MRG. Thus, the Mayor's authority is ranged with the activities covered by MCDC, but at the same time the Mayor as the Minister of Development Affairs has authority over development planning in the region. In a way, this structure is similar with the structure of DAO directly working under the regional ministry of development affairs in the rest of country as described in the Section (3). The hierarchical order of MCDC as organization and within the Regional Government are as follows;

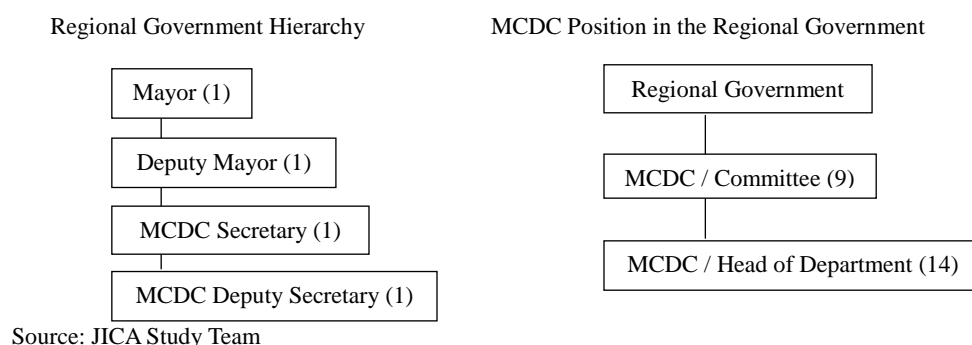


Figure 1.3.10: MCDC Hierarchical Order

(5) Urban Planning in Patheingyi and Mawlamyine³

Though the basic governance framework is the same with other state or region of the country, Ayeyawady Region and Mon State are reported to try different approach in planning phase of annual budget for municipal activities.

³ UNDP, "The State of Local Governance: Trends in Mon", 2014; UNDP "The State of Local Governance: Trend in Ayeyawady", 2014

In Ayeyawady Region, new practices for “participatory planning” are taking place, these are consultations with local communities and interest groups to obtain suggestions and priorities. This is happening at the township level in Ayeyawady through line ministry institutions such as the Township Planning and Implementation Committee (TPIC). The strongest emphasis on public participation is identified in Patheingyi, where businessmen and “elders” or recognized leaders from the community are the prominent members. However, still, horizontal coordination has been a problem among DAO and line ministries in township planning level.

In Mon State, the state government has development affairs committees at the state/region level to mirror those at the township level, which is unique and can be only seen in Yangon and Shan. The Minister of Development Affairs serves as the state/region development affairs committee’s chairperson, and the state/region director for DAO serves as the committee’s secretary.

Also, Township Management Committee (TMC) is emerging as the key driver for the adoption of township development plans and priorities, in consultation with the three other township committees (TDSC, TMAC, and TFMC) and relevant departments. TMC also displaced to some degree the planning role of the TPIC which has been rendered largely inactive in assisting such a mandate of the Ministry of National Planning and Economic Development (MoNPED) to correct and compile local economic data for midterm planning purpose.

1.4 Review of Existing Plans

1.4.1 Overview of Urban Development Plans

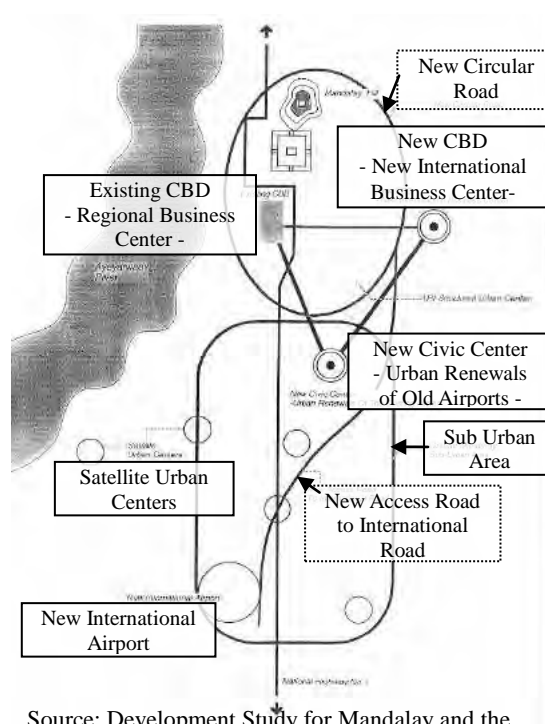
The target three cities have existing urban development plans made by several organizations. MOC made plans for each city. Mandalay has plans made by ECFA (1996) and MCDC (2012). Patheingyi and Mawlamyine have plans made by each Township Development Committee. Below is a brief summary of each plan.

(1) Mandalay

1) Master Plan by ECFA (Chiyoda) (1996)

Engineering Consulting Firms Association, Japan (ECFA) which organization included Chiyoda Corporation made an urban master plan of Mandalay according to an agreement with MCDC in 1996. This master plan made development concepts including conceptual structure plan and implementation plan based on review of development trend in that period. The plan includes infrastructure plan such as transportation, water supply, sewage, and electricity.

It planned three city cores in the northern area of the city; i) existing central business district (CBD) to serve as regional business center, ii) new CBD to serve as international business center, and iii) new civic center to be the service area for the city population. And the southern area was planned as sub urban area consisting of regional industrial park, national heritage park, export processing zone with National Highway-1, and new access road to international road. Figure 1.4.1 shows the conceptual structure plan in the Chiyoda Plan. This structure idea had been utilized as a basic development concept of Mandalay.



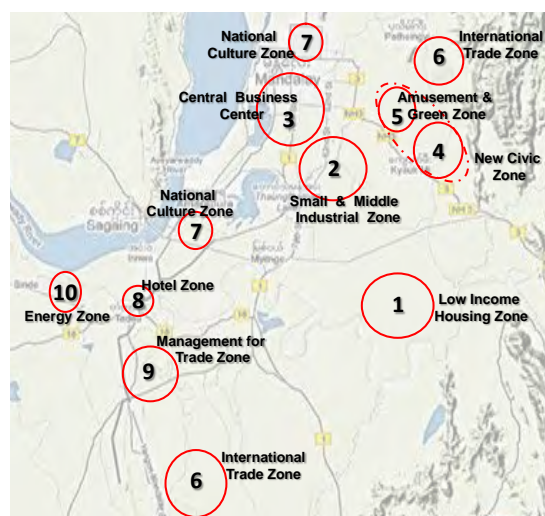
Source: Development Study for Mandalay and the Region, Chiyoda Corporation

Figure 1.4.1: Conceptual Structure Plan in Chiyoda Plan

2) Master Plan by MCDC (2012)

Basing on the plan made by Chiyoda Corporation above, MCDC made a 30-year city development plan in 2012, target year of which is 2040. It proposed ten kinds of development areas as follows:

- i) Low Income Housing Zone
- ii) Small and Middle Industrial Zone
- iii) Central Business Center
- iv) New Civic Zone
- v) Amusement and Green Zone
- vi) International Trade Zone
- vii) National Culture Zone
- viii) Hotel Zone
- ix) Management for Trade Zone
- x) Energy Zone



Source: MCDC

Figure 1.4.2: Zone Plan in MCDC Plan

Figure 1.4.2 shows the zone plan in the MCDC plan. While the plan basically followed the structure idea of the ECFA plan, it includes new development areas with emphasizing on industrial activities such as industrial zone, trade zone and hotel zone in suburban area in south and east. It reflected demands of urban and economic expansion which increased since the ECFA plan.

3) Conceptual Plan by MOC (2013)

Government of Myanmar laid down a policy on urban and regional development. It urged Region/State Government to make long term plans for urban development for their region which is considered from comprehensive points including society, economy, environment and infrastructures. To follow the policy and to complement the MCDC plan, Mandalay Region Government, and the Ministry of Transportation requested MOC to support the preparation of urban project plan. MOC completed to prepare the Mandalay Urban Development Conceptual Plan in consultation with the Mandalay Region Government, Transportation Minister, mayor, and MCDC committee members.

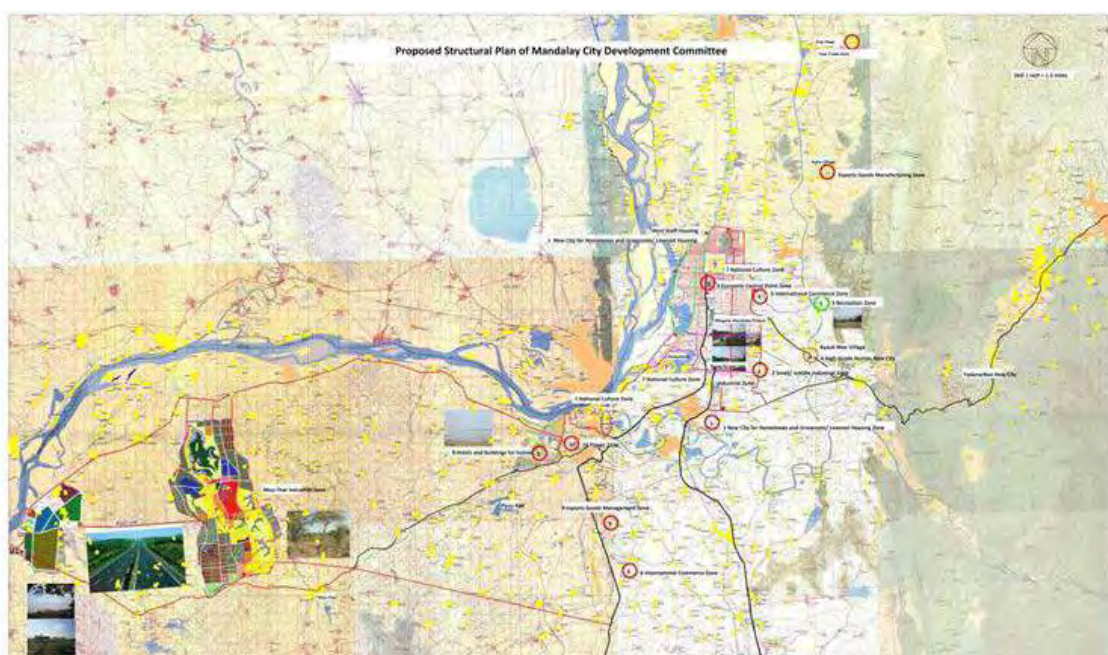
The MOC conceptual plan defined development areas more detailed as shown in the Figure 1.4.3 with basing on the MCDC plan above. MOC proposed the structure plan not only for Mandalay City area but also a wider area including Myotha Industrial Area as shown in the following Figure 1.4.4.

One of the remarkable issues is, however, currently Mandalay City doesn't have effective means to control urban development to realize any structure plan under the pressure of rapid urban development. Therefore the plan has not yet been implemented.



Source: Mandalay Urban Development Conceptual Plan, MOC

Figure 1.4.3: Structure Plan for Mandalay City in MOC Plan



Source: Mandalay Urban Development Conceptual Plan, MOC

Figure 1.4.4: Structure Plan for Wider Mandalay in MOC Plan

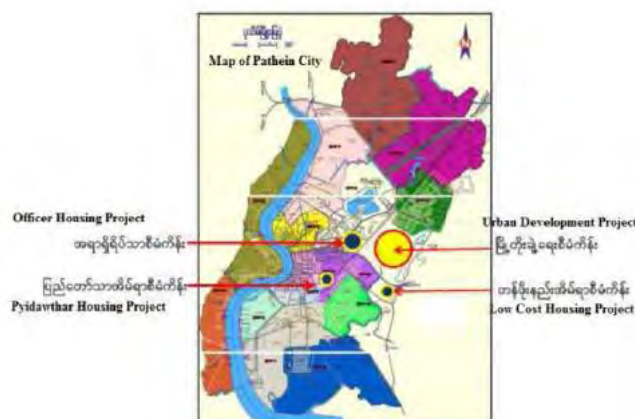
(2) Patheingyi

1) Conceptual Plan by MOC

MOC made the urban development plans of Patheingyi urban area in January 2014. The main contents are the current situation of Patheingyi urban area including urban infrastructure and social status, development plan and project implementation program including new urban area and housing project. Figure 1.4.5 shows the proposed project location for Patheingyi in MOC plan.

2) Patheingyi Town Plan by Patheingyi Township Development Committee

Patheingyi Township Development Committee made the town plan in February 2012 according to Township Development Committees Law and direction of Regional Minister in Ayeyawady Region Government. The plan consists of current condition of the city and proposed development project including upgrade of urban infrastructures. Although the plan includes development projects of some area in the city, they did not include the development vision and structure plan comprehensively for the whole city.



Source: Patheingyi Urban Development Conceptual Plan, MOC
Figure 1.4.5: Proposed Project Location for Patheingyi in MOC Plan

(3) Mawlamyine

1) Conceptual Plan by MOC (2013)

MOC made urban development plans of Mawlamyine City in 2013. The plan consists of current situation of the city including urban infrastructures and social status, and proposed urban development project including new urban area development and housing redevelopment project. Figure 1.4.6 shows the proposed project location for Mawlamyine in MOC plan.

2) Mawlamyine Town Plan by Mawlamyine Township Development Committee

Mawlamyine town plan was made by Mawlamyine Township Development Committee in January 2016. The plan consists of current situation of the city including infrastructure and social status, and proposed development projects. Although the plan includes development projects of some area in the city, they do not include the development vision and structure plan comprehensively for the whole city.



Source: Mawlamyine Urban Development Conceptual Plan, MOC

Figure 1.4.6: Proposed Project Location for Mawlamyine in MOC Plan

1.4.2 Review of MOC Conceptual Plan

(1) General Outline of Conceptual Plan

1) Outline

The Government of Myanmar laid down the policies on urban and regional development of each state and region through systematic developing of long-term plans such as town plan, city plan, structure plan, and master plan. Therefore, the region and state governments have drawn 30-year long term plans for urban development for their regions. In doing so, comprehensive urban development design, which is drawn through conducting assessments on social, economic, transportation, infrastructure and environmental contexts, becomes a necessity.

Corresponding to this necessity, the Ministry of Construction and Department of Urban and Housing Development (DUHD) gave expertise in helping for drafting urban project and formulation of the plan as conceptual plan.

The formulation of the city conceptual plan was conducted for 56 cities until 2015, and is expected to be formulated for 25 cities in 2016. The criteria for the selection of the cities is not clearly defined, but following matters are considered for the selection according to the general consideration for the cities' grade in Myanmar (ref: City grade in the definition of the draft of "Urban and Regional Development Planning Law", described in 1.2.1 of this report).

- Location, urban activities, role and status, structure and socio-economic development status of the city or town
- Population
- Population density
- Employment status in non-agricultural activities
- Natural resources availability and basic infrastructure development

Table 1.4.1: List of 56 Cities for Conceptual Plans (until 2015)

| | | |
|--|---|--|
| Kachin State 1. Myitkyina 2. Puta-O 3. Bhamo | Bago Region 18. Bago 19. Pyay 20. Taungoo | Rakhine State 35. Sittwe 36. Thandwe 37. Kyaukpadaung 38. Mrauk-U 39. Maungdaw (appropriated for plan) |
| Kayah State 4. Loileik | Mon State 21. Mawlamyine 22. Thabon 23. Mudon 24. Kyaukse Magway Region 25. Magway 26. Pakokku 27. Yenangyaung 28. Chauk | Shan State 45. Lashio 46. Muse 47. Tachileik 48. Taunggyi 49. Kengtung 50. Kalaw |
| Kayah State 5. Myawaddy 6. Kawkaik 7. Hpa-An | Mandalay Region 29. Mandalay 30. Myingyan 31. Mogoke 32. Meiktila 33. Pyin Oolwin 34. Bagan_Nyaung-U | Ayeyawady Region 51. Patheingyi 52. Hinthada 53. Maubin (in progress) 54. Bogale (in progress) 55. Pyaw (in progress) |
| Chin State 8. Hakha Falam (Lonpee) | | Naypyitaw Council Area 56. Naypyitaw (appropriated for plan) |
| Sagaing Region 9. Hkamti 10. Sagaing 11. Monywa 12. Shwebo 13. Tamu 14. Kale | | |
| Tanintharyi Region | | |

| | | |
|---|--|--|
| 15. Dawei 16. Myeik 17. Kawthoung | | |
|---|--|--|

Source: DUHD

The MOC conceptual plan is intended to be authorized after the enactment of the Urban and Regional Development Planning Law in 2016. The plan is expected to be developed as the city master plan with the further studies on detailed plan (base of spatial regulating plan) and implementation plan (of the development project, construction of infrastructure, etc.).

2) Function of Conceptual Plan in the Urban Planning

The current MOC conceptual plan is formulated as a base of future preparation and detailed plan, which is expected to function as the base of spatial control for area development to individual building such as development capacity and volume of the building.

From the interview with the officers of DUHD, following uses are expected as the functions of the conceptual plan.

- Indicating spatial structure of the city

The conceptual plan is expected to show general spatial structure of the city indicating important areas with function and land use, linkage of each area (path), and major nodes (points, crossing, and small district).

- Showing basic information of the urban planning matters

- Current land use
- Plans of technical infrastructure network
- Existing plans

In the case of the target three cities for this study, several housing and industrial development plans are included in the conceptual plan. These plans are proposed document and under examination. For further study and formulation of the master plan, it is necessary to check the conformity of the plan to current situation such as land use, land availability, natural conditions, and development demand.

- Guiding order of implementation of urban planning projects (construction of infrastructure, development, etc.)

In the relation of the area development and infrastructure development, the order of the project needs to be strategically considered and designated in the plan.

And for the use of further master plan and detailed plans, the following uses of the plan are assumed.

- For Regulation of Development and Land Use
 - Urbanized Area, Urbanization control Area, and Non-urbanized Area

At first, the plan should designate the boundary of the urbanized area, which includes current urbanized area and future expansion area. Also non-urbanized area, such as preservation area, disaster hazard area, and agriculture area should be considered and designated in the plan.

- Location and Area of the Future Urban Development and Major Infrastructure Facilities

Areas for the future urban development and infrastructure should be examined during the formulation process of the master plan and detailed plan. These areas need to be reserved for the future development use and their land use should be controlled.

➤ Details of Spatial Regulation

According to the result of the conceptual plan and further master plan, the detailed plan will be prepared for the regulation of individual buildings and small district. It might include regulation and planning index such as land use, building coverage ratio (BCR), floor area ratio (FAR), and building height.

Looking at these plans, the outline of the land use and development capacity should be examined in the study process of the master plan.

• The Referential Document for Authorization of the Future Development Project

For the use of base document of authorization, the planning requirement should be described in the plan. The following are example of contents to be included in the plan:

- Area and boundary of the urbanized plan;
- Principle land use and development capacity; and
- Consideration for planning (such as requirement of infrastructure, public space, and public facility).

3) Formulation Process of MOC Conceptual Plan

Following the planning process is taken into consideration for the formulation of the conceptual plan in general cases.

Seven planners are engaged in the study and formulation of the conceptual plans as the main activity. Under the team leader, about ten planning members (2 planners, 7 surveyors, and 1 assistant) are organized for the study and planning, in general cases.

The planning works are executed in one and a half months with

- One week for preparation of the study (in Nay Pyi Taw),
- Two weeks for field survey in the target city, and
- Three weeks for the formulation of the plans.

The plans are set reflecting the information offered by the responsible person of the infrastructure development of the Township Development Committee as well as the discussion results with them. The demographic information used for the planning is offered by the Migration Department. Stakeholders meetings were held twice during the planning process.

4) Direction of the Formulation of Master Plan, and Information in the Current MOC Conceptual Plan

The study evaluates the current planning items in the MOC conceptual plan and further master plans in consideration of the future use of the plan.

The contents, which should be supplemented for further planning of the master plan, and the information, which is described in the current MOC conceptual plans of the target three cities, are shown in Table 1.4.2.

Table 1.4.2: Direction of the Formulation of Master Plan, and Information in the Current MOC Conceptual Plan

| Planning Themes | | Example of Contents for the Formulation of Master Plan | Status and Issues of the Conceptual Plan, and Consideration for Further Plan |
|-------------------|--|---|--|
| Related plans | International, national, regional plans | Function of the city in the international context, International road network, Function of the city in the national context, Function of the city in the regional context, National industrial structure | Adequate related plans are referred for the conceptual plans. It is necessary to consider the spatial relations and directions of the industrial development with related regions and cities. |
| | Plans prepared by the local government | | From the three cities, only Mandalay had prepared the plan. |
| Current situation | Outline of the city | Brief explanation of historical background, Important traffic infrastructure, General spatial structure, Composition of townships and local governance | Necessary information is explained in the document. But details of the information such as spatial structure and traffic infrastructure are not mentioned in the report. |
| | Natural conditions | Location latitude and longitude, Geographical features, Temperature (Climate), Rainfall | Necessary information is explained for the three cities. It is necessary to study and evaluate the results and effects on the development area such as inundation. |
| | Population, demography | Increase rate of population, Current population density, Future prospect of population, Future prospect of population density | Population areas differ by cities (by available information). Some city studies are based on township and others are based on wards. For further planning, it is necessary to consider precise study level and differences of the trend of the demography. |
| | Current industry | General view of Industry, General agricultural product, Agricultural trade, Touristic industry, Predicting industry, Commercial Industry | The level of the study and importance of the description differs by city. It is not studied precisely in 2 out of 3 cities. It is necessary to consider relations between industrial development policy and spatial development. |
| | Development situation of the city | Major development in recent days, Development problem, Situation of development, (appropriateness to the governmental regulation), Development guidelines of state government, Housing development | Major industrial developments are described. They mentioned about housing development mainly. |
| | Current land use | Land use balance, Spatial structure | The evaluation differs by city. Some studies on land use balance (composition based on quantity), and some others study spatial structure. For further planning, it is necessary to study both. |
| | Current infrastructure | Structure of main road, Situation of road, Situation of railways, Situation of other transportations (water, Air), Situation of water availability, Situation of drainage, Situation of electric availability, Situation of waste management, Social infrastructure | Current situations of infrastructures are described in the conceptual plan. The information mentions mainly about capacity. Details of the network and differences of the situation by areas are needed to be examined for further study. |
| | Culture and tourism | Historical monuments, Recreation | The precision of the study differs by city and it is not mentioned in some city. It is expected to be studied for the further plans. |
| | Buildings | Numbers of commercial buildings, Numbers of residential buildings | Numbers of major commercial buildings and residential buildings are noted in the study on small cities. It will be necessary to examine for the detailed study level. |
| | Evaluation of the current status of the city | | Only one case is examined. The evaluation is necessary for the formulation of the development policies for the conceptual plan and |

| | | | |
|----------------------------|-------------------------------|---|---|
| | | | further plans (master plan). |
| Planning | Development policy | | Only one case is examined. Development policies are recommended to be shown for easier understanding of the plans. |
| | Development strategy by theme | Preservation of heritage, Formulation of touristic path, Green city concept, Job opportunities and urban settlement, Housing settlement, Solution of slums, education and technology, Transportation and industry | In one case, it is mentioned in order to identify the issues to be tackled. |
| | Planning target | Rate of numbers of housings to residents | The conceptual plan mentions the quantity of the housing supply as planning target. For further study, it is necessary to consider relations to other land uses and future development areas. |
| | Spatial development Scheme | Sub-urban center, Industrial zone, Export processing zone and industry, Development and foreign investment, Future city expansion | In one case, there is consideration for spatial structure such as urban center, functional zones, and future expansion of urban areas. For further plans, abovementioned spatial structures need to be studied with relation of the zone and current spatial situation. |
| | Future development by sector | Road network | Road network is mentioned in one case. The future development vision needs to be examined in further planning. |
| | Individual zone development | Description of development project, Evaluation of existing development project | The plans, which are currently proposed, are included in the conceptual plan, sometimes without assessment process. It is necessary to evaluate the suitability of the plans and then to reflect to the conceptual plan and further plans. |
| Implementation of the plan | Implementation matters | Housing finance, Implementation process | The examination on implementation process and feasibility of the development projects are quite limited in the document of the conceptual plan. These matters need to be considered in the process of the formulation of further spatial and development plans. |

Source: JICA Study Team

(2) Conceptual Plans of Target Three Cities

Most of the conceptual plan describes much about related plans and current situation of the city according to the availability of the resources. But these aspects are individually described without examination of interrelationships between each other. For the further plans, it is necessary to consider the following matters:

- Relationships between each aspect of planning field;
- Relationships between current urban status and future development; and
- Relationship between planning information and spatial planning.

The information and planning contents in the conceptual plan differ by case. In order to clarify the major ideas in the current conceptual plans to be reflected to the further planning and the important planning issues to be examined in the planning, the following sections show major results of the conceptual plan and planning issues to be studied for the further planning.

1) Mandalay

(I) Major results of the conceptual plan

Following results are major results of the conceptual plan, which are to be referred for the further planning.

- Concept of Development of the City

The plan describes the development concept of the future city in two levels. One corresponds to the development demand in the national development context and shows expected function of the city such as transportation center, development corridors, bi-polar development, and center of education and health.

The other identifies current demand and issues of the city to be tackled in the near future.

These planning concepts should be well considered in the further planning process.

- Spatial Structures of the City

The concept plan includes the drawing of basic spatial structure plan with boundary for future urbanized (expansion) area. Still it is necessary to adjust the plan to the development demand; basic spatial concept could be referred for further planning process.

- Spatial Linkage with the Surrounding Areas of the City

The conceptual plan studies about the development in surrounding areas in 50 km to 100 km range. As the central city of the Northern Myanmar, the plan should consider functional relation and spatial linkage between these areas.

(II) Issues to be Studied for the Further Planning

For further planning, the following planning issues need to be considered.

- Study on the Verification of the Adequateness of the Urban Development Area

The abovementioned future expansion area is roughly designated and too extensive for the expected increase of future population. For guidance of the future development control, the urbanized area, urbanization control area, and the non-urban area should be studied based on the current spatial situation and infrastructures network.

- Relation Between Proposed Spatial Structure and Current Infrastructure

Proposed spatial structure plan shows the composition of general function of the city. For the further development of the plan, it is necessary to consider their linkage. For this purpose, the main path (highway, major road, and walkway) and important nodes (airport, rail way) need to be considered and integrated in the plan.

- Study on Development Capacity of the Plan

Specific planning index will be required for control and regulation by detailed plan. For this purpose, development capacity should be examined in accordance with the assumed spatial composition and building types in précised level.

- Implementation Process (order) of the Plan

For the development of Mandalay, it is necessary to consider plural development in the different areas and direction of the city. And it is necessary to reflect on the corresponding infrastructure facilities. Because of their plural needs and demand in different and diverse areas, the strategic implementation of individual development, and its order are obligatory for their realization and implementation.

2) Pathein

(I) Major Results of the Conceptual Plan

The following are major results of the conceptual plan, which are to be referred for further planning.

- Current Land Use with Proposed Housing Development

The conceptual plan shows the current land use with proposed housing development projects. These plans could be used as the basis of the further planning.

- Study on Location of the Administrative Area (Central Business District)

The conceptual plan studies on options of spatial structure according to the shift of administrative area (central business district) of the city. The further master plan can utilize the result of the study for its spatial composition.

- Study on Proposed Housing Development

The current conceptual plan resumes existing proposal plans of the housing development in the city. It is still necessary to examine their suitability for the future development vision of the city; these results could be used as reference for future development.

(II) Issues to be Studied for Further Planning

For further planning, the following planning issues need to be considered.

- Study on Industrial Development Trend and Policy

For the development of Pathein Planning Area, it is necessary to set up the major direction of industrial development of the city. Pathein relates plural industrial sectors such as agriculture, tourism, and logistics according to its geographical location and historical background. Depending on the changes of demand to the function of the city in the future, the direction of the main industry and its prospect need to be determined. The spatial composition of the city and expansion of the urbanized area should be formulated reflecting the abovementioned results.

- Study on the Urban Development Area

In the conceptual plan of Patheingyi, there is no specific forecast of future population. For the plan of Patheingyi, the study on population is quite important for further study because current population is not much and it affects expansion of the urbanized area much. Increase of the population and migration of residents according to the new industrial development need to be studied and their results should be reflected in the further plan.

- Consideration on Functional Zoning in Urban Area

Land use plan of the conceptual plan shows current land use with existing proposed plan of housing development. For further planning, it is necessary to evaluate current plans and future development demand, then to integrate it into the spatial development plan.

According to the abovementioned industrial development policy, major function of the city and required area for corresponding functional zones need to be determined and calculated. And their basic spatial structures should be formulated with path and node, in order to direct basic development direction of the city.

3) Mawlamyine

(I) Major Results of the Conceptual Plan

The following results are major results of the conceptual plan, which are to be referred for further planning.

- Current Land Use with Proposed Housing Development

The conceptual plan shows current land use with proposed housing development projects. These plans could be used as the base of further planning.

- Status of the City in the International and Regional Context

Industries of the Mawlamyine closely relate with the neighboring cities and country (Thailand) because of its geographical locations. The conceptual plan resumes the development needs and direction in the context of the regional and international development. These considerations could be reflected to the further planning study.

- Industrial Development Trend and Policy

The analysis on the industrial development for the Mawlamyine is studied and their results are shown as the possible direction of industrial development of the city. Considering these policies as the option of development, the directions of the cities' vision need to be discussed and formulated.

(II) Issues to be Studied for the Further Planning

For further planning, the following planning issues need to be considered.

- Study on the Urban Development Area

In consideration of the future development of Mawlamyine, inundation is an important factor which determined candidate sites of future expansion of the city. Also the bridge between the current city center and Bilu Island is newly constructed, and development in the island is also expected in the future.

The further master plan should consider the abovementioned matters and be formulated.

- Consideration on Functional Zoning in the Urban Area

The current conceptual plan includes land use plan in the document, but it shows the current land use with proposed housing development plans. For the purpose of guiding city's development in the future, it is necessary to show clearly the functional zoning and its linkage in the plan.

- Implementation Process (Order) of the Plan

In the case of Mawlamyine, the facility of the current infrastructure needs to be well considered for future development and expansion of the city because of their limited capacity. It is assumed that expansion and new installation of infrastructure facilities will be required before the urbanization development. Because of these situations, the implementation process of infrastructure facilities is quite important for smooth execution of urban development projects.

1.4.3 Overview of On-going and Recent Donor's Activities

Several projects were or have been conducted by donors in the target cities. Especially Mandalay has been conducted many projects in recent years. Table 1.4.3 summarizes on-going and recent donors activities in the cities.

Table 1.4.3: On-going and Recent Donor's Activities

| Project | Donor | Purpose | Period | City |
|---|-------|--|-----------|------------|
| Urban Services Improvement Project | FASEP | To present various elements of projects focusing on solid waste management, water supply and transport | Till 2015 | Mandalay |
| Future Cities Program in the Asia-Pacific Region | ADB | To enhance operational knowledge and long-term sector engagement of Mandalay as one of selected seven Asian cities. The core project sector of the program for Mandalay City will be water supply system and solid waste management. | On-going | Mandalay |
| Mandalay Urban Services Improvement Project | ADB | (i) water supply system improvements, (ii) drainage and flood protection, (iii) wastewater management, (iv) solid waste management and (v) institutional capacity strengthening and public awareness raising. | Till 2015 | Mandalay |
| The Project for Improvement of Water Supply System in Mandalay City | JICA | To construct a water supply system in Pyigyidagun Township and disinfection facilities for the existing water supply facilities in Mandalay City | Till 2015 | Mandalay |
| Third Greater Mekong Sub-Region Corridor Towns Development Project | ADB | (i) To make a plan of water and other urban infrastructure and services and (ii) To identify heritage buildings of Mawlamyine to conserve and utilize them | Till 2015 | Mawlamyine |

Source: The Projects mentioned in the table

1.5 Fact Findings of Target Three Cities

1.5.1 Environmental and Social Status

(1) Environmental Status

1) Geographic Features of Mandalay, Patheingyi and Mawlamyine

Myanmar is the largest country in mainland Southeast Asia with a total of land area of approximate 678,500 km². It stretches 936 km from east to west, and 2,051 km from north to south. It is bound by Bangladesh and India in the northwest, PR China and Lao People's Democratic Republic in the northeast, Thailand in the southeast, and the Bay of Bengal and the Indian ocean in the southwest. Its coastline spans 1,930 km from the borders of Bangladesh and Thailand. In topography, Myanmar is mainly hills and valleys and surrounded in the north, east, and west by mountain ranges, showing gradually sloping down from north to south, northwest to east, and southeast to west, with fertile flat land in the central. Myanmar can be divided into seven major topographic regions as follows:

- Northern Hills
- Western Hills
- Shan Plateau
- Central Belt
- Lower Burma Delta
- Rakhine Coastal Region
- Tanintharyi Coastal Strip

The target three cities, Mandalay, Patheingyi, and Mawlamyine located in the central, the southeast, and the southwest of Myanmar, respectively.

(I) Mandalay

Mandalay is situated in the flat central part of Myanmar, 716 km north of Yangon, sitting on the east bank of the Ayeyawady River. It was founded in 1857 as the royal capital. It sits on the Sagin fault, a tectonic plate boundary between the India and Sunda plates. Geographically and economically, it is the hub city for international trade to India and China in the upper Myanmar, with good land transportation connections, as well as the regional center with its developed inland water port. Having the royal palace backed by 240 m high Mandalay hill on the north, this old capital stretches its boundary to south along the Ayeyawady Bank.

(II) Patheingyi

Patheingyi sits in the western edge of the fertile Ayeyawady Delta, 190 km west from Yangon, and is the capital city of the third most populated Ayeyawady Region, which is the country's main crop supplier. It lies on the Patheingyi River which is a western branch of the Ayeyawady River, as a port city. Though distant from ocean, it is the most important delta port outside of Yangon. Patheingyi is known by its beautiful silver sand beaches along the coast of Bengal, namely Ngwesang Beach and Chaungtha Beach. Being the capital city, Patheingyi functions as a transit city that people and products can move from one place to other through various transportation methods such as river boat, road, and railroad.

(III) Mawlamyine

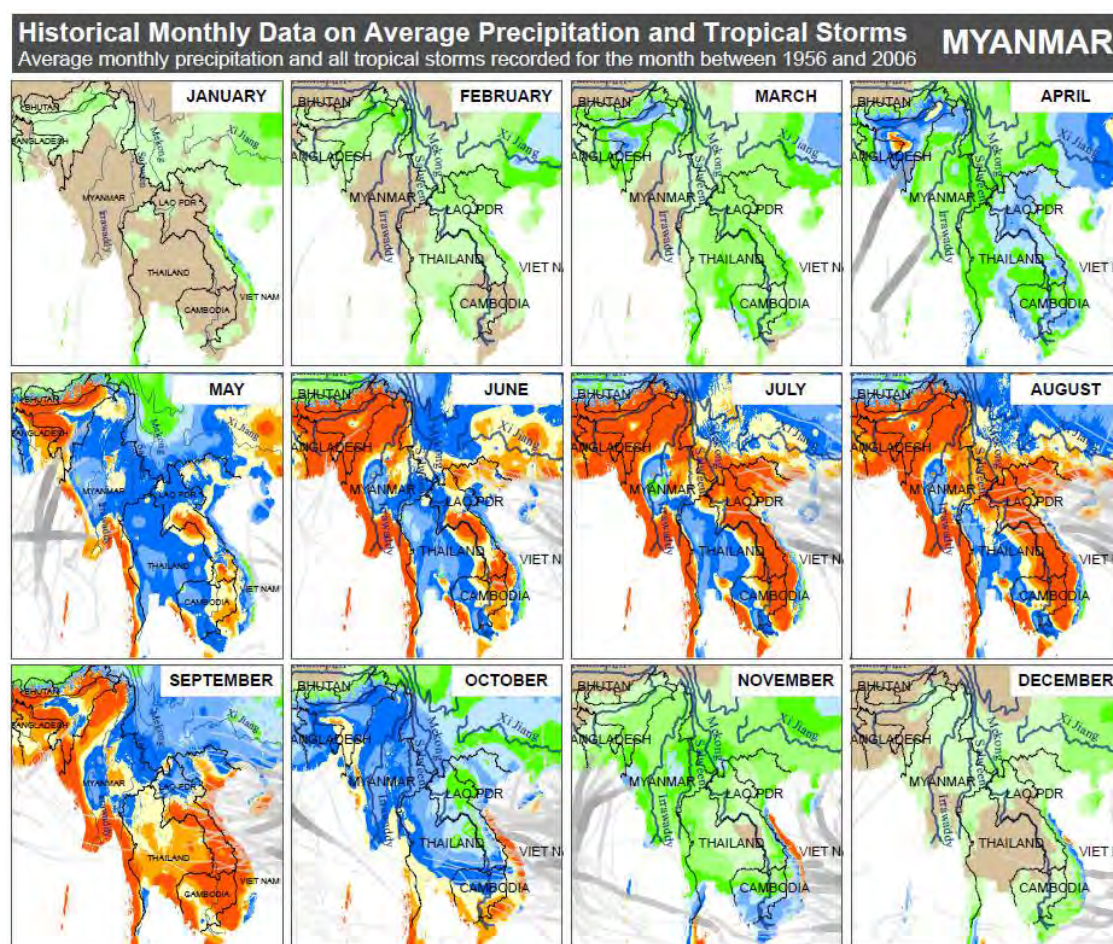
Mawlamyine, the capital of Mon State, locates at the mouth of Thanlwin (Salween) River in the south part of Myanmar, 300 km southeast from Yangon. Part of the state is bordered by Thailand in

the south east and the Gulf of Mottama and the Andaman Sea in the west. This regional capital city sits in the Thanlwin Delta but flanked by low hills from east to west.

2) Climate Conditions of Mandalay, Patheingyi, and Mawlamyine

Myanmar has several climate zones ranging from the temperate region in the north to the dry zone in central Myanmar and the monsoon prone areas in the northwest, west, and south. Myanmar has a tropical wet climate with distinct seasons; summer, rainy, and winter. The summer season runs from March to the end of April. The south west monsoon winds signal the start of the rainy season in early May and ends in October and the winter season from November to February. As the typical of the tropics, during the rainy season, the weather is humid, wet, and warm.

The amount of rainfall varies per region; the coastal area receives up to 5,000 mm of rain per year while the central dry zone areas have less than 750 mm. Average monthly precipitations on Myanmar are shown in Figure 1.5.1. The temperature in Myanmar likewise varies according to location. On average, its temperature is around 21°C. However, it could drop to as low as -1°C to 0°C in the northern highlands, and increase by as much as 32°C and 40°C in the coastal and central areas¹.



Source: MIMU

Figure 1.5.1: Average Precipitation and Tropical Storm

¹ Ministry of Environmental Conservation and Forestry (MOECF), 2012

(I) Mandalay

Mandalay features a tropical wet and dry climate under the Köppen climate classification with noticeably warmer and cooler periods of the year. Mandalay is very hot during the months of April and May, with average high temperatures easily exceeding 35°C. It is common to see high temperatures surpassing 40°C during these two months in the city. Mandalay also features wet and dry seasons of nearly equal length, with the wet season running from May through October and the dry season covering the remaining six months. Table 1.5.1 summarizes the climate data of Mandalay from 1961 to 1990.

Table 1.5.1: Climate Data of Mandalay (1961-1990)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Ave Max °C | 28.6 | 32.1 | 35.8 | 38.4 | 36.8 | 34.2 | 34.3 | 32.3 | 33.1 | 32.2 | 30.2 | 28.2 |
| Ave Min °C | 13.3 | 14.9 | 19.7 | 24.4 | 25.8 | 25.8 | 25.8 | 25.2 | 24.9 | 23.5 | 19.4 | 14.8 |

Source:

- 1) "World Weather Information Service – Mandalay". World Meteorological Organization. Retrieved 23 February 2013
- 2) "Weatherbase: Historical Weather for Mandalay, Myanmar". Weatherbase. Retrieved 23 February 2013.
- 3) Cappelen, John; Jensen, Jens. "Myanmar – Mandalay". Climate Data for Selected Stations (1931–1960) (in Danish). Danish Meteorological Institute. p. 188.

(II) Pathein

Pathein has a tropical monsoon climate according to the Köppen climate classification system. Pathein experiences a sustained period of extraordinary rainfall from June through August. The dry season which runs from December through April, generally sees noticeably cooler temperatures than the remainder of the year. Table 1.5.2 summarizes the climate data of Pathein.

Table 1.5.2: Climate Data of Pathien (2011)

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Ave Max °C | 33.3 | 35.0 | 36.7 | 35.0 | 32.2 | 33.3 | 30.0 | 30.6 | 30.0 | 32.8 | 32.8 | 30.6 |
| Ave Min °C | 17.2 | 19.4 | 21.1 | 23.9 | 25.6 | 25.6 | 24.4 | 24.4 | 24.4 | 24.4 | 21.7 | 20.0 |

Source: Pathein Township Development Committee, 2011

(III) Mawlamyine

Mawlamyine experiences a tropical climate with a lower humidity than in most parts of South East Asia. Its temperature averages between 25.6 C during January, its coolest month to 29.4 C in April, it's hottest month. The rainy season is between June and October although the greatest rainfalls usually occur in July and August. The average annual rainfall in Mawlmayine is 190 inches.

Table 1.5.3: Climate Data of Mawlamyine

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Ave Max °C | 31.6 | 33.2 | 34.4 | 35.0 | 31.8 | 29.3 | 28.4 | 28.2 | 29.4 | 31.3 | 31.8 | 30.7 |
| Ave Min °C | 17.1 | 19.8 | 22.8 | 24.7 | 24.3 | 23.6 | 23.3 | 23.3 | 23.5 | 23.4 | 22.0 | 20.1 |

Source: Climate Data.org (<http://en.climate-data.org/>)

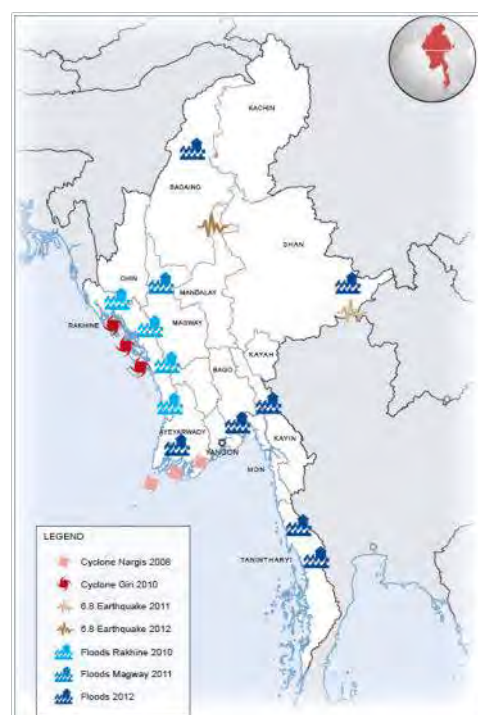
3) Natural Disaster²

Myanmar faces a variety of natural and manmade hazards, and it was ranked the 42nd most at risk country in the world according to the 2012 World Risk Report. The 203 Global Climate Risk Index identified Myanmar as one of the countries most affected by severe weather disasters during the period from 1992 to 2011, due to the Myanmar's location, topography, climate, and geology. The major natural disasters in Myanmar are forest fire, landslides, earthquake, floods, drought, and cyclones.

Among all, more than 70% of disaster accounts for man-made forest fire and flooding ranked second accounting for 11%. Myanmar's long coastline and extensive river networks present a range of flood hazards across the country. The mountainous northern region is prone to fast running flash floods, especially during the monsoon season. The Ayeyawady Delta is vulnerable to widespread flooding when rivers are swollen by rain with high tide.

Droughts are generally located in what is called the dry zone, which is located in the Central Inner Burman Basin and covers parts of three divisions and about 10% of the country's total land area.

Being positioned on the Bay of Bengal, Myanmar faces cyclone hazards and the accompanying threats of high winds, heavy rain, and storm surge. Cyclone season runs from April to December, but the most dangerous points of the season are pre-monsoon in April and May, and post-monsoon from October to December. Over the past 20 years, the monsoon season has been shorter in duration but more intense, resulting in greater flooding in a slightly smaller time period. Also, in recent years, each storm season has showed a tendency for cyclones to curve around and hit at lower latitudes and the frequency of the storms hitting Myanmar has increased. Recent major national disasters in Myanmar are presented in Table 1.5.4.



Source: OCHA (Office for the Coordination of Humanitarian Affairs)

Figure 1.5.2: Natural Disasters in Myanmar 2002-2012

Table 1.5.4: Major Natural Disasters in Myanmar in Recent Years

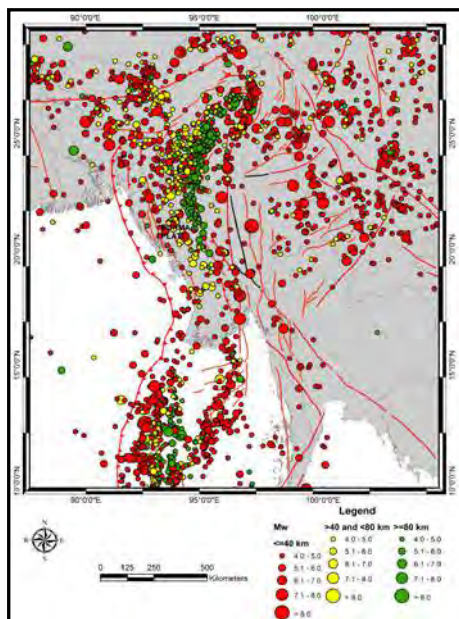
| Year | Disaster | Damage |
|-------------|---------------------------|---|
| May 2008 | Cyclone Nargis | Left some 140,000 people dead and missing in the Ayeyawady Delta region. An estimated 2.4 million people lost their homes and livelihoods |
| Jun 2010 | Flood in northern Rakhine | Total 68 people were dead and 29,000 families were affected. Over 800 houses were completely destroyed. |
| Oct. 2010 | Cyclone Giri | At least 45 people were dead, 100,000 people became homeless and some 260,000 people were affected |
| Mar. 2011 | 6.8 earthquake in Shan | Over 18,000 people were affected. At least 74 people were dead and 125 injured. Over 3,000 people became homeless |
| Oct. 2011 | Flood in Magway | Nearly 30,000 people were affected to varying degree. |
| Aug. 2012 | Floods | Ayeyawady Region was the worst affected with some 48,000 people displaced. Over 136,000 acres of farmland, houses, roads and bridges were damaged |
| Nov. 2012 | 6.8 earthquake in north | At least 16 people were dead and 52 injured, with over 400 houses, 65 schools and some 100 religious building damaged |

Source: Myanmar Earthquake Committee, Mandalay Earthquake Scenario Planning Summary 26 February 2015

² Center for Excellence in Disaster Management and Humanitarian Assistance, “Myanmar Disaster Management Reference Handbook”, 2014

(I) Mandalay

Mandalay locates in the center dry zone of Myanmar, sitting on the Sagaing Fault, which is the most prominent active fault in Myanmar. The major concerns over natural disasters of the city are mainly drought and earthquake, and occasional flooding in the low land. Especially, earthquake is potential most dangerous natural disaster in the region, as it hits the city and its surrounding areas historically due to the one of the most active Sagaing Fault, as is shown in figure 1.5.5. The historic earthquake records are shown in table 1.5.5. The last earthquake with severe damages around Mandalay city was recorded in 2012 in Sagaing. With Magnitude 6.8, it caused several pagodas and historic buildings severely damaged and 18 death toll and over 100 injuries are report. The latest 2016 April earthquake had Magnitude 6.8 but with 130km deep epic center and caused no major damage.



Source: Myanmar Earthquake Committee, Mandalay Earthquake Scenario Planning Summary 26 February 2015

Figure 1.5.3: Historic Earthquake Categorization

Table 1.5.5: Seismicity of Mandalay Region (1429-2012)

| Date | Location | Magnitude or brief description |
|-----------------|------------------------------------|---|
| 1429 | Innwa | Fire-stopping enclosure walls fell |
| 1467 | Innwa | Pagodas, solid and hollow, and brick monasteries destroyed |
| 24, July, 1485 | Mandalay | 3 well-known pagodas fell |
| 1501 | Innwa | Pagodas, etc. fell |
| 6, June, 1620 | Innwa | Ground surface broken, river fishes were killed after quake |
| 10, Sept, 1646 | Innwa | |
| 11, June, 1648 | Innwa | |
| 1, Sept, 1660 | Innwa | |
| 3, Apr, 1690 | Innwa | |
| 15, Sept, 1696 | Innwa | 4 well-known pagodas destroyed |
| 8, Aug, 1714 | Innwa | Pagodas, etc. fell; the water from the river gushed into the city |
| 15, Jul, 1771 | Innwa | |
| 9, June, 1776 | Innwa | A well-known pagoda fell |
| 26, April, 1830 | Innwa | |
| 21, Mar, 1839 | Innwa | Old palace and many buildings demolished |
| 23, Mar, 1839 | Innwa | Pagodas and city walls fell; ground surface broken; the rivers' flow was reversed for some time; Mingun Pagoda shattered; about 300 to 400 persons killed |
| 16, July, 1956 | Sagaing (Mandalay) | Several pagodas severely damaged |
| 11, Nov, 2012 | Thabeikkyin (Sagaing and Mandalay) | Richter Scale 6.8. Death toll 18 and 116 injured. 181 houses, 58 pagodas, 79 monasteries, 20 schools and 9 government buildings were totally collapsed. 2315 houses, 605 pagodas, 527 monasteries and 126 government buildings were damaged. Total lost is 8140.12 million. |

Source: Myanmar Earthquake Committee, Mandalay Earthquake Scenario Planning Summary 26 February 2015

Mandalay also has some potential causes of floods such as a lack of urban drainage facility, the Ayeyawady flooding, and large river discharge from Shan Plateau to the city. Particularly, south west part of the city is prone to flooding due to the topographic features as shown in Figure 1.5.4.

(II) Patheingyi

Patheingyi sits in the western edge of the fertile Ayeyawady delta. It is the capital city of the third most populated Ayeyawady region, which is the country's main crop supply. It lies along the Patheingyi river which is a western branch of the Ayeyawady river. Though distant from ocean, it is the most important delta port outside of Yangon. On its west edge, Patheingyi has beautiful coast line facing to Bengal Bay, namely Ngwesang Beach and Chaungtha Beach. Being as the capital city, Patheingyi functions as a transit city that people and products can move from one place to other place through various transportation methods such as river boat, road, and railroad.

(III) Mawlamyine

Mawlamyine sits in the mouth of the Thanlwin River. Mawlamyine has natural protection from tsunami or high rise of sea water triggered by tropical cyclones, being sheltered by Bilugyun (Blue) Island from outer ocean. Mawlamyine is less prone to earthquakes or cyclones, but susceptible to

flooding in the lower area in the north east after intensive rainfalls, due to the combination of topographic and drainage system problems as shown in Figure 1.5.4.



Source; ADB, “TA-8472 MYA:
 Preparing Mandalay Urban Service
 Improvement Project IE
 131003110-06-RP-104, Issue A”, June
 2015

Source; Pathien Township
 Development Organization

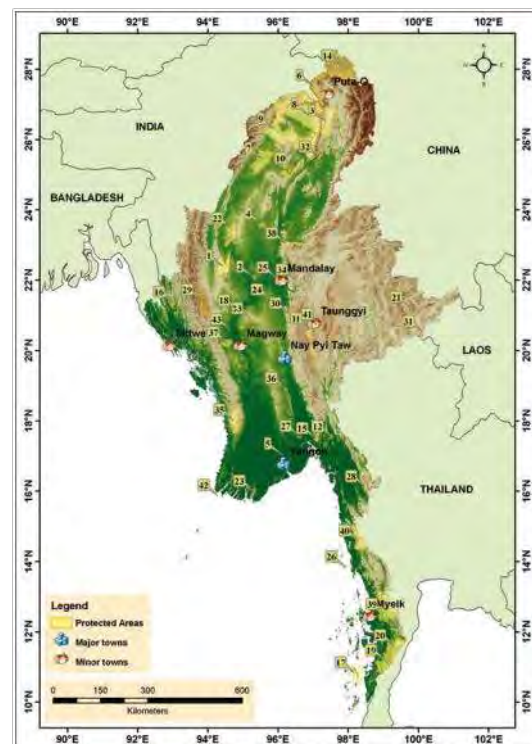
Source; JICA Study Team

Figure 1.5.4: Flood Hazard Map of Mandalay, Patheingyi, and Mawlamyine

4) Natural Protection areas of Mandalay, Patheingyi and Mawlamyine

Myanmar establishes many protected areas by the Myanmar Forest Policy (1995) which mandates an increase in protected areas (PAs) to 5 % of the country’s total land. Later, this target was adjusted to 10% by 30-year National Forestry Master Plan of Ministry of Environmental Conservation and Forestry (MOECF). As of 2015, Myanmar has 38906.49 km² in 40 PAs and 12 proposed PAs representing diverse ecosystems, which cover about 6% of the total area (Table 1.5.6). Seven of the 40 PAs of Myanmar are designated as ASEAN Heritage Parks (AHPs). The AHPs of Myanmar are Hkakaborazi National Park, Indawgyi Wetland Wildlife Sanctuary, Inlay Lake wildlife Sanctuary, Natmataung National Park, Meinmahlakyun Wildlife Sanctuary and Lampi Marine National Park. In addition, Moeyungyi Wetland Wildlife Sanctuary has been designated as a Ramsar Site in 2005 due to being as significant habitat for the globally important bird species.

As seen in Figure 1.5.5, there is no PAs designated within the target area of this study in Mandalay, Patheingyi and Mawlamyine, respectively.



Source: Institute Oikos and Biodiversity and Natural Conservation Associations, “Myanmar Protected Areas, Context, Current status and Challenges”, 2011

Figure 1.5.5: Natural Disasters in Myanmar 2002-2012

Table 1.5.6: Protected Areas in Myanmar

| | PROTECTED AREA | NATIOANL DESIGNATION | STATUS | Year | AREA |
|----|-----------------------------|----------------------|------------|------|----------|
| 1 | Alaungdaw Kathapa | National Park | Designated | 1989 | 1597.62 |
| 2 | Bawditataung | Nature Reserve | Proposed | 2008 | 72.52 |
| 3 | Bumhpabum | Wildlife Sanctuary | Designated | 2004 | 1854.43 |
| 4 | Chatthin | Wildlife Sanctuary | Designated | 1941 | 269.36 |
| | Chungponkan | * Wildlife Sanctuary | Designated | 2013 | 2.20 |
| | Dipayon | * Wildlife Sanctuary | Proposed | - | 13.60 |
| 5 | Hlawga | Wildlife Park | Designated | 1989 | 6.24 |
| 6 | Hponkanrazi | Wildlife Sanctuary | Designated | 2003 | 2703.95 |
| 7 | Htamanthi | Wildlife Sanctuary | Designated | 1974 | 2150.73 |
| 8 | Hukaung Valley | Wildlife Sanctuary | Designated | 2004 | 6371.37 |
| 9 | Hukaung Valley (Extension) | * Wildlife Sanctuary | Designated | 2010 | 15431.16 |
| 10 | Indawgyi Lake | Wildlife Sanctuary | Designated | 2004 | 814.99 |
| 11 | Inlay Lake | Wildlife Sanctuary | Designated | 1985 | 641.9 |
| | Kadonlay Kyun | * Wildlife Sanctuary | Proposed | - | 2.59 |
| 12 | Kahilu | Wildlife Sanctuary | Designated | 1928 | 160.56 |
| 13 | Kelatha | Wildlife Sanctuary | Designated | 1942 | 23.93 |
| 14 | Khakaborazi | National Park | Designated | 1998 | 3812.46 |
| 15 | Kyaikhtyoe | Wildlife Sanctuary | Designated | 2001 | 156.23 |
| | Kyauk-Pan-Taung | * Wildlife Sanctuary | Designated | 2013 | 132.61 |
| 16 | Lampi Island Marine | National Park | Designated | 1996 | 204.84 |
| 17 | Lawkananda | Wildlife Sanctuary | Designated | 1995 | 0.47 |
| 18 | Lenya | National Park | Proposed | 2002 | 1761.19 |
| 19 | Lenya (Extension) | National Park | Proposed | 2004 | 1398.59 |
| 20 | Loimwe | Protected Area | Designated | 1996 | 42.84 |
| 21 | Letskoon | * Wildlife Sanctuary | Proposed | 2002 | 1,180.35 |
| 22 | Maharmyaing | Wildlife Sanctuary | Proposed | 2002 | 1180.39 |
| 23 | Mainmahla Kyun | Wildlife Sanctuary | Designated | 1993 | 136.69 |
| | Maymyo | * Game Sancturay | Designated | 1918 | 126.90 |
| 24 | Minsontaung | Wildlife Sanctuary | Designated | 2001 | 22.6 |
| 25 | Minwuntaung | Wildlife Sanctuary | Designated | 1972 | 205.88 |
| 26 | Moscov Island | Wildlife Sanctuary | Designated | 1927 | 49.19 |
| 27 | Moyingyi Wetland | Bird Sanctuary | Designated | 1988 | 103.6 |
| 28 | Mulayit | Wildlife Sanctuary | Designated | 1936 | 138.54 |
| 29 | Natma Taung | * National Park | Designated | 2010 | 713.52 |
| | North Zamari | * Elephant Range | Proposed | 2012 | 983.10 |
| | Pakchan | * Nature Reserve | Proposed | 1983 | 1451.96 |
| 30 | Panlaung-Pyadalin Cave | Wildlife Sanctuary | Designated | 2002 | 333.8 |
| 31 | Parasar (Par Sar) | Protected Area | Designated | 1996 | 77.02 |
| | Pegu Yomas | * Ntional Park | Proposed | - | 1,463.35 |
| 32 | Pidaung | Wildlife Sanctuary | Designated | 1918 | 122.08 |
| 33 | Popa | Mountain Park | Designated | 1989 | 128.54 |
| 34 | Pyin-O-Lwin | Bird Sanctuary | Designated | 1918 | 127.25 |
| 35 | Rakhine Yoma Elephant Range | Wildlife Reserve | Designated | 2002 | 1755.7 |
| 36 | Shinpinkyetthauk | Wildlife Sanctuary | Proposed | 2006 | 71.9 |
| 37 | Shweseetaw | Wildlife Sanctuary | Designated | 1940 | 552.7 |
| 38 | Shwe-U-Daung | Wildlife Sanctuary | Designated | 1918 | 325.95 |
| 39 | Tanintharyi | National Park | Proposed | 2002 | 2071.81 |
| 40 | Tanintharyi | * Nature Reserve | Designated | 2005 | 1699.99 |
| 41 | Taunggyi | Bird Sanctuary | Designated | 1930 | 16.06 |
| 42 | Thamihla Kyun | Wildlife Sanctuary | Designated | 1970 | 0.88 |
| 43 | Wenthtikan | Bird Sanctuary | Designated | 1939 | 4.4 |
| | Wunbaik | * Reserved Forest | Designated | 2008 | 229.19 |

Source: Forest Department, World Database on Protected Areas (WDPA), Institute Oikos and Biodiversity and Natural Conservation Associations, "Myanmar Protected Areas, Context, Current status and Challenges", 2011

*modified based on the information based on "2014 United Nations List of Protected areas of Myanmar"

5) Environmental Quality of Mandalay, Patheingyi and Mawlamyine

Myanmar enacted the National Environmental Quality (Emission) Guidelines in December 2015. Before the enactment of the Guideline, there was no regulations mandating to monitor neither the air quality nor water quality at any stationed sources or mobile sources; hence, there was no technology capacity on measuring environmental quality or regular monitoring records of any city in Myanmar.

(I) Air Quality

Air quality monitoring was conducted in January 2008 by National Commission for Environmental Affairs (NCEA) at three selected sites in Mandalay commercial, residential, and near to industrial zone areas which results are shown in Table 1.5.7. Also, between 2009 and 2013, the air quality monitoring was conducted in selected 15 cities to check the baseline quality for setting up EIA guidelines. Mandalay and Mawlamyine were selected as one of those 15 cities, but Patheingyi was not included.

The results in Mandalay and Mawlamyine from EIA preparation monitoring, shown in Table 1.5.8, shows terrible level of PM10 compared to the WHO standard in both cities. The low level of SO_x and NO_x suggests lower level of industrial activity, relatively speaking, at this stage in both cities.

Up to now, there is no record of measured air quality in Patheingyi. The monitoring results from Mandalay and Mawlamyine suggest even lower level of air emissions in Patheingyi, considering the current status of industry activity.

Table 1.5.7: Air Quality Monitoring in Mandalay in 2008

| SITE | TSPM (μg/M3) | PM10 (μg/M3) | SO ₂ (μg/M3) | NO ₂ (μg/M3) |
|---------------------------------------|--------------|-------------------|---|---------------------------------------|
| Commercial (Zai Cho Market) | 495.87 | 112.498 | 0.86 | 32.13 |
| Residential (MCDC Office) | 213.08 | 61.67 | 0.98 | 17.80 |
| Industrial (Mandalay Industrial Zone) | 350.57 | 131.54 | 1.50 | 19.14 |
| WHO Standards | - | 50 (24-hour mean) | 20 (24-hour mean) 500 (10-minute mean) | 40 (annual mean) 200 (1-hour mean) |

Ministry of Transportation, 4th Regional Environmentally Sustainable Transport Forum (2009)

Table 1.5.8: Air Quality Monitoring in Mandalay and in Mawlamyine

| Location | Pollutant Concentrations (μg/m ³) | | | | | |
|------------|---|------|-----------------|-----------------|-----|------|
| | CO | VOC | NO ₂ | SO ₂ | TSP | PM10 |
| Mandalay | 0.3 | 0.1 | 38 | <LOD | 108 | 404 |
| Mawlamyine | 0.7 | <LOD | 57 | 2 | 213 | 124 |

Source: "ASEAN – German Technical Cooperation Clean Air for Smaller Cities in the ASEAN Region", 2014 April

(II) Water Quality

There is a general lack of access to safe drinking water and basic sanitation is a crucial issue in Myanmar as a whole, due to the extremely limited infrastructure. River and lake pollution from sewage, industrial waste, and solid waste disposal in particular are serious problems. The only control of water pollution was through the guidelines issued in June 1994 by the Myanmar Investment Commission (MIC), which require waste-water treatment systems on new investment projects, till recent.

In Mandalay, in 2013, a study on the Ayeyawady River quality was conducted by Myanmar Development Research Institute (MDRI).

The study found high arsenic levels, up to 30 ppb (parts per billion) in Mandalay in dry season, while the downstream sites observations of the Ayeyawady River were only 10 ppb. Arsenic contamination was expectedly occurring as a by-product from copper, gold, silver, and meal ores mining operations in the upper stream. In addition to high arsenic presence, higher cyanide levels

than WHO guideline level of 0.07 mg/L were found in Mandalay and other cities. Also, the study observed high ammonia nitrogen level, and significant levels of coliforms and E. coli consistently in the river, which confirmed raw sewage and leachate pollutions from municipalities and shipping operations³.

Also, as a part of ADB survey for water supply project, surface water survey and sampling was carried out by a laboratory (E-Guard) appointed by the PPTA Consultant, as well as in situ measurements, in November 2014. Results of water quality monitoring in Mandalay in 2014 is summarized in table 1.5.7.

Table 1.5.9: Water Quality Monitoring in Mandalay in 2014

| ID | TEM (°C) | DEPTH (M) | PH | COMPENSATED EC (MS/CM) | TDS (PPM) | SALINITY (PPT) | DO (PPM) | COD (PPM) |
|--------|----------|-----------|------|------------------------|-----------|----------------|----------|------------|
| C - 01 | 29.1 | 1 | 7.55 | 659 | 428.3 | 0.3 | 2.44 | 50<val<100 |
| C - 02 | 31.8 | 0.6 | 7.71 | 598 | 388.5 | 0.3 | 4.05 | 50<val<60 |
| C - 03 | 29.7 | 0.8 | 9.1 | 1619 | 1049 | 0.8 | 0.24 | ≥ 100 |
| C - 04 | 27.7 | 0.8 | 7.16 | 732 | 475 | 0.4 | 3.4 | 75<val<100 |
| C - 05 | 27.8 | ≤ 0.3 | 7.47 | 1239 | 805 | 0.6 | 2.7 | 75<val<100 |
| C - 06 | 28.2 | ≤ 0.3 | 7.35 | 962 | 625 | 0.5 | 5.3 | 90<val<100 |

Source: MCDC, Final Report vol. 3 “Initial Environmental Examination Report”, “Preparing Mandalay Urban Service Improvement Project (ADB ref. # TA-8472 MYA)”, Aug. 2015

In Mawlamyine, Mawlamyine University conducted water quality test and sediment test as a part of the environmental protection research work in 2014. The tests were conducted to check concentration level of heavy elements, toxic elements and radioactive elements in the sediments and water of the Thanlwin River. However, the basic water quality such as pH level, TDS, COD, DO levels were not the target of study thus there was no such data recorded.

In Patheingyi, as a part of the study on water sector in Yangon and Patheingyi funded by MHLW of Japan, simple water sampling test was conducted in 2014 and the results are shown in Table 1.5.10.

In all three target cities, water quality is expected to be lower than the WHO standard considering direct raw sewage discharge, leaks from uncontrolled municipal dumping sites, and/or upper stream mining activities or other uncontrolled direct discharge from industries to the surface water system. It is highly expected that further increase in economic development and population in urban area would eventually lead potential pollution to the ground water system.

Table 1.5.10: Water Quality Monitoring in Patheingyi

| Sites | NTU | pH | Fe | Al | color | Cl- |
|------------------|-------|---------|------|---------|-------|-----|
| Patheingyi river | 100.0 | 8.2 | 1.20 | 0.7 | 18.6 | 3.0 |
| Daga river | 112.0 | 8.1 | 2.01 | 1.03 | 39.9 | 2.9 |
| Royal Lake | 13.5 | 8.6 | 0.24 | <0.02 | 6.2 | 3.0 |
| WHO. | 5 | 5.8~8.6 | 0.3 | 0.1-0.2 | 15 | 250 |

Source: Yachiyo Engineering Co. etc. “Water Supply Improvement Study in Yangon and Patheingyi”, Mar. 2014

6) Environmental Regulations

Prior to the updates of Environmental Conservation Law in 2012, Myanmar did not have any legislative framework to monitor, measure, nor regulate environmental quality.

The updated 2012 Environmental Conservation Law and 2014 Rules empower MOECF to regulate and establish a “prior permission scheme” for a range of business activities that “may cause impact on environmental quality”. The Environmental Conservation Law is based on the “polluter pays

³ MCDC, Final Report vol. 3 “Initial Environmental Examination Report”, “Preparing Mandalay Urban Service Improvement Project (ADB ref. # TA-8472 MYA)”, Aug. 2015

principle”, with compensation for environmental impacts to be paid to a fund to be set up by MOECAP. In addition, the Law requires that any business that requires prior permission must have insurance cover for impacts on the environment. The Law provides for criminal penalties (although it is unclear if these apply to business entities) and payment of compensation for damages.

In December 2015, MOECAP promulgated the Environmental Impact Assessment Procedure (EIA Procedure), drafted with support from Asian Development Bank and based on guidelines from the International Finance Corporation, together with National Environmental Quality (Emission) Guideline.

This guideline provides the basis for regulating and controlling noise, vibration, air emissions, and liquid discharge from various sources to prevent pollution for protecting human and ecosystem health. The newly set guidelines on air, wastewater, noise level, and odor are for general and for industry specific use, to any projects subject to the EIA Procedure. However the set of guidelines for industrial projects does not envisage the urban or zone development, or program type of development which consists from multiple different activities, thus the guidelines are not applicable to those types of projects. Moreover, there is no clear guidance on how to conduct EIA Procedure for urban development or economic zone development without applicable emission standards.

(2) Social Status

This section attempts to review the current social status in Mandalay, Patheingyi, and Mawlamyine with emphasis on the following areas; Education, Health, Poverty, and Disability.

1) Education

(I) Education System in Myanmar

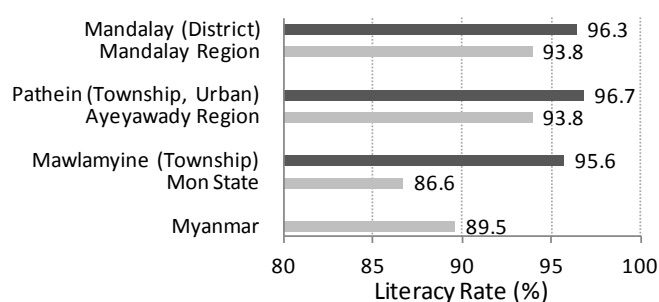
The structure of basic education in Myanmar consists of five years of primary school education, four years of middle school education, and two years of high school education (5-4-2). A Myanmar child starts his or her schooling at the age of five. Official commencement date for schools is every 1st of June.

The higher education period before master’s degree varies between 3-6 years which depends on their field of studies.

(II) Education Indicator

I) Literacy

Figure 1.5.6 shows the literacy rate in the target cities. The literacy rate in every target city is more than 95% and all these target cities are higher than the ones in the surrounding area and the entire Myanmar, which indicates that basic education prevails more widely in the cities.



Source: JICA Study Team based on The 2014 Myanmar Population and Housing Census

Figure 1.5.6: Literacy Rate in the Target Cities

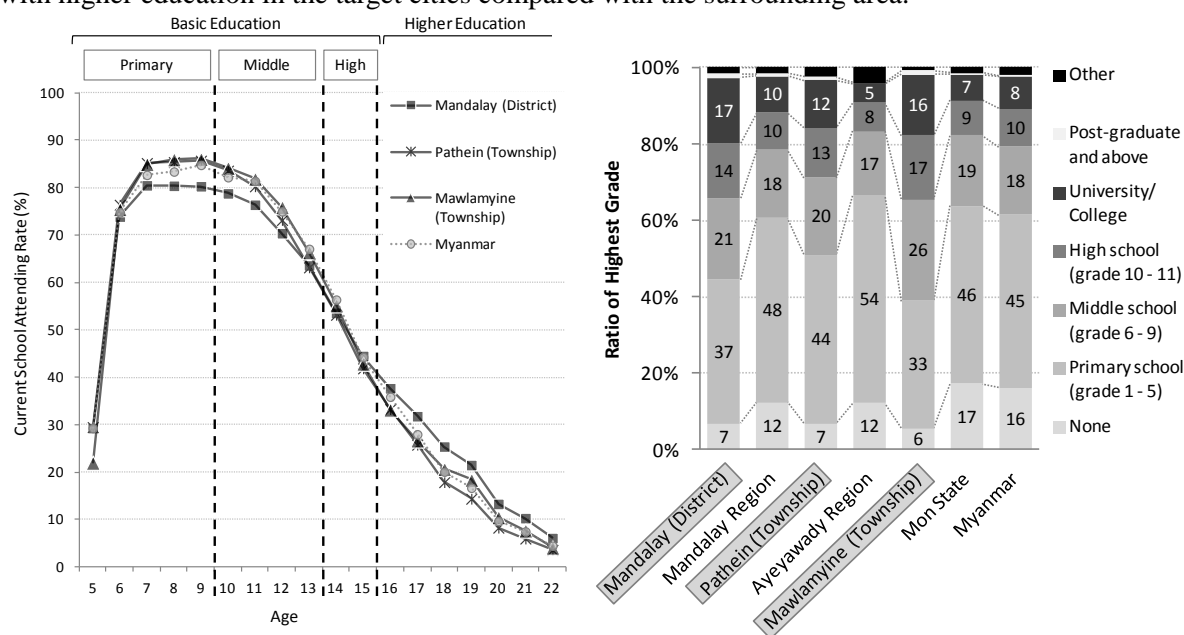
II) School / College Attendance

School attendance in Myanmar decreases gradually after the completion of the primary education cycle, as shown in Figure 1.5.8. The attendance rates of Myanmar on the average are 75%-85% for 6-9 years old (primary school age), 67%-82% for 10-13 years old (middle school age), 44-56% for 14-15 years old (high school age) and 36% for 16 years old (the age to start to enroll to higher education). The rates in Patheingyi Township and Mawlamyine Township show almost the same tendency with the one of Myanmar or slightly higher in primary school. The rates of basic education

in Mandalay District are 3-5% lower than Myanmar. On the other hand, the rate of higher education in Mandalay District is 4-5% higher than Myanmar.

III) Highest Level of Education

Ratio of population of 25 years and over whose highest level of education completed under primary school in Myanmar is 61% as shown in Figure 1.5.7. The ratios of Mandalay Region, Ayeyawady Region, and Mon State are 60.7%, 66.5%, and 63.7%, respectively, these are almost the same with the whole Myanmar. On the other hand, the ratios of Mandalay District, Patheingyi Township, and Mawlamyine Township are 44.4%, 51.0%, and 39.0%, respectively. And the population ratio whose highest level of education completed is more than the university or college in Mandalay District, Patheingyi Township, and Mawlamyine Township are also higher than the surrounding areas and the whole Myanmar. These suggest that basic education prevails more widely and there is more people with higher education in the target cities compared with the surrounding area.



Note: The above relation between age and school does not reflect the students who have repeated the school years.
Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 1.5.8: Current School Attending Rate

Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 1.5.7: Composition of Population who are 25 Years and Over by Highest Level of Education

(III) Facility and Staff

I) Number of Facilities and Staff

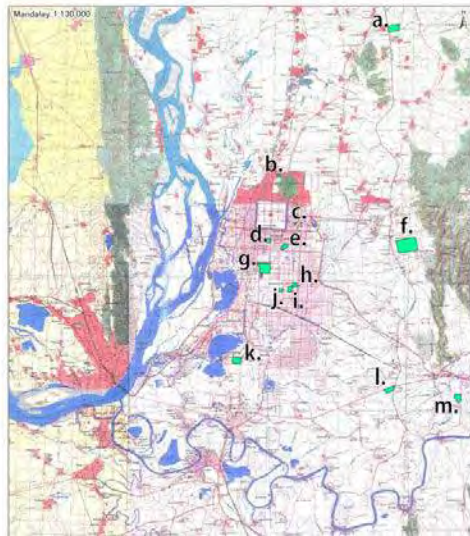
Table 1.5.11 summarize the number of basic education facilities, staff, and students in the target cities. And Table 1.5.12- Table 1.5.14 illustrate location of higher education facilities.

Table 1.5.11: Number of Schools, Teachers, and Students

| | | Mandalay (District) | Patheingyi (Township) | Mawlamyine (Township) |
|--------------------|----------------|---------------------|-----------------------|-----------------------|
| Number of Schools | Primary School | 339 | 246 | 113 |
| | Middle School | 37 | 17 | 14 |
| | High School | 37 | 13 | 15 |
| Number of Students | Primary School | 110,797 | 34,907 | 24,281 |
| | Middle School | 73,817 | 18,001 | 16,113 |
| | High School | 22,703 | 7,211 | 6,289 |
| Number of Teachers | Primary School | 3,930 | 1,351 | 1,055 |
| | Middle School | 2,280 | 520 | 666 |
| | High School | 840 | 267 | 272 |

Source: Education Statistical Year Book, 2013-2014 (2014)

Table 1.5.12: Location of Major Higher Education Facilities in Mandalay City



| | Higher Education Facility | Number of Students |
|----|--|--------------------|
| a. | University of Computer Studies | 625 |
| b. | University of Traditional Medicine | 357 |
| c. | University of Foreign Languages | 1,425 |
| d. | University of Medicine | 418 |
| e. | Teacher Training College | 448 |
| f. | Mandalay Technological University | 6,937 |
| g. | Mandalay University | 3,263 |
| h. | University of Dental Medicine | 824 |
| i. | University of Nursing | 948 |
| j. | Institute of Sports and Physical Education | 576 |
| k. | Yadanarpon University | 18,615 |
| l. | Institute of Pharmacy | 326 |
| m. | National University of Arts and Culture | 193 |

Source: JICA Study Team based on Data from GAD

Table 1.5.13: Location of Major Higher Education Facilities in Patheingyi Planning Area



| | Higher Education Facility | Number of Students |
|----|-------------------------------------|--------------------|
| a. | Patheingyi Technological University | (NA) |
| b. | Education College | 279 |
| c. | University of Computer Science | 282 |
| d. | Patheingyi University | 4,742 |
| e. | Nursing School | (NA) |

Source: JICA Study Team based on Data from GAD

Table 1.5.14: Location of Major Higher Education Facilities in Patheingyi Planning Area



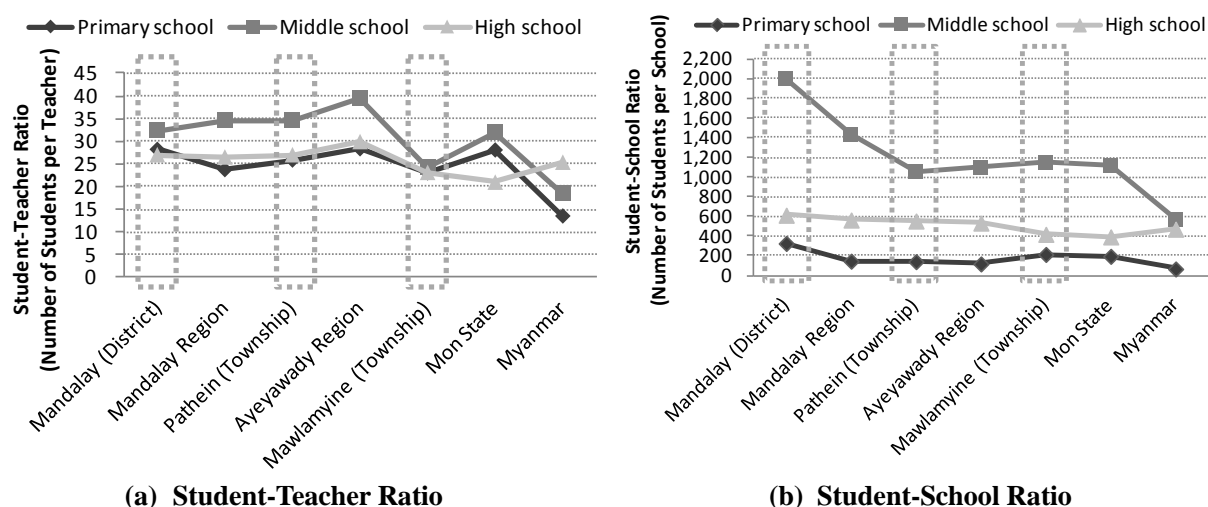
| | Higher Education Facility | Number of Students |
|----|-------------------------------------|--------------------|
| a. | Mawlamyine University | 1,2081 |
| b. | Mawlamyine Technological University | 2,171 |
| c. | Education College | 599 |

Source: JICA Study Team based on Data from Mawlamyine University

II) Indicator about Facilities and Staff

Provision of a sufficient number of teachers is one of the indicators to measure the quality of education. Figure 1.5.9 (a) (on the left side) shows the ratio of student / teacher. The ratios of the primary and middle schools in Mandalay District, Patheingyi Township, and Mawlamyine Township are 12-16 points higher than the ratio of the whole Myanmar. The regions and the state where the three cities belong also show higher numbers than Myanmar. This indicates that the supply of education staff in the regions and state is behind the whole Myanmar.

Preparation of facilities for primary and middle school education is also at a lower level in each city. Figure 1.5.9 (b) (on the right side) shows the number of students per school in basic education. Especially, the number of middle school in every three cities is quite high, which is more than 1,000. The number of primary school in Mandalay District shows significantly high number, which is approximately 2,000.



Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 1.5.9: Student-Teacher Ratio and Student-School Ratio

2) Health

(I) Basic Health Situation

Although there are many kinds of diseases that affect Myanmar people, the most prevailing types of morbidity in Myanmar are injuries (10.0%), complications of pregnancy and delivery (6.9%), and single spontaneous delivery (6.0%) as shown in Table 1.5.15. Most frequent causes of mortality are human immunodeficiency virus (HIV) (6.6%), septicemia (6.1%), and injuries (5.4%) as shown in Table 1.5.16.

Table 1.5.15: Single Leading Causes of Morbidity in Myanmar (2012)

| No. | Cause | Percentage (%) |
|-----|--|----------------|
| 1. | Other injuries of specified, unspecified and multiple body regions | 10.0 |
| 2. | Other complications of pregnancy and delivery | 6.9 |
| 3. | Single spontaneous delivery | 6.0 |
| 4. | Diarrhea and gastroenteritis of presumed infectious origin | 5.8 |
| 5. | Other viral diseases | 3.8 |
| 6. | Other pregnancies with abortive outcome | 2.6 |
| 7. | Gastritis and duodenitis | 2.4 |
| 8. | Malaria | 2.4 |
| 9. | Cataract and other disorders of lens | 2.4 |
| 10. | Other acute upper respiratory infections | 2.0 |
| | All other causes | 55.7 |
| | Total | 100.0 |

Source: JICA Study Team based on Health Statistics, Ministry of Health, Myanmar

Table 1.5.16: Single Leading Causes of Mortality in Myanmar (2012)

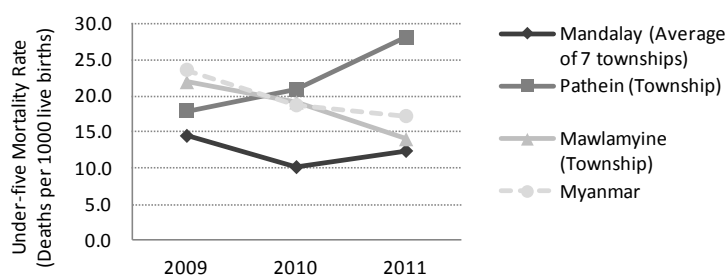
| No. | Cause | Percentage (%) |
|-----|---|----------------|
| 1. | Human immunodeficiency virus [HIV] | 6.6 |
| 2. | Septicemia | 6.1 |
| 3. | Other injuries of specified, unspecified and multiple body regions | 5.4 |
| 4. | Slow fetal growth, fetal malnutrition and disorders related to short gestation and low birth weight | 4.6 |
| 5. | Other diseases of liver | 4.0 |
| 6. | Other diseases of the respiratory system | 3.7 |
| 7. | Intrauterine hypoxia and birth asphyxia | 3.4 |
| 8. | Heart failure | 3.3 |
| 9. | Respiratory tuberculosis | 3.2 |
| 10. | Intracranial hemorrhage | 2.9 |
| | All other causes | 56.8 |
| | Total | 100.0 |

Source: JICA Study Team based on Health Statistics, Ministry of Health, Myanmar

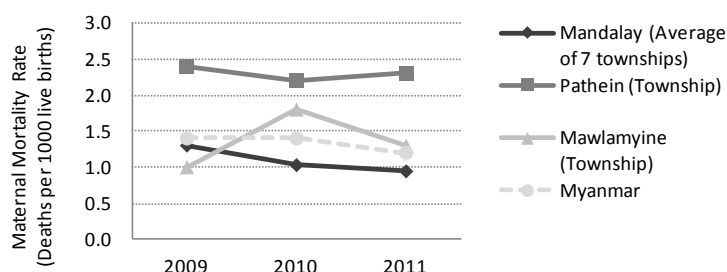
Figure 1.5.10 shows the basic health indicators of infant mortality rate, under-five mortality rate, and maternal mortality rate in the whole Myanmar, Mandalay, Patheingyi, and Mawlamyine. Every condition in Myanmar has improved through the past few years. The indicators in Mandalay have kept better than Myanmar. Mawlamyine also improved through the past few years and the indicator levels have been better or almost the same with Myanmar. The infant mortality rate and under-five mortality rate of Patheingyi got worse, and all indicators are worse than Myanmar.



(a) Infant Mortality Rate



(b) Under-five Mortality Rate



(c) Maternal Mortality Rate

Source: JICA Study Team based on the data from Township Health Profile 2011, Ministry of Health, Myanmar

Figure 1.5.10: Basic Health Indicators

(II) Health Facilities

I) Mandalay

In Mandalay District, there are 12 large hospitals, 22 medium hospitals, 11 small hospitals, and 4 clinics. The biggest hospital, the Mandalay General Hospital, is located in the central area of Mandalay near the palace and the Mandalay Railway Station.

II) Patheingyi

There are regional hospital with 250 beds, two leprosy mission clinics, and 83 private clinics. There are also traditional medicine hospital, private traditional medicine production, and traditional medicine clinics in the town. The biggest hospital, the regional hospital, is located at a few hundred meters east of Shwemawdaw Pagoda, which is around the central area of Patheingyi.

III) Mawlamyine

There are state hospital, three rural health centers, two station hospitals, and 12 sub-health centers. The biggest hospital, the state hospital, is located near Than Lwin Garden on Upper Main Road.

3) Poverty

UNDP implemented integrated household living conditions surveys in the whole Myanmar area in 2005 and 2010. Table 1.5.17 shows the percentage of the population who were poor in Mandalay Region, Ayeyawady Region, Mon State, and the whole Myanmar. Ratio of poor population in every urban area decreased from 2005 to 2010. And poor ratio in urban area is, in general, lower than the rural area. The ratio of the urban area in 2010 is 17.5% lower than Mandalay and 10.8% lower in Ayeyawady than its rural area. On the other hand, the ratio of rural area in the Mon State is 1.8% lower than its urban area.

Table 1.5.17: Percentage of Poor Population

| | Urban | | Rural | | Total | |
|------------------|-------|------|-------|------|-------|------|
| | 2005 | 2010 | 2005 | 2010 | 2005 | 2010 |
| Mandalay Region | 24.1 | 14.1 | 44.7 | 31.6 | 38.9 | 26.6 |
| Ayeyawady Region | 24.4 | 23.1 | 30.3 | 33.9 | 29.3 | 32.2 |
| Mon State | 22.5 | 17.8 | 21.3 | 16 | 21.5 | 16.3 |
| Myanmar Total | 21.5 | 15.7 | 35.8 | 29.2 | 32.1 | 25.6 |

Note: Poverty lines were set as MMK 162,136 per adult equivalent per year in 2005 and MMK 376,151 in 2010
Source: Integrated Household Living Conditions Survey in Myanmar (2009-2010), UNDP

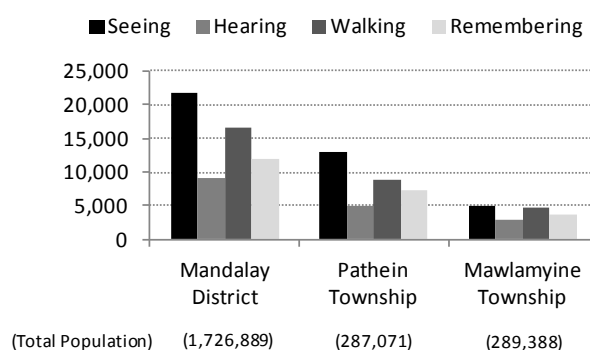
4) Disability

Disability is a situation where a person is at a greater risk than the general population of experiencing restrictions in performing routine activities or participating in roles such as work if no supportive measures are offered. The percentage of the population who has any form of disability in Mandalay District, Patheingyi Township, and Mawlamyine Township is 2.4%, 7.4%, and 3.6%, respectively as shown in Table 1.5.18. The most frequent disability type is seeing difficulty. Followed by walking, hearing, and remembering (slow learning development) difficulties. Figure 1.5.11 shows the population of persons with disabilities.

Table 1.5.18: Disability Prevalence Rate

| Area | Disability Prevalence Rate |
|---------------------|----------------------------|
| Mandalay District | 2.4% |
| Patheingyi Township | 7.4% |
| Mawlamyine Township | 3.6% |

Note: Population with any form of disability is counted
Source: The 2014 Myanmar Population and Housing Census



Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

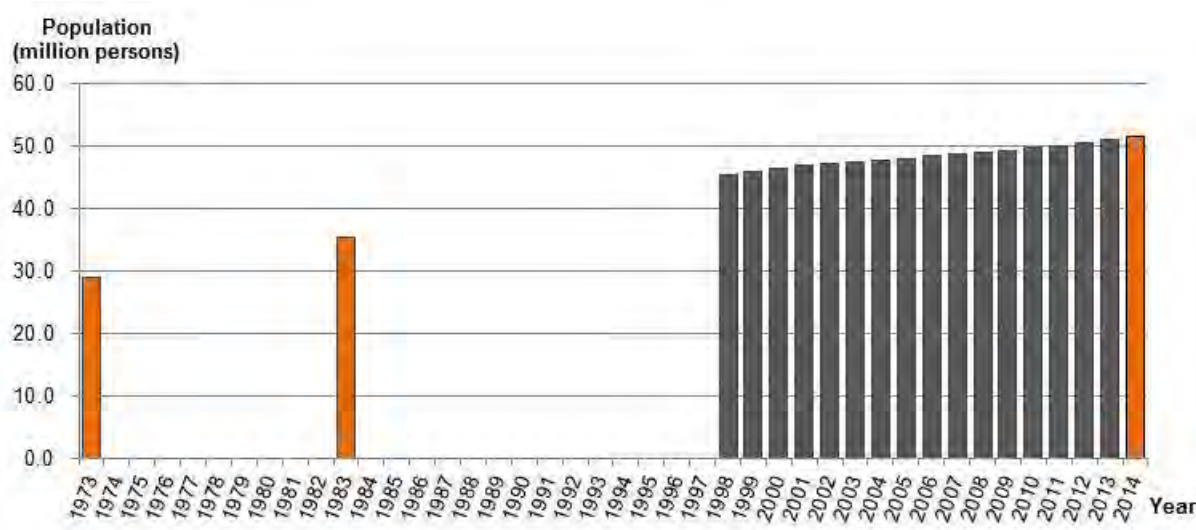
Figure 1.5.11: Population with Disabilities

1.5.2 Socio-economic Status

(1) National Socio-economic Development

According to the 2014 Myanmar Population and Housing Census, which was a nation-wide census conducted in 2014 for the first time in 31 years, the population of Myanmar was 51.4 million persons. The following figure shows national population of Myanmar from 1973 to 2014. Prior to the 2014 Census after 1950, a national census was conducted in 1973 and 1983, and the country's population was 28.9 million and 35.3 million respectively. The population grew 1.78 times over the last 41 years. Figure 1.5.12 shows the national population of Myanmar from 1973 to 2014.

The annual growth rate of the population has been slowing down. From 1973 to 1983, the population increased at the rate of 2.02% annually. The growth rate between 1983 and 2014 was 1.22%. Based on the estimated population by International Monetary Fund, the annual growth rate from 1998 to 2014 was 0.80%. The 2014 Census itself too estimated that the population growth rate between 2003 and 2014 was 0.89% annually, which shows that the Myanmar is currently one of the countries with the lowest population growth rate in ASEAN.



Note: Figures from 1998 to 2013 are estimated by IMF.

Source: The 2014 Myanmar Population and Housing Census; International Monetary Fund, *World Economic Outlook Database*, October 2015

Figure 1.5.12: National Population of Myanmar 1973-2014

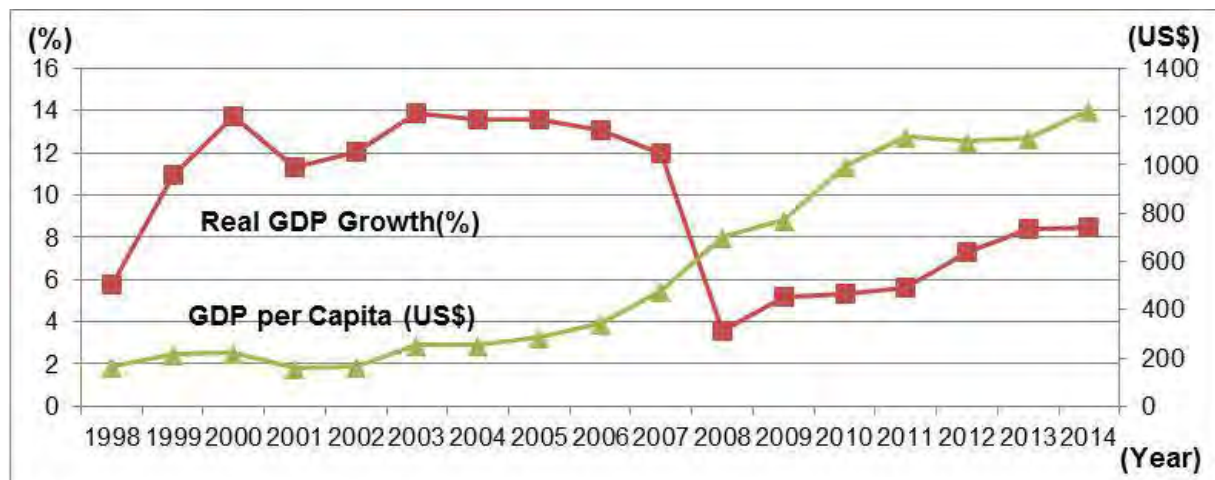
Table 1.5.19 indicates population changes of each region and state from 1983 to 2014. As regards the three regions and state where the target cities are located, Ayeyawady Region and Mandalay Region are the second and third populous regions after Yangon Region where 12% of the total population lives in each region. Mon State's share in the total population is 4.0% in 2014. The annual population growth rate of all the three regions and state during the same period underperformed the national average figure of 1.2%. However, it should be noted that Nay Pyi Taw is separately presented for 2014 in the table as Council Territory which became a new capital in 2006, though previously the area belonged to the Mandalay Region.

Table 1.5.19: Population by Region and State in 1983 and 2014

| Region/State | Population (thousand) | | Proportion to the Total Population | | Annual Population Growth |
|--------------------|-----------------------|--------|------------------------------------|--------|--------------------------|
| | 1983 | 2014 | 1983 | 2014 | |
| Kachin State | 905 | 1,689 | 2.6% | 3.3% | 2.0% |
| Kayah State | 168 | 287 | 0.5% | 0.6% | 1.7% |
| Kayin State | 1,055 | 1,574 | 3.0% | 3.1% | 1.3% |
| Chin State | 369 | 479 | 1.0% | 0.9% | 0.8% |
| Sagaing Region | 3,862 | 5,325 | 10.9% | 10.3% | 1.0% |
| Tanintharyi Region | 917 | 1,408 | 2.6% | 2.7% | 1.4% |
| Bago Region | 3,800 | 4,867 | 10.8% | 9.5% | 0.8% |
| Magway Region | 3,243 | 3,917 | 9.2% | 7.6% | 0.6% |
| Mandalay Region | 4,578 | 6,166 | 13.0% | 12.0% | 1.0% |
| Mon State | 1,680 | 2,054 | 4.8% | 4.0% | 0.7% |
| Rakhine State | 2,046 | 3,189 | 5.8% | 6.2% | 1.4% |
| Yangon Region | 3,966 | 7,361 | 11.2% | 14.3% | 2.0% |
| Shan State | 3,717 | 5,824 | 10.5% | 11.3% | 1.5% |
| Ayeyawady Region | 4,994 | 6,185 | 14.1% | 12.0% | 0.7% |
| Nay Pyi Taw | - | 1,160 | - | 2.3% | - |
| Total | 35,308 | 51,486 | 100.0% | 100.0% | 1.2% |

Source: The 2014 Myanmar Population and Housing Census

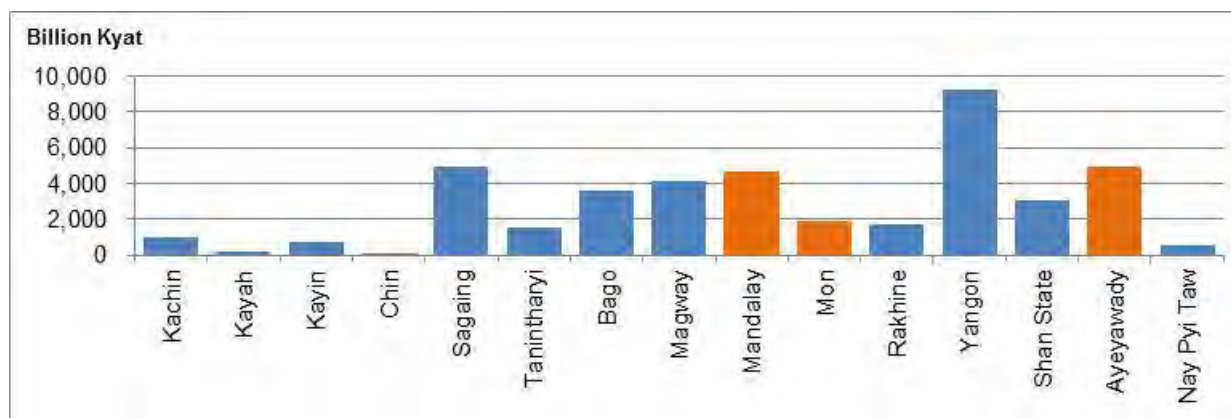
Myanmar's economic growth is continuing on an upward trend after 2011 when a liberalization process started. According to World Bank's Myanmar Economic Monitor (October 2015), Myanmar has recorded an average real GDP growth rate of 7.1% per annum from 2010/11 to 2014/15, and this is comparable to other high performing countries in the five-year period following the start of economic liberalization, such as Thailand (8.5%), China (8.2%), Vietnam (7.7%), and India (6.0%). GDP per capita was estimated to reach USD1,228 in 2014/15. Development of GDP growth and GDP per capita from 1998 to 2014 is shown in Figure 1.5.13.



Source: International Monetary Fund, *World Economic Outlook Database*, October 2015

Figure 1.5.13: Development of GDP Growth and GDP per Capita

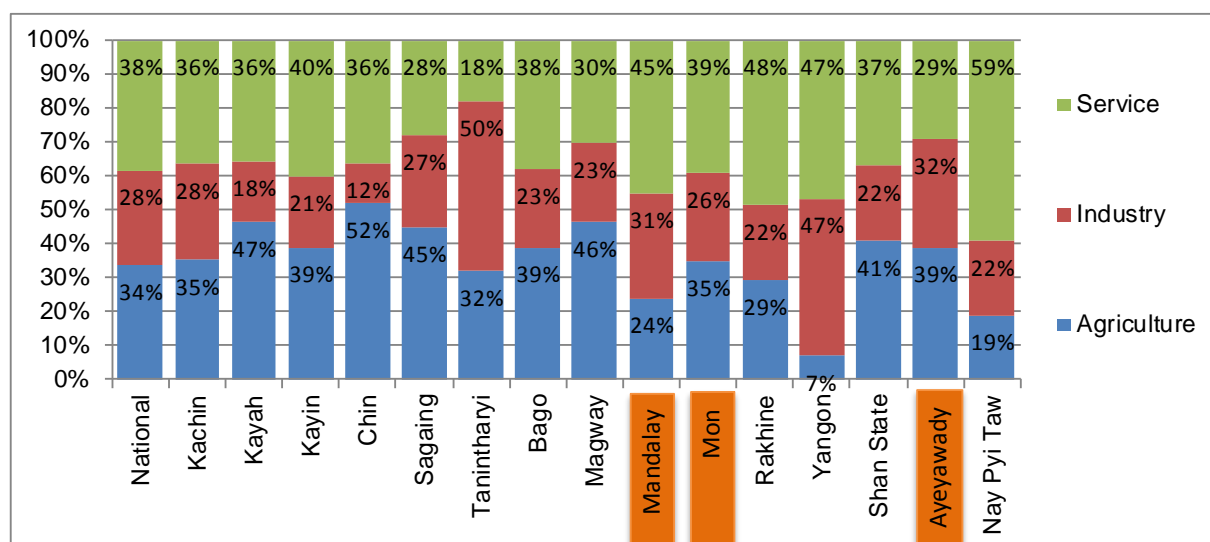
Figure 1.5.14 shows Gross Regional Domestic Product (GRDP) by region and state in 2011. Yangon, Sagaing, Ayeyawady, Mandalay, Magway were the top five contributors to the national economy, accounting for 66.3% of the national GDP when combined. GRDPs of Mandalay Region, Ayeyawady Region, and Mon State corresponded to 11.1%, 11.6%, and 4.4% of the national GDP, respectively.



Source: JICA, Preparatory Survey for the Project for Strengthening Connectivity of International Highway in Mekong Region, 2015.

Figure 1.5.14: GRDP by Region and State in 2011

Figure 1.5.15 indicates Sectoral Structure of Myanmar's GDP and GRDP by Region and State in 2012/13. Percentage composition at the national level of agriculture, industry, and service sectors were 34%, 28%, and 38% respectively. Mandalay Region had larger proportions of industry and service sectors than the national GDP, showing 24%, 31%, and 45% for agriculture, industry, and service sectors, respectively. The corresponding percentages for Ayeyawady Region are 39%, 32%, and 29%, indicating greater importance of agriculture to the regional economy. Mon State has a similar sectoral composition to the national one, with 35%, 26%, and 39% for agriculture, industry, and service sectors, respectively.



Source: Ministry of National Planning and Economic Development, *National Comprehensive Development Plan*, 2014.

Figure 1.5.15: Sectoral Structure by Region and State in 2012/13

(2) Socio-economic Development of the Target Cities

Table 1.5.20 indicates population of the regions and state comprising the target cities of the survey, divided by district and township, and also divided into urban and rural populations.

Mandalay City administered by Mandalay City Development Committee (MCDC) is currently composed of seven townships, and they also form Mandalay District. Five out of seven townships are fully urbanized areas which have long constituted the city. Amarapura Township and Patheingyi Township were incorporated into the city in 2011 and 2015, respectively. Mandalay District with a population of 1.7 million occupies 28% of Mandalay Region in population size, and 76.4% of the district population are urban residents.

Patheingyi City is the urban area of Patheingyi Township, which is one of seven townships in Patheingyi District. The District has the largest population in Ayeyawady Region. The total population of Patheingyi Township is 287,000, out of which 170,000 or 59% of people are considered to be urban residents.

Mawlamyine City is the urban area of Mawlamyine Township, which is one of six townships in Mawlamyine District. There are only two districts in Mon State and Mawlamyine District has a larger population. Among the population of 289,000 in Mawlamyine Township, 254,000 people are urban dwellers, which shows a quite high rate of urban population.

Table 1.5.20: Population of Three Regions and State by District and Township in 2014

| Region or State District/Township | Population (thousand) | | | Urban Population |
|--------------------------------------|-----------------------|--------|--------|---------------------|
| | Total | Urban | Rural | |
| Union | 50,280 | 14,878 | 35,402 | 29.6% |
| Yangon Region | 7,361 | 5,161 | 2,200 | 70.1% |
| Mandalay Region | 6,166 | 2,143 | 4,022 | 34.8% |
| Mandalay District | 1,727 | 1,319 | 407 | 76.4% |
| Aungmyetharzan | 266 | 266 | | 100.0% |
| Chanayetharzan | 197 | 197 | | 100.0% |
| Mahaangmye | 241 | 241 | | 100.0% |
| Chanmyathazi | 284 | 284 | | 100.0% |
| Pyigyidagun | 238 | 238 | | 100.0% |
| Amarapura | 238 | 81 | 157 | 34.0% |
| Patheingyi | 264 | 13 | 251 | 4.9% |
| PYIN O O LWIN District | 1,002 | 282 | 720 | 28.1% |
| KYAUkse District | 741 | 82 | 660 | 11.1% |
| MYINGYAN District | 1,056 | 168 | 888 | 15.9% |
| NYAUNG U District | 240 | 54 | 186 | 22.5% |
| YAMETHIN District | 518 | 60 | 458 | 11.6% |
| MEIKTILA District | 882 | 178 | 703 | 20.2% |
| Ayeyawady Region | 6,185 | 873 | 5,312 | 14.1% |
| PATHEINGYI District | 1,631 | 304 | 1,327 | 18.6% |
| Kangyidaunt | 178 | 11 | 167 | 6.2% |
| Kyaungon | 163 | 16 | 147 | 9.8% |
| Kyonpyaw | 236 | 24 | 212 | 10.2% |
| Ngaputaw | 169 | 11 | 158 | 6.5% |
| Patheingyi | 287 | 170 | 117 | 59.2% |
| Yekyi | 105 | 11 | 94 | 10.5% |
| Thapaung | 154 | 7 | 147 | 4.5% |
| Ngayokaung(ST) | 41 | 3 | 38 | 7.3% |
| Hainggyikyun(ST) | 115 | 15 | 100 | 13.0% |
| Shwethaungyan(ST) | 50 | 3 | 46 | 6.0% |
| Ngwehsaung(ST) | 44 | 14 | 30 | 31.8% |
| Ngathaingchaung(ST) | 89 | 19 | 70 | 21.3% |

| Region or State District/Township | Population (thousand) | | | Urban Population |
|--------------------------------------|-----------------------|-------|-------|---------------------|
| | Total | Urban | Rural | |
| PHYAPON District | 1,033 | 136 | 898 | 13.2% |
| MAUBIN | 974 | 109 | 865 | 11.2% |
| MYAUNGMYA District | 782 | 94 | 687 | 12.0% |
| LABUTTA District | 627 | 66 | 560 | 10.5% |
| HINTHADA District | 1,139 | 163 | 975 | 14.3% |
| Mon State | 2,054 | 572 | 1,482 | 27.8% |
| MAWLAMYINE District | 1,232 | 434 | 798 | 35.2% |
| Mawlamyine | 289 | 254 | 36 | 87.9% |
| Kyaikemaraw | 196 | 11 | 185 | 5.6% |
| Chaungzon | 122 | 8 | 114 | 6.6% |
| Thanbyuzayat | 171 | 57 | 113 | 33.3% |
| Mudon | 191 | 53 | 138 | 27.7% |
| Ye | 152 | 34 | 118 | 22.4% |
| Lamine(ST) | 88 | 14 | 75 | 15.9% |
| Khawzar(ST) | 23 | 4 | 19 | 17.4% |
| THATON District | 822 | 138 | 684 | 16.8% |

Note: ST = Sub Township

Source: The 2014 Myanmar Population and Housing Census

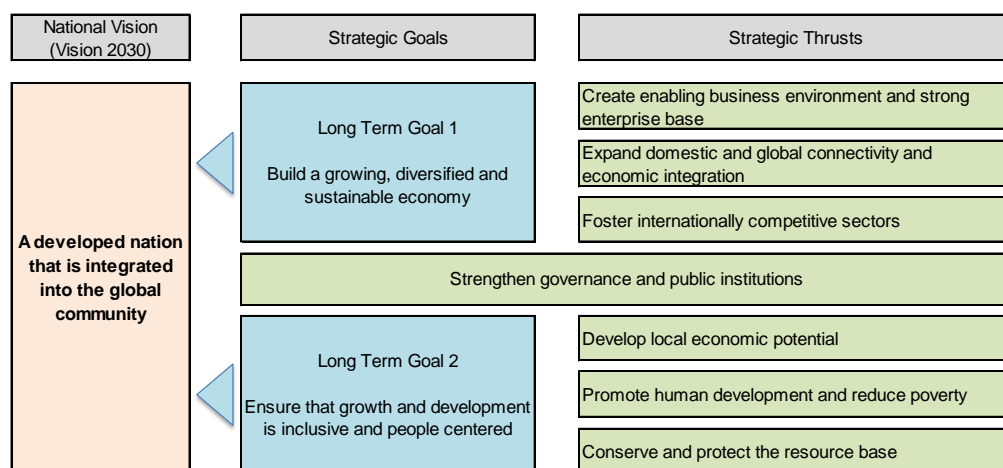
1.5.3 Industrial Development Status

In this section, firstly, important plan and vision developed at the national level related to industrial development will be explained. After that, the present situation of industrial development and activities mainly at the national and regional levels will be reviewed based on the literatures such as government plans, statistics, survey reports prepared as part of other development cooperation projects, and interviews with the concerned persons such as officials of the Myanmar government and JICA experts. The detailed status of industrial development of each target city is described in “Part 2: 2.2 Plans” of this report.

(1) National-level Plan and Vision on Industrial Development

1) National Comprehensive Development Plan (NCDP)

National Comprehensive Development Plan (NCDP) is a twenty-year perspective of Myanmar's development toward the year 2030, which was formulated in 2014 by consolidating the various planning initiatives within the integrated framework. As stated above in this chapter (1.1.1), NCDP presents the guidelines of comprehensive development of all sectors and strategic national development goals, and the long-time plan is expected to be implemented with four successive five-year plans. Under the vision of becoming a developed nation that is integrated into the global community, NCDP provides two strategic goals and seven strategic thrusts to realize the vision through the process of reform and structural transformation (Figure 1.5.16).



Source: MNPED, National Comprehensive Development Plan, 2014.

Figure 1.5.16: NCDP Framework for Long Term Sustainable Development

As seen in the two long-term strategic goals in the above figure, the basic philosophy of NCDP can be described as a combination of economic growth through market-oriented reforms and inclusive growth involving local development and social and environmental issues.

As a base of Myanmar's initial industrialization process, NCDP adopts a two-polar growth strategy that focuses on further industrialization of Yangon and Mandalay. By concentrating limited investment resources into the two cities which already enjoy a high level of economic agglomeration, the strategy expects to bring about immediate policy impacts to kick start the country's integration into the regional and global production networks. At the same time, NCDP proposes that comparative advantages of each region or state should be focal areas for investment and local pro-growth planning to mitigate social and economic disparities among regions and states as a longer-term objective of the government. It also presents potential area(s) of structural transformation of each region or state based on its comparative advantages, indicating Mandalay as "growth center", Ayeyawady as "agriculture and services", and Mon as "services and agriculture".

2) Myanmar Industrial Development Vision (MIDV)

Myanmar Industrial Development Vision (MIDV) is a future vision of Myanmar's industrial development, with the objective of revealing (i) projection of Myanmar's staged industrial development that simultaneously achieve nation-wide balanced development and sustainable economic growth, and (ii) priority industrial policies to be implemented for the coming five years to realize the future projection. Originally, the formulation of MIDV was proposed by Japan in 2014. After exchanges of views among parties of both public and private sectors between the Myanmar and Japanese governments, MIDV was finalized and handed over to the ex-president H.E.U Thein Sein from Prime Minister Abe in July 2015. MIDV's industrial strategies and priority policies were developed in line with NCDP.

As a prime approach of MIDV, "Urban-Rural Synergy Strategy" intends to create virtuous cycle between urban and rural development to realize their simultaneous and mutual development, through development of labor intensive industries led by foreign capital in urban areas, and that of agriculture, forestry, and fishery, as well as traditional products utilizing regional or state characteristics in rural areas. It is elaborated as follows:

(I) Future of manufacturing industry: Urban manufacturing cluster formation

MIDV indicates the importance of fostering urban manufacturing clusters since physical infrastructures are better developed and a number of benefits are expected from agglomeration such as easier collaborations with supporting services and reduced transaction costs in urban areas. It

then proposes promotion of sufficient investments and cluster formation in urban areas centered in Yangon and Mandalay to realize sustainable economic growth by utilizing Myanmar's limited financial and other resources. This direction is consistent with the two-polar growth strategy proposed in NCDP.

MIDV illustrates some of the industries that are expected to form clusters in the coming several years, which are i) construction material, ii) food processing, iii) chemicals (fertilizer, detergent, paint, etc.), iv) plastics processing, v) textile products, and vi) labor-intensive assembly and other industries.

(II) Future of agriculture, forestry, and fishery products: establishing value chain exploiting local uniqueness and connectivity

MIDV recognizes that Myanmar has a variety of local products of unique characteristics associated with individual regions and states, and has a great potential to gain the markets of huge neighboring countries such as China and India if logistics infrastructures are improved to smoothly link regions and cities in the country and abroad. In addition, there is large potential of productivity improvement in these products, since modern technology and knowledge such as mechanization is yet to be introduced widely in Myanmar. Based on the above perception, MIDV spells out regional characteristics and available resources of different geographical areas. Table 1.5.21 shows the summary of characteristics and resources of the three areas that are related to this Study.

Table 1.5.21: Summary of Characteristics and Resources of the Three Areas

| Area | Characteristics and available resources |
|--|--|
| Dry Area in middle and north Myanmar including Mandalay Region | <ul style="list-style-type: none"> This area is suited for specialty commercial crops such as sesame, peanut, sunflower, maize, onion, cotton, and medicinal herbs. Significant growth is achievable if the following issues are promoted: <ul style="list-style-type: none"> ➢ Expanded market-driven production ➢ Collaboration with business partners to timely react to market preferences ➢ Quality improvement such as logistics technology This area is endowed with abundant forestry resources such as teak groves in the Bago Mountains. Sustainable management of these forestry resources is expected to contribute to the area's development. |
| Ayeyawady Delta Area including Ayeyawady Region | <ul style="list-style-type: none"> This area is suited for internationally competitive rice production. Productivity and quality improvement is expected if the following issues are promoted, leading to an increase in the presence in the international market: <ul style="list-style-type: none"> ➢ Development of production infrastructure (such as irrigation) ➢ Breeding better strains ➢ Mechanization ➢ Quality improvement such as storage technology Partly owing to its proximity of Yangon as a main consumer market, livestock breeding is a major industry in this area catering for urban consumers. In response to increasing demand for dairy products, cattle breeding and milk and dairy production are also increasing. |
| Southern region including Mon State | <ul style="list-style-type: none"> This area is suited for rubber production. Processing plants of natural rubber are located in Kayah State. Promotion of related industries is expected in the future as the natural rubber production expands As labor cost in neighboring countries would rise in the middle and long term, significant growth is achievable if the following issues are promoted: <ul style="list-style-type: none"> ➢ Quality control ➢ Investment in manufacturing process ➢ Collaboration with end-users |

Source: Myanmar Industrial Development Vision; Presentation Material of "Myanmar Industrial Development Vision" presented by Mr. Kazuaki Morii, Embassy of Japan in Myanmar at Workshop on Myanmar Industrial Development Vision (MIDV) and the Next Five-Year Plan on February 2, 2016.

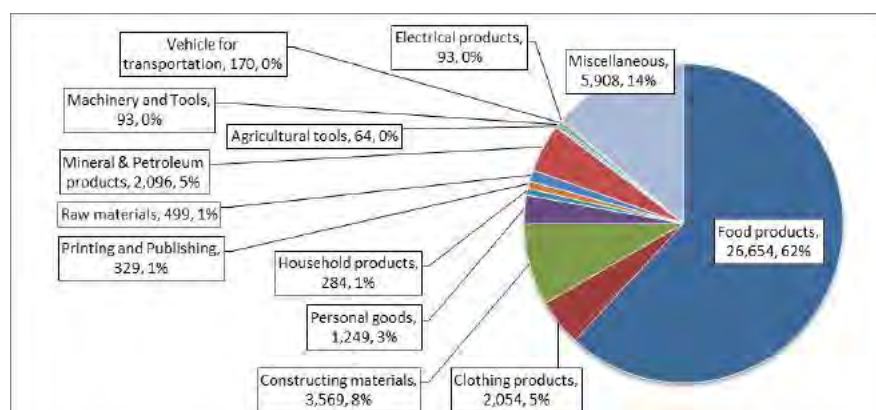
MIDV also sees the potential of pioneering industrialization of traditional products and cultural heritages. It is proposed that these local products, which are rooted in sophisticated traditional cultures of individual regions and states, should explore foreign upper-end markets by making the maximum

use of their traditional design and techniques. Among the examples of these local products are handicrafts such as Patheingyi umbrella in Ayeyawady Region and Bagan lacquerware in Mandalay Region, and traditional textiles in different regions and states including Mon State.

(2) Industrial Composition

Figure 1.5.17 shows the number of private industries by industrial category in Myanmar. A total of 43,062 industries were registered in 2014. Among them, industries related to “food products” are by far the largest in number accounting for 62%. Next to “food products”, “miscellaneous”, “construction materials”, “mineral and petroleum”, and “clothing products” account for 14%, 8%, 5%, and 5%, respectively.

Out of the total number of industries, 29,720 industries, or 69%, are categorized as small industries in size. There are 7,959 medium and 5,383 large industries, consisting of 18% and 13% of the total number respectively. According to “Myanmar Industry Directory 2015-16”, categorization by scale of private industry in Myanmar is made by such criteria as manpower, horsepower, annual gross production, and investment. For example, enterprises with over 100 employees are categorized as large scale. This implies that relatively “small” enterprises for other countries which are more industrially-developed may be included in the group of large-scale industries.



Source: Myanmar Industry Directory 2015-16.

Figure 1.5.17: Number and Share of Industries by Category in Myanmar in 2014

Table 1.5.22 indicates the number of private industries by region and state in 2014. In connection with the three cities targeted by this study, Mandalay Region, Ayeyawady Region, and Mon State had a total of 7,281, 5,809, and 2,155 registered industries in 2014, respectively. Mandalay Region had the greatest number of registered industries among all regions and states in Myanmar. Particularly, there were more medium and small scale industries in the region than in Yangon Region. Ayeyawady Region had the third largest number of registered industries in Myanmar after Mandalay Region and Yangon Region in 2014, and more than 80% of the total industries in the region were small scale ones. Mon State was ranked as the 8th position among 15 regions and states in terms of number of industries in 2014. More than 80% of the total industries in the state were small industries.

Table 1.5.22: Number of Registered Industries by Region and State in 2014

| Region/State | Number of Industries | | | | Share to Total |
|--------------------|----------------------|--------|-------|-------|----------------|
| | Large | Medium | Small | Total | |
| Kachin State | 40 | 109 | 1,061 | 1,210 | 2.8% |
| Kayah State | 16 | 253 | 100 | 369 | 0.9% |
| Kayin State | 97 | 65 | 757 | 919 | 2.1% |
| Chin State | 1 | 5 | 613 | 619 | 1.4% |
| Sagaing Region | 294 | 781 | 2,984 | 4,059 | 9.4% |
| Tanintharyi Region | 144 | 92 | 1,064 | 1,300 | 3.0% |

| | | | | | |
|------------------|-------|-------|--------|--------|--------|
| Bago Region | 285 | 888 | 3,434 | 4,607 | 10.7% |
| Magway Region | 155 | 299 | 2,384 | 2,838 | 6.6% |
| Mandalay Region | 1,129 | 2,262 | 3,890 | 7,281 | 16.9% |
| Mon State | 127 | 245 | 1,783 | 2,155 | 5.0% |
| Rakhine State | 57 | 85 | 1,762 | 1,904 | 4.4% |
| Yangon Region | 2,289 | 1,709 | 1,985 | 5,983 | 13.9% |
| Shan State | 204 | 410 | 2,811 | 3,425 | 8.0% |
| Ayeyawady Region | 458 | 602 | 4,749 | 5,809 | 13.5% |
| Nay Pyi Taw | 87 | 154 | 343 | 584 | 1.4% |
| Total | 5,383 | 7,959 | 29,720 | 43,062 | 100.0% |

Source: Myanmar Industry Directory 2015-16.

(3) International Trade

Table 1.5.23 shows Myanmar's export composition by main commodities. "Natural gas" is the greatest export items accounting for about 30% of the total commodity export, followed by "agricultural products" such as pulses, and rice and rice products, "garment", "base metal and ores", and "precious and semi-precious minerals". On the other hand, Myanmar mainly imports "machinery and transport equipment", "manufactured goods chiefly by materials", "miscellaneous transactions and commodities", and "mineral fuels, lubricants and related materials", which constituted about 77% of the total import commodities in terms of value in 2014-15, as indicated in Table 1.5.24.

Table 1.5.23: Myanmar's Export by Type of Principal Commodities

| Commodity | 2013-2014 | | 2014-2015 (p) | |
|--|---------------------|---------------|---------------------|---------------|
| | Value (USD Million) | Share (%) | Value (USD Million) | Share (%) |
| TOTAL EXPORTS | 11,204 | 100.0% | 12,524 | 100.0% |
| AGRICULTURAL PRODUCTS | 1,058 | 9.4% | 1,240 | 9.9% |
| Rice and rice products | 134 | 1.2% | 151 | 1.2% |
| Pulses | 743 | 6.6% | 951 | 7.6% |
| Raw rubber | 72 | 0.6% | 38 | 0.3% |
| Other Agricultural Products | 109 | 1.0% | 97 | 0.8% |
| ANIMAL PRODUCTS | 11 | 0.1% | 8 | 0.1% |
| MARINE PRODUCTS | 206 | 1.8% | 160 | 1.3% |
| Fish | 158 | 1.4% | 109 | 0.9% |
| Prawn | 31 | 0.3% | 30 | 0.2% |
| TIMBER | 898 | 8.0% | 42 | 0.3% |
| Teak | 667 | 6.0% | 36 | 0.3% |
| Hardwood | 231 | 2.1% | 6 | 0.0% |
| BASE METAL AND ORES | 107 | 1.0% | 426 | 3.4% |
| PRECIOUS AND SEMI-PRECIOUS MINERALS | 604 | 5.4% | 280 | 2.2% |
| Precious Stones and Pearls | 604 | 5.4% | 280 | 2.2% |
| GAS | 3,299 | 29.4% | 3,707 | 29.6% |
| GARMENT | 883 | 7.9% | 1,022 | 8.2% |
| OTHER COMMODITIES | 4,138 | 36.9% | 5,639 | 45.0% |

Source: Myanmar Data 2015 (Statistical Yearbook 2015)

Table 1.5.24: Myanmar's Import by Commodity Section

| Commodity Section | 2013-2014 | | 2014-2015 (p) | |
|-----------------------|---------------------|---------------|---------------------|---------------|
| | Value (USD Million) | Share (%) | Value (USD Million) | Share (%) |
| GRAND TOTAL | 13,760 | 100.0% | 16,633 | 100.0% |
| Food | 470 | 3.4% | 731 | 4.4% |
| Beverages and tobacco | 63 | 0.5% | 66 | 0.4% |

| | | | | |
|---|-------|-------|-------|-------|
| Crude materials, inedible except fuel | 69 | 0.5% | 95 | 0.6% |
| Mineral fuels, lubricants and related materials | 2,363 | 17.2% | 2,563 | 15.4% |
| Animal and vegetable oils and fats | 543 | 3.9% | 557 | 3.4% |
| Chemicals | 972 | 7.1% | 1,137 | 6.8% |
| Manufactured goods chiefly by materials | 2,497 | 18.1% | 2,834 | 17.0% |
| Machinery and transport equipment | 4,174 | 30.3% | 4,748 | 28.5% |
| Miscellaneous manufactured articles | 492 | 3.6% | 1,155 | 6.9% |
| Miscellaneous transactions and commodities | 2,116 | 15.4% | 2,746 | 16.5% |

Note: Data based on Burma Standard International Trade Classification (BSIC)

Source: Myanmar Data 2015 (Statistical Yearbook 2015)

Table 1.5.25 and Table 1.5.26 indicate the main partner countries to Myanmar's export and import. The three neighboring countries, namely China, Thailand, and India to a lesser extent, are the most important partners to Myanmar's export. Myanmar's main export items to China are natural gas, jade, rice and agricultural products, and wood products. Exports to Thailand are mostly natural gas, vegetable products including rice, and animal and animal products. To India, agricultural products and wood products are the main export items. Myanmar mainly exports agricultural products to these neighboring countries through border trade, and import consumer goods, electronics and machinery.

Table 1.5.25: Direction of Myanmar's Export by Country

| Country | 2013-2014 | | 2014-2015 (p) | |
|-------------------------|---------------------|---------------|---------------------|---------------|
| | Value (USD Million) | Share (%) | Value (USD Million) | Share (%) |
| GRAND TOTAL | 11,204 | 100.0% | 12,524 | 100.0% |
| China, People's Rep. of | 2,911 | 26.0% | 4,674 | 37.3% |
| Thailand | 4,306 | 38.4% | 4,029 | 32.2% |
| Singapore | 694 | 6.2% | 759 | 6.1% |
| India | 1,144 | 10.2% | 746 | 6.0% |
| Japan | 513 | 4.6% | 556 | 4.4% |
| Korea, Rep. of | 353 | 3.1% | 370 | 3.0% |
| Hong Kong | 489 | 4.4% | 289 | 2.3% |
| Malaysia | 109 | 1.0% | 265 | 2.1% |
| Indonesia | 60 | 0.5% | 86 | 0.7% |

Note: (p) provisional

Source: Myanmar Data 2015 (Statistical Yearbook 2015)

Table 1.5.26: Direction of Myanmar's Import by Country

| Country | 2013-2014 | | 2014-2015 (p) | |
|-------------------------|---------------------|---------------|---------------------|---------------|
| | Value (USD Million) | Share (%) | Value (USD Million) | Share (%) |
| GRAND TOTAL | 13,760 | 122.8% | 16,633 | 132.8% |
| China, People's Rep. of | 4,105 | 36.6% | 5,020 | 40.1% |
| Singapore | 2,910 | 26.0% | 4,137 | 33.0% |
| Japan | 1,296 | 11.6% | 1,749 | 14.0% |
| Thailand | 1,377 | 12.3% | 1,679 | 13.4% |
| Malaysia | 840 | 7.5% | 744 | 5.9% |
| India | 494 | 4.4% | 595 | 4.8% |
| Indonesia | 439 | 3.9% | 551 | 4.4% |
| United States | 80 | 0.7% | 494 | 3.9% |
| Korea, Republic of | 1,218 | 10.9% | 493 | 3.9% |

Note: (p) provisional

Source: Myanmar Data 2015 (Statistical Yearbook 2015)

(4) Foreign Investment

Table 1.5.27 indicates the total investment amounts of permitted enterprises in Myanmar by sector under the Foreign Investment Law. “Oil and gas” and “power” sectors account for 78% of the total cumulative investment amounts. In 2014-15, “oil and gas” is still the biggest investment sector attracting 40% of the total investment amount, followed by “transport and communication” and “manufacturing”.

**Table 1.5.27: Total Investment of Permitted Enterprises by Sector
under the Foreign Investment Law**

| Sectors | 2014-2015 | | | Cumulative Total as of March 31, 2015 | | |
|---------------------------|--------------------|---------------------|---------------|---------------------------------------|---------------------|---------------|
| | No. of Enterprises | Foreign Investment | | No. of Enterprises | Foreign Investment | |
| | | Value (USD Million) | Share (%) | | Value (USD Million) | Share (%) |
| TOTAL | 211 | 8,011 | 100.0% | 895 | 54,236 | 100.0% |
| Agriculture | 4 | 40 | 0.5% | 17 | 243 | 0.4% |
| Livestock & Fishery | 5 | 27 | 0.3% | 34 | 453 | 0.8% |
| Mining | 1 | 6 | 0.1% | 70 | 2,869 | 5.3% |
| Oil and Gas | 26 | 3,220 | 40.2% | 141 | 17,593 | 32.4% |
| Manufacturing | 141 | 1,502 | 18.8% | 477 | 5,490 | 10.1% |
| Power | 1 | 40 | 0.5% | 8 | 19,325 | 35.6% |
| Transport & Communication | 8 | 1,679 | 21.0% | 28 | 3,183 | 5.9% |
| Hotel & Tourism | 5 | 358 | 4.5% | 57 | 2,158 | 4.0% |
| Real Estate Development | 6 | 781 | 9.7% | 29 | 2,278 | 4.2% |
| Industrial Estate | - | - | - | 3 | 193 | 0.4% |
| Construction | - | - | - | 2 | 38 | 0.1% |
| Others | 14 | 357 | 4.5% | 29 | 414 | 0.8% |

Source: Myanmar Data 2015 (Statistical Yearbook 2015)

Table 1.5.28 shows the total investment amounts of permitted enterprises by region and state under the Foreign Investment Law. In 2014-15, a total of 211 enterprises were permitted in Myanmar with investment amounts of USD 8,011 million. The table also indicates that foreign investments have been concentrated into Yangon Region. In 2014-15, about 73% of the total enterprises and 47% of the total investment amounts were directed to the region. In Mandalay Region, on the other hand, only 7 enterprises were permitted with the increased investment of 667 million US dollars. 6 enterprises were permitted in Ayeyawady Region with the investment of 166 million US dollars, and 6 enterprises were permitted in Mon State with the investment of 326 million US dollars in the same year.

**Table 1.5.28: Total Investment of Permitted Enterprises by Region and State
under the Foreign Investment Law**

| Region and State | (USD Million) | | | | | | | | | |
|------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | 2010-2011 | | 2011-2012 | | 2012-2013 | | 2013-2014 | | 2014-2015 | |
| | No. of Enterprises | Foreign Investment | No. of Enterprises | Foreign Investment | No. of Enterprises | Foreign Investment | No. of Enterprises | Foreign Investment | No. of Enterprises | Foreign Investment |
| TOTAL | 24 | 19,999 * | 13 | 4,644 * | 94 | 1,419 * | 123 | 4,107 * | 211 | 8,011 * |
| Kachin State | 2 | 8,219 | 1 | 4,344 | - | - | - | - | - | - |
| Kayah State | - | - | - | - | - | - | - | - | 1 | 2 |
| Kayin State | 1 | 186 | - | - | - | - | - | - | - | - |
| Chin State | - | - | 1 | 2 | - | - | - | - | - | - |
| Sagaing | 3 | 1,396 | - | - | - | - | 4 | 201 | 4 | 144 |

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| Region | | | | | | | | | | | |
|--------------------|---|-------|---|------|----|-------|-----|---------|-----|-------|---|
| Tanintharyi Region | 7 | 320 | - | - | 3 | 206 | 2 | 33 * | 6 | 601 | |
| Bago Region | 1 | 2 | 1 | 26 | 5 | 58 | 7 | 627 * | 17 | 460 | * |
| Magway Region | - | - | 2 | 123 | 2 | 39 | - | - | 3 | 234 | |
| Mandalay Region | - | - | 1 | 26 | 2 | 65 | 2 | 82 | 7 | 667 | * |
| Mon State | 2 | 2,945 | - | - | - | - | 1 | 375 | 6 | 326 | |
| Rakhine State | 5 | 6,867 | 1 | 18 | - | - | - | - | 5 | 1,618 | |
| Yangon Region | 3 | 64 * | 5 | 33 * | 80 | 834 * | 102 | 2,745 * | 154 | 3,767 | |
| Shan State | - | - | - | - | 1 | 199 | 2 | 33 | 1 | 17 | * |
| Ayeyawady Region | - | - | 1 | 73 | 1 | 20 | 3 | 11 | 6 | 166 | |
| Nay Pyi Taw | - | - | - | - | - | - | - | - | 1 | 9 | |

Note: * Increased in investment value.

Source: MNPED Central Statistical Organization, "Myanmar Data CD-ROM 2015", February 2016. (Originally from Directorate of Investment and Company Administration)

1.5.4 Urban Development Status

(1) History of Urban Planning

The target three cities have individually long history. Mandalay was the last royal capital of Burma (Myanmar) in the Konbaung Dynasty, the last independent Burmese Kingdom. Patheingyi flourished especially after the British colonization due to its huge scale of agricultural development as inland logistic hub in Ayeyarwaddy Delta. Mawlamyine was the first capital of British Burma (Myanmar) in middle of the 19th century. More explanations of the target three cities were quoted from the conceptual plans made by MOC.

1) Mandalay

The year that founded the Yadanarbon Mandalay Palace was composed with verses “*Oak Kyaw Kyit Aye Mandalay*”, “*Inn Gyi Kyar Ount Yadanarbon*” these indicate 1221 ME in Myanmar traditional practice to take note of numerical numbers. Mandalay was established simultaneously with seven Buddha places at Myanmar Year (Era) ME 1332, 6th wan of Kason. Yadanarbon Mandalay can be divided with the three river lanes such as the Ayeyarwaddy River, the Dhokehtawaddy River, the Matayar River, and Shan Plateau; and designated the boundary as a wide region that is 35 miles from north to south and 15 miles from east to west.

During the establishment, the year was during the Buddhist era when monuments and city are established with a square shape. There were 2,400 Tar (Tar = Myanmar Measurement, 1 Tar = 2 miles) in the four walls of the city and 600 Tar for each wall. The wall of the city is situated straight from east to west, from north to south, and a city gate in each of the walls of the city, and the middle gate is situated straight from east to west, north to south of the palace. There are 54 wards (Pya Kwet in Myanmar language) in the east, west, north, and south and it is founded by designating the boundary called East ward, West ward, North ward and South ward. In 1993, Mandalay City has five townships, in addition to these townships such as Aungmyetharzan, Chanayetharzan, Mahaaungmye, and Chanmyatharzi Townships. Pyigyidagun Township has been included and its area is 45.72 miles². (abstracted from MOC conceptual plan)

2) Patheingyi

Patheingyi was named as Thinzawarnargaya when the King Thiri Da Mar Thaw Ka was the ruler at the time of Buddhist year 218. The pagoda Shwe Muttaw was constructed by King Thiri Da Mar Thaw Ka. In year 536, the name was changed as Patheingyi. Later it is called Pathi when King Ka Lar Pa Thi was the ruler. In year 595, the Wunna brothers assassinated King Ka Lar Pa Thi and the name was changed from Pathi to Patheingyi again. In year 600, King Thamukawtha was the ruler and the country was very crowded and developed, this time it was named as Nargayawaypula, but after his death the place was once again called Patheingyi until now.(abstracted from MOC conceptual plan)

3) Mawlamyine










Mawlamyine is a city of Mon State .The city was established in 1573. The Ataran River is in the east while ChaungSone Town and the Thanlwin River are in the west of the city. Mudon and KyikeMayaw cities are in the south. The Thanlwin River and Pong Town are located in the north of the city.

Mawlamyine City was established in BC 1573 and now it is situated in Mawlamyine District. Economic, educational, and institutional infrastructures of the city are in good condition for this instance. PhayaThonzu Road and No. (8) East- West Corridor Main Road are located in Mawlamyine and serving as a good intercity transportation. (abstracted from MOC conceptual plan)

(2) Characteristics of the Cities (Tourism Resources and Townscape)

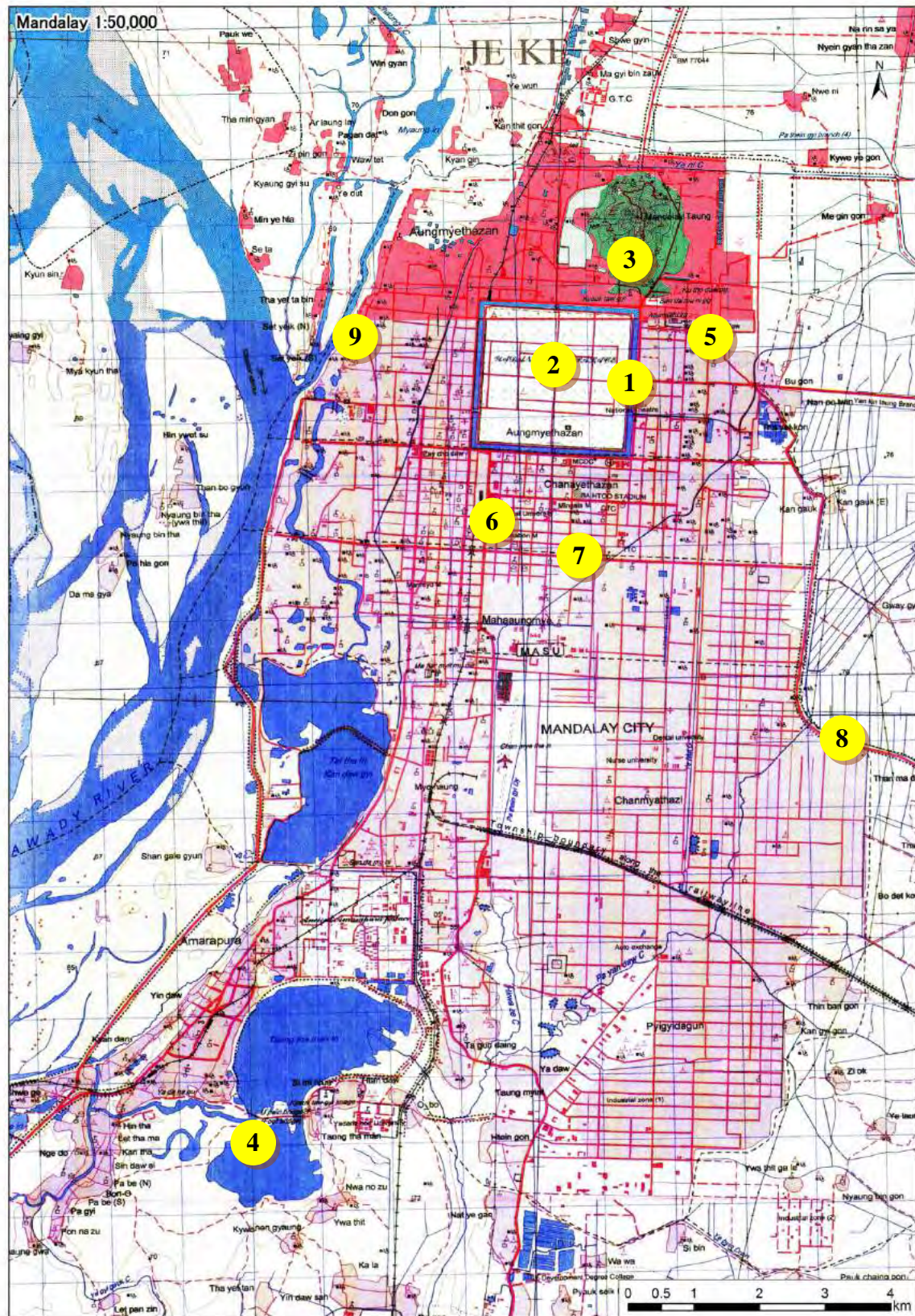
1) Mandalay

The most prominent characteristics of Mandalay townscape is old palace and grid pattern city which are formed in the era of last royal capital. Mandalay hill is the symbol of the city which can be seen from city area. Wooden heritages such as the bridge and monastery are also attractive tourism destinations of Mandalay.

| | | |
|---|--|---|
|  |  |  |
| <p>Mandalay Hill and Old Palace (1) These are symbol of the city and attract both residents and tourists.</p> | <p>Old Palace Site (2) The site, which stretch 2km square, is used for museum and garrison.</p> | <p>View from Mandalay Hill (3) On top of the hill, there is a famous pagoda which has panoramic view.</p> |
|  |  |  |
| <p>U-bein Bridge (4) Teakwood bridge crosses Taungthaman Lake. This built in mid of 19th century.</p> | <p>Shwenandaw Monastery (5) This monastery was built in 1880, which is famous for teak carvings.</p> | <p>City Center Townscape (6) This is one of the typical townscapes from main road (Street No. 78) .</p> |
|  |  |  |
| <p>Roads and Intersections (7) Main intersections have signals. There are many motorcycles. Source: JICA Study Team</p> | <p>Informal Housing (8) Outer ring roads seem to have enough space for future road expansion.</p> | <p>Informal Housing (9) Informal houses (slums) can be seen mainly on the riversides and lakesides.</p> |

Note: the number next to each title corresponds to one in the map (next page).

Figure 1.5.18: Characteristics of Mandalay












Source: JICA Study Team (Base-map: Ministry of Agriculture & Irrigation, 2005)

Figure 1.5.19: Characteristics of Mandalay (Location Map)

2) Pathein

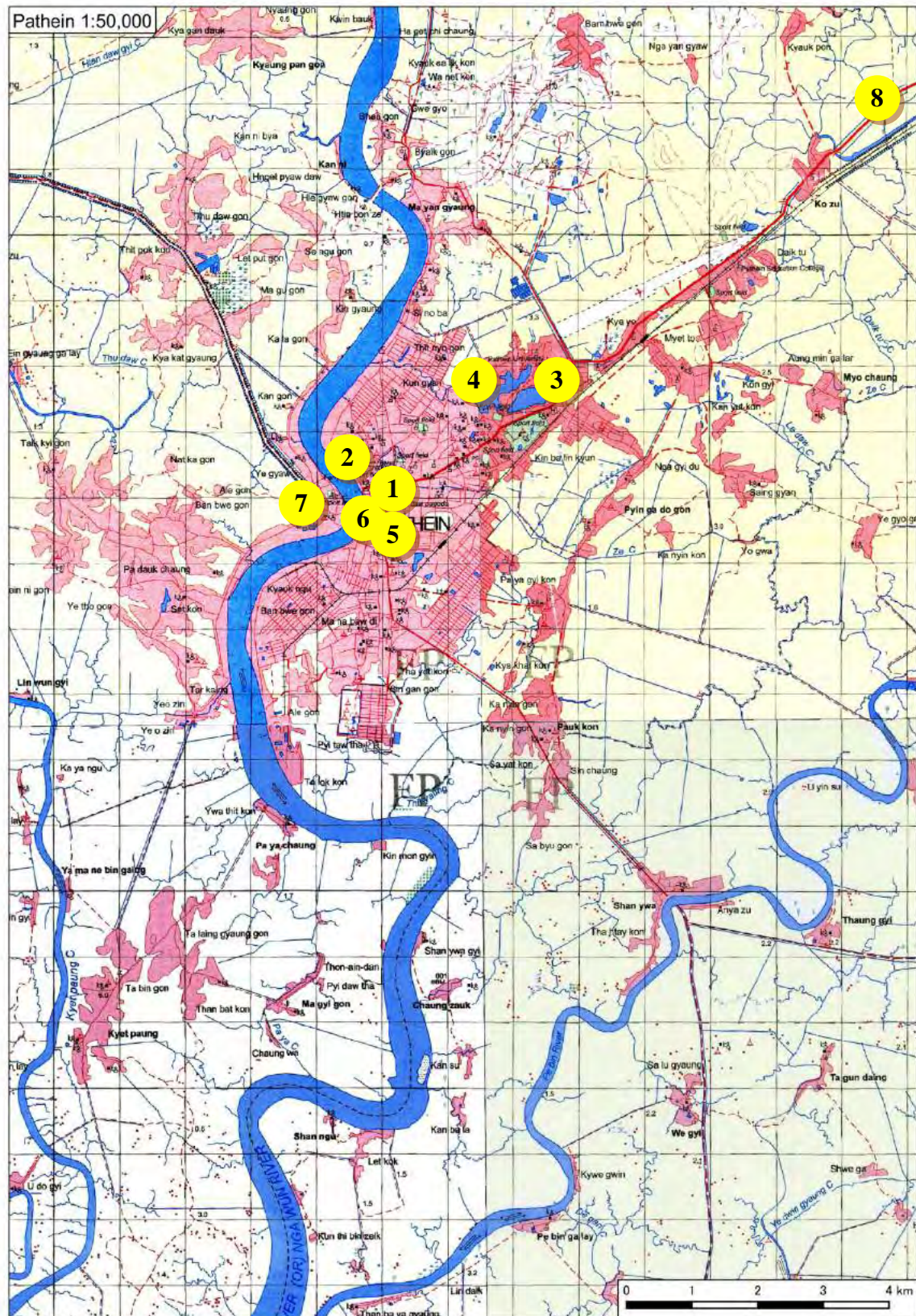
Since Pathein City is quite flat as in the delta area of Ayeyawady River, there is no topographical landmark such as mountain or hill. Waterfront of rivers and lakes feature unique character of the city. Chaungtha Beach and Ngwe Saung Beach facing to the Bay of Bengal have tourism potential in close relationship with Pathein city as transport hub connecting with Yangon.

| | | |
|--|--|---|
|  |  |  |
| <p>Shwemokhtaw Pagoda (1) This long-history pagoda is located in the city center as a landmark of the city.</p> | <p>Riverside Plaza (2) Facing to Pathein River, there is a plaza which has open-space to the public.</p> | <p>Lakes (3) In the city center, there are two large lakes which provide amenity space.</p> |
|  |  |  |
| <p>Lakeside Park (4) Along the lakes, an amusement park and a university was provided.</p> | <p>City Center Townscape (5) In the city center, relatively low rise buildings can be seen.</p> | <p>Pathein River and Jetty (6) Along the Pathein River, there are jetties for cargos and passengers.</p> |
|  |  |  |
| <p>Opposite Shore (7) The opposite shore of the city center looks less developed area.</p> | <p>Paddy Fields in Countryside (8) Huge area of paddy fields surrounds the city of Pathein as the delta area.</p> | <p>Chaungtha Beach (9) From 1.5 hours distance from Pathein by car, there are two popular beaches.</p> |

Source: JICA Study Team

Note: the number next to each title corresponds to one in the map (next page).

Figure 1.5.20: Characteristics of Pathein












Source: JICA Study Team (Base-map: Ministry of Agriculture & Irrigation, 2005)

Figure 1.5.21: Characteristics of Patheingyi (Location Map)

3) Mawlamyine

Townscape of Mawlamyine is prominently characterized as beautiful natural landscape made by Yankin Hill and Thanlwin River. As the former capital of the British colonial, a lot of historical buildings are remained in the city, which have big potential for tourism development in the future.

| | | |
|--|--|---|
|  |  |  |
| Kyaik Tan Lan Pagoda (1) On the Yankin Hill, there are pagoda and monastery as landmark of the city. | View from Yankin Hill (2) On top of the hill, there is panoramic view of the city and the river. | Historical Church (3) Many historical buildings in the British colonial can attract tourists. |
|  |  |  |
| Historical Buildings (4) Many historical buildings in the British colonial can attract tourists. | River and Boulevard (5) Thanlwin River and a boulevard along it provide open atmosphere. | Riverside Townscape (6) Mid-rise (4 stories) buildings stand in line facing to the river. |
|  |  |  |
| City Center Townscape (7) In the city center, relatively low rise buildings can be seen. | Thanlwin Bridge (8) The bridge, 2006 opened, is the longest road and rail bridge in Myanmar. | Rubber Plantations (9) Huge area of rubber plantations surrounds the city of Mawlamyine. |

Source: JICA Study Team

Note: the number next to each title corresponds to one in the map (next page).

Figure 1.5.22: Characteristics of Mawlamyine



Source: JICA Study Team (Base-map: Ministry of Agriculture & Irrigation, 2005)

Figure 1.5.23: Characteristics of Mawlamyine (Location Map)

(3) Regulations of Building and Land Use

1) Mandalay

According to the “Building Rules, Regulations and Procedures, and Responsibilities” issued by Building and Warehouse Department, MCDC, regulations related to building, land use, and development procedure exist in Mandalay as shown in Table 1.5.29.

It must be emphasized that the streets surrounding the palace have the regulation which control building heights along the streets up to 4 stories.

Table 1.5.29: Regulation of Building and Land Use, Development Procedure in Mandalay

| Items | Specification | Exact Area or Street |
|--------------------------------|---|---|
| Building Height Control | Not to allow high rise buildings to be more than 4 stories | 26 B Street, 80 Street, 66 Street, 12 Street along the moat |
| High-rise Buildings Inspection | Building permission up to 12 stories check and issued by MCDC and buildings more than 12 stories will be inspected and surveyed by CQHP | - |
| Place to be Left in the Plot | The rest space must be 5 ft in front, 4 ft at the back, 2 ft each at both sides of the building in the downtown area. | From Shwe Ta Chaung to 72 Street, 26 Street to 35 Street |
| | Space must be left at 12 ft in front, 6 ft at the back, and 3 ft each at both sides of the building. | In other area of the city |
| MCDC Permission Proposal | Soil test report and structural design calculation are needed for the buildings which have 4 stories and more. | - |
| Ground Level of Building | The plinth height must be at a minimum 1.5 ft higher than the nearest road level. | - |
| Building Wall Height | Building wall height must be 12 ft on the ground floor and 10 ft each on the upper floors. | - |

Source: JICA Study Team

2) Patheingyi and Mawlamyine

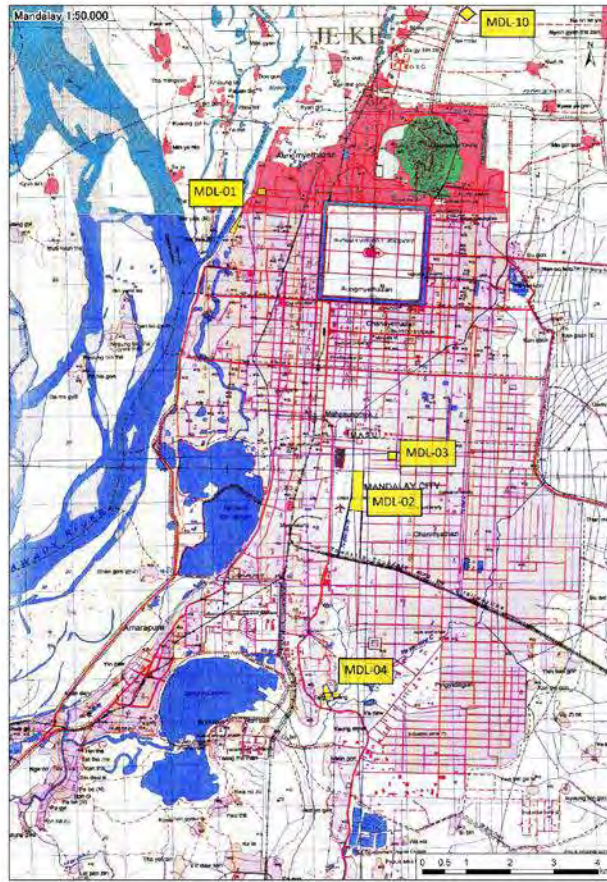
In the survey conducted in March, Patheingyi, and Mawlamyine seem not to have any specific regulations related to building and land use.

(4) Current Urban Development Projects

Proposed, on-going, and currently completed urban development projects, regardless of public or private, were checked through the field survey or interview conducted with related organization. Based on the survey result, it is identified that Mandalay has a lot of proposals of large-scale development projects from both foreign investors and domestic investors at not only inside of the city but also its suburbs. Although Patheingyi and Mawlamyine tend to have more housing projects initiated by public sector, some private projects appear gradually. Such tendency will be surely accelerated more in the future.

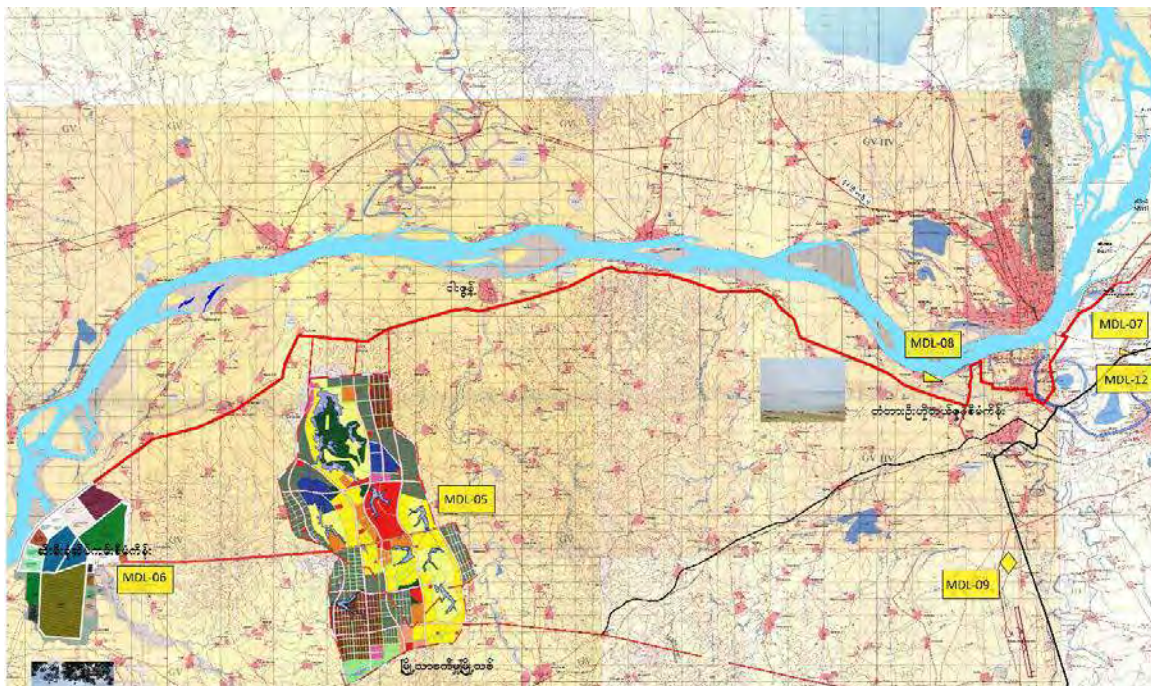
1) Mandalay

In Mandalay some large-scale projects are on-going such as “Mingalar Mandalay (MDL-01)”, “Mandalay Industrial Trade Center Project, so-called MITC (MDL-04)” in the existing urban area. These projects will bring its city center function toward southward in the future due to those volumes and facilities. Considering the suburbs of Mandalay, “Myota Industrial Parks (MDL-05)” and other unidentified projects will serve as triggers in the expansion of Mandalay City function as one of the largest HUB of Myanmar in the context of international logistic.



Source: JICA Study Team


Figure 1.5.24: Map of Mandalay Showing Development Projects



Source: JICA Study Team based on the topography map


Figure 1.5.25: Map of Mandalay Showing Development Projects

Table 1.5.30: Outline of Development Project in Mandalay 01

| | | |
|-----------|---|--|
| MDL-01 | | |
| Name | Low cost rental housing project for squatters |  |
| Type | 22 Nos. of six storey 12 units, total 1584 units | |
| Status | Completed. | |
| Developer | Government (Myanmar) Mandalay City Development Committee (MCDC) | |
| Location | Block No (444/1), Strand Rd, Bet;12x14 St, Aungmyethazan Tsp, (2) Block No (444/2), Bet;14x19 St, Aungmyethazan Tsp, Mandalay (3) Block No (105), Bet;19x21 St, Aungmyethazan Tsp, Mandalay | |
| Area | (1) Block No (444/1) - 2.486 Acre (1.003ha) (2) Block No (444/2) - 3.914 Acre (1.58ha) (3) Block No (105) - 2.196 Acre (0.889ha) | |
| Schedule | Project Start on March 2014. Block No (444/1) – 14 Units (95% Done) Block No (444/2), Block No (105) – 8 Units (80% Done) | |
| Outline | Available Room Number - 1584 Units, (10x20) sft in each unit. Number of Applicants - 1889Nos Proposed renting fees - 30,000 Ks/month Foundation Type - V pile Earthquake resistance - up to 8.5 Richter scale | |
| Budget | 11334.311 Million MMK (8.28 Million USD) | |

Source: JICA Study Team

Table 1.5.31: Outline of Development Project in Mandalay 02

| | | |
|-----------|---|--|
| MDL-02 | | |
| Name | Mingalar Mandalay CBD |  |
| Type | Multi-purpose Development | |
| Status | Under Construction | |
| Developer | Private Company (Myanmar) New Star Light Co., Ltd & C.A.D Co.,Ltd & JV with MCDC | |
| Location | 73 St, Bet; Thazin St & Ngu Shwe War St, Chan Mya Tharzi Tsp. | |
| Area | 45.99 Acre (18.6 ha) | |
| Schedule | Project Phase 1 Done. Phase 2 ongoing. | |
| Outline | <p>Hotel : (1) MCDC Hotel (68,000 sft) (2) Pullman Hotel (758,000 sft)</p> <p>Shop House :127 Units divided into 7 blocks including ten Types.Each units is 4 storey (800,000 sft)</p> <p>Condominium:(1) Ngu Shwe Wah Condominium (117,000 sft), (2) Mingalar Condominium; 144 units and 250 car parking lots. (178,000 sft).</p> <p>Villa: 6 Types. Total gross area 6000 -8000 sft). (Total-388,000 sft)</p> <p>Shopping Center: Citymart, Myanmar's leading retailer, and Ocean Super centre is a multi-storey retail complex with a supermarket. (222,000 sft)</p> <p>Car Parking: Multi-Story, 600 nos of parking lot (280,000 sft)</p> <p>Public Utilities: (28,000 sft)</p> | |
| Budget | 91 Billion MMK (70.07 million USD)* | |


Source: JICA Study Team

Table 1.5.32: Outline of Development Project in Mandalay 03

| | | |
|----------------|--|---|
| MDL-03 | | |
| Name | Mandalay City Convention Center & Commercial Complex Project |  |
| Type | Mixed Used Commercial, Residential, Hospitality and Entertainment complex. | |
| Status | Under Construction | |
| Developer | Joint Venture with Private Company & Government (Myanmar) MCDC and Mandalay Investment & Development Group. | |
| Constructed by | CAD Construction Co.,Ltd & New Star Light Construction Co.,Ltd | |
| Location | Teik Pan Road, Bet; 69 x 72 St Chan Mya Tha Zi Tsp, Mandalay. | |
| Area | 14.8 Acre (5.98 ha) | |
| Schedule | Phase 1: The construction of the Mandalay Convention Centre; Phase 2: The building of a commercial complex including hotels, offices, shopping center and condominiums Phase 3: Includes arts and entertainment facilities, including an amusement park. Soft opening ceremony of MCC on March 2016. The whole project is expected to be completed in 2019. | |
| Outline | Functional Hall, Ball Room, Conference Room, 6 Nos of Seminar Room, Back of House, Pre-Functional Hall | |
| Budget | 25 million USD | |


Source: JICA Study Team

Table 1.5.33: Outline of Development Project in Mandalay 04

| | | |
|-----------|--|--|
| MDL-04 | | |
| Name | Mandalay Industrial Trade Center Project (MITC) |  |
| Type | Mixed-used comprises an exhibition centre, trade and industrial zones as well as residential and commercial areas. | |
| Status | Under Construction | |
| Developer | Private Company (Myanmar) Mandalay Garden City Construction Group | |
| Location | Pyigyidagun Township, Mandalay | |
| Area | 70Acre (28.3ha) | |
| Schedule | N/A | |
| Outline | N/A | |
| Budget | N/A | |

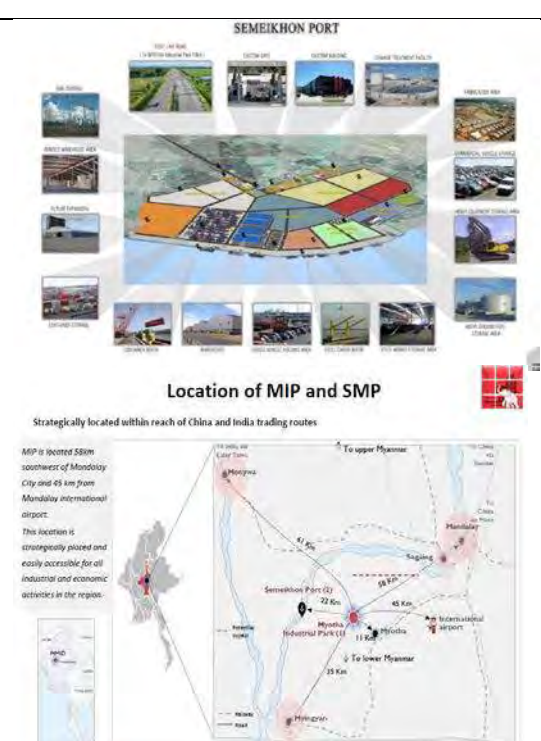
Source: JICA Study Team

Table 1.5.34: Outline of Development Project in Mandalay 05

| | | |
|--------------|---|--|
| MDL-05 | | |
| Project Name | Myotha Industrial Park (MIP) |  |
| Type | Large scale mixed-used industrial park | |
| Status | Under Construction | |
| Developer | JV with Mandalay Regional Government and Mandalay Myotha Industrial Development Public Co. Ltd. (MMID) | |
| Location | 58km from Mandalay, 45 from Mandalay International Airport | |
| Area | 10,337 acres (4183.24 ha) | |
| Schedule | <p>Phase 1 :Year 2013-2018; development work will be done on 2,000 acre of Myotha Industrial Park.</p> <p>Phase 2 :Year 2019-2024, development work will be done on 4,375 acre of MIP and adjoining Semeikhon Port areas.</p> <p>Phase 3 :Year 2025 onwards, development work will be done the remaining 3,978 acres of Myotha Industrial Park.</p> | |
| Outline | <ul style="list-style-type: none"> -Industrial, warehouse and logistic, residential development -Road and transportation, green open space and water bodies -Commercial public facilities, public utilities and amenities | |
| Budget | NA | |



Source: JICA Study Team

Table 1.5.35: Outline of Development Project in Mandalay 06

| | | |
|-----------|--|--|
| MDL-06 | | |
| Name | Semeikhon Port (SMP) |  |
| Type | Commercial river port with modern port facilities and port supportive industries. | |
| Status | Under Construction | |
| Developer | JV with Mandalay Regional Government and Mandalay Myotha Industrial Development Public Co. Ltd. (MMID) | |
| Location | 23 km from MIP | |
| Area | 380 Acre (152 ha) with Quay Length of 1.5 km. | |
| Schedule | NA | |
| Outline | -The main operation port yard, processing areas warehousing, Free Trade Zone and administrative, ancillary services and transshipping areas. | |
| Budget | NA | |


Source: JICA Study Team

Table 1.5.36: Outline of Development Project in Mandalay 07

| | | |
|-----------|--|---|
| MDL-07 | | |
| Name | Grand City (Jade Garden) |   |
| Type | Mixed Use | |
| Status | Under Construction | |
| Developer | Private Company (Myanmar) Tet Lann Company, Man Amara Development Company Limited, Alpha Leo Construction Company and Aye Aye Khaing Co Ltd | |
| Location | Amarapura Township, Mandalay Region. | |
| Area | 530 Acre (214.5 ha) | |
| Schedule | NA | |
| Outline | NA | |
| Budget | NA | |


Source: JICA Study Team

Table 1.5.37: Outline of Development Project in Mandalay 08

| | | |
|-----------|--|--|
| MDL-08 | | |
| Name | Tada-U Hotel Zone |  |
| Type | Tourism Development | |
| Status | Under Construction | |
| Developer | Private Company (Myanmar) Myanmar Tourism Development Public Co.,Ltd | |
| Location | 8.6 miles North of Tada-U International Airport, Tadarooo Township, Mandalay. | |
| Area | 5548 Acres (808 ha) | |
| Schedule | NA | |
| Outline | <ul style="list-style-type: none"> - Foreign investors will build about 100 hotels on about 237ha of land, while local investors will built 192 hotels on 410ha. - Business zone, hotel zone, general business zone, high standard park for recreation, housings, high standard housings, offices, hotels, horse riding clubs, reservoir for growing plants for all seasons, drains, high standard roads, flower beds along roads, water purification plant and power plant. | |
| Budget | US\$ 560 million | |


Source: JICA Study Team

Table 1.5.38: Outline of Development Project in Mandalay 09

| | | |
|-----------|---|--|
| MDL-09 | | |
| Name | Whole Sales Market |  |
| Type | Commercial | |
| Status | Proposal | |
| Developer | Private Company (Myanmar) Mandalay Green City Co.,Ltd | |
| Location | Sinkaing Township, Near Paleik and Airport. | |
| Area | 100 Acre (40.47 ha) | |
| Schedule | NA | |
| Outline | Shops, residential buildings, and hotels and many other buildings | |
| Budget | NA | |

Source: JICA Study Team

Table 1.5.39: Outline of Development Project in Mandalay 10

| | | |
|-----------|---|---|
| MDL-10 | | |
| Name | Mannaykarit Housing Project |  |
| Type | Housing | |
| Status | Under Construction | |
| Developer | Private Company (Myanmar) Thanti Thitsar Co.,Ltd | |
| Location | Miles stone 8/4 on Mandalay-Mogoke Road, | |
| Area | 65 Acre (26.3 ha) | |
| Schedule | NA | |
| Outline | Multipurpose housing | |
| Budget | NA | |


Source: JICA Study Team

Table 1.5.40: Outline of Development Project in Mandalay 11

| | |
|-----------|-----------------------|
| MDL-11 | |
| Name | Special Business Zone |
| Type | Commercial |
| Status | Proposal |
| Developer | NA |
| Location | NA |
| Area | 120 Acre, (48.56 ha) |
| Schedule | Targeted Year on 2018 |
| Outline | NA |
| Budget | NA |

Source: GAD, Mandalay

Table 1.5.41: Outline of Development Project in Mandalay 12

| | | |
|-----------|--|--|
| MDL-12 | | |
| Name | Myit Nge Dry Port |  |
| Type | Commercial | |
| Status | Proposal | |
| Developer | Joint Venture with Ministry of Transport and Communication and Private Sector | |
| Location | Myit Nge (7 miles from Tadar Oo International Airport), Amarapura Township | |
| Area | Group A-32.426 Acres (13.12 ha), Group B- 42.674 Acres (17.27 ha) Total - 75.1 acres (30.4 ha) | |
| Schedule | NA | |
| Outline | To spread out cargos from Thilawa to Upper Myanmar, China and India. | |
| Budget | US \$ 40 million | |

Source; Mr. Myo Myint Aung, General Manager (Admin & Plan), Myanma Railway

Table 1.5.42: Outline of Development Project in Mandalay 13

| | |
|-----------|-------------------------------|
| MDL-13 | |
| Name | Yay Taw University |
| Type | Education |
| Status | Proposal |
| Developer | NA |
| Location | Patheingyi Township, Mandalay |
| Area | NA |
| Schedule | NA |
| Outline | 5 Majoring Subjects |
| Budget | NA |

Source: GAD, Mandalay

Table 1.5.43: Outline of Development Project in Mandalay 14

| | |
|-----------|---------------------------|
| MDL-14 | |
| Name | Ethnic Housing |
| Type | Housing Development |
| Status | Proposal |
| Developer | NA |
| Location | Northern part of Mandalay |
| Area | 250 Acre (101.17 ha) |
| Schedule | NA |
| Outline | NA |
| Budget | NA |

Source: GAD, Mandalay

Table 1.5.44: Outline of Development Project in Mandalay 15

| | |
|-----------|--|
| MDL-15 | |
| Name | Upgrading High-quality Bus Terminal |
| Type | Public Transport |
| Status | Proposal |
| Developer | NA |
| Location | Pyigyidagun Township, Mandalay |
| Area | 250 Acre (101.17 ha) |
| Schedule | NA |
| Outline | To upgrade in international standard bus terminal. Shopping mall, City Mart supermarket and residential condominiums will be included. |
| Budget | NA |

Source: GAD, Mandalay

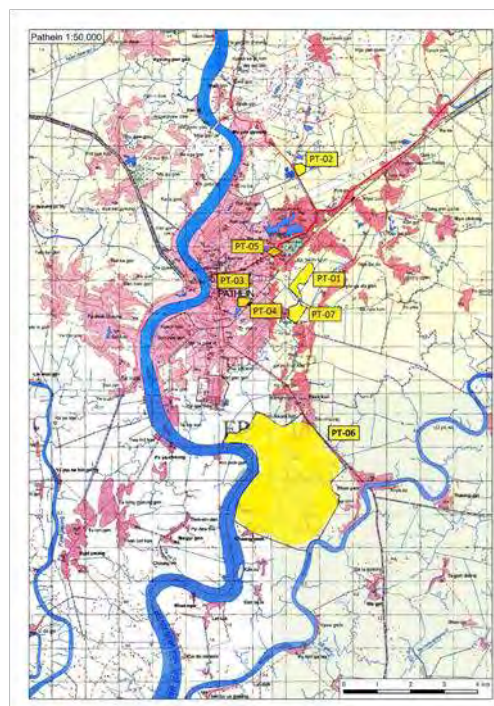
Table 1.5.45: Outline of Development Project in Mandalay 16

| | |
|-----------|------------------------------------|
| MDL-16 | |
| Name | Water purification factory, |
| Type | Infrastructure Development Project |
| Status | Proposal |
| Developer | ADB |
| Location | For Mandalay City |
| Area | NA |
| Schedule | NA |
| Outline | NA |
| Budget | \$ 80 million |

Source: GAD, Mandalay

2) Patheingyi

Patheingyi has some on-going housing supply projects conducted by public sector. On the other hand, Delta Industrial Group (DIG), a domestic developer, has been conducting large-scale project, namely “Mya Kyun Tar Housing Project (PT-01)”, which will promote to transfer city center function eastwards with change of traffic mode from inland water to road.



Source: JICA Study Team

Figure 1.5.26: Map of Patheingyi Showing Development Projects


Table 1.5.46: Outline of Development Project in Patheingyi 01

| | |
|-----------|---|
| PT-01 | |
| Name | Mya Kyun Tar Housing Project |
| Type | Housing Development |
| Status | Under Construction |
| Developer | Private Company (Myanmar) Delta Industrial Group (DIG) |
| Location | Near Patheingyi Golf Course |
| Area | 150 Acre (60.7 ha) |
| Schedule | Project opening ceremony in May 18, 2015 |
| Outline | NA |
| Budget | NA |




Source: JICA Study Team

Table 1.5.47: Outline of Development Project in Patheingyi 02

| | | |
|-----------|---|--|
| PT-02 | | |
| Name | Platinum Patheingyi Condominium |  |
| Type | Luxury housing with residential villas & Condominium towers | |
| Status | Under Construction | |
| Developer | Private (Singapore & Myanmar) H & Co Real Estate Holding Ltd | |
| Location | Near Patheingyi University, Taung Paw Tan Street, Patheingyi | |
| Area | 18 Acre (7.3 ha) | |
| Schedule | Project ground breaking ceremony in May 18, 2015 | |
| Outline | <ul style="list-style-type: none"> - 26 villas, 3 condominiums with a total of 410 units, - Shopping Center, Cinema & Hotels. Approximate Ks 1per sft. - The initial phase 35 units retail and pedestrian plaza is underway. | |
| Budget | 200 million USD | |


Source: JICA Study Team

Table 1.5.48: Outline of Development Project in Patheingyi 03

| | | |
|-----------|---|--|
| PT-03 | | |
| Name | Ocean Super Center (Patheingyi) |  |
| Type | Shopping Mall | |
| Status | Under Construction | |
| Developer | Private Company (Myanmar) City Mart Holding Co.,Ltd | |
| Location | Strand Road, Near City Hall, Patheingyi | |
| Area | NA | |
| Schedule | NA | |
| Outline | NA | |
| Budget | NA | |


Source: JICA Study Team

Table 1.5.49: Outline of Development Project in Patheingyi 04

| | | |
|-----------|--|--|
| PT04 | | |
| Name | Pyidawtar Housing Redevelopment Project |  |
| Type | Staff Housing | |
| Status | Under Construction | |
| Developer | DUHD | |
| Location | Budaryone Street, Near Patheingyi Prison | |
| Area | 22 Acre (8.9 ha) | |
| Schedule | Phase by phase according to budget | |
| Outline | <p>Existing Housing 2 Units 4 Storey - 25 Nos, Single Storey - 150 Nos Total numbers of Room - 350 Nos.</p> <p>Proposed Housing 4 Units 3 Storey - 12 Nos, 4 Units 3 Storey - 21 Nos, 4 Units 2 Storey - 8 Nos Total numbers of Room - 428 Nos.</p> | |
| Budget | NA | |


Source: JICA Study Team (*1USD=1298.7 MMK , refer from JICA)

Table 1.5.50: Outline of Development Project in Patheingyi 05

| | | |
|-----------|--|--|
| PT-05 | | |
| Name | Officer Housing Project |  |
| Type | Housing | |
| Status | Under Construction | |
| Developer | DUHD | |
| Location | Near Patheingyi Golf Course. | |
| Area | 28 Acre (11.33ha) | |
| Schedule | NA | |
| Outline | Proposed Housing Single Storey – 28 Nos, 6 Units 4 Storey (3Bedrooms) -1 Nos 6 Units 4 Storey (2Bedrooms) -3 Nos, 4 Units 4 Storey -12 Nos 2 Units 2 Storey – 4 Nos. Total numbers of room – 296 Nos. | |
| Budget | NA | |


Source: JICA Study Team

Table 1.5.51: Outline of Development Project in Patheingyi 06

| | | |
|-----------|---|--|
| PT-06 | | |
| Name | Patheingyi Industrial City |  |
| Type | Industrial Zone & Commercial | |
| Status | Under Construction | |
| Developer | Private Company (Myanmar) Ayeyarwaddy Development Public Co.,Ltd | |
| Location | Patheingyi-Ngathay Road. | |
| Area | 1770 Acres (716.29 ha) | |
| Schedule | completion on March 2018. | |
| Outline | NA | |
| Budget | NA | |

Source: JICA Study Team

Table 1.5.52: Outline of Development Project in Patheingyi 07

| | | |
|-----------|---|--|
| PT-07 | | |
| Name | Low Cost Housing Project |  |
| Type | Housing | |
| Status | Proposal | |
| Developer | DUHD | |
| Location | Near Mahar Sayti & Bypass Road, Patheingyi | |
| Area | NA | |
| Schedule | NA | |
| Outline | NA | |
| Budget | NA | |

Source: JICA Study Team

3) Mawlamyine


Mawlamyine has some on-going housing supply projects conducted by public sector as same as Patheingyi. On the other hand, “Kyauk Tan Industrial Zone (MLM-04)” will be important project to promote industrial and logistic function in Mawlamyine.



Source: JICA Study Team



Figure 1.5.27: Map of Mawlamyine Showing Development Projects

Table 1.5.53: Outline of Development Project in Mawlamyine 01

| | | |
|-----------|---|--|
| MLM-01 | | |
| Name | Ocean Super Center (Mawlamyine) |  |
| Type | Shopping Mall | |
| Status | Completed | |
| Developer | Private Company (Myanmar) City Mart Holding Co.,Ltd | |
| Location | Upper Main Road, Bo Kone Ward, Mawlamyine, Mon State | |
| Area | NA | |
| Schedule | Opened on March 2016 | |
| Outline | NA | |
| Budget | 3,000 million MMK (2.3 million USD) | |

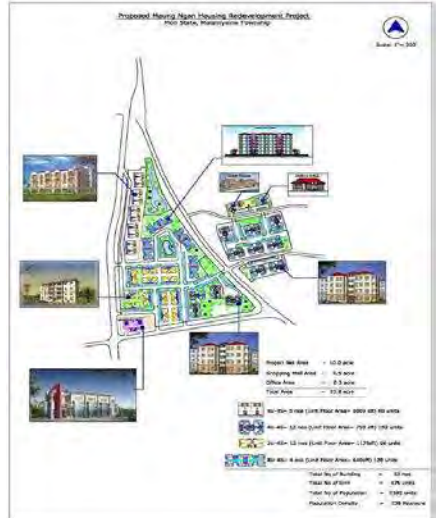
Source: JICA Study Team

Table 1.5.54: Outline of Development Project in Mawlamyine 02

| | | |
|-----------|--|---|
| MLM-02 | | |
| Name | Thanlwin Bridge (Chaungzon) |  |
| Type | Bridge Construction | |
| Status | Under Construction | |
| Developer | Government (Myanmar, Japan) Japan-Myanmar joint venture | |
| Location | Mupun Jetty, Mawlamyine | |
| Area | NA | |
| Schedule | Start on 2014 and plan to finish on December 2016. | |
| Outline | 1586 m long linking Mupun jetty in Mawlamyine with Ka-nyaw village on Belu Kyun, |  |
| Budget | 60 Billion MMK (46.2 million USD) | |


Source: JICA Study Team

Table 1.5.55: Outline of Development Project in Mawlamyine 03

| | | |
|-----------|--|--|
| MLM-03 | | |
| Name | Maung Ngan Staff Housing Redevelopment Project |  |
| Type | Staff Housing | |
| Status | Under Construction | |
| Developer | DUHD | |
| Location | Kyaik khami Rd & Upper Main Road, Mawlamyine | |
| Area | 10.8 Acre (4.05 ha) | |
| Schedule | NA | |
| Outline | <p>Existing Housing -6 Units 2 Storey -9Nos, 4 Unit 3 Storey -4 Nos -4 Units 4 Storey -1Nos. Total numbers of room – 118 Nos.</p> <p>Proposed Housing -4 Unit 4 Storey -12 Nos, 2Unit 4 Storey-12 Nos -8 Unit 4 Storey- 4 Nos, Total numbers of room- 476 Nos.</p> | |
| Budget | NA | |


Source: JICA Study Team

Table 1.5.56: Outline of Development Project in Mawlamyine 04

| | | |
|-----------|--|---|
| MLM-04 | | |
| Name | Kyauk Tan Industrial Zone. |  |
| Type | Industry | |
| Status | Under Construction | |
| Developer | PPP | |
| Location | Mawlamyine | |
| Area | 254Acre (102.8 ha) | |
| Schedule | NA | |
| Outline | The infra structure such as electricity, road are done 80% | |
| Budget | NA | |


Source: JICA Study Team

Table 1.5.57: Outline of Development Project in Mawlamyine 05

| | | |
|-----------|--|--|
| MLM-05 | | |
| Name | Proposal of Pyidawtar Staff Housing Redevelopment Project |  |
| Type | Staff Housing | |
| Status | Proposal | |
| Developer | DUHD | |
| Location | Between lower main road & Bogyoke Road, Mawlamyine | |
| Area | 9.8 Acre (3.97 ha) | |
| Schedule | NA | |
| Outline | <p>Existing Housing -8Unit 2 Storey- 25 Nos, Total numbers of room -200 nos</p> <p>Proposed Housing -4Unit 4 Storey -9 Nos, 2 Unit 4 Storey -6 Nos. Total numbers of room – 416 Nos.</p> | |
| Budget | NA | |


Source: JICA Study Team

Table 1.5.58: Outline of Development Project in Mawlamyine 06

| | | |
|-----------|---|--|
| MLM-06 | | |
| Name | Ngan Tay & Aye Tar Yar Town Expansion Project |  |
| Type | Town Expansion | |
| Status | Proposal | |
| Developer | NA | |
| Location | Mawlamyine | |
| Area | 514.6 Acre (84.28 ha) | |
| Schedule | NA | |
| Outline | Please see the detail in the figure. | |
| Budget | NA | |

Source: JICA Study Team

Table 1.5.59: Outline of Development Project in Mawlamyine 07

| | | |
|-----------|---|---|
| MLM-07 | | |
| Name | Proposed Mu Yang City Expansion Project |  |
| Type | Town Expansion | |
| Status | Proposal | |
| Developer | NA | |
| Location | Mawlamyine | |
| Area | 514.6 Acre (208.25 ha) | |
| Schedule | NA | |
| Outline | Please see in the figure. | |
| Budget | NA | |

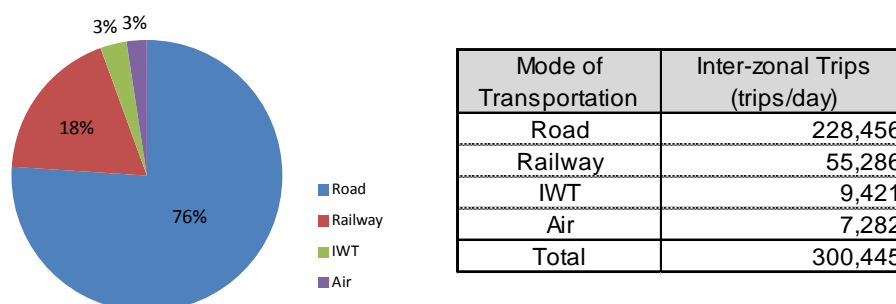
Source: JICA Study Team

1.5.5 Infrastructure Status

(1) Road and Transportation

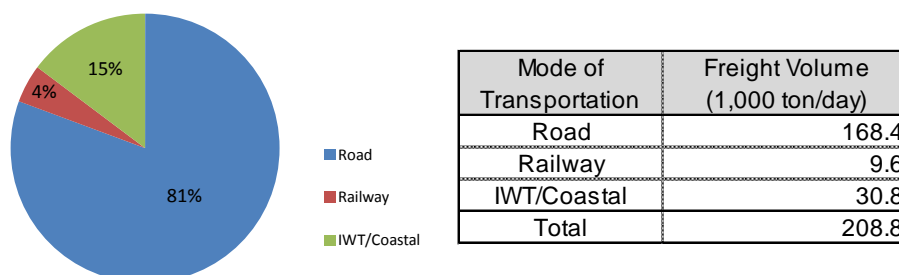
1) Outline

The road network in Myanmar with a total length of approximately 150,000,000 km is covering approximately 80% of both passenger and cargo transport volume of the country. The current modal share ratios of the passenger and the freight transport are shown in Figure 1.5.28 and Figure 1.5.29, respectively.



Source: JICA Study Team referenced to MYT Plan, JICA 2014

Figure 1.5.28: Modal Share of Passenger Transport



Source: JICA Study Team referenced to MYT Plan, JICA 2014

Figure 1.5.29: Modal Share of Freight Transport

Based on the recent rapid increase in the traffic demand under the national economic development and the following changes in the modal share of the transportation, the national transportation master plan referred as “The Survey Program for the National Transport Development Plan, 2014 (or so called “MYT Plan”) was prepared under the support of JICA and officially approved by GOM.

In the master plan, the strategic economic corridors were proposed to accelerate national development.

The three target cities in this study are also included in the economic corridors of MYT Plan as shown in Figure 1.5.30. Since MYT Plan was officially approved by GOM, the economic corridors of MYT Plan related to the target cities have been referred in this study.



Source: MYT Plan, JICA, 2014

Figure 1.5.30: National Economic Corridors in Myanmar

The current status of the infrastructures of the transport sectors of the three target cities (Mandalay, Mawlamyine, and Patheingyi) is shown below.

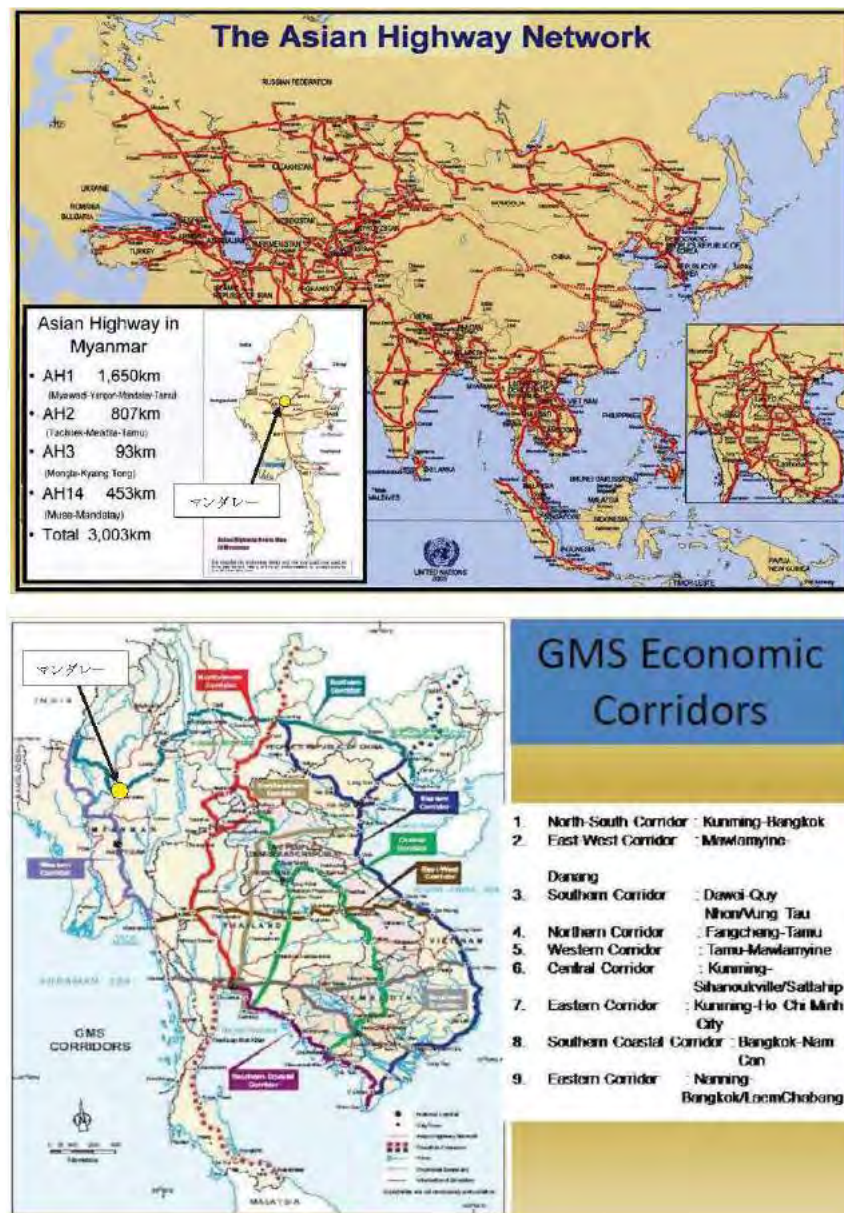
2) Mandalay

Mandalay City has the second largest population, 1,225,553 (2014 census), and the last royal capital of Burma. The city is located in the main node of the economic corridor in the national transportation master plan (MYT Plan). In addition, it is noted that the city has earthquake risk since it is located in the vicinity of the Sagaing Fault.

(I) Road Sector

Myanmar is connected with the neighboring and regional countries through the international corridors such as Asian Highway and GMS Economic Corridor.

Mandalay is a strategic nodal point of Asian Highway (AH1, AH2, and AH14) and GMS Northern Economic Corridor, as shown in Figure 1.5.31 and Table 1.5.60.



Source: Department of Public Works, MOC

Figure 1.5.31: National Economic Corridors in Myanmar

Table 1.5.60: International Corridor through Mandalay

| Asian Highway Network | |
|-----------------------|--|
| AH 1 | (India) – Tamu – Mandalay – Meiktila – Yangon – Bago – Phagyi – Thaton – Myawadi – (Thailand) |
| AH 2 | (India) – Tamu – Mandalay – Meiktila – Kengtungi – Tachileik – (Thailand, Lao PDR) |
| AH 14 | Mandalay – Lashio – Muse – (China) |
| GMS Economic Corridor | |
| Northern Corridor | (India) – Tamu – Mandalay – Muse – (China: Kunming – Fancheng) |

Source: JICA Study Team based on Department of Public Works, MOC

I) Current Condition

Mandalay City consists of six townships under the jurisdiction of Mandalay City Development Committee (MCDC). As well as the city development committee of Yangon City and Naypyidaw City, the roads within the city boundary are managed by the committee (MCDC) in its planning, construction, operation and maintenance. The budget is sourced from toll and parking fees to be collected from road users.

The Ministry for Progress of Border Areas and National Races and Development Affairs (MPBND) is the road administrator for roads outside the city boundary and the budget is allocated by the central government. The Ministry of Construction is responsible for the access-controlled expressway and the state-linking highways.

The road network in Mandalay City is shown in Figure 1.5.32. The road network is formed towards the south from the palace and the central city area forms a grid-pattern road network as shown in Figure 1.5.33.

It is quite easy and common for the citizens to share the destination to express a destination such as "the corner of 35 roads and 73".



Source: MCDC, 2016

Figure 1.5.32: Road Network in Mandalay City



Source: MCDC, 2016

Figure 1.5.33: Grid-pattern Road Network in Central Area of Mandalay City

There are three flyovers in the city which details are summarized in Table 1.5.61. The flyovers were constructed by Myanmar Railway and MCDC to pass across the railway track. Current conditions of the flyovers are presented in Figure 1.5.34.

Table 1.5.61: Flyovers in Mandalay City

| Name of Bridges | Construction Period | Length | Structure Type | Expenditure (Kyat) |
|---|----------------------|-----------|----------------|--------------------|
| Yan Gyi Aung Bridge (35 th Street) | Sep.1989- Dec. 1990 | L=863 ft | PC-I Girder | 11,500,000 |
| Mya Thida Market Bridge (42 nd Street) | 1992 | 12 spans | PC-I Girder | |
| Chan Mya Mar Lar Bridge (Chan Mya Waddy Street) | Sep. 1991- Mar. 1992 | L=1,156ft | PC-I Girder | |

Source: JICA Study Team



(Yan Gyi Aung Bridge)

Open areas under the bridges have been used as market place. There is an evidence that these bridges were exposed to fire. There is a concern regarding cracks on the bridges due to thermal expansion.



The deterioration of the bridge surface pavement can be seen at any bridges.



(Mya Thida Market Bridge)



Chan Mya Waddy Bridge

Source: JICA Study Team

Figure 1.5.34: Current Condition of Flyovers

Major intersections in the city have been signalized. There are two types of signal lighting in the city although other major cities in Myanmar have uniformed standard type only. Presumably such non-standard types were donated or procured by/from foreign country. The signal system is well maintained by MCDC and the police force. There are roundabouts in the cities without traffic signal. The roundabouts are still well-controlled under the current traffic volume. Current condition of traffic signal and intersection are presented in Figure 1.5.35.

The traffic signal in the city has not been synchronized each other and are operated as “stand-alone” system. In order to maximize the capacity of signalized intersections, the synchronized signal system controlled by the traffic control center is commonly installed in the advanced countries.



(Standard Type Signal)



(Arrow Display Signal)



(CCTV Cameras)



(Roundabout Intersection)

Source: JICA Study Team

Figure 1.5.35: Current Condition of Traffic Signal and Intersection

In Mandalay as well as Yangon, traffic congestion will worsen in the future. Currently, regular traffic congestion is not seen except at the limited intersections at peak hours in the morning and in the evening.

The result of the trial calculation of the road saturation ratio of the main roads is presented in Table 1.5.62. Index of saturation represents that the congestion is generated in excess of 0.75 and the capacity excess exceeds 1.0.

The saturation ratio during the peak hours has been estimated at 0.82 in Sagain-Mandalay Street. This is considered to match the actual field situation. Immediate measure should be taken for this street. On the other hand, serious congestion is not estimated for the other roads under the current traffic volume. However, concerning the future traffic growth, these roads are also getting congested in the near future.

Table 1.5.62: Estimated Saturation Ratio on Major Roads

| Survey Point (number of lanes) | Inbound (vehicle) | | Outbound (vehicle) | | Total (vehicle) | | Total Volume at Peak Hrs (V) | Road Capacity (C) | Saturation Rate |
|--|----------------------|-----------|-----------------------|-----------|--------------------|-----------|------------------------------------|-------------------------|--------------------|
| | Vehicle | Motorbike | Vehicle | Motorbike | Vehicle | Motorbike | (pcu/h) | (pcu/h) | (V/C) |
| Corner of 35 x 63 (wider 4-lane) | 11,945 | 11,577 | 10,376 | 10,061 | 22,321 | 21,638 | 2,881 | 4,400 | 0.65 |
| Corner of 26 x 76 (wider 4-lane) | 11,669 | 13,855 | 7,900 | 12,530 | 19,569 | 26,385 | 2,748 | 4,400 | 0.62 |
| Sagain-Mandalay St. (wider 4-lane) | 5,083 | 47,044 | 4,503 | 40,930 | 9,586 | 87,974 | 3,598 | 4,400 | 0.82 |
| Corner of 62 x Inn-Khyu (narrow 4-lane) | 4,532 | 8,715 | 4,085 | 8,078 | 8,617 | 16,793 | 1,365 | 3,200 | 0.43 |

Source: Estimated by the JICA Study Team based on the traffic survey by MCDC

The vehicle registration number in Mandalay Region is summarized in Table 1.5.50. According to MCDC, two-wheeled vehicle's registration number in Mandalay Region is 30% of the entire number in Myanmar.

Table 1.5.63: Registered Vehicle in Mandalay Region

| Type of Vehicle | City | Others | Region Total |
|-----------------|---------|---------|--------------|
| Passenger Car | 1,983 | 772 | 2,755 |
| Light Truck | 21,213 | 4,500 | 25,713 |
| Heavy Truck | 10,356 | 4,260 | 14,619 |
| Private Car | 51,043 | 8,165 | 59,208 |
| Others | 7,680 | 1,679 | 9,359 |
| Two Wheeler | 749,310 | 534,109 | 1,283,419 |
| Three Wheeler | 19,732 | 2,543 | 22,275 |
| Trawlergi | 14,890 | 1,664 | 16,554 |
| Heavy Machinery | 45 | 77 | 122 |
| Total | 876,252 | 557,772 | 1,434,024 |

Source: JST based on the statistics of RTAD, May 2015

Two wheelers such as motorbikes are parked on the street everywhere decreasing the road capacity. Motorbike is a convenient urban mobility for the citizens. The diffusion of motorbike in the city might inhibit the smooth modal shift to the public transport. Current conditions of motorbikes in the city are presented in Figure 1.5.36.



(Motorbikes and Bicycles on the Road)

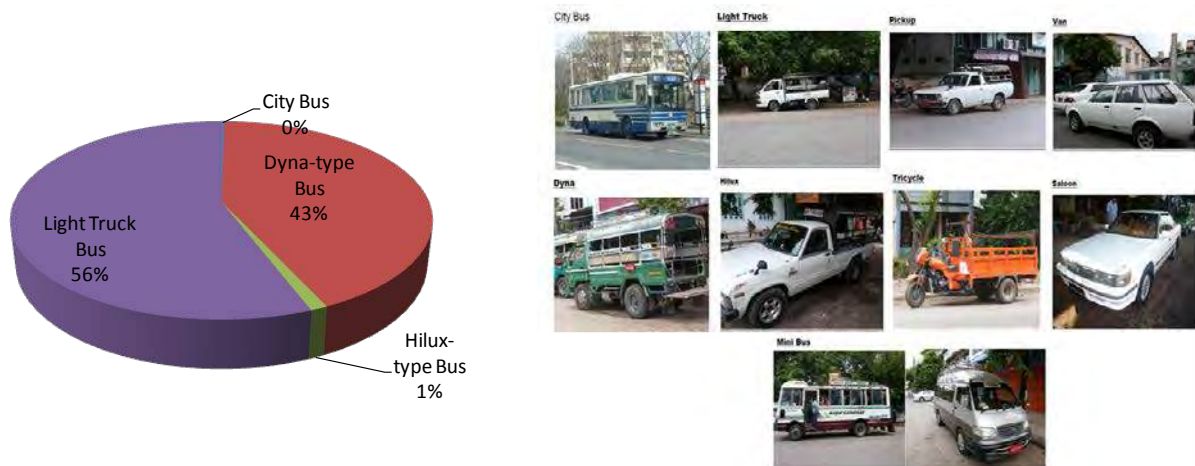
Source: JICA Study Team



(On-road Parking of Motorbikes)

Figure 1.5.36: Current Condition of Motorbike

Figure 1.5.37 shows the public transport of Mandalay City excluding the railway. As short-trips transportation, taxis and small buses are the majority, large-size busses are not operated for short-trips.



Source: JICA Study Team based on information from MCDC

Figure 1.5.37: Available Public Transport System Except Railways

The designated routes of the city bus are shown in Figure 1.5.38. Passengers can find the destination bound of bus through its route number, which is written on top of the bus.

Many bus shelters are installed along the roads in the city but these are not commonly used well. Passengers are substantially getting on and off everywhere in the streets. Such operation is similar with taxis. The bus shelters donated by advertising agencies are lined with plurality despite not being utilized.

The city bus management committee under the Mandalay Regional Government, the Mini Bus Management Committee (MBMC) controls 807 buses belonging to 57 bus teams which consist of registered individual business owners.



Source: MCDC

Figure 1.5.38: Designated Bus Routes in Mandalay City

Public transport for short-distance trip using the river is not developed at the moment.

On the other hand, inter-city buses (highway buses) have been operating for the medium/long-distance transport. Mandalay City Highway Bus Management Committee (HBMC) is responsible for route management, management of bus terminals, and safety guidance to the private bus operator. Highway bus network to and from Mandalay is shown in Figure 1.5.39.



Source: JICA Study Team based on information from HBMC, 2016

Figure 1.5.39: Highway Bus Network to/from Mandalay

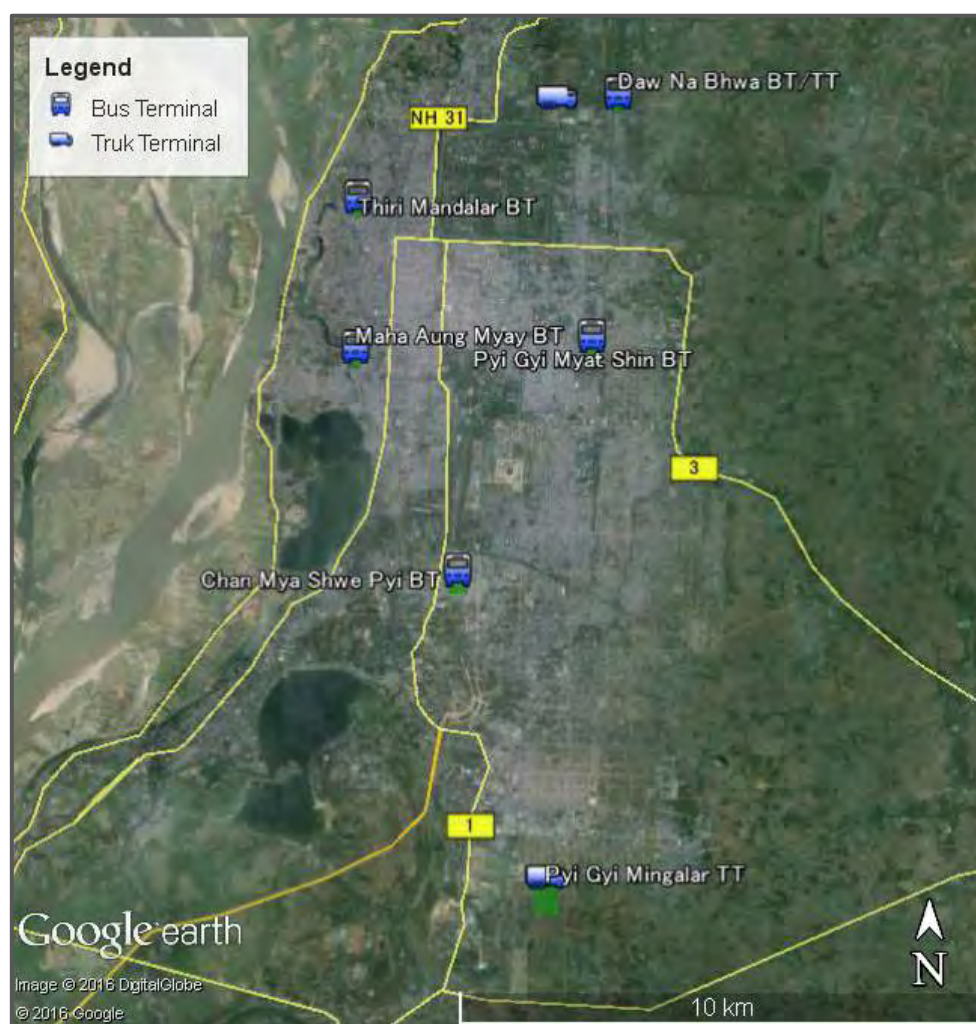
There are five bus terminals mainly for highway buses between Mandalay and the major cities in the country which details are presented in Table 1.5.64. Among them, Daw Na Bwa Bus Terminal located in the north of the city is still not fully utilize because the new terminal just opened in January 2016. Locations of the terminals are also presented in Figure 1.5.40.

Table 1.5.64: Bus Terminals in Mandalay

| Terminals | Main Destination | Open Year | Area (ha) | Number of Trips (trips/day) | Number of Passenger per day |
|----------------|---|-----------|-----------|-----------------------------|-----------------------------|
| Thiri Man Dala | Madaya, Mogoke, Chin State, Kachin State, Sagaing Region, Magway Region | 1996 | 1.2 | 527 | 11,709 |

| | | | | | |
|---------------------------|---|-----------|------|-------|--------|
| Mahaaungmyay | Around Mandalay Region within 50 miles | 2003 | 1.2 | 431 | 4,805 |
| Chan Mya Shwe Pyi | Yangon, Naypyitaw, Taunggyi Town, Rakhine Region, Magway Region, Kayin Region | 1992 | 6.8 | 385 | 9,228 |
| Pyi Gyi Myat Shin | Pyinoolwin, Kyaukse, Hsipaw, Lashio, Muse, Shan State (North) | 1991 | 3.1 | 63 | 1,613 |
| Daw Na Bwa (Newly opened) | Mogaung, Mohnyin, Myitkyina, Hopin | 2016 Jan. | 1.4 | 40 | 677 |
| Total | | | 13.7 | 1,446 | 28,032 |

Source: JICA Study Team



Source: JICA Study Team

Figure 1.5.40: Location Map of the Bus Terminals and Truck Terminal

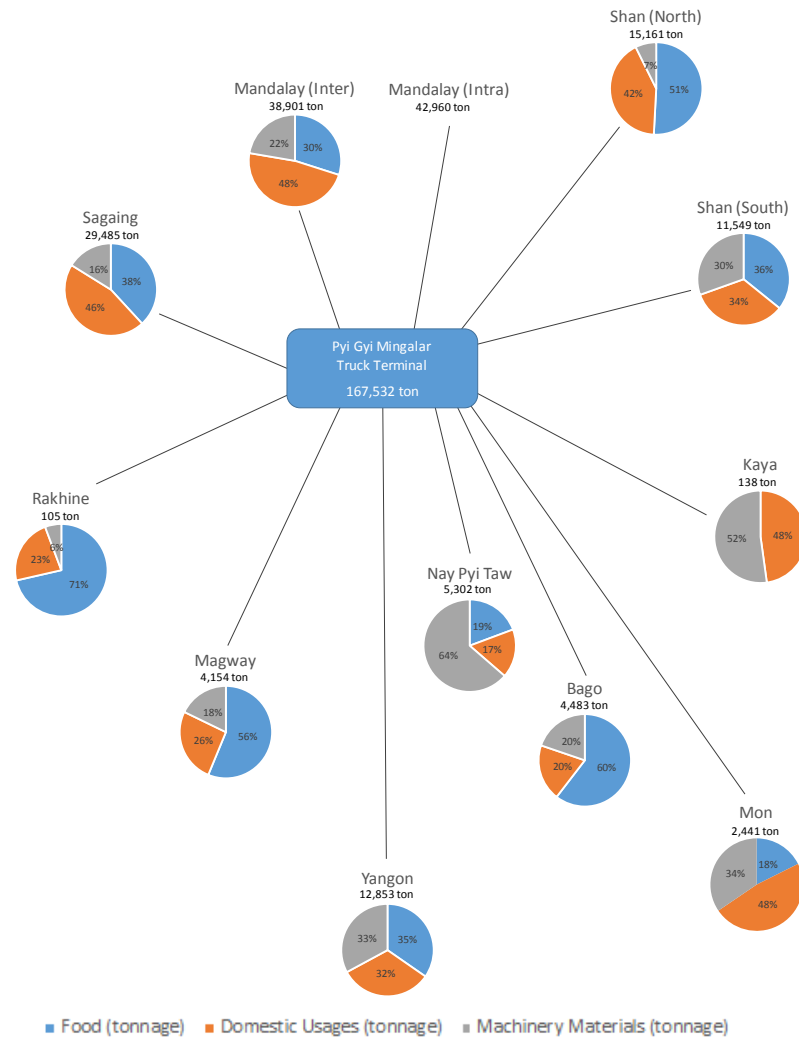
In the city south, there is a logistic terminal (Pyi Gyi Mingalar Truck Terminal shown in Figure 1.5.40 above) maintained by MCDC. Wholesale dealers have been rent, or purchase warehouses from MCDC for their own business. Truck owners are providing the transport services under the contract with these wholesale dealers. TMC (Truck Management Committee) under MCDC, at the logistics center gate, collects admission fees from the trucks at the central gate of the terminal.

The terminal function as the temporary storage and collection and delivery of luggage. The function of the inland depot (inland bonded storage Parking: customs office, general warehouse, bonded warehouse, such as the inspection area) is not available in the terminal. Customs procedures for cargo from China, etc., have been carried out at the border by the wholesale dealers.

According to the monthly report prepared by TMC (January 2015), handling cargo are three categories such as food products (rice, vegetables, meat, etc.), domestic usage (daily products: clothing, such as China, India and Thailand made of consumer electronics products), construction materials (machinery items, iron, cement, sand, etc.) is the main thing.

The terminal is handling approximately 170,000 tons of cargo per month. The amount of each region is shown in Figure 1.5.41. Largest amount is the cargo handling within MCDC which has 42,960 tons or more per month.

Monthly Cargo Handling Volume at Pyi Gyi Mingalar Truck Terminal in Mandalay



Source: JICA Study Team based on LTMC statistics in January 2016

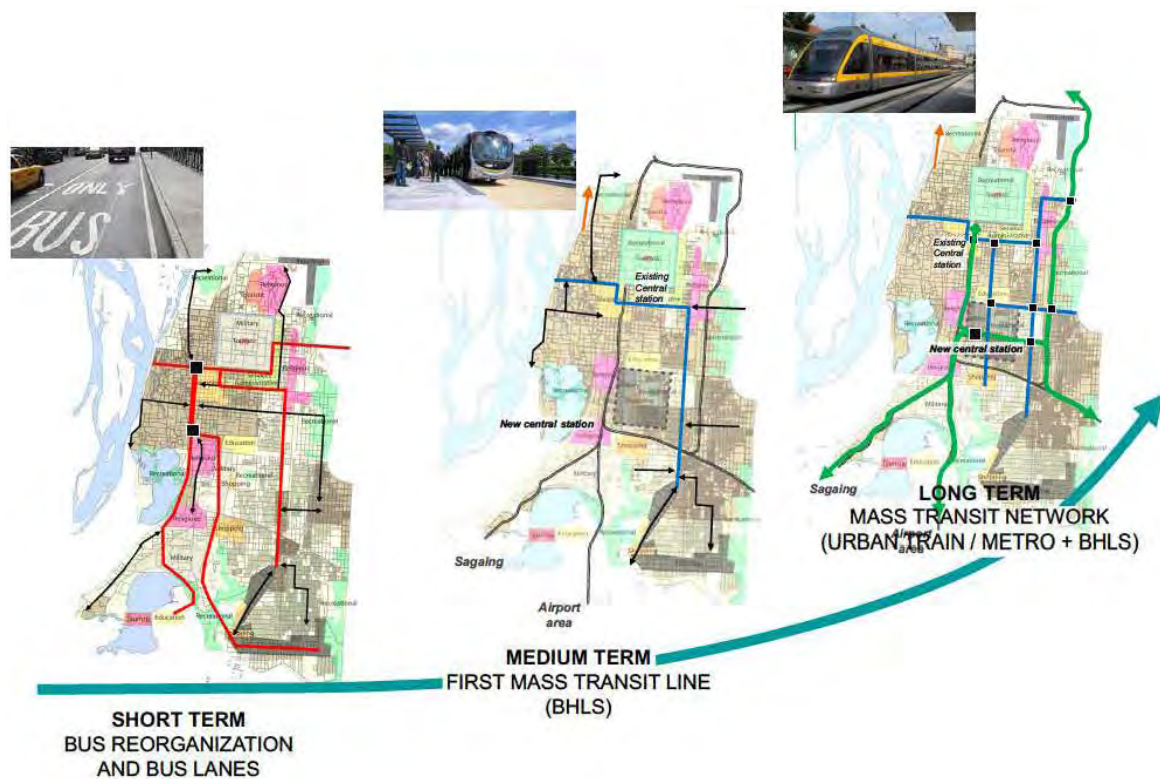
Figure 1.5.41: Cargo Handling to/from the Truck Terminal

(i) BRT Pilot Project

Fonds d'Études et d'Aide au Secteur Privé (FASEP) is the grant survey scheme for the purpose of private sector support by French government. FASEP conducted the multi-sector infrastructure master plan, "Sustainable Development of Urban Infrastructures and Services in Mandalay City" in 2016 and supported MCDC to prepare a "public transport master plan" shown in Figure 1.5.43. According to the final report of the study, quantitative traffic engineering approach based on traffic surveys and PT survey has not been conducted yet.

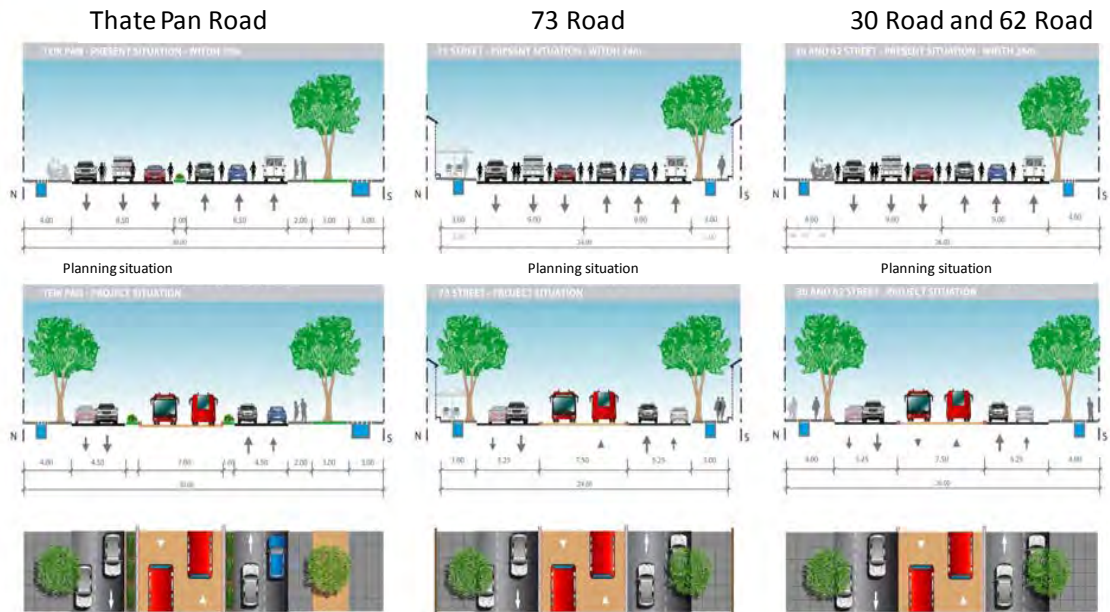
In the master plan, "re-organization of the existing bus network" for short-term measure, "high-standard bus services (BRT network)" for medium-term and "construction of the urban MRT" for long-term were proposed.

For the BRT network, the schematic design for a priority route was conducted as a pilot project. The feasibility has not been confirmed yet since there is no quantitative data to analyze the demand. The outline and project cost of the BRT pilot project are presented in Figure 1.5.44 and Figure 1.5.45, respectively.

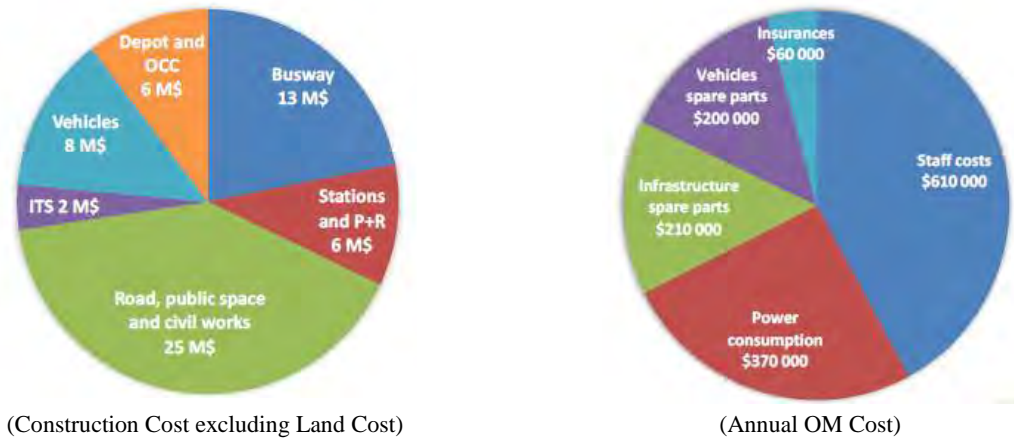


Source: Sustainable Development of Urban Infrastructures and Services in Mandalay City, Final Report in 2016

Figure 1.5.43: Public Transport Master Plan by FASEP



Source: Sustainable Development of Urban Infrastructures and Services in Mandalay City, Final Report in 2016
Figure 1.5.44: Outline of BRT Pilot Project



Source: Sustainable Development of Urban Infrastructures and Services in Mandalay City, Final Report in 2016

Figure 1.5.45: Project Cost for BRT Pilot Project

(ii) Advanced Traffic Control System Project

MCDC is implementing the project to upgrade their signal control system using an advanced signal control by Australian SCAT system enabling to link each signal and the newly central control center constructed in the building of MCDC. The project will be completed by April 2016. The project is financed by MCDC own budget. General layout of advanced traffic control system project is presented in Figure 1.5.46.



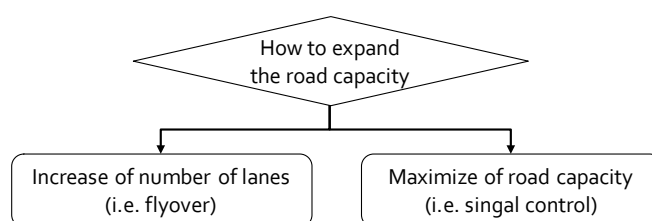
Source: MCDC

Figure 1.5.46: General Layout of Advanced Traffic Control System Project

III) Fact Findings and Issues

Situation of road sector is summarized as follows:

- < Grid-pattern Network > The road network in the city center has a grid-pattern network. Accordingly, it is quite easy not only for the citizens but also for tourists to express their destination such as "corner of roads 35 and 73". It makes exploring the city in combination of public transport and walking easy. Proper street signboard system on each street will work effectively.
- < Existing Road Capacity > Currently, traffic congestion is only observed on Sagaing-Mandalay Street. However, the capacity of other roads is going to be saturated in the near future based on the JICA Study Team's estimation of saturation ratio. Thus, measures to increase the road capacity in the city should be addressed now. Figure 1.5.47 shows the general flow to increase road capacity.



Source: JICA Study Team

Figure 1.5.47: Increase of Road Capacity

However, the city center is already densely built-up; and widening and new construction of roads will be quite difficult. Capacity maximization of existing roads will be urgently needed. MCDC is implementing the upgrading of the signal system and this project will be useful. It is noted that there are two types of signal lighting in Mandalay although the other cities have uniformed standard type. Citizens in Mandalay might be familiar with it but the tourists outside Mandalay might be confused on the signal direction. The types of signal should be uniformed in future.

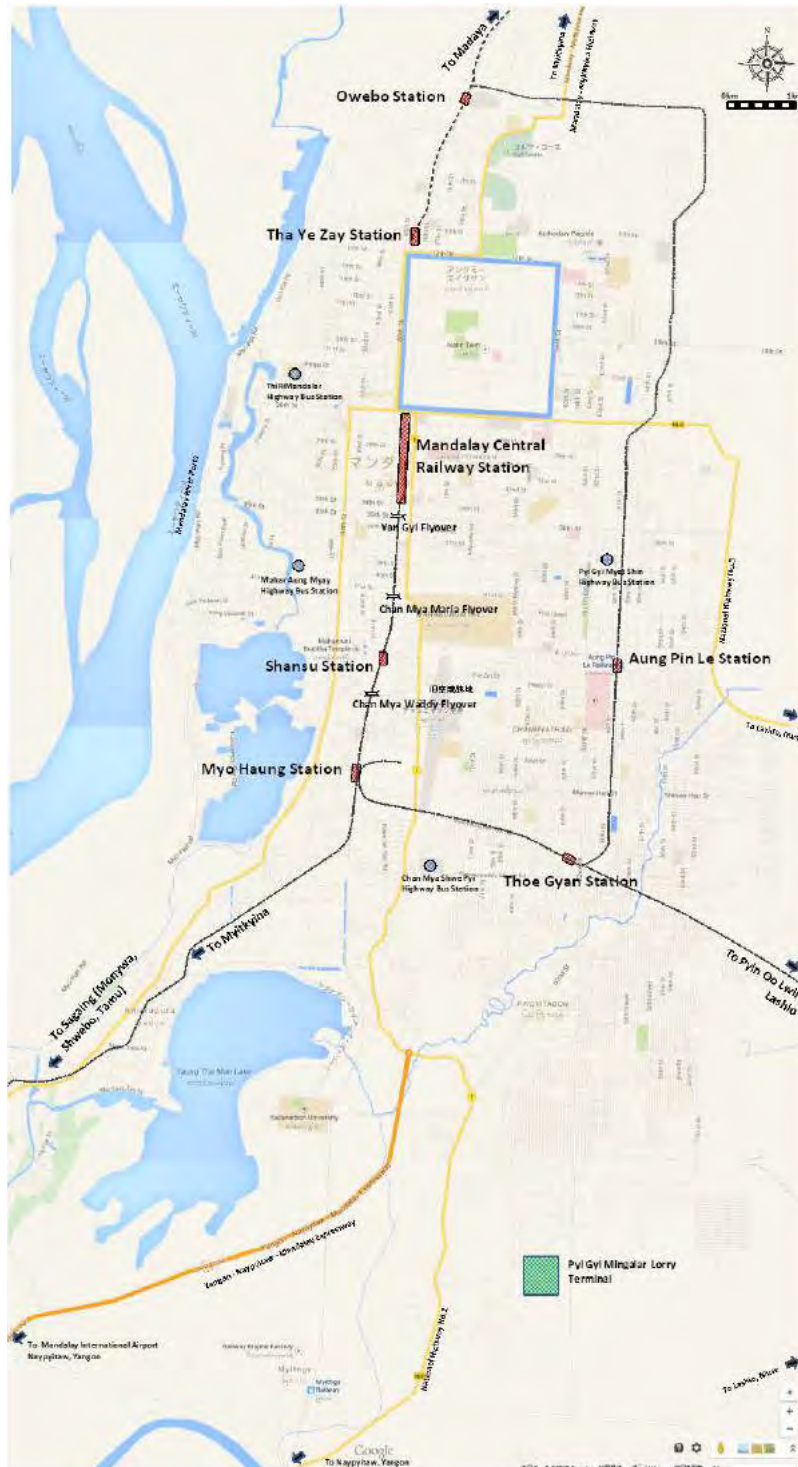
- < New Road Network > Urbanization of Mandalay is expanding in the southeast direction. MIC and other high-tech industrial park/residential area are proposed. The new backbone road network to support the development will be necessary. The ring road network will function well not only as a new backbone but also a diversion road to avoid congestion in the city center.
- < Parking Space > The road network in Mandalay has a relatively wide width. However, the outer lane is often occupied by parked vehicles. MCDC established a guideline for commercial buildings on the necessity to install parking space. But it is not actually materializing since there is no legal binding force. The development of controlled on-road parking and off-road parking will be required.
- < Public Transport > The busses are under operation based on the route network established by the government agency. Even only small busses (light-size truck type) are in service, no passenger queuing are observed in the city. The demand of the busses are still less within the capacity of the current system.
- < Future Public Transport > The project cost of the proposed BRT is USD 60 million but the feasibility such as financial viability has not been confirmed yet. Traffic survey should be conducted to justify the economic and financial feasibility of the proposed project.

- < Truck Terminal > Pyi Gyi Mingalar Truck Terminal is a sole logistic truck terminal in the city. The terminal has recently opened but is already getting saturated. Possible expansion or relocation in suburban area shall be considered based on the comprehensive urban planning.
- < Emergency Road Network > Mandalay has earthquake risk since the city is located in the vicinity of the Sagaing fault. Emergency road network with adequate road width under the possible blockade by debris of the building and proper connection with the emergency activity space such as hospital, open spaces, airport, and government buildings.
- <Airport Access> No public transportation is currently operated to access the international airport. The private companies, such as airline companies and taxi companies operate transit service to the airport from the Mandalay city.

(II) Railway Sector

I) Current Condition

Figure 1.5.48 presents the railway network in Mandalay City.



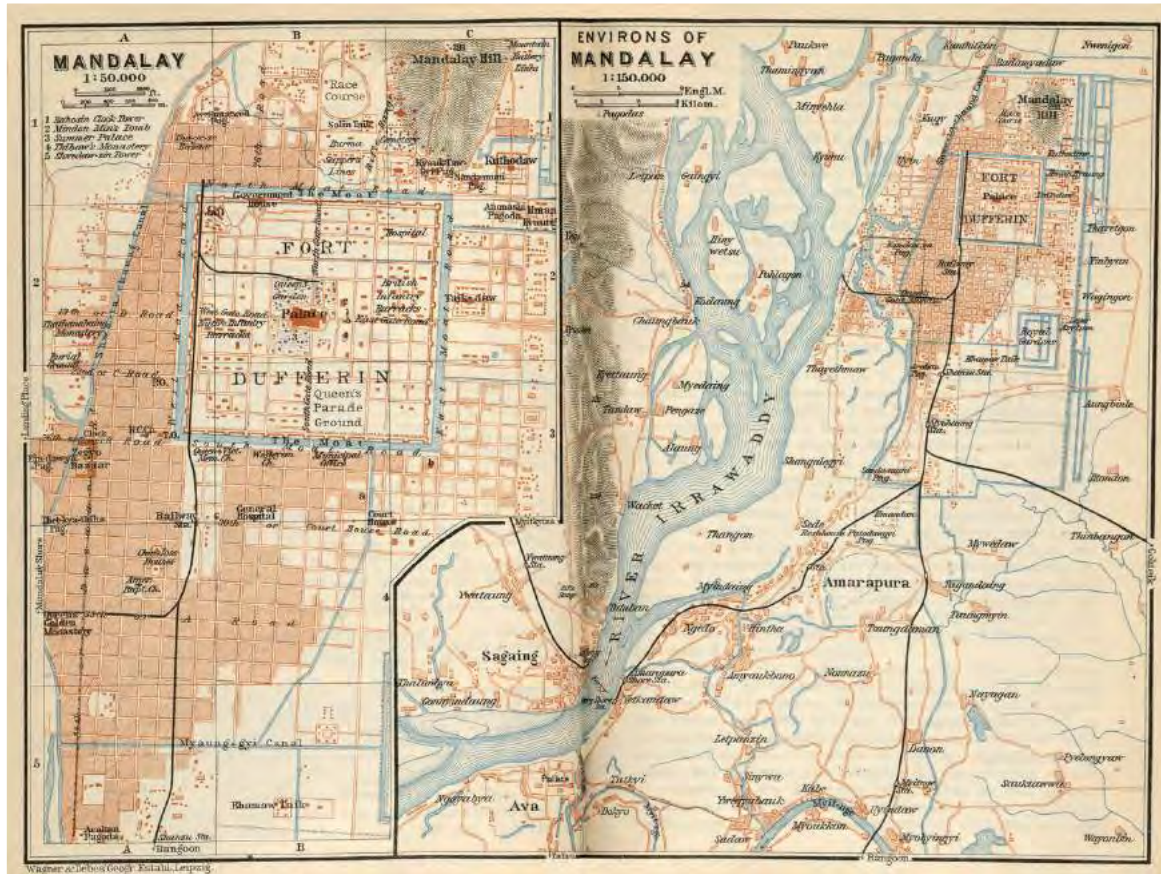
Source: JICA Study Team based on Google Map

Figure 1.5.48: Railway Network in Mandalay

As shown in Figure 1.5.63, the railway network in the city center forms a circular-like network with a missing link section at the Royal Palace. During the British colonial era, Mandalay Central

Railway Station and Tha Ye Zay Railway Station were connected by a track on the Royal Palace as shown in Figure Figure 1.5.49.

After the independence, the railway inside the Royal Palace was dismantled. As an alternative route to connect between the Central Station and Tha Ye Zay Station, the eastern diversion track was installed and the railway network formed the current existing network. The military was stationed in the area where the railway track was previously placed in the palace.



Source: Historical Old Map in 1914, University of Texas Libraries

Figure 1.5.49: Railway Track on the Old Map

The number of daily passengers and revenue of the main stations are summarized in Table Table 1.5.65. The passengers of the eastern section of the circular line (Thoe Gyan Station, Aung Pin Le Station) are extremely few. Current operation of the circular section is substantially forwarding the dead-head car between the Central Station to Tha Ye Zay Station for the daytime railway operation between Tha Ye Zay Station and Madaya.

Table 1.5.65: Passenger Volume and Revenue of Major Stations in Mandalay

| Station | Number of Passengers (person/day) | Revenue (MMK/day) |
|--------------------------|--------------------------------------|----------------------|
| Mandalay Central Station | 2,700 | 10,673,295 |
| Shan Su Station | 30 | 16,720 |
| Myo Haung Station | 83 | 37,675 |
| Thoe Gyan Station | 10 | 3,075 |
| Aung Pin Le Station | 7 | 1,240 |
| Owebo Station | 401 | 24,615 |
| Tha Ye Zay Station | 795 | 81,620 |
| Total | 4,026 | 10,838,240 |

Source: Myamma Railway

The time schedule of each line and the freight costs are shown in Table 1.5.66.

Table 1.5.66: Time Schedule

| Line | Length (km) | Required Time (hrs) | Daily Number of Operation | | Cargo Rate (MMK/ton.km) |
|-----------------------|-------------|-----------------------------|---------------------------|-------|-------------------------|
| | | | Passenger | Cargo | |
| Mandalay - Yangon | 613.0 | About 15-20 hrs | 8 | 4 | 28 |
| Mandalay - Myitkyina | 548.4 | About 16-17 hrs | 12 | 2 | 28 |
| Mandalay - Lashio | 289.2 | 15:35 (Up), 17:40 (Down) | 2 | 2 | 42 |
| Mandalay - Tha Ye Zay | 26.5 | 2:00 (Up) 2:05 (Down) | 1 | - | - |
| Tha Ye Zay - Madaya | 16.7 | 1:30 (Up) 1:30 (Down) | 3 | - | - |
| Mandalay - Monywa | 123.5 | 4:40 (Up) 5:05 (Down) | 2 | - | - |

Source: Myamma Railway

- **Mandalay/Myohaung – Yangon**

Twelve flights (eight flights for passenger, four flights for cargo) have been operating daily. Around 22,000 tons of cargoes (beans to Yangon, fertilizer, construction materials from Yangon) are delivered. The transportation cost is MMK 28/ton-km. Passenger volume is 33,000 per month.

- **Mandalay/Myohaung – Lashio**

Freight train is delivering rice and other food to the military base in Lashio. Operating frequency is 3 or 4 round trips only in a month and the freight cost is MMK 42/km-ton.

From Mandalay to Lashio, it will take six hours travel time by vehicle. On the other hand, more than 15 hours will be required by train. The section passes through the mountainous areas to Lashio, which has a maximum gradient of 4.0%, and switchback-operation is necessary for uphill section as shown in Figure 1.5.50.



Source: JICA Study Team based on Google Earth

Figure 1.5.50: Switchback Operation to Lashio

- **Mandalay - Myitkyina**

Fourteen flights (12 flights for passenger, 2 flights for cargo) are operated. Approximately 1,800-2,000 passengers per day use this line. Around 11,000 tons of construction materials are monthly delivered to Myitkyina. Wood is mainly transported from Myitkyina.

• **Mandalay – Madaya**

The section between Mandalay Central Station and Tha Ye Zay Station is part of the circular track in the city. However, the line is not used for passenger. The train unit departs from Mandalay Station at 05:00 a.m. towards Tha Ye Zay Station almost without passenger. In Tha Ye Zay Station, a diesel head unit is replaced to tail end. And the unit is operated between Tha Ye Zay Station to Madaya (three round-trips) in the daytime. In the evening, the head unit is again replaced in Tha Ye Zay Station for returning to Mandalay Central Station. In the daytime, none of the train units is operated in the eastern section of the circular track.

In the circular track, the western section has a double-track (partially three tracks) and the other section has a single track only. Current condition of the circular track is presented in Figure 1.5.51.



(Western Section)



(Southern Section)



(Eastern Section)



(Eastern Section)



(Houses along Eastern Section)



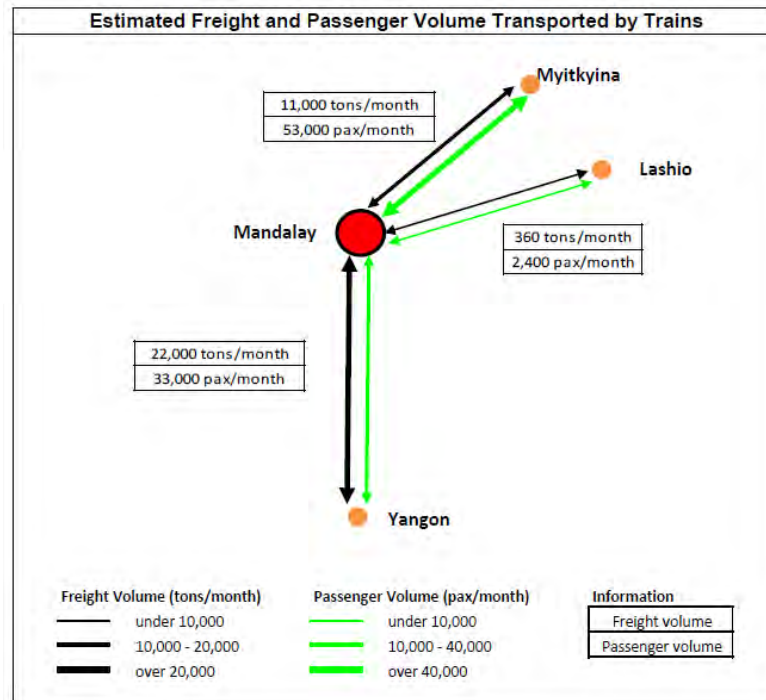
(Aung Pin Le RS in Eastern Section)

Source: JICA Study Team

Figure 1.5.51: Current Condition of Circular Track

• **Mandalay – Monywa**

Only one round-trip is served for approximately 30 passengers per day. Figure 1.5.52 shows the monthly average cargo and passenger volume among Mandalay, Yangon, Lashio, and Myitkyina.



Source: JICA Study Team based on Google Earth

Figure 1.5.52: Monthly Cargo/Passenger Volume

II) Existing Studies/Plans/Projects

(i) Yangon-Mandalay Railway Track Improvement (616.8 km)

The project aims for the renovation and improvement of railway facilities. This project is divided into three phases and currently, the detailed design of Phase1 (Yangon - Tangguh: 267 km) is being conducted. The section includes Mandalay in Phase 3 but the implementation schedule has not been fixed yet.

(ii) MRT Construction on Circular Track

The public transport master plan by FASEP proposed the urban MRT for long-term to utilize the existing railway track of the circular line.

III) Fact Findings and Issues

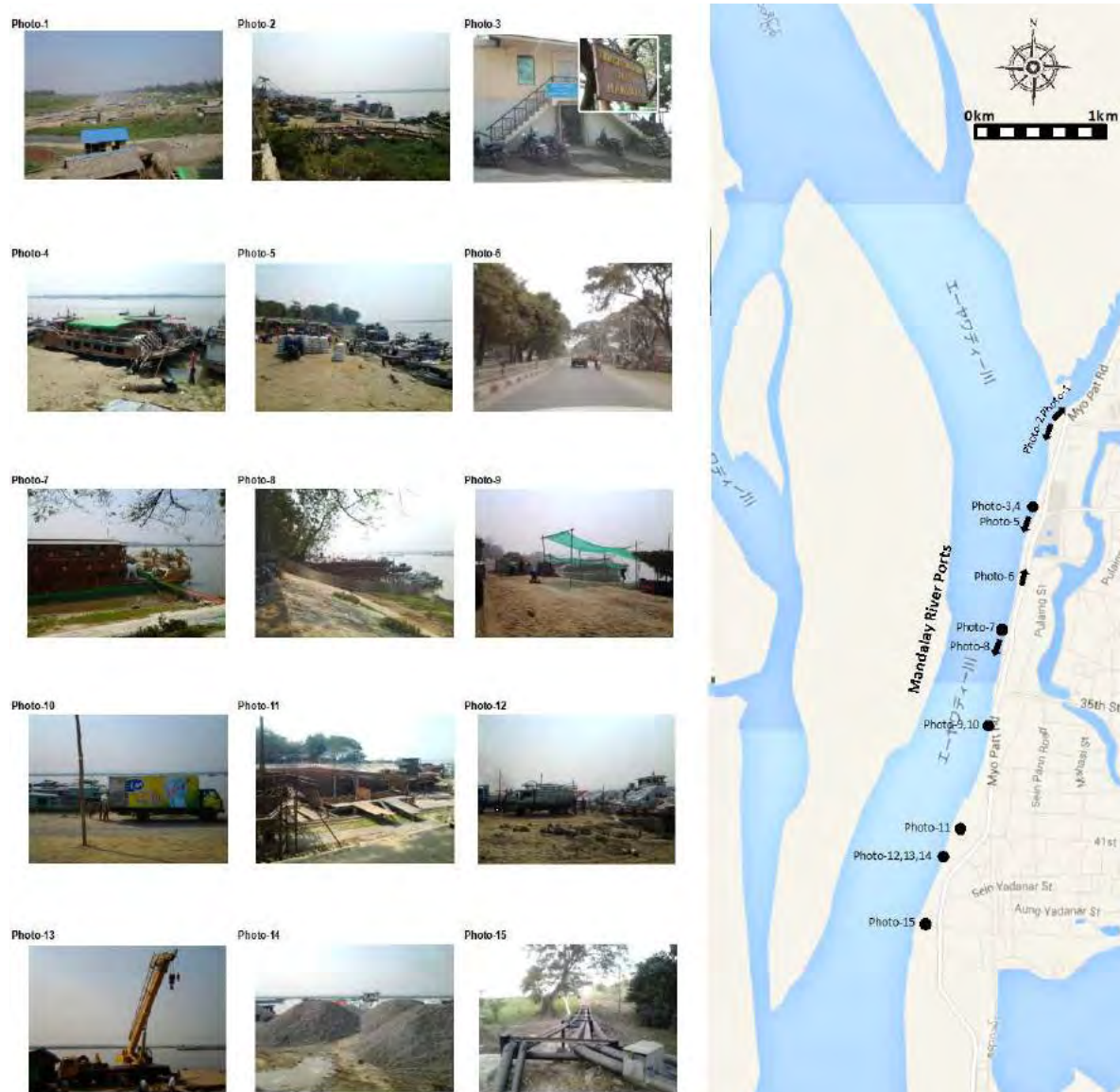
Situation of railway sector is summarized as follows:

- <Aging Infrastructure > Other railway lines in the country, the infrastructure such as signal system, station building, railway crossing, and railway track are not well maintained and updated.
- < Private Investment > Mandalay Central Station was renovated and a private capital hotel was opened in the building.
- < Asset in Urban Area > Mandalay City has a circular-like railway network in the city center. However, the circular network has not been utilized well and forwarding dead-head car is operating only once a day without passengers while the railway track is located in a prime location in the city.
- < Further Detailed Survey > Traffic survey should be conducted to justify the feasibility of the proposed MRT project.

(III) Port Sector

I) Current Condition

There is a wharf managed by IWT, DWIR, and some private companies along the Ayeyawady River (approximately 5 km in length). Boats and vessels owned by IWT or private company are used for passenger and cargo transport. The monthly average traffic of cargo ships (arrival/departure) is around 280 units handling 18 tons of cargoes. Passenger ships are carrying approximately 60,000 pax/month by 120 units. Modernized port facilities are not available in the wharf. Cargo is carried by manpower on a plate of wood between ship and wharf. In the river bank, there is a shipyard and a small oil pipeline facility. Figure 1.5.53 shows the overview of the Mandalay River ports.

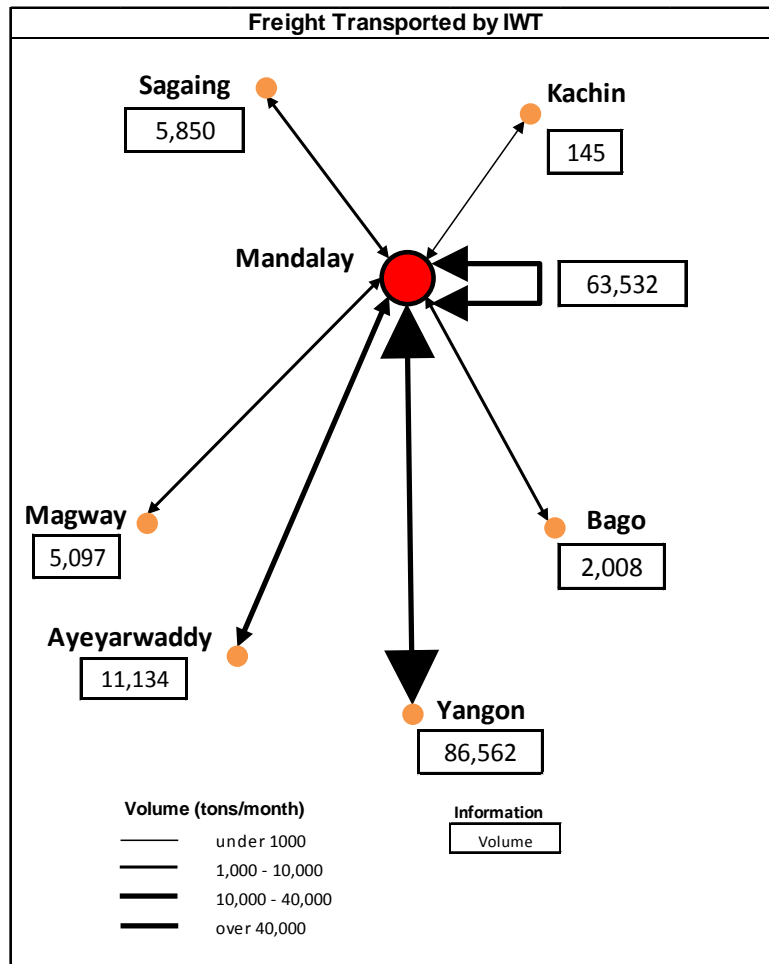


Source: Port Dep. Site Survey Report, Nippon Koei. Co. Ltd.

Figure 1.5.53: Overview of Mandalay River Ports

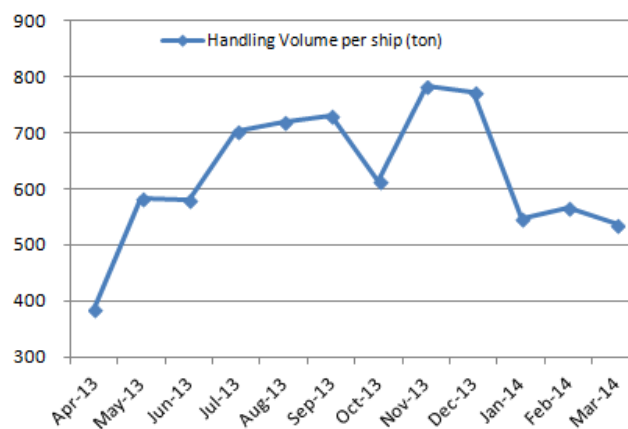
Inland water transportation has an advantage in long distance mass transit. However, the water level difference between the rainy season and dry season extends to around 10 m. During the dry season, there is also a section in which draught is limited to less than 0.8 m. Ships must lighten the load to clear such shallow water way.

Figure 1.5.54 shows the monthly average cargo handling volume in March 2013 to April 2014 to/from the Mandalay River Port. The total handling volume was 183,748 tons/month. The largest amount of 86,000 tons/month is to/from Yangon District and the second largest of 63,000 tons/month is near Mandalay.



Source: JICA Study Team based on IWT Report in 2014

Figure 1.5.54: Cargo Handling Volume by Regions (Monthly Average)



Source: JICA Study Team based on IWT Report in 2014

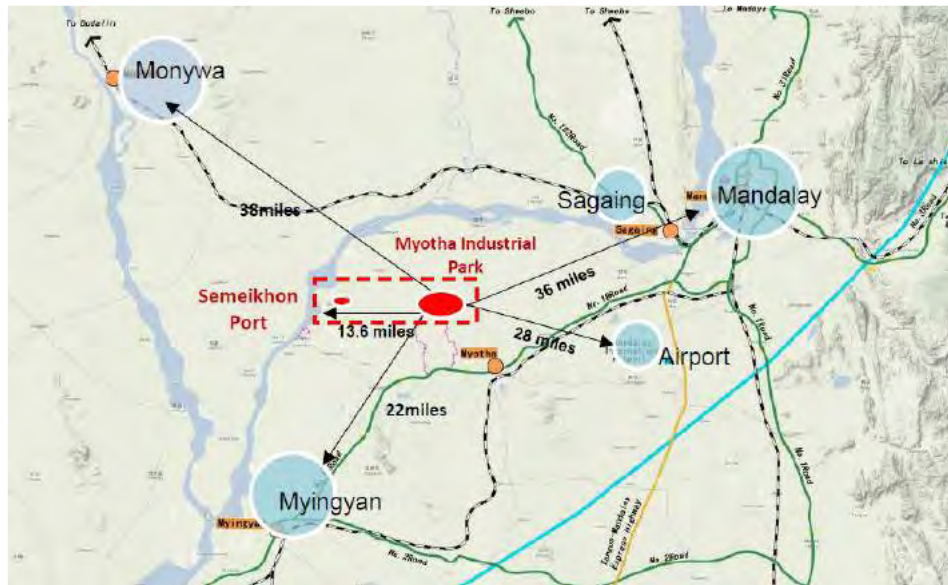
Figure 1.5.55: Average Transport Weight per One Ship

According to Figure 1.5.55, cargo weight per ship during the dry season (January to April) is 400 to 550 tons only. It is revealed that the severe draft restrictions reduce the cargo weight. However, a

certain amount of cargo volume must be carried even during the dry season. Accordingly, the shipping company shall increase the number of ships. Safety issues in the narrow water way with many ships become serious.

II) Existing Studies/Plans/Projects

Mandalay Port is expected to be improved by Japanese ODA and Myo Tha Industrial Park has been developed on the position of about 60 km to the southwest of Mandalay City. Semeikhon Port is also under construction to enable the handling of cargo to/from the industrial park. Locations of the Myo Tha Industrial Park and Semeikhon Port are shown in Figure 1.5.56. Figure 1.5.57 shows the images of the proposed Semeikhon Port.



Source: MMID (Mandalay Myo Tha Industrial Development Public Co.,Ltd)

Figure 1.5.56: Myo Tha Industrial Area and Semeikhon Port



(Low water level)



(High water level)

Source: MMID (Mandalay Myo Tha Industrial Development Public Co.,Ltd)

Figure 1.5.57: Proposed Semeikhon Port

III) Fact Findings and Issues

Situation of port sector is summarized as follows:

- < Draft Restriction > There is a severe draft restriction during the dry season. In order to clear the shallow water way, cargo weight must be reduced and the number of ships must be increased. Safety issues in narrow water way become serious especially during the dry season.

- < Cargo Handling > There is no modern port facility in the port. Cargo is carried by manpower. Generally, the advantage of inland water transportation is the large cargo/bulk transportation and mass transit. However, the cargo size is limited by the manual transport capacity for loading and unloading. In order to utilize the inland transport further, mechanization of loading/unloading will be required. Figure 1.5.58 shows the images of the manual cargo handling in the port.



Source: JICA Study Team

Figure 1.5.58: Manual Cargo Handling

- < New Port > Mandalay new port is being planned with modernized port facilities. Location of the port shall be determined carefully not only considering the factors of the harbor side such as the water depth but also the urban planning and connectivity with the road network.

(IV) Airport Sector

I) Current Condition

International and domestic airlines summarized in Table 1.5.67 are operating their services in Mandalay International Airport (MIA).

Table 1.5.67: Airlines and Destinations

| International Airlines | | Destinations |
|------------------------|-------------------------------|--|
| 1) | Asian Wings Airways | Chiang Mai |
| 2) | Bangkok Airways | Bangkok-Suvarnabhumi, ^[3] Chiang Mai |
| 3) | China Eastern Airlines | Kunming |
| 4) | Golden Myanmar Airlines | Imphal |
| 5) | HK Express | Hong Kong (begins 5 September 2016) ^[4] |
| 6) | Myanmar Airways International | Gaya, Kunming, ^[5] Seoul-Incheon |
| 7) | SilkAir | Singapore |
| 8) | Thai AirAsia | Bangkok-Don Mueang |
| 9) | Thai Smile | Bangkok-Suvarnabhumi |
| Domestic Airlines | | Destinations |
| 1) | Air Bagan | Bagan, Bhamo, Heho, Homalin, Monywa, Kalembo, Kengtung, Lashio, Myitkyina, Naypyidaw, |
| 2) | Air KBZ | Bhamo, Bagan, Heho, Kalembo, Myitkyina, Tachileik, Yangon |
| 3) | Air Mandalay | Myitkyina, Yangon |
| 4) | Asian Wings Airways | Bagan, Heho, Yangon |
| 5) | FMI Air | Bagan, Naypyidaw, Yangon |
| 6) | Golden Myanmar Airlines | Bagan, Bhamo, Heho, Kengtung, Myitkyina, Tachileik, Thandwe, Yangon |
| 7) | Mann Yatanarpon Airlines | Yangon, Bagan, Heho, Thandwe, Kengtung, Tachileik, Myitkyina |
| 8) | Myanmar National Airlines | Bhamo, Kalembo, Kengtung, Khamti, Myitkyina, Naypyidaw, Pakokku, Tachileik, Yangon |
| 9) | Myanmar Airways International | Yangon |
| 10) | Yangon Airways | Bagan, Bhamo, Heho, Kalembo, Kengtung, Lashio, Myitkyina, Naypyidaw, Tachileik, Yangon |

Source: JICA Study Team

After 2010, the number of flights flying in the Mandalay International Airport has been increasing year by year, as shown in Table 1.5.68, especially international flights have increased significantly.

Table 1.5.68: Number of Flights in MIA

| Year | Number of Flights | | | |
|------|-------------------|---------------|--------|---------------|
| | Domestic | International | Total | Increase Rate |
| 2010 | 5,746 | 536 | 6,282 | |
| 2011 | 7,484 | 737 | 8,221 | 131% |
| 2012 | 8,912 | 520 | 9,432 | 115% |
| 2013 | 9,469 | 1,444 | 10,913 | 116% |

Source: DCA

The old Mandalay Airport in the city is now being used for small aircraft such as private jet and training aircraft.

II) Existing Studies/Plans/Project

DCA is planning to make the Mandalay International Airport as a hub cargo airport. An international private consortium is going to invest for a cargo terminal building.

III) Fact Findings and Issues

Situation of airport sector is summarized as follows:

- < Old Airport > In the vicinity of the old airport, urban development is accelerated with shopping malls, stadiums, and residences. MCDC has positioned this area as the new CBD. The old airport divided the existing city center and the new CBD. The future utilization of the old airport is a major issue on urban planning. The new CBD building behind the airport is shown in Figure 1.5.59.



Source: JICA Study Team

Figure 1.5.59: New CBD Area behind Old Airport

- < Service Level of MIA > Future demand of Mandalay International Airport will be increasing and basic infrastructure such as public transportation to access the airport shall be developed.

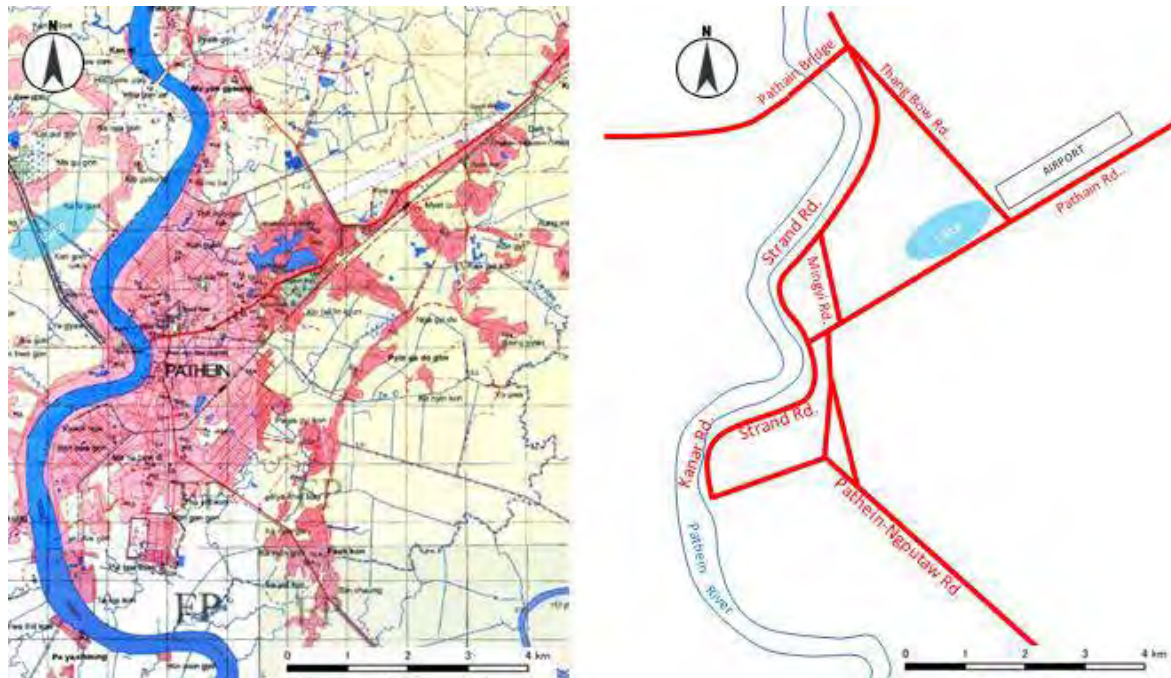
3) Patheingyi

Patheingyi City is an inland port city with a 2004 population estimated at 315,600, and the capital of the Ayeyawady Region. The city is located on the “Delt Area Network” in the national transportation master plan (MYT Plan).

(I) Road Sector

I) Current Condition

The road network of Patheingyi City is shown in Figure 1.5.60. Patheingyi Road continued from Yangon and Strand Road along the river is the backbone of the road network forming a T-shaped network; and urbanization is generally extending along this network. Patheingyi Bridge (L= 645 m) located in the north of the city connects the city and the opposite shore. Current condition of roads in Patheingyi City is shown in Figure 1.5.61.



Source: JICA Study Team based on Topographic Map, MoECAP, 2003

Figure 1.5.60: Road Network in Patheingyi City



Source: JICA Study Team

Figure 1.5.61: Road Condition in Patheingyi City

Traffic congestion is not observed in the city even on the main road. Major intersections are controlled by traffic signals.

Modes of the public transportation for short trips mainly inside the city is shown in Figure 1.5.62. Bicycle-type taxis and light truck taxis are commonly used by the citizens. Also the small boats are frequently operated between the city and the opposite shore.



(Bicycle Taxi)



(Light Truck Taxi)

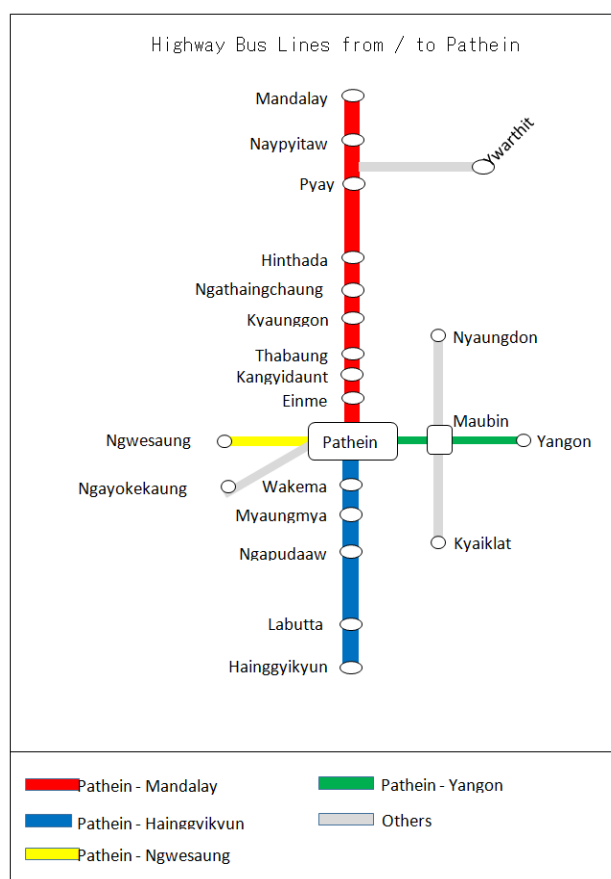


(Boat)

Source: JICA Study Team

Figure 1.5.62: Public Transport in Patheingyi City (Except Railway)

Inter-city buses (highway buses) are operated for medium/long distance trips. YaHTaka is responsible for route management, management of bus terminals, and safety guidance to the private bus operator. Figure 1.5.63 shows the highway bus network to/from Patheingyi City.



Source: JICA Study Team based on Information from YaHTaka

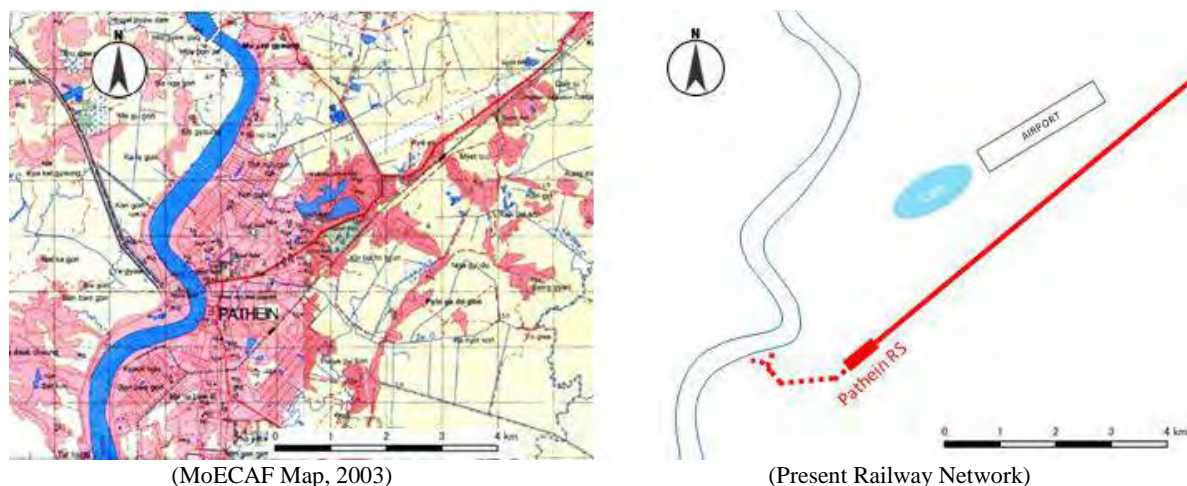
Figure 1.5.63: Highway Bus Network to/from Patheingyi

There is one bus terminal inside the recent developing industrial area in the city. Figure 1.5.64 describes the location of the bus and truck terminals in Patheingyi City.

(II) Railway Sector

I) Current Condition

The railway network in Pathein is shown in Figure 1.5.65. The railway track between Pathein Railway Station and the river bank has not been used for a long time. Table 1.5.69 summarizes the volume of passenger and revenue of Pathein Railway Station. Current condition of the railway in Pathein City is presented in Figure 1.5.66.



Source: JICA Study Team based on Topographic Map, MoECAAF, 2003

Figure 1.5.65: Railway Network in Mawlamyine

Table 1.5.69: Passenger Volume and Revenue of Pathein Railway Station

| Station | Number of Passengers (person/day) | Revenue (MMK/day) |
|-------------------------|--------------------------------------|----------------------|
| Pathein Railway Station | - | - |

Source: Myamma Railway

The time schedule of each line and freight costs are shown in Table 1.5.70.

Table 1.5.70: Time Schedule

| Line | Length (km) | Required Time (hrs) | Daily num. of Operation | Cargo Rate (MMK/ton.km) |
|-------------------|----------------|------------------------|-------------------------|----------------------------|
| Pathein – Kyankin | - | 10-15 hrs | 4 trips | - |

Source: Myamma Railway



(Pathein Railway Station)



(Abandoned Track)



(Unloaded Cargo from Train)



(Cargo Re-loading to Truck)

Source: JICA Study Team

Figure 1.5.66: Condition of Railway in Pathein

II) Existing Studies/Plans/Projects

No particular studies/plans/projects.

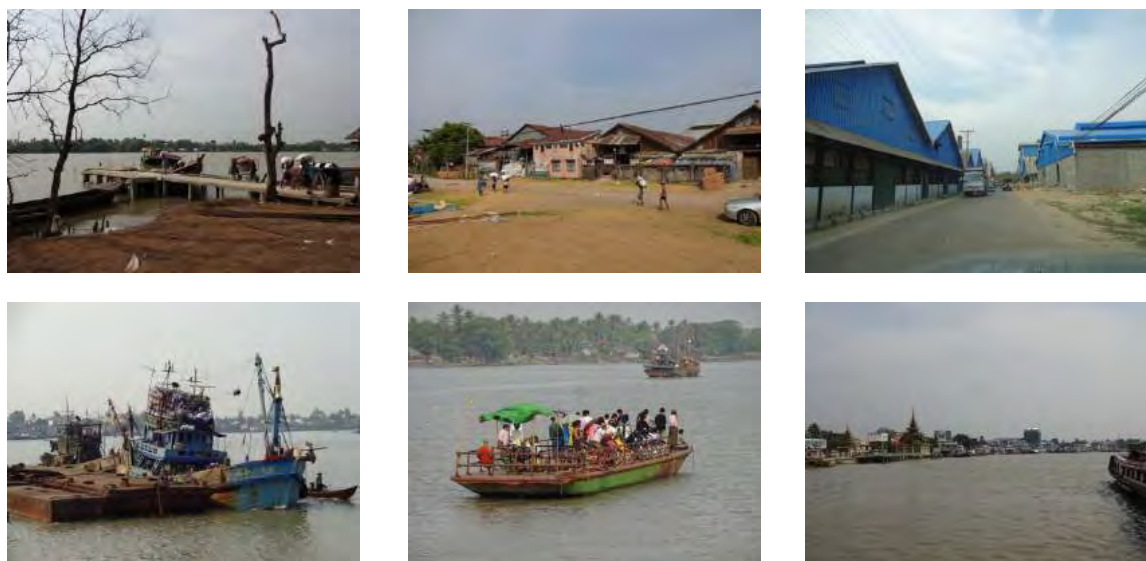
III) Fact Findings and Issues

Situation of railway sector is summarized as follows:

- < General > The condition of Pathein Road was improved and the travel time of vehicle between Yangon and Pathein is much faster than that of the railway. However, Pathein Road only has two lanes and is passing through small towns/villages along the road. The mixture of high-speed through traffic and community traffic for small villages results to serious traffic accidents. When the level of services of the railway (i.e., speed and riding quality), the demand of the railway might be raised.
- < Abandoned Track > The railway track between Pathein Station and the river bank has not been used for a long time. DUHD, MOC proposed this abandoned railway track to be replaced by a new road.
- < Cargo Handling > Cargo handling (loading and unloading) relies on manpower only. Double handling maneuver between cargo unit and truck is conducted at the station.

(III) Port Sector

Information is still under the process of collection and the photos showing the current conditions are introduced in Figure 1.5.67. Further updating will be conducted in the following report.



Source: JICA Study Team

Figure 1.5.67: Condition of Ports in Patheingyi

(IV) Airport Sector

Patheingyi Airport is currently used by the military and the investigation could not be conducted.

4) Mawlamyine

Mawlamyine City has the third largest population in Myanmar. The city is located in the east-west economic corridor in the national transportation master plan (MYT Plan). Along the corridor, Dawei SEZ and other several SEZs are planned. Also Mawlamyine is the strategic nodal point of GMS East-West Corridor (Mawlamyine-Danang) and GMS West Corridor (Tamu-Mawlamyine) as shown in Table 1.5.71.

Table 1.5.71: International Corridor through Mawlamyine

| GMS Economic Corridor | |
|-----------------------|---|
| East-West Corridor | (Thailand) – Myawaddy – Mawlamyine |
| Western Corridor | (India) – Tamu – Nay Pyi Taw - Bago - Mawlamyine |

Source: JICA Study Team

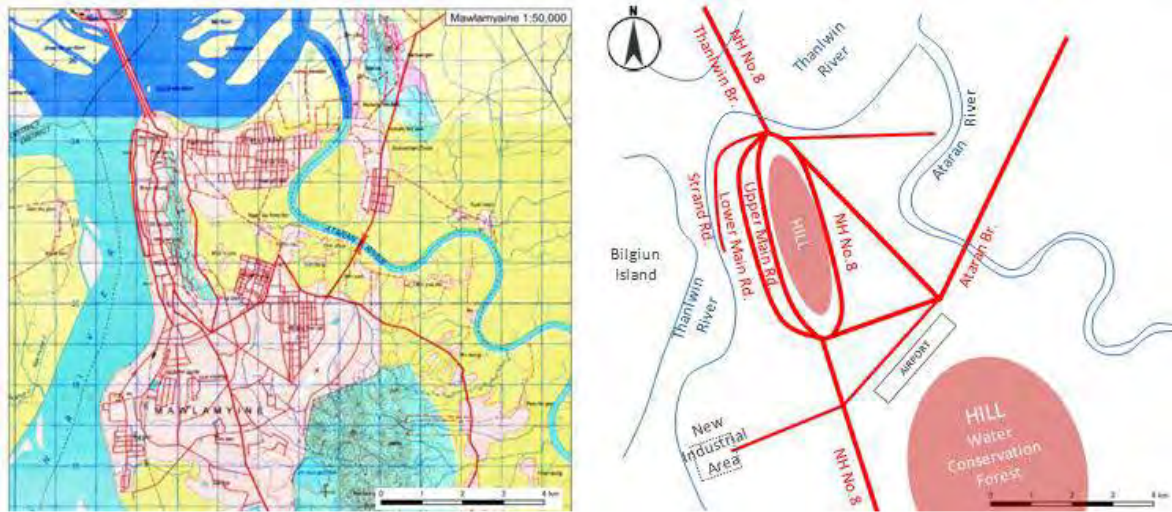
(I) Road Sector

I) Current Condition

The road network in Mawlamyine is shown in Figure 1.5.68. GMS Economic Corridor is connected with the city through Ataran Bridge. National Highway No.8 is passing through the city from north to south. There is a hilly terrain in the city which has many religious facilities and the main arterial roads were diverted to both sides of the hill.

The central urban area is extending in the western side of the hill along Strand Road, Lower Road and Upper Main Road. The width of the north-south main roads is 2-lane width and the width of the east-west roads linking these north-south main roads is relatively narrow. The road network in

Mawlamyine City is shown in Figure 1.5.68. Current condition of roads in Mawlamyine City is presented in Figure 1.5.69.



Source: JICA Study Team based on Topographic Map, MOECAP, 2003

Figure 1.5.68: Road Network in Mawlamyine City



(NH No.8 : Near Thaton)



(NH No.8 : North of Thanlwin Bridge)



(Thanlwin Bridge)



(Hill Top View toward East of the City)



(Lower Main Road)



(Upper Main Road)



(NH No.8 : East of the Hill)



(NH No.8 : South of the city)



(Strand Road)



(Cargo Handling on Strand Road)



(Roads in New Industrial Area)



(Ataran Bridge)



(Road toward Thaton after Ataran Br.)

Source: JICA Study Team

Figure 1.5.69: Road Condition in Mawlamyine City

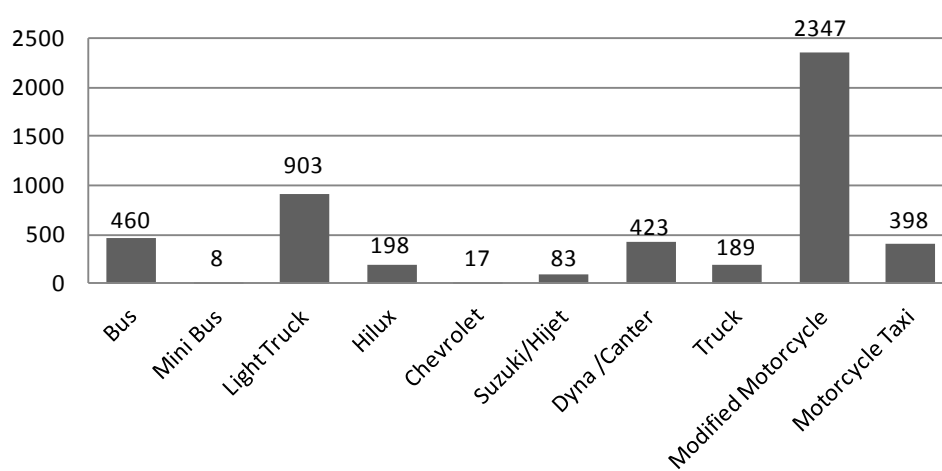
Generally, traffic congestion is not observed in the city except for Strand Road which has congestion during the peak hours of cargo handling on the road. Major intersections are controlled by traffic signals.

Modes of public transportation for short trips mainly inside the city are shown in Figure 1.5.70. Modified motorcycle-type taxis and light truck taxis are commonly used by the citizens. Also the small boats are frequently operated between the city and Bilugyun Island. Number of registered commercial vehicles in Mon State is summarized in Figure 1.5.71.



Source: JICA Study Team

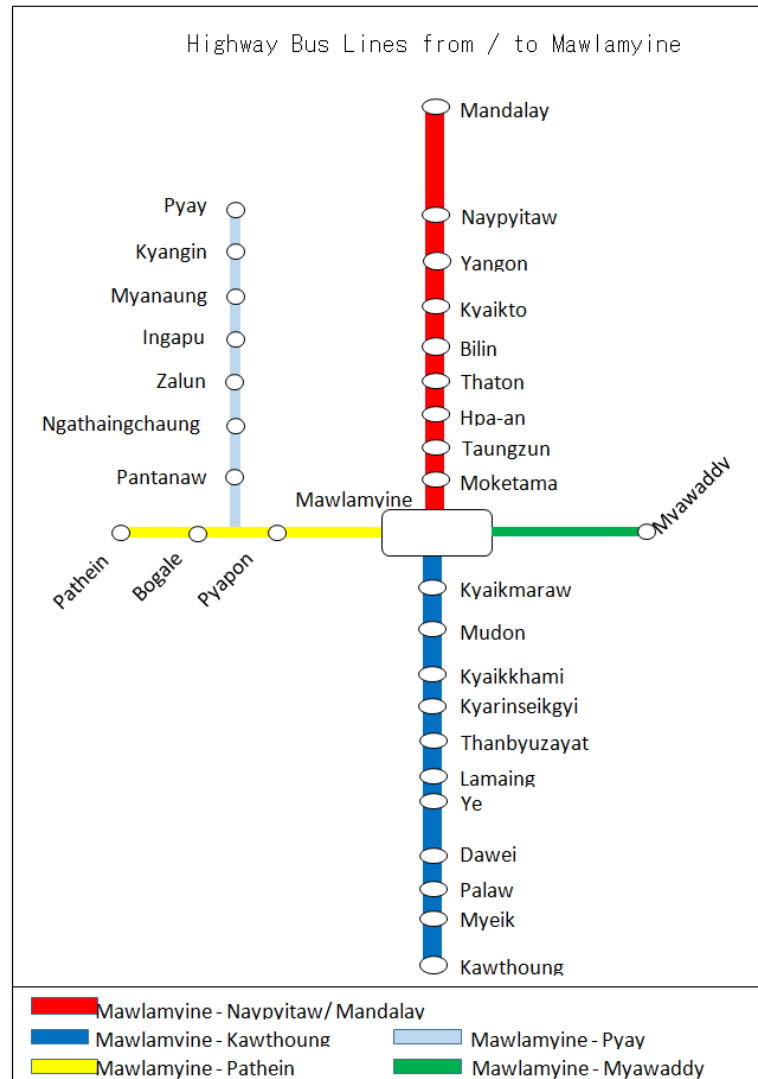
Figure 1.5.70: Public Transport in Mawlamyine City (Except Railway)



Source: JICA Study Team based on Statistics by YaHTaka in May 2015

Figure 1.5.71: Number of Registered Commercial Vehicles in Mon State

On the other hand, inter-city buses (highway buses) are operated for medium/long-distance trips. Mon State City Highway Bus Management Committee, YaHTaka is responsible for route management, management of bus terminals, and safety guidance to the private bus operator. Highway bus network of Mawlamyine City is shown in Figure 1.5.72.



Source: JICA Study Team based on Information from YaHTaka

Figure 1.5.72: Highway Bus Network to/from Mawlamyine

There are two bus terminals in the city. Mawlamyine Bus Terminal located in the north of the Mawlamyine Railway Station serves highway buses bound for the northern area in the country such as Yangon. Zeigyo Bus Terminal located in the south of the city center serves highway buses bound for the southern area in the country such as Dawei.

The Mawlamyine Bus Terminal is going to be saturated and the extension of the terminal behind the existing terminal is planned. The location of the bus terminals in Mawlamyine City is shown in Figure 1.5.73 and terminal information is summarized in Table 1.5.72.



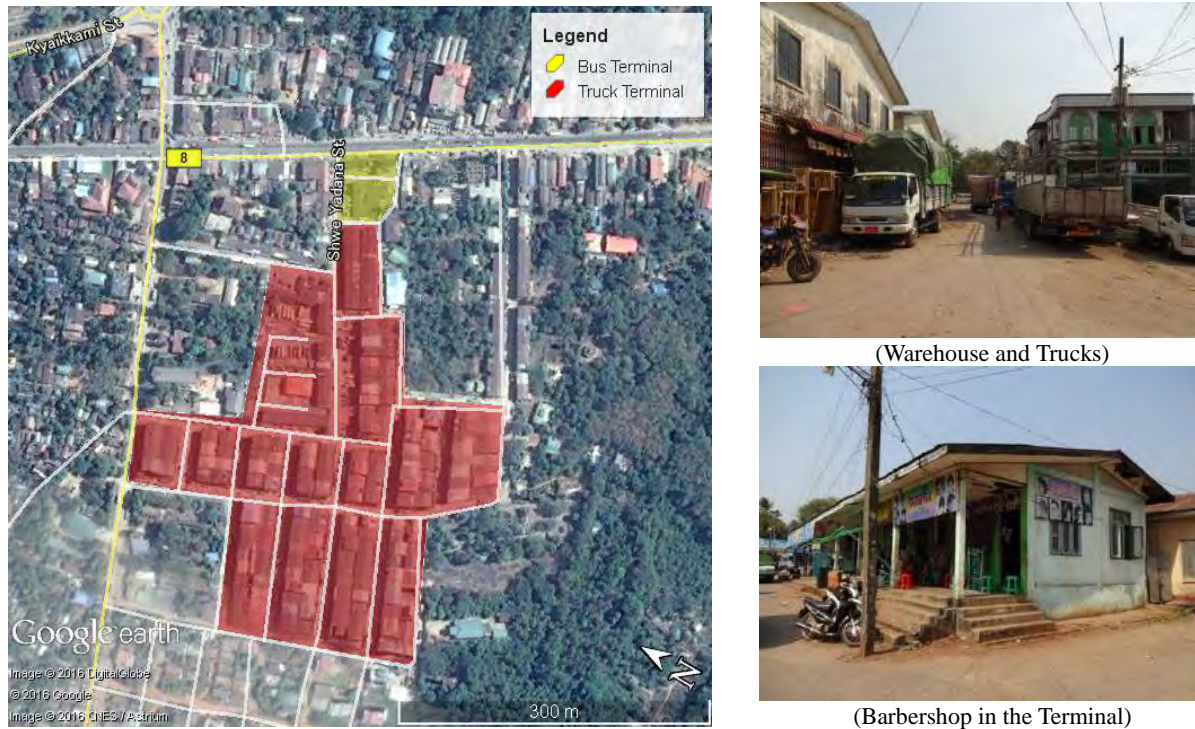
Figure 1.5.73: Location of Bus Terminals in Mawlamyine

Table 1.5.72: Bus Terminals in Mawlamyine

| Terminals | Main Destination | Area (ha) | Number of Trips (trips/day) | Number of Passenger per day |
|------------|--|-----------|-----------------------------|-----------------------------|
| Mawlamyine | Yangon, Mandalay, Mogoke, Chin Naypyitaw, State, Kachin State, Sagaing Region, Magway Region | 1.6 | 71 | 1,849 |
| Zeigyo | Except the above | 0.4 | - | - |

Source: Monthly Statistics in January 2016, YaHTaka and JICA Study Team

The truck terminal is located just behind Zeigyo Bus Terminal. There are many small-sized warehouses operated by private companies or individuals inside the terminal but the loading/unloading space is quite narrow. Sprawling the urban area toward the southern area of the city, this terminal is currently located in the urban area. Location of the truck terminal in Mawlamyine City is shown in Figure 1.5.74.



Source: JICA Study Team based on Google Earth

Figure 1.5.74: Location of Truck Terminals in Mawlamyine

II) Existing Studies/Plans/Projects

There are two ongoing road related projects.

(i) Extension of Strand Road Construction Project (From Nyaunglaypin Stream to Charcoal Harbour)

Strand Road will be extended further toward south with 1,395 m length. A private investor, Sone Yay Group which owned Ngwe Moe Hotel is investing in the road construction project. The construction period of the project is four months and the project will be completed by April 2016. Images of the Strand Road project extension are shown in Figure 1.5.75.



Source: JICA Study Team

Figure 1.5.75: Extension of Strand Road Project

(ii) Thanlwin Bridge (Chaungzone) Construction Project

Public Works Department, MOC is constructing the new steel truss bridge to connect the city and Bilgiun Island (Chaungzone Township). The bridge will be completed in December 2016. Images of the construction of the Thanlwin Bridge are shown in Figure 1.5.76.



(Construction in the River)

Source: JICA Study Team



(Substructure)

Figure 1.5.76: Thanlwin Bridge under Construction

III) Fact Findings and Issues

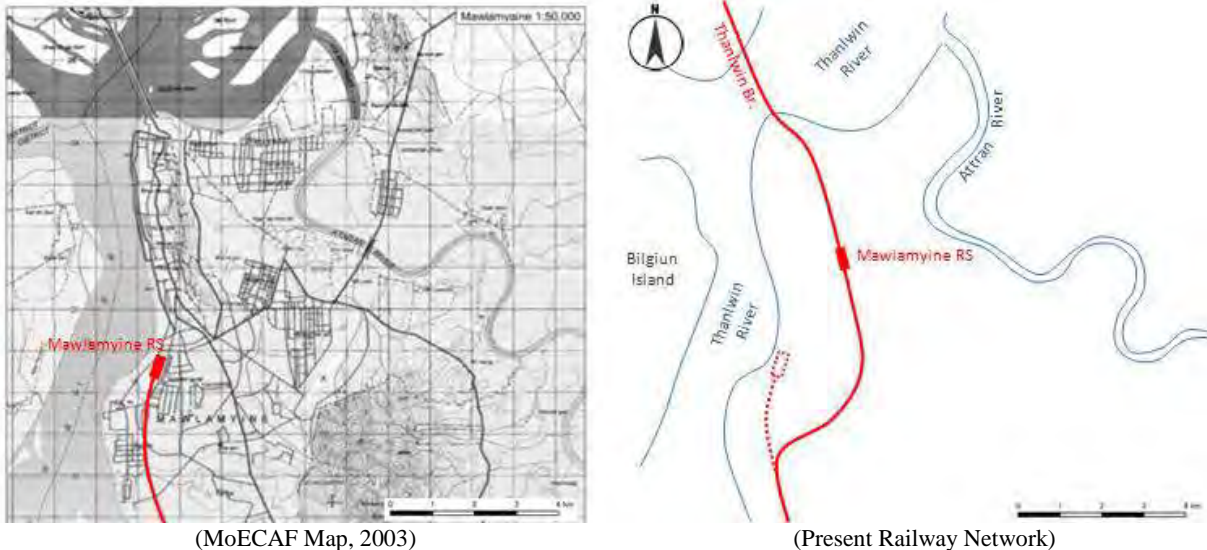
Situation of road sector is summarized as follows:

- <On-road Cargo Handling> Traffic congestion is observed during peak hours of cargo handling on Strand Road. Provision of cargo handling space could solve this issue.
- < Public Transport > Generally, traffic congestion is not found in the city except on Strand Road mentioned above. Large-sized bus is not allowed to operate for short-trip traffic in the city. It is easy to catch small-sized taxi (motorbike or light truck type) everywhere in the city. The large demand for public transportation might not be expected.
- <Bus Terminal > Mawlamyine Bus Terminal will become saturated and the expansion is planned already.
- < Truck Terminal > Zeigyo Truck Terminal is located in the built-up area and the relocation of the terminal might be considered. A possible candidate for the relocation might be the new industrial area in Kyau Tan which is located further south from Zeigyo.
- < New Industrial Area > The future road network shall be proposed taking into account the new industrial area in Kyau Tan and urban spatial planning.
- < New Bridge > Access road for Thanlwin (Chaungzone) Bridge in Mawlamyine City is quite narrow.

(II) Railway Sector

I) Current Condition

Figure 1.5.77 presents the railway network in Mawlamyine City. Thanlwin Bridge completed in 2005 connects the railway network between Mawlamyine and Yangon. The old railway track, the dotted red line in Figure 1.5.77, has not been in service. Table 1.5.73 shows the volume of passengers and the revenue of Mawlamyine Railway Station.



Source: JICA Study Team based on Topographic Map, MoECAFP, 2003

Figure 1.5.77: Railway Network in Mawlamyine

Table 1.5.73: Passenger Volume and Revenue of Mawlamyine Railway Station

| Station | Number of Passengers (person/day) | Revenue (MMK/day) |
|----------------------------|--------------------------------------|----------------------|
| Mawlamyine Railway Station | - | - |

Source: Myamma Railway

The time schedule of each line and the freight costs are shown in Table 1.5.74. Current condition of the railway in Mawlamyine is presented in Figure 1.5.78.

Table 1.5.74: Time Schedule

| Line | Length (km) | Required Time (hrs) | Daily Number of Operation | | Cargo Rate (MMK/ton.km) |
|--------------------------|----------------|------------------------|---------------------------|-------|----------------------------|
| | | | Passenger | Cargo | |
| Mawlamyine – Nay Pyi Taw | - | About 15-20 hrs | 8 | 4 | 28 |

Source: Myamma Railway



(Train Unit of Yangon-Mawlamyine Line)



(Passenger Car)



(Cargo Unit)



(Station Building)



(Platform)



(Cargo Unloading from Cargo Unit)



(Cargo Re-loading to Vehicle)

Source: JICA Study Team

Figure 1.5.78: Condition of Railway in Mawlamyine

II) Existing Studies/Plans/Projects

No particular studies/plans/projects.

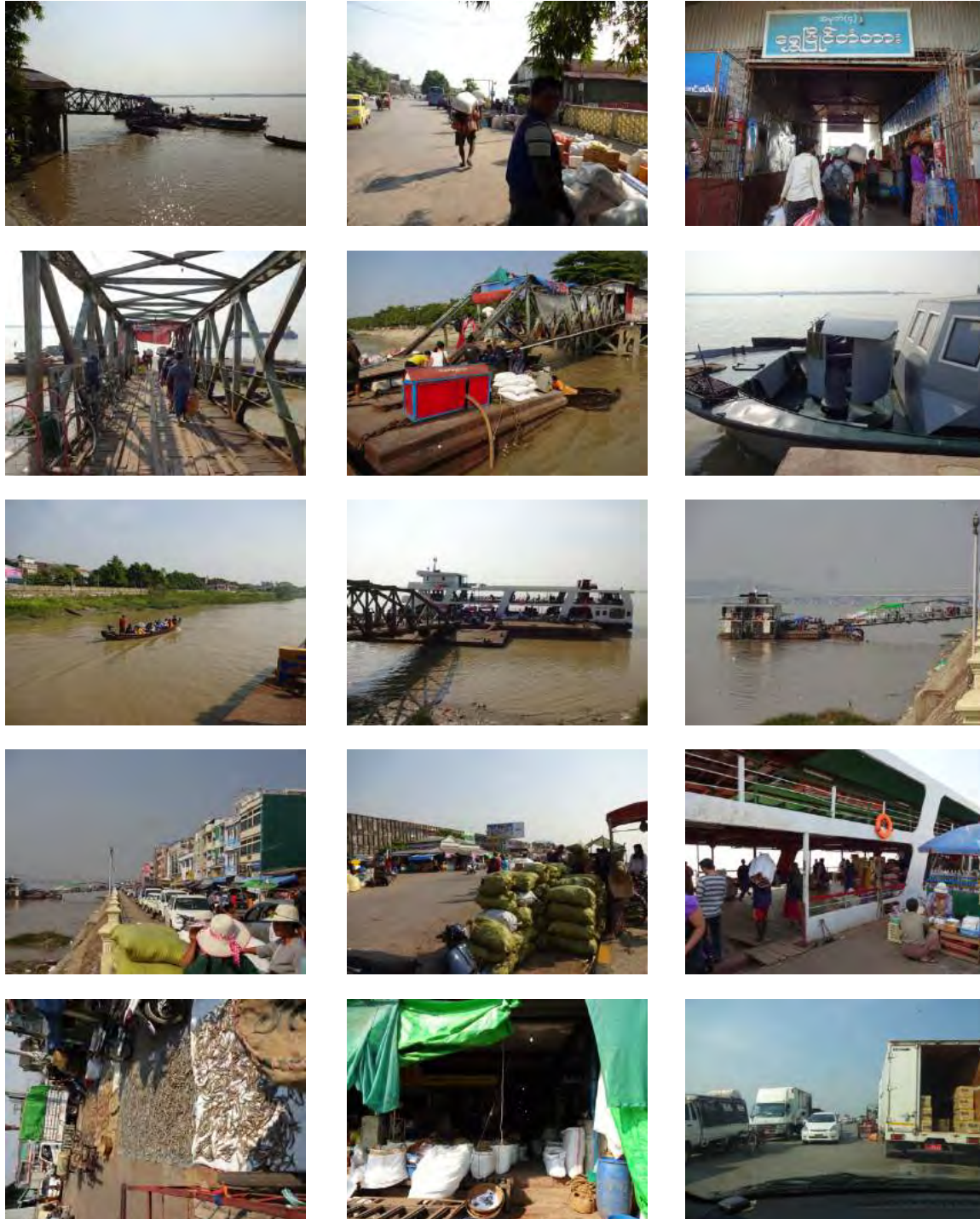
III) Fact Findings and Issues

Situation of railway sector is summarized as follows:

- < General > The condition of National Highway No.8 (NH No.8) was improved and the travel time of vehicles between Yangon and Mawlamyine is much faster than that of the railway. However, NH No.8 only has 2 lanes and is passing through the small towns/villages along the road. The mixture of high-speed through traffic and community traffic for small villages results to serious traffic accidents. When the level of services of the railway (i.e., speed and riding quality) upgrades, the demand of the railway might be raised.
- < Abandoned Track > Since the completion of new railway track, the section toward the old station has not been used for passengers.
- < Cargo Handling > Cargo handling (loading and unloading) relies only on manpower. Double handling maneuver between cargo unit and truck is conducted at the station.

(III) Port Sector

Information is still under the process of collection and the photos showing the current conditions are introduced in Figure 1.5.79. Further updating will be conducted in the following report.



Source: JICA Study Team

Figure 1.5.79: Condition of Ports in Mawlamyine

(IV) Airport Sector

I) Current Condition

Mawlamyine Airport was opened in 1945. Mawlamyine has the third largest population in the country but no daily flight is being operated in this airport. Myanmar National Airline is operating a flight once a week.

A charter flight from Thailand (Nok Air) operated for around two years until last year but the flight was withdrawn already.

Due to less traffic demand, the maintenance budget for this airport is postponed and defects were observed as shown in Figure 1.5.80.



(Runway)

Overlay was conducted only at the central strip.



(Runway)

Weeds growing from the crack



(Runway)

Trees are growing adjacent to the runway



(Terminal Building)

Source: JICA Study Team



(Damaged Aviation Lights)



(Access Road to the Airport)

Figure 1.5.80: Condition of Airport in Mawlamyine

II) Existing Studies/Plans/Project

No particular studies/plans/projects.

III) Fact Findings and Issues

Situation of airport sector is summarized as follows:

- < General > It will be necessary to confirm the role of the airport and development priorities of the airport.

(2) Water Supply, Sewerage and Drainage

1) Mandalay

Water and Sanitation Department of MCDC manages water supply system and sewage collection. Drainage facilities such as ditch, waterway, and canal are managed as follows:

- Construction of drainage facilities: Road and Bridge Department
- Water quality management in drainage facilities: Water and Sanitation Department
- Garbage collection in drainage facilities: Cleaning Department

Water and Sanitation Department of MCDC is composed of four sections, namely (1) Procurement, Storage, and Maintenance Section, (2) Sanitation Section, (3) Water Distribution Section, and (4) Tube Wells, Electrical and Mechanical Section, and it has about 400 staffs.

(I) Water Supply

I) Current Condition

A water supply project in Mandalay City was started in 1983 under the financial assistance of ADB and OPEC, and the operation started in 1992. Then, the water supply system has been gradually developed by MCDC's own budget. In the current year, water supply system has been established mainly in four townships (Aungmyetharzan, Mahaaungmye, Chanayetharzan, and Chanmyathazi) and its water source is through groundwater from the 36 tube wells along the Ayeyawady River and surface water from the Red River. On the other hand, there is an insufficient piped water supply system in remaining two townships (Pyigyidagun and Amarapura). In 2013, serviced population has reached 0.7 million and an average service ratio is about 57% in Mandalay City as shown in Table 1.5.75. The average total water supply is about 130,000 m³/day. The details are shown in Table 1.5.76.

Table 1.5.75: Water Supply Service Ratio in Each Township

| Township | Population | Population Served | Ratio (%) |
|-------------------|------------|-------------------|-----------|
| 1. Aungmyetharzan | 254,898 | 224,128 | 88% |
| 2. Chanayetharzan | 229,847 | 220,653 | 96% |
| 3. Mahaaungmye | 233,557 | 185,687 | 80% |
| 4. Chanmyathazi | 199,519 | 89,317 | 45% |
| 5. Pyigyidagun | 157,062 | 7,158 | 5% |
| 6. Amarapura | 207,678 | 1,414 | 1% |
| Total | 1,282,561 | 728,357 | 57% |

Source: Water and Sanitation Department of MCDC

Table 1.5.76: Summary of Water Supply Service in Mandalay

| Items | | Contents | Remarks |
|-----------------------------|----------------------------|-----------------------------------|-----------------------------|
| Township area | | 829.1 km ² | |
| Township of all | | 7 townships | |
| Township of supplying water | | 6 townships | |
| Current water demand | | About 170,000 m ³ /day | For 6 townships (135 lpcd) |
| Current water supply | | About 130,000 m ³ /day | |
| Covered population rate | | 57% | |
| Non-covered population rate | | 43% | |
| Water facility | No.1 Booster pump station | 10 to 14 million gallons | Water source: 28 tube wells |
| | No.2 Booster pump station | 0.5 million gallons | Water source: 3 tube wells |
| | No.3 Booster pump station | 0.5 million gallons | Water source: 3 tube wells |
| | No.4 Water treatment plant | 2.0 million gallons | Water source: Red River |
| | No.5 Booster pump station | 0.1 million gallons | Water source: 2 tube wells |

| | | | |
|-------------|----------------------------|------------------------|-------------------------------|
| Other water | No.6 Booster pump station | 0.06 million gallons | Water source: 3 tube wells |
| | No.7 Booster pump station | 0.3 million gallons | Water source: 3 tube wells |
| | No.8 Water treatment plant | 10 million gallons | Water source: Ayeyawady River |
| | No.9 Booster pump station | 0.6 million gallons | Water source: 2 tube wells |
| | No.1 Elevated tank | 450 m ³ | Water source: 2 tube wells |
| | No.2 Elevated tank | 230 m ³ | Water source: 1 tube well |
| | Mandalay Hill reservoir | 11,500 m ³ | No.1 BSP and No.8 WTP |
| | Public tube wells | 41 spots | |
| | Private tube wells | more than 20,000 spots | |

Source: Water and Sanitation Department of MCDC

Existing main water supply facilities operated in Mandalay City are as follows:

(i) No.4 Water Treatment Plant

No.4 Water Treatment Plant (No.4 WTP), shown in Figure 1.5.81, was constructed by MCDC with its own fund, and its operation was started in 2007. Its planned capacity is 9,000 m³/day (actual capacity: 5,600 m³/day) and the service area is limited to the vicinity of this WTP. The water resource of No.4 WTP is the Red River and its treatment process is a slow sand filtration system. This plant supplies treated water for only 7 hours per day.



Source: JICA Study Team

Figure 1.5.81: No.4 Water Treatment Plant

(ii) No.8 Water Treatment Plant

No.8 WTP, shown in Figure 1.5.82, was designed according to the JICA master plan, and was constructed by MCDC in 2013 with its own fund. This WTP aims at supplementing the existing 36 tube wells, and this will supply treated water to the existing network. It has the planned capacity of 45,000 m³/day (under rehabilitation) and the water demand of four townships will be satisfied by this WTP.



Source: JICA Study Team

Figure 1.5.82: No.8 Water Treatment Plant

(iii) Existing Network

Existing water supply network in Mandalay City is composed of about 9 km of transmission pipeline, 110 km of distribution main, and 250 km of distribution network. The materials used for the existing pipelines are DIP (for transmission and distribution main) and PVC (for distribution network), while HDPE is slightly used. Non-revenue water (NRW) is the water that has been produced and "lost" before it reaches the customer. NRW ratio is about 50% (within, NRW of the pipeline is 36%), and it should be decreased as much as possible to make the most of limited water sources. As for the water service charge, users have to pay the charge by every three months to the financial organization of Mandalay City. The water service charge of raise on April 2015 is 85 kyats/m³ for domestic use and 110 kyats/m³ for commercial use. The tap water is not used by some domestic users who have own tube well and many poor people who use public well water, although the inexpensive charge.

(iv) Tube Wells

In the eastern and southern parts of Mandalay City, there are 41 tube wells and their public taps, which are operated by MCDC. In addition, some households have their own shallow wells and the number of wells exceeds 20,000. Due to the power outage, tube wells frequently stop operation. Figure 1.5.83 shows images of a tube well and of No. 5 pump station.



Source: JICA Study Team

Figure 1.5.83: Tube Well and No.5 Pump Station

Location of the said facilities is shown in Figure 1.5.84.

III) Fact Findings and Issues

- <Insufficient Water Supply Volume for Urban Life and Development> Pumping discharge from tube wells has been declining. There is an insufficient public water supply system in Pyigyidagun and Amarapura townships. Right now, Pyigyidagun Township has covered a water supply of 5% only, and will cover 30% and the remaining 70% after the JICA Grant Aid. The construction of new WTP which utilizes surface water, the extension of pipeline, and the upgrading of distribution reservoir will be required. Technical assistance for capacity development for the operation of rapid sand filtration system will be required due to lack of know-how. Improvement of electric supply is required in order to have stable water supply.
- <Improvement of Low Pressure in the Eastern Area> Upgrading of distribution reservoir and pumping facilities will be required. Quality of water supply is not good.
- <Deterioration and Drawdown of Groundwater> Public water supply system to industrial zone will be required in order to minimize groundwater usage. Technical assistance for groundwater management is required.
- <High NRW Ratio> Reason of NRW (pipeline's NRW 36%) will be investigated and appropriate measures will be implemented. Technical assistance for NRW reduction will be required.

(II) Sewerage

I) Current Condition

There is no public wastewater treatment plant (WWTP) to treat domestic wastewater in Mandalay City. Wastewater from households, commercial, and administrative facilities in Mandalay City is treated by pit toilet or septic tank at their own place. The effluents of septic tanks are discharged to street drain and drainage channel, and finally flow into the river via ponds without appropriate treatment. In the industrial zone on the southern side of Mandalay City, most of the factories do not have their own WWTP. These are the causes of water pollution on rivers and ponds.

There are about 58,000 septic tanks and 40,000 pit toilets in Mandalay City. Most of human septage and sludge from pit toilets and septic tanks are collected by 15 vacuum cars owned by the Water and Sanitation Department of MCDC, and it is carried to the oxidation pond located in the eastern outskirts of Mandalay City.

MCDC installed a simple treatment facility on Thingzaer Creek as shown in Figure 1.5.85 and a coarse screen on Shwe Ta Channel using its own funds. But, the effect against water pollution may be small.



Source: JICA Study Team

Figure 1.5.85: Simple Treatment by Aerator on Thingzaer Creek

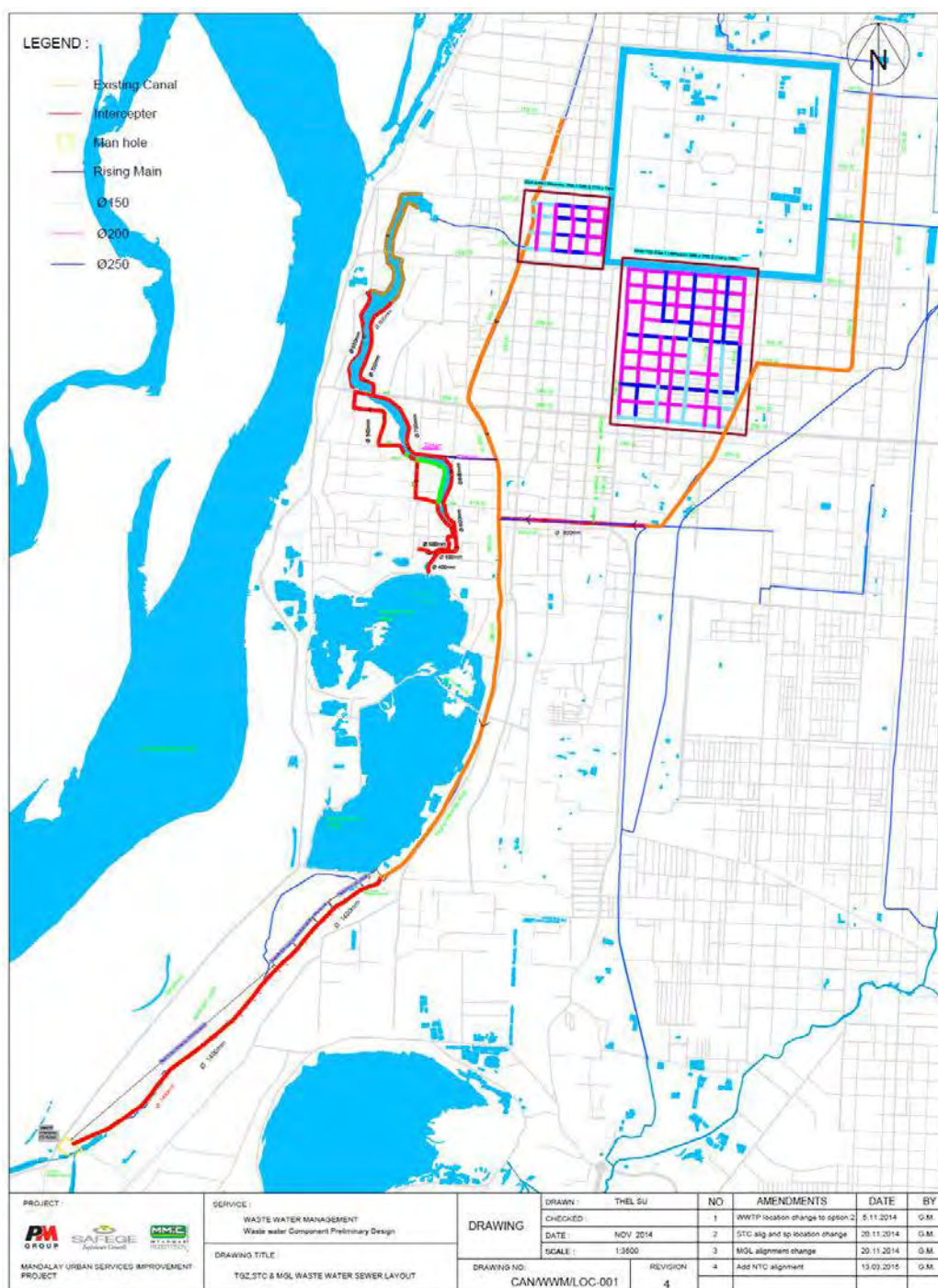
II) Existing Studies/Plan/Projects

(i) Mandalay Urban Services Improvement Project (ADB Loan Project)

The Mandalay Urban Services Improvement Project will substantially improve the environment and public health conditions toward the vision of creating a clean and prosperous green city by 2040. ADB and AFD will provide financing for the project. The scope of the study has been proposed as follows:

- The sewerage project of interceptor system for Shwe Ta Chaung, Ngwe Ta Chaung, Tingazar Creek, WWTP (75,000m³/day first phase) on Nankad Lake as enhanced primary treatment;
- Improvement of septic tank sludge management method;
- Pilot project of sewer pipes;
- Drainage maintenance of open channel dredging;
- Soft measures of waste water management and rubbish removal; and
- Improvement of pump station capacity and management of lake.

The layout of sewerage project of interceptor in Mandalay City is shown in Figure 1.5.86.



Source: MCDC provided

Figure 1.5.86: Sewerage Project of Interceptor System in Mandalay

(ii) Mandalay Industrial Zone Wastewater Treatment Project (BOT Project)

MCDC had invited interested firms to participate in the wastewater treatment project in Mandalay Industrial Zone (No.1, No.2), and a company in Thailand got the negotiation rights. The project will be done this year. The capacity of WWTP is 2,000 m³/day (planned inflow BOD 6,500 mg/L). The WWTP will be built near the southern pond. The site for the wastewater treatment plant in the industrial zone is shown in Figure 1.5.87.



Source: JICA Study Team

Figure 1.5.87: Site of Industrial Zone Wastewater Treatment Plant

(iii) Feasibility Studies of Wastewater Treatment Project (Korea and Thailand)

A Korean company (SUNJIN) and Thailand company (TEAM) studied the feasibility study (F/S) of each wastewater treatment project in Mandalay City based on their memorandum of understanding (MOU) with Mandalay City. Reasons such as difficulty in the acquisition of the treatment plant site and lack of funds, resulted to non-implementation of the projects.

III) Fact Findings and Issues

< Need for Sewerage System and Appropriate Treatment Process > Local residents continue dumping their trash to the existing drainage channels resulting to emission of offensive odor that causes degradation of the water environment. To decrease the risk of waterborne infectious diseases and groundwater contamination, a new WWTP with appropriate treatment process, such as conventional activated sludge process will be required urgently. Due to the reasons that there is a lack of strategy for sewerage development and the need to materialize the sewerage system in Mandalay City at present, a comprehensive master plan will be required.

(III) Drainage

I) Current Condition

There are nine main drainage channels, three drainage pumps, two retention ponds, and many sluice gates in Mandalay City. These facilities do not have enough capacity during heavy rains. So, low-lying areas located in the northwestern and southeastern areas in Mandalay City are sometimes flooded (once in a few years) as shown in Figure 1.5.88.



Source: MCDC

Figure 1.5.88: Flooding in Mandalay in September 2014

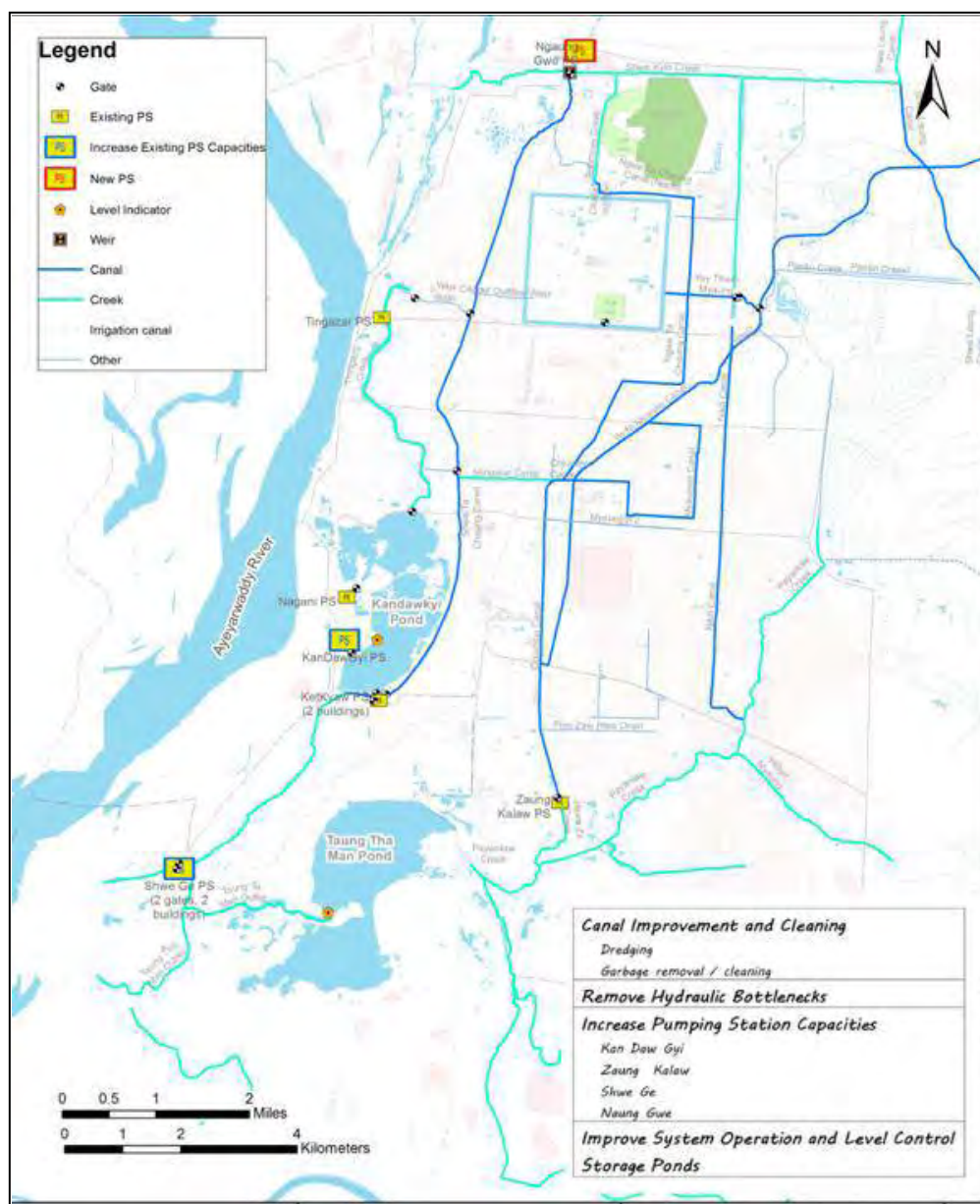
II) Existing Studies/Plan/Projects

(i) Mandalay Urban Services Improvement Project (ADB Loan Project)

The scope of the drainage project has been proposed as follows:

- Dredging and garbage removal of main canals;
- Removal of hydraulic bottlenecks (primarily in Thin Gaza);
- Increased pumping station capacities;
- Improve system operation through monitoring and level control of lakes; and
- Overflow from Shwetachaung and other parts of the wastewater system.

Location of drainage projects in Mandalay City is presented in Figure 1.5.89.



Source: MCDC provided

Figure 1.5.89: Location of the Drainage Projects in Mandalay

III) Fact Findings and Issues

Upgrading of drainage facilities based on a comprehensive drainage improvement plan will be required to improve the current situation.

- The intricate canal system serves as the drainage network for storm water during the rainy season.
- According to the existing and future modeled hydrological conditions, including the impact of climate change, different options to improve drainage will be assessed.
- The project will dredge canals and drains, remove hydraulic bottlenecks, and implement nonstructural measures to manage the drainage network.

2) Pathein

(I) Water Supply

I) Current Condition

Currently, there is no modern water supply system in Pathein City. Residents get water from the dug well and tube well. Five bottled water factories which use the RO membrane and more than 1,000 water vendors are playing important role in drinking water supply in Pathein City. The price of bottled water is MMK 300 per 20-liter bottle, which is very high. Water vendors take water from the wells (mostly shallow wells) in such places as temples which have relatively good water quality and transport it in polyethylene tanks and sell it to the households. Many households have their own wells but the water quality of most of these wells is not good and not suitable for drinking purpose. Therefore, majority of general citizens buy bottled water for drinking purpose and use the water from the wells for domestic use other than for drinking. Since the bottled water is very expensive, some of them use the water from the water vendors as the drinking water. If they do not have their own wells, they need to rely on the water from water vendors for non-drinking domestic use.

Low income population who cannot afford to buy the bottled water or water from water vendors take water from rainwater storage ponds by bucket that is free of charge and use it. Sometimes they drink the water without boiling it.

The water quality of shallow wells in temples and rainwater storage pond, which low income citizens and the poor in Pathein City use as the source of their drinking water is tested. In all water sources tested, *Escherichia coli* bacteria are found. In some wells and rain water storage pond, high intensity of *Escherichia coli* are found. The current condition of drinking water safety in Pathein City is very bad and the development of a water supply system is highly needed. The details are shown in Table 1.5.77.

Table 1.5.77: Summary of Water Supply Service in Pathein

| Items | | Contents | Remarks |
|-------------------------|-----------------------------|-----------------------|------------------------|
| Township area | | 159.4 km ² | |
| Covered population rate | | 0 % | no water supply system |
| Other water | Public tube well, dug well | 40 to 50 spots | |
| | Private tube well, dug well | No count | |
| | Drinking pure bottled water | 5 companies | |

Source: PCDC

Existing water supply situation used in Pathein City is as follows:

(i) Personal Tube Well

Images of a typical personal tube well are shown in Figure 1.5.90.



Source: JICA Study Team

Figure 1.5.90: Personal Tube Well

(ii) Public Well and Public Tap Water

Images of a typical public well and public tap water are shown in Figure 1.5.91



Source: JICA Study Team

Figure 1.5.91: Public Well and Public Tap Water

(iii) Drink Water Production

Images of a typical production of drinking water in 20 L containers are shown in Figure 1.5.92 and in PET-bottle in Figure 1.5.93.



Source: JICA Study Team

Figure 1.5.92: Drinking Water Production (20L)



Source: JICA Study Team

Figure 1.5.93: Drinking Water Production (PET-Bottle)

II) Existing Studies/Plan/Projects

Water supply improvement plan for Patheingyi City is as follows:

- Myanmar Three Cities Water Supply Management Improvement Project (March 2013, Ministry of Health, Labor and Welfare (MHLW) of Japan)

The MHLW Project Team collected information and data and conducted discussions with the State (Regional) Cabinets and CDC in Patheingyi City. Based on the results of these survey and discussion, the MHLW Project Team made up proposals for the improvement of water supply management in the city.

III) Fact Findings and Issues

- <Drinking Water Supply to the Poor in Patheingyi City> Bottled water or water sold by vendors are priced beyond the means of the poor. Therefore, the poor in Patheingyi City rely on rainwater storage ponds as the source of drinking water, the water quality of which is absolutely not appropriate for drinking and poses danger on human life. As a countermeasure for poverty alleviation, the development of water supply system in the city is urgently needed.
- <Master Plan for Effective Water Supply System in Patheingyi City> Since the water supply development needs to fulfill the future water demand, it is necessary to establish the planning framework based on the population growth forecast and to decide the target year for facility development.

Since the terrain of Patheingyi and the nearby area is characterized with flat land, the location of the facilities should be decided taking into consideration the possibility of minimizing the energy cost.

Selection of water source is the most important factor in the planning of the water supply system. Water quality analysis in both the dry season and rainy season should be conducted for all possible water sources (both surface water sources and groundwater sources). Since the water supply facilities would be used for long term, the selection of water source should also take into account the possible residential, commercial, and industrial development based on the city development plan.

- <Other Issues> In Patheingyi, they have a plan to do water supply system through a joint venture with a Thai company. The plan is called built-own-operate (BOO) system with contract of 30 years. As a private project, this is for profit-service only. That is why MTDC also wants to do it with JICA loan with government arrangement.

(II) Sewerage

I) Current Condition

There is no public WWTP to treat domestic wastewater in Pathein City. Wastewater from households, commercial, and administrative facilities in Pathein City is deposited in pit toilet or septic tank at their own place. The effluents of septic tanks are discharged to street drains and drainage channel, and finally flow into the river via ponds without appropriate treatment. These are the causes of water pollution on rivers and ponds.

Local residents continue dumping their trash to the existing drainage channels resulting to offensive odor causing degradation of the water environment. The situation of the dirty drainage and river is shown in Figure 1.5.94.



Source: JICA Study Team

Figure 1.5.94: Dirty Drainage Canal in Pathein City

II) Existing Studies/Plan/Projects

There are no studies and plans for the sewage system in Pathein City.

III) Fact Findings and Issues

< Improper On-site Treatment Facilities > Although the water injection type toilet without a septic tank has become extensively popular, toilets of this type should be changed with the septic tank. Furthermore, there are no disposal facilities but only for sludge in Pathein City, and the sludge removed from the septic tank is thrown into the existing final dumping site.

< Need for Sewage System Project > The effective development of sewerage system is strongly required in Pathein City. However, the sewerage system project requires long time and large funds.

(III) Drainage

I) Current Condition

There are a total of nine creeks in the town that are used for drainage. The wastewater from collection drain goes to the creek from there it goes to the Nga Wun River. The capacity of the existing drainage and channel in Pathein City is not enough for heavy rains. So, low-lying areas in the city are sometimes flooded (once in a few years) as shown in Figure 1.5.95.



Source: JICA Study Team

Source: MCDC

Figure 1.5.95: Main Drainage Channel and Flooding in Patheingyi in August 2012

II) Existing Studies/Plan/Projects

There are no studies and master plans for the drainage system in Patheingyi City. PCDC will do dredging and removal of garbage on the main drainage and canals regularly.

III) Fact Findings and Issues

< Insufficient drainage canal > The issue points of the existing drainage canal are shown below.

- Flooding does happen regularly in some specific low areas.
- In most drainage canals which are dug manually, there is no hardness of the drainage canal lining.
- There are few gates, banks, and pumps which prevent flooding in the low-lying areas.
- Some drainage canals have accumulated soil sediments.
- Drainage canal is a dumping place for residents.

PCDC proposed to include the following contents in the study of drainage system project:

- Setting of the target year and design conditions of drainage systems;
- Reconstruction plan for the existing lines; and
- Organization and management plan.

3) Mawlamyine

(I) Water Supply

I) Current Condition

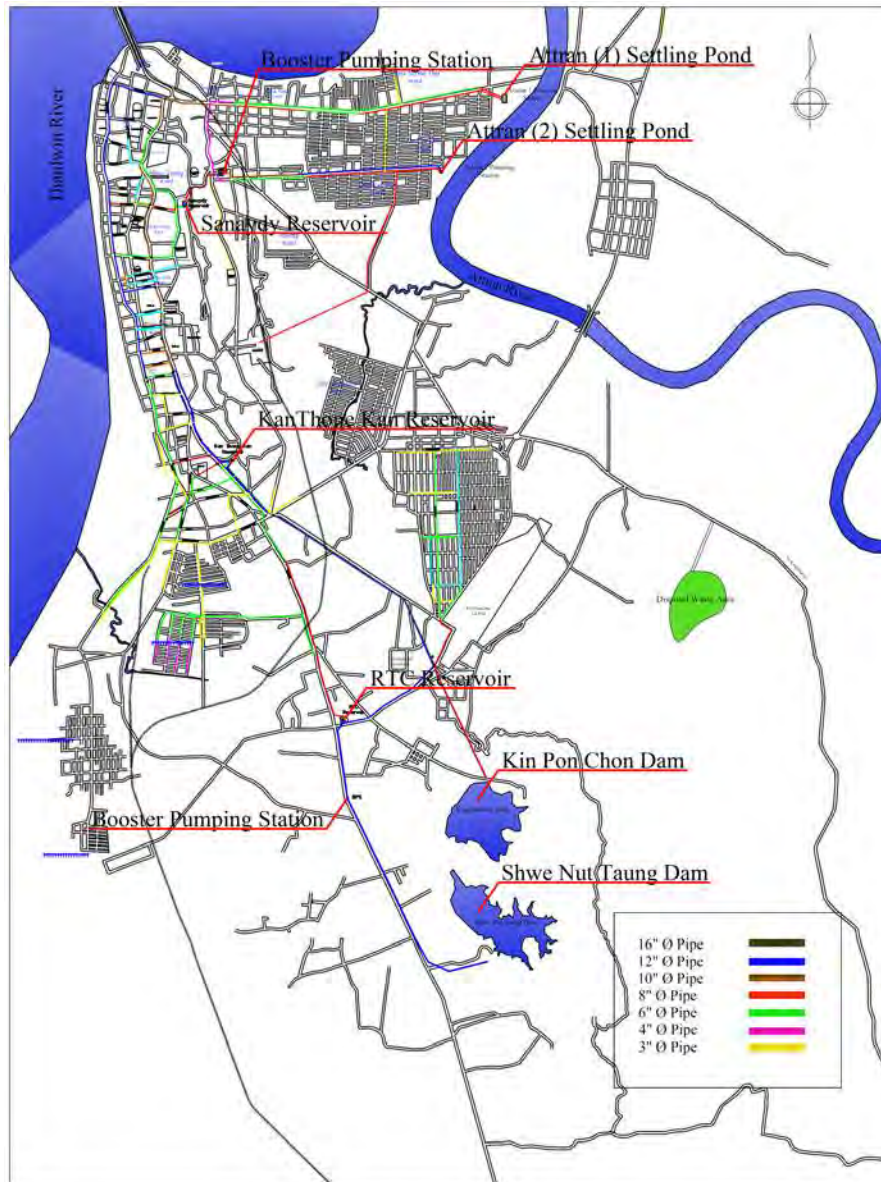
Mawlamyine Township area (about 53 km²) supplies water up to 22 quarters out of 40 quarters. Currently, the city has its capability to supply water of 16,400 m³/day while water demand is nearly twice compared with the water supply. Total quantity of water intake is 3.6 million gallons/day by four water intakes. Also, the water tariff is charged at MMK 150 (as 225 gallons) and the quality of existing tap water in Mawlamyine does not meet WHO treated water standard. Some people need to rely on other water sources such as tube well, dug well, hand pump, earth reservoir, and brick reservoir. The details are shown in Table 1.5.78.

Table 1.5.78: Summary of Water Supply Service in Mawlamyine

| Items | | Contents | Remarks |
|-----------------------------|-----------------------------|----------------------------------|-------------------------|
| Township area | | 218.9 km ² | |
| Quarter of all | | 40 quarters | |
| Quarter of supplying water | | 22 quarters | |
| Current water demand | | About 30,000 m ³ /day | |
| Current water supply | | About 16,400 m ³ /day | |
| Covered population rate | | 55% | |
| Non-covered population rate | | 45% | |
| Water intake | Kin Pon Chone Dam | 1.2 million gallons | Water source: Dam water |
| | Shwe Nut Taung Dam | 0.9 million gallons | Water source: Dam water |
| | Ataran-1 (Settling pond) | 0.7 million gallons | Water source: River |
| | Ataran-2 (Settling pond) | 0.8 million gallons | Water source: River |
| Other water | Public tube well | 3 spots | |
| | Public earth reservoir | 26 tanks | |
| | Public brick reservoir | 23 tanks | |
| | Private tube well, dug well | more than 4,100 spots | |
| | Drinking pure bottled water | 5 companies | |

Source: MTDC

Currently, there is no treatment process (chemical utilization) in water supply process in Mawlamyine. Raw water is pumped from raw water sources to reservoir tanks and distributed to households. Raw water has many types of *Escherichia coli*, and most of them are harmless. But some of *Escherichia coli* bacteria can cause diarrhea. Some of them may also cause severe anemia or kidney failure, which can lead to death. Figure 1.5.96 shows the location of existing water supply facility in Mawlamyine City.



Source: MTDC (modified by the JICA Study Team)

Figure 1.5.96: Location of Existing Water Supply Facility in Mawlamyine

Existing water supply facilities are operated in Mawlamyine City as follows:

(i) Kin Pon Chone Dam

The water supply system as water source of Kin Pon Chone Dam has started for the first time in Mawlamyine in 1920. The water supply from the dam is a gravity flow system. The water level of the dam is lowered in the dry season. Most of the facilities were constructed during the 1920s and had become too old. These facilities need repairing. Figure 1.5.97 shows the images of the Kin Pon Chone Dam.



Source: JICA Study Team

Figure 1.5.97: Kin Pon Chone Dam

(ii) Shwe Nut Taung Dam

The water supply in Mawlamyine comes from Shwe Nut Taung Dam. The dam is the main system for daily water intake of 1.2 million gallons. However, the water level of the dam tends to be lower in the dry season because the upstream components are holding pond of rainfall. Water from the Shwe Nut Taung Dam is transmitted to the booster pumping station, and then, is pumped up to RTC and to the Kan Thone Kan Reservoir. Figure 1.5.98 shows images of the Shwe Nut Taung Dam.



Source: JICA Study Team

Figure 1.5.98: Shwe Nut Taung Dam

(iii) Ataran-1 Settling Pond and Pump Station

Ataran-1 system transmits and distributes water to residents directly through main and sub-main pipelines. Although sufficient quantity of water flows in the river, water quality of the river is not good. The supernatant water of natural lagoon-type pond is not clear water because it has poor treatment system. The capacity is too small and the water supply time is limited to 4 to 8 hours per day. Figure 1.5.99 shows images of Ataran-1 settling pond and pump station.



Source: JICA Study Team

Figure 1.5.99: Ataran-1 Settling Pond and Pump Station

(iv) Ataran-2 Settling Pond and Pump Station

Ataran-2 system transmits water to the pumping station, and then, the water is pumped up to the Sanaydy Reservoir, and is distributed to residents by gravity flow. Also Ataran-2 system has the same water quality condition of Ataran-1. Figure 1.5.100 and Figure 1.5.101 show images of Ataran-2 River Intake and Ataran-1 settling pond and pump station, respectively.



Source: JICA Study Team

Figure 1.5.100: Ataran-2 River Intake



Source: JICA Study Team

Figure 1.5.101: Ataran-2 Settling Pond and Pump Station

(v) Water Reservoir Pond and Booster Pump Station

The water is pumped up from the booster pumping station to the Sanaydy Reservoir. Currently, the elevated tank is not used. The ponds do not have roofs. Hence, cloudy water, trash, vermin, and bug might accumulate there. Figure 1.5.102 shows images of the water reservoir pond and booster pump station.



Source: JICA Study Team

Figure 1.5.102: Water Reservoir Pond and Booster Pump Station

(vi) Sanaydy Reservoir

The two tanks of Sanaydy Reservoir have roofs, and the water in the tanks is distributed to residents by gravity flow. Figure 1.5.103 shows images of Sanaydy Reservoir.



Source: JICA Study Team

Figure 1.5.103: Sanaydy Reservoir

(vii) Public Brick Reservoir and Earth Reservoir

Brick reservoir and earth reservoir are provided in the town by Mawlamyine CDC. In the low income settlement in the north eastern area, residents draw water from the public reservoirs called brick reservoirs and earth reservoirs and use it for domestic use including drinking after boiling. The water supplied from the river has high turbidity and high color, affecting the drinking water safety. Figure 1.5.104 shows images of public brick reservoir and earth reservoir.



Source: JICA Study Team

Figure 1.5.104: Public Brick Reservoir and Earth Reservoir

(viii) Private Tube Well

Some residents have private tube well or dug well. The underground water level also tends to be low during the dry season, and it depletes in some cases. Figure 1.5.105 shows images of a private tube well.



Source: JICA Study Team

Figure 1.5.105: Private Tube Well

II) Existing Studies/Plan/Projects

Water supply improvement plan for Mawlamyine City is as follows:

- New investment on tap water treatment system project (submitted to Mon State, July 2014, Mawlamyine CDC);
- Enhancement of Shwe Nut Taung System (installation of $\phi 12$ inch PVC pipe and construction of 0.1 million gallons distribution reservoir, JICA);
- Enhancement of Ataran-2 System (installations of $\phi 10$ inch PVC pipe and 60 HP pump, JICA); and
- Myanmar Three Cities Water Supply Management Improvement Project (March 2013, Ministry of Health, Labor and Welfare of Japan).

Since the amount of water supply in Mawlamyine is insufficient, Mawlamyine CDC plans to increase the amount of water by these projects. Mawlamyine CDC can duplicate the pipeline by these projects. So these projects are effective from the viewpoint of not only securing the amount of

water but also maintenance, because these pipes can be used as backup pipes during emergency or renewal.

III) Fact Findings and Issues

The issues of water supply works in Mawlamyine City are as follows:

- <Piped Water Supply Coverage Ratio> The total number of taps is only 8,500. The population connected to the Mawlamyine CDC water supply system remains as low as 18% of the total population. The promotion of tap water connected to the house is urgently needed.
- <Quality of Supplied Water and Safety of Drinking Water> Regarding the current situation on quality of raw water from the river system (Ataran-1 and Ataran-2) in Mawlamyine City, appropriate purification process is not applied throughout the system, and chlorination is not applied as disinfection.

This indicates a risk to health as drinking water contains coliform, it is necessary to establish an appropriate water supply system with appropriate purification process.

- <Drinking Water Supply for the Poor> According to MCDC, 75% of the citizens in Mawlamyine City purchased bottled water for drinking purpose but the remaining 25% are the poor citizens who cannot purchase bottled water and they are drinking untreated water after boiling.

The areas where many poor population reside are the low income settlement in the north eastern part of the city and village in the south western part of the city. The poor has the strong desire for the development of the water supply system. It is highly desirable to install sub-main pipes and secondary and tertiary pipes in the area in order to promote house connections.

- < Need for O&M Capacity Development and Human Resource Development of Water Supply> In the future, in the construction, operation and maintenance of purification plant and rebuilding, maintenance of piping network, necessary technical skills, and work volumes may increase remarkably. It is necessary to continuously provide experts and technical guidance to Mawlamyine CDC, and it is necessary for Mawlamyine CDC to plan the personnel training of engineers and secure enough number of the most suitable engineers.

(II) Sewerage

I) Current Condition

There is no public WWTP to treat domestic wastewater in Mawlamyine City. Wastewater from households, commercial, and administrative facilities in Mawlamyine City is deposited to pit toilet or septic tank at their own place. The effluents of septic tanks are discharged to street drain and drainage channel, and finally flow into the river via ponds without appropriate treatment. They are the causes of water pollution on rivers and ponds.

Local residents continue dumping their trash to the existing drainage channels resulting to offensive odor causing degradation of the water environment. The situation of the dirty drainage and river is shown in Figure 1.5.106.



Source: JICA Study Team

Figure 1.5.106: Dirty Drainage Canal in Mawlamyine City

II) Existing Studies/Plan/Projects

There are no studies and plans for the sewage system in Mawlamyine City.

III) Fact Findings and Issues

< Improper On-site Treatment Facilities > Although water injection type toilet without a septic tank has become extensively popular, the toilets of this type should be changed with septic tank. Furthermore, there are no disposal facilities but only for sludge in Mawlamyine City, and the sludge removed from the septic tank is thrown into the existing final dumping site.

< Need for Sewage System Project > In order to effectively develop a sewerage system in Mawlamyine City, formulation of a master plan is strongly required in Mawlamyine City. However, the development of the sewerage system project requires a long period of time and enough funds.

(III) Drainage

I) Current Condition

The capacity of existing drainage and channel in Mawlamyine City is not enough for heavy rains. So, low-lying areas in Mawlamyine City are sometimes flooded (once in a few years) as shown in Figure 1.5.107.



Source: JICA Study Team

Figure 1.5.107: Main Drainage Channel and Traces of Flooding

II) Existing Studies/Plan/Projects

There are no studies and master plans for the drainage system in Mawlamyine City. Mawlamyine CDC will do dredging and removal of garbage on main drainage and channel regularly.

III) Fact Findings and Issues

< Insufficient Drainage Canal > Mawlamyine CDC does not have any conditions of hydrological and existing data of drainage systems in the city. Some surveys on the existing drainage will be required and some meteorological observation will be collected for improvement of the drainage system.

The issue points of the existing drainage canal are shown below.

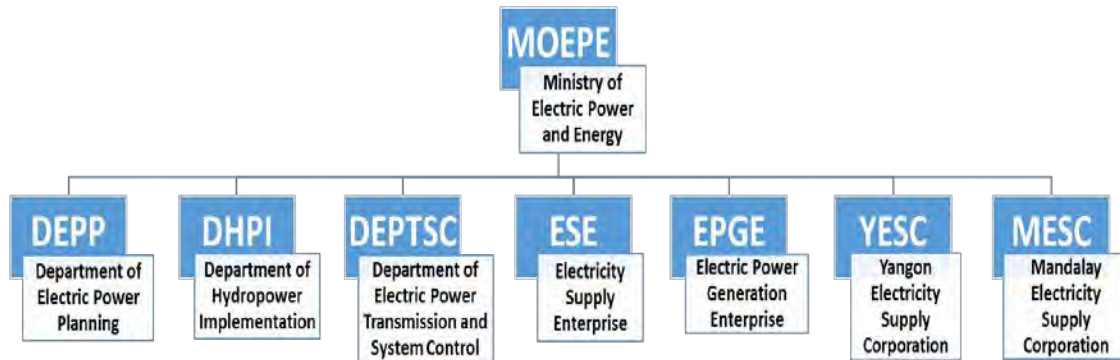
- Some drainage canals have many accumulated soil sediments.
- Some illegal buildings are on a drainage canal.
- Some water pipes and electric cables are in the drainage and are blockage to the flow.
- Drainage canal is a dumping place for residents.
- A small cross drain at a road crossing is a bottleneck.

(3) Electricity

1) Myanmar

(I) Management System

I) Present Organization of Power Sector



Source: JICA Study Team based on MOEPE data

Figure 1.5.108: Organization Diagram of Power Sector Administration

Figure 1.5.108 shows the organizational chart of the power sector administration. The responsibilities of the organizations are stated as follows:

- Department of Electric Power Planning (DEPP): Planning of hydropower, coal-fired power, gas turbine, wind, solar, and other projects.
- Electric Power Generation Enterprise (EPGE): Implementation of electric power generation projects except hydropower generation.
- Department of Hydropower Implementation (DHPI): Implementation of hydropower projects.
- Department of Electric Power Transmission & Control and System Control (DEPTSC): Transmission and control of electric power generated by all existing power station.
- Electricity Supply Enterprise (ESE): Electricity distribution of Myanmar except Yangon and Mandalay City.
- Yangon Electricity Supply Corporation (YESC): Electricity distribution in Yangon City.
- Mandalay Electricity Supply Corporation (MESC): Electricity distribution in Mandalay City.

At the electricity distribution level (ESE, MESC, and YESC), the organizations are hierarchized by division or state offices, district offices, and township offices from the highest to the lowest. Retail electricity sales and operation-maintenance of 11 kV or less of distribution lines are done by township offices.

II) Electric Power System Control Organization

At present, electric power system control is performed by the National Control Center (NCC- Nay Pyi Taw) and Load Dispatch Center (LDC-Yangon). The basic tasks of these organizations are to provide electricity for consumers' benefit and safe usage and to maintain the supply and demand balance. In order to control electricity generation and distribution tasks at various conditions, only telephone network systems (CDMA, GSM, Auto telephone, etc.) and Power Line Carrier (PLC) network are being used generally at present.

In order to advance the system control, supervisory control and data acquisition/energy management system (SCADA-EMS) is now being established at a small scale by the Myanmar engineers for test purpose at the National Control Center (NCC- Nay Pyi Taw). In the future, load dispatch is planned to be performed by the Regional Control Center in Yangon (RCC-Yangon) and the Regional Control Center in Mandalay (RCC-Mandalay). And so, SCADA-EMS system will be placed in NCC-Nay Pyi Taw, RCC-Yangon, and RCC-Mandalay. The Power Line Carrier (PLC) system will be replaced by optical fibre ground wire (OPGW) network.

III) Electricity Tariff

After being confirmed from the Union Parliament, the following electricity rate shown in Table 1.5.79 has been executed from April 1, 2014.

Table 1.5.79: Electricity Tariff in Myanmar

| Consumer Type | Unit (kWh) | Fixed Rate (MMK) |
|-----------------------|--------------------|------------------|
| Domestic/Residential | 1 to 100 | 35 |
| | 101 to 200 | 40 |
| | 201 and above | 50 |
| Industrial/Commercial | 1 to 500 | 75 |
| | 501 to 10,000 | 100 |
| | 10,001 to 50,000 | 125 |
| | 50,001 to 200,000 | 150 |
| | 200,001 to 300,000 | 125 |
| | >300,001 | 100 |

Source: MOEPE

(II) Myanmar's Power Generation

I) Current Condition

Currently, Myanmar generates 5,235 MW, an increase from 3,413 MW in 2015 according to president's office website. The government developed its IPP system in 2011 to encourage private investment in electricity production, hoping to produce more power and ease shortages. The first projects were in the Yangon area – privately run gas-fired power plants in Hlawga, Ywama, Ahlone, and Thaketa started electricity generation in 2013. According to the demand forecast (high case) stated in the National Electricity Master Plan, the country will need 4,531 MW in 2020-21, 8,121MW in 2025-26, and 14,542MW in 2030-31. With existing 26 hydroelectric power plants (3,271 MW), 18 gas-fueled (1,548 MW), 1 coal-fired (120 MW) power plant, 647 diesel generators (84 MW), and 32 small hydro power plants (34 MW). Myanmar's total installed capacity is approximately 5,057 MW. Table 1.5.80, Table 1.5.81, Table 1.5.82, and Table 1.5.83 show the lists of available installed power generation capacity till date.

Table 1.5.80: Existing Hydroelectric Power Plant

| No. | Plant | Number of Generators | Total Output Capacity (MW) | Remark |
|-----|---------------|----------------------|----------------------------|----------------|
| 1 | BaLuuChaung-2 | 6 | 168 | Government Own |
| 2 | KingDa | 2 | 56 | |
| 3 | SelDawGyi | 2 | 25 | |
| 4 | BaLuuChaung-1 | 2 | 28 | |
| 5 | ZawGyi-1 | 3 | 18 | |
| 6 | ZawGyi-2 | 2 | 12 | |
| 7 | ZaungTu | 2 | 20 | |
| 8 | ThaPhannSeik | 3 | 30 | |
| 9 | MoneChaung | 3 | 75 | |
| 10 | PaungLaung | 4 | 280 | |
| 11 | TiiKyit | 2 | 120 | |
| 12 | YeNwe | 2 | 25 | |
| 13 | KhaPaung | 2 | 30 | |

| No. | Plant | Number of Generators | Total Output Capacity (MW) | Remark |
|----------|------------------|----------------------|----------------------------|---|
| 14 | KyaingTaung | 3 | 54 | |
| 15 | YeYwa | 4 | 790 | |
| 16 | ShweKyiin | 4 | 75 | |
| 17 | KyiOwnKyiWa | 2 | 74 | |
| 18 | KongChaung | 3 | 60 | |
| 19 | NanCho | 2 | 40 | |
| 20 | PhyuuChaung | 2 | 40 | |
| 21 | Upper PaungLaung | 2 | 140 | |
| Subtotal | | 57 | 2160 | |
| 22 | ThauntYayKhat-2 | 3 | 120 | BOT/Private |
| 23 | BaLuuChaung-3 | 2 | 52 | |
| Subtotal | | 5 | 172 | |
| 24 | ShweLi-1 | 6 | 600 (300) | JV Notes: Figures in () exports to China by JV Project. |
| 25 | TarPein-1 | 4 | 240 (221) | |
| 26 | ChiPhawNge | 3 | 99 (Unknown) | |
| Subtotal | | 13 | 939 (521) | |
| Total | | 75 | 3,271 (521) | |

Source: JICA Study Team based on MOEPE data

Table 1.5.81: Existing Gas-Fueled and Coal Power Plants

| No. | Plant | Output (MW) | Commissioning |
|--------------------|--------------------------------|-------------------------|---------------|
| 1 | Kyunchaung | 54 | 1974 |
| 2 | Shwedaung | 55 | 1975 |
| 3 | Ywama | 70 | 1980 |
| 4 | Mann | 37 | 1980 |
| 5 | Myanaung | 35 | 1984 |
| 6 | Thatone | 51 | 1985 |
| 7 | Thaketa | 92 | 1990 |
| 8 | Ahlone | 154 | 1995 |
| 9 | Hlawga | 154 | 1996 |
| 10 | Kyauk Phyu | 184 | 2013 |
| 11 | Myingyan | (Kyauk Phyu + Myingyan) | 2016 |
| 12 | Ahlone (Toyo Thai) | 121 | 2013 |
| 13 | Ywama (MSP) | 52 | 2013 |
| 14 | Hlawga (MCP) | 54 | 2013 |
| 15 | Thaketa (Max) | 53 | 2013 |
| 16 | Ywama (EGAT) | 52 | 2014 |
| 17 | Kyaukse (APR) | 100 | 2014 |
| 18 | Mawlamyine Combined Cycle (ML) | 230 | 2016 |
| Total (Gas-fired) | | 1548 | |
| 19 | Tigyit (Coal-fired) | 120 | 2004 |
| Total (Coal-fired) | | 120 | |

Source: JICA Study Team based on MOEPE data

Table 1.5.82: Overview List of Diesel Power Generator Currently Distributing Electricity within State / Region (Data Updated: December 2015)

| No. | State / Region | Town / Village Total | Number of generators | | | Power Output (KW) | | | I.P.P for electricity | State gov. owned | Total generator | Total power output KW |
|-----|----------------|-------------------------|-------------------------|------|-------------------|-------------------|------|-------------------|-----------------------|------------------|-----------------|--------------------------|
| | | | Dep. Owned | JICA | Dep. + JICA | Dep. Owned | JICA | Dep. + JICA | | | | |
| 1. | Kachin | 21 | 42 | - | 42 | 4346.2 | - | 4346.2 | 9 | 2 | 53 | 6279 |
| 2. | Kayah | 14 | 21 | 7 | 28 | 457.6 | 340 | 797.6 | | | 28 | 797.6 |
| 3. | Kayin | 25 | 41 | 4 | 45 | 6270.8 | 280 | 6550.8 | | | 45 | 6550.8 |
| 4. | Chin | 10 | 28 | - | 28 | 2575.2 | - | 2575.2 | | | 28 | 2575.2 |
| 5. | Sagaing | 36 | 75 | 5 | 80 | 12521.4 | 200 | 12721.4 | 4 | | 84 | 13681.4 |
| 6. | Tanintharyi | 19 | 8 | 10 | 18 | 676 | 600 | 1276 | | | 18 | 1276 |
| 7. | Naypyitaw | - | 17 | - | 17 | 5280 | - | 5280 | | | 17 | 5280 |
| 8. | Bago (east) | 2 | 11 | 4 | 15 | 1937.2 | 200 | 2137.2 | | | 15 | 2137.2 |
| 9. | Bago (west) | 1 | 2 | 1 | 3 | 1540 | 160 | 1700 | | | 3 | 1700 |
| 10. | Magway | 6 | 24 | - | 24 | 4516 | - | 4516 | | | 24 | 4516 |
| 11. | Mon | 7 | 14 | - | 14 | 2504 | - | 2504 | | | 14 | 2504 |
| 12. | Rakhine | 50 | 76 | 33 | 109 | 13024.8 | 3280 | 16304.8 | 2 | 2 | 113 | 17544.8 |
| 13. | Shan (south) | 32 | 62 | 18 | 80 | 2065.6 | 960 | 3025.6 | | | 80 | 3025.6 |
| 14. | Shan (east) | 28 | 52 | 10 | 62 | 5698 | 1760 | 7458 | | | 62 | 7458 |
| 15. | Shan (north) | 17 | 25 | 9 | 34 | 2901.36 | 1320 | 4221.4 | | | 34 | 4221.36 |
| 16. | Ayeyarwaddy | 8 | 29 | - | 29 | 3899.2 | - | 3899.2 | | | 29 | 3899.2 |
| | Total | 276 | 527 | 101 | 628 | 70213.4 | 9100 | 79313.4 | 15 | 4 | 647 | 83446.20 |

Source: MOEPE

Table 1.5.83: Small Hydropower Industry List (Data Updated: December 2015)

| No. of hydro industry: 32 | | | | | |
|--------------------------------------|-------------------|-----------------|---------------|---------------------|----------------------------|
| No. of generator: 73 | | | | | |
| Total output of generator: 34,174 MW | | | | | |
| No. | Name | Location | | River / Stream Name | Power of generator (kW) |
| | | State/ Division | Town | | |
| 1. | Nan Kham Kha | Kachin | Mogaung | Nan Kham Kha | 1,250 x 4=5,000 |
| 2. | Ga Lai Chaung | Kachin | Hopin | Ga Lai Chaung | 630 x 2=1,260 |
| 3. | Nam Twan | Kachin | Putao | Nam Twan | 100 x 2=200 |
| 4. | Hwae Ka Pu | Kayah | Hpasawng | Hwae Ka Pu | 64 x 54=118 |
| 5. | Hpapun | Kayah | Hpapun | Lei Ka Paw | 50 x 12=62 |
| 6. | Lai Bar | Chin | Falam | Lai Bar | 300 x 2=600 |
| 7. | Daung Bar | Chin | Hakha | Daung Bar | 200 x 3=600 |
| 8. | Nga Sit Bar | Chin | Falam | Nga Sit Bar | 500 x 3=1,500 |
| 9. | Chi Chaung | Chin | Mindat | Chi Chaung | 100 x 2=200 160 x 1=160 |
| 10. | Nam Laung | Chin | Matupi | Nam Laung | 100 x 2=200 |
| 11. | Twi Hsaung | Chin | Tonzang | Twi Hsaung | 100 x 2=200 |
| 12. | Zar Lwi | Chin | Tedim | Zar Lwi | 200 x 2=400 |
| 13. | Paletwa | Chin | Paletwa | Thin Thal | 25 x 2=50 |
| 14. | Zee Chaung | Sagaing | Kale | Zee Chaung | 630 x 2=1,260 |
| 15. | Lahe | Sagaing | Lahe | Lahe (Hwae Hun Nyu) | 50 x 1=50 |
| 16. | Kyunsu | Tanintharyi | Kyunsu | Kat Hta Lu | 75 x 2=150 100 x 1=100 |
| 17. | Ma Li | Tanintharyi | Ma Li | Yae Ta Kun | 64 x 3=192 |
| 18. | Pa Thi | Bago (east) | Taungoo | Pa Thi | 1,000 x 2=2,000 |
| 19. | Mogoke | Mandalay | Mogoke | Yae Ni | 2,000 x 2=4,000 |
| 20. | Wet Wun | Mandalay | Pyinoolwin | Ge Laung | 225 x 2=450 |
| 21. | Zin Kyaik | Mon | Paung | Zin Kyaik | 64 x 3=192 |
| 22. | Tat Kyi | Shan (south) | Lawksawk | Zaw Gyi | 600 x 2=1,200 |
| 23. | Kunhing | Shan (south) | Kunhing | Nam Shan | 100 x 2=200 |
| 24. | Nam Woke | Shan (east) | Kengtung | Nam Woke | 1,000 x 3=3,000 |
| 25. | Nam Lat | Shan (east) | Kengtung | Nam Lat | 160 x 3=480 |
| 26. | Mal Pan | Shan (east) | Mine Sat | Mal Pan | 600 x 2=1,200 |
| 27. | Nam Hmyaw | Shan (north) | Lashio | Nam Hmyaw | 2,000 x 2=4,000 |
| 28. | Nam Saung Ngaung | Shan (north) | Kyaukse | Nam Saung Ngaung | 2,000 x 2=4,000 |
| 29. | Nam Kham | Shan (north) | Nam Kham | Nam Ma Hla | 100 x 2=200 |
| 30. | Nam Huu Mon | Shan (north) | Kaung Kha | Nam Huu Mon | 75 x 2=150 |
| 31. | Nam Hsaung Chaung | Shan (north) | Ho Pan | Nam Hsaung Chaung | 250 x 2=500 |
| 32. | Par Kyat Haw | Shan (north) | Chin Shwe Haw | Nam Taung Haw | 200 x 1=200 100 x 1=100 |

Source: MOEPE

II) Existing Studies/ Plan/ Project

Some ongoing generation projects are being implemented and hence are shown in Table 1.5.84 and Table 1.5.85. Table 1.5.86 shows the projects related to Myanmar Power Sector. Table 1.5.87 shows the power generation plan (2016 to 2030) of Myanmar

Table 1.5.84: Ongoing Hydropower Projects

| No. | Name | Installed Capacity (MW) | Percentage/Stage of completion |
|---|--------------------|-------------------------|--------------------------------|
| Implemented by MoEP, DHPI | | | |
| 1 | Upper Yae Ywa | 280 | 23.822% |
| 2 | Shwe Li (3) | 1050 | 9.92% |
| 3 | Richman | 111 | 41.59% |
| 4 | Upper Kyaing Taung | 51 | 29.53% |
| 5 | Upper Nam Twan | 3.2 | 42.31% |
| | Total | 1495.2 | |
| Implemented by Local Companies with BOT system | | | |
| 1 | Upper Balu Chaung | 30.4 | Submitted EIA/SIA |
| 2 | Namatu (Thi Paw) | 100 | Implementing FSR |
| 3 | Mine Wa | 60 | Confirmed FSR |
| 4 | Nam Lin | 36 | Implementing Survey |
| | Total | 226.4 | |

Source: MOEPE

Table 1.5.85: Ongoing Generation Project

| No. | Type of generation | Number of projects | Generation Capacity (MW) |
|-----|------------------------------------|--------------------|--------------------------|
| 1 | Hydropower project | | |
| | a. MoEP, DHPI | 5 | 1495.2 |
| | b. Ethnic business companies (BOT) | 4 | 226.4 |
| | Total | 9 | 1721.6 |
| 2 | Solar Power project (JV/BOT) | 3 | 530 |
| 3 | Wind power project (JV/BOT) | 3 | 4032 |
| 4 | Geo-thermal power project (JV/BOT) | 1 | 200 |

Source: MOEPE

Table 1.5.86: Projects Related to Myanmar Power Sector

| Sector Planning | Legal and Regulatory | Financial Sustainability | Transmission & Distribution | Generation | Rural Energy |
|---|--|--|---|---|---|
| Analytical Basis for Strategic Decisions (WB) | EITI ¹⁾ Application Support (WB) | Financial Viability Action Plan (WB) | Distribution Improvement in Yangon (JICA) | New GTCC ²⁾ for MEPE & IPPs; PPP ³⁾ Transactions (WB) | Off-grid power Program (ADB) |
| Energy Master Plan for NEMC (ADB, Japan/JFPR ⁴⁾) | Electricity Law & Electricity Regulation (ADB/Norway) | Strengthening Financial Management (Multi-donor) | 4-region Distribution System Improvement (ADB) | Donated GT and Generators (GOT ⁵⁾ , Japan/JICA) | Rural Electrification Project (WB) |
| National Electricity Master Plan (JICA) | | | National Power Transmission Network (ADB-JICA-Korea) | Urgent Rehabilitation and Upgrade (Yangon, Thilawa, Baluchang, Hlaingtharyar) (JICA) | Rural Power Infrastructure (electrification in 14 regions/states) (JICA) |
| National Electrification Plan (WB) | Rural Electrification Law (AD) | Economic Valuation of Natural Gas in domestic mkt. (WB) | Advisor for Yangon Electricity Supply System (JICA) | National Electrification Plan (WB) | Rural Electrification Law (ADB) |
| Energy Efficiency Policy and Renewable Energy Development Plan (ADB) | Environmental and Social Safeguard and Conservation (ADB) | | YESB Corporatization Support through Investment and Advisory Support (WBG) | Energy Efficiency Policy and Renewable Energy Development Plan (ADB) | Environmental and Social Safeguard and Conservation (ADB) |

- 1) EITI Extractive Industries Transparency Initiative
- 2) GTCC Gas Turbine Combined Cycle
- 3) PPP Public Private Partnership
- 4) JFPR Japan Fund for Poverty Reduction Program
- 5) GOT Government of Thailand

Source: DEP

Source: Final Report, The Project for Formulation of the National Electricity Master Plan in the Republic of the Union of Myanmar

Table 1.5.87: Power Generation Plan (2016 to 2030)

| Developer | Type of power projects | | | | | Total | |
|-----------|------------------------|----------|------------|--------|---------|-------------|------|
| | Hydro | Coal | Gas | Solar | Wind | MW | Nos. |
| MOEP | 1592.2 MW | - | 256 MW | - | - | 1851.20 | 9 |
| | 6 Nos. | - | 3 Nos. | | | | |
| B.O.T | 190.4 MW | 3320 MW | 994.42 MW | - | 2930 | 7434.82 | 9 |
| | 3 Nos. | 2 Nos. | 2 Nos. | | 2 Nos. | | |
| JV/B.O.T | 6852 MW | 9560 MW | - | 530 MW | 1102 MW | 18044 | 46 |
| | 33 Nos. | 9 Nos. | - | 3 Nos. | 1 Nos. | | |
| Rental | - | - | 152.96 MW | - | - | 152.96 | 2 |
| | - | - | 2 Nos. | - | - | | |
| Total | 8637.6 MW | 12880 MW | 1403.38 MW | 530 MW | 4032 MW | 27482.98 MW | |
| | 42 Nos. | 11 Nos. | 7 Nos. | 3 Nos. | 3 Nos. | 66 Nos. | |

Source: MOEPE

III) Fact Finding

By comparing Table 1.5.84 and Table 1.5.85, it is found that all the planned solar and wind power plants are already ongoing projects. One hydro power plant planned to be developed by MOEPE is still to be implemented. Hydropower plant projects that are planned to be developed through build-operate-transfer (BOT) schemes are also ongoing.

The coal and gas fired power plants that are planned to be established by 2030 will have a total capacity of around 14,283 MW. These power plants are not in the ongoing projects lists and are yet to be built. In the case of coal fired power plants, the Myanmar government plans BOT or JV projects which encourage IPP schemes. Also a large portion of planned gas-fueled generation encourages independent power producer (IPP) schemes.

The problem with hydro-power plants in Myanmar is that these plants have as low as 30% of overall capacity factor due to the season changes.

(III) Myanmar's Power Transmission and Distribution

I) Current Condition and Plan

The electric power transmission systems in Myanmar consisting of 230 kV, 132 kV, and 66 kV systems, are under the authority of the Department of Electric Power Transmission and System Control (DEPTSC). The number of facilities and the capacities are shown in Table 1.5.88.

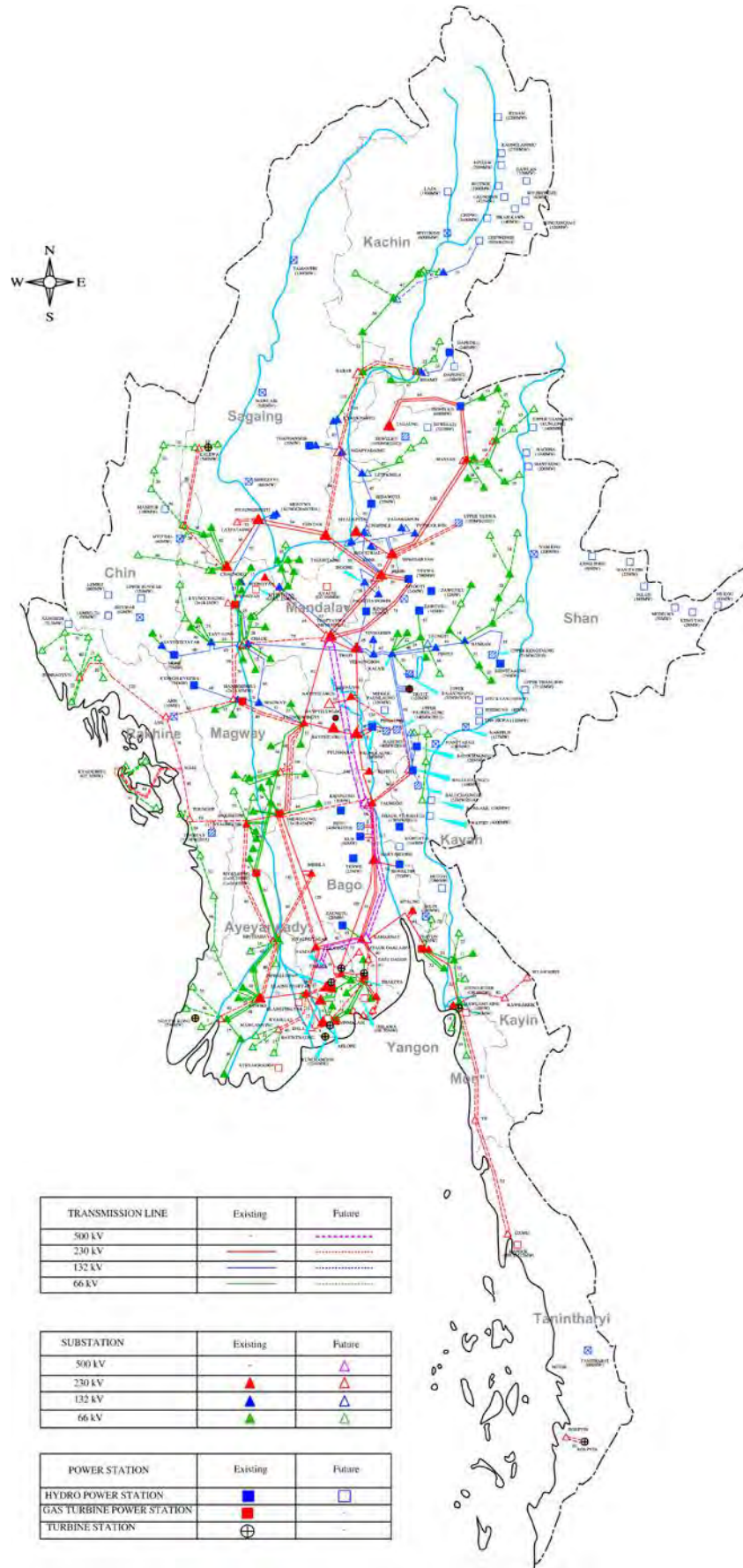
Table 1.5.88: Electric Power Transmission Facilities under DEPTSC

| Voltage (kV) | Transmission Line | | Substation | |
|--------------|-------------------|-----------------------------|-------------------|-------------------|
| | No. of Line | Line Length (km) Approx. | No. of Substation | Capacity (MVA) |
| 230 | 55 | 3,854 | 38 | 4,795 |
| 132 | 39 | 2,195 | 30 | 1,871 |
| 66 | 174 | 5,027 | 141 | 2,739 |
| Total | 268 | 11,075 | 208 | 9,405 |

Source: JICA Study Team based on data provided by DEPTSC, February 2015

Figure 1.5.109 shows the existing power system and five-year plan on transmission system by MOEPE. In order to transmit electrical power efficiently from the northern part of Myanmar to the main load center (Yangon), the construction of a part of the planned 500 kV transmission line project is ongoing.

The electric power distribution systems in Myanmar consist of 33 kV, 11 kV, 6.6 kV, and 0.4 kV systems.



Source: MOEPE, 2013

Figure 1.5.109: Existing Power System and Five-Year Plan (Source: MOEPE, 2013)

2) Mandalay

For the time being, Mandalay District consists of seven townships; Amarapura, Pyigyitagun, Chanmyathazi, Mahaaungmyay, Chanayethazan, Aungmyethazan, and Patheingyi. Mandalay District is considered to be the second largest city in Myanmar after Yangon. A well-planned infrastructure could make the city as a role model for the future Myanmar's urban development. Hence, an informative discussion on the current situation of electrical infrastructure, existing studies or projects, and fact findings remain as follows:

(I) Generation in Mandalay

I) Current Condition

At present, there are no power plants in Mandalay District. Table 1.5.89 shows the existing power stations in Mandalay Region.

Table 1.5.89: Power Plants in Mandalay Region

| Power Plant | Source | Capacity (MW) | Connected Substation |
|-------------|--------|---------------|----------------------|
| Yeywa | Hydro | 790 | Belin/Meikhtila |
| Paunglong | Hydro | 280 | Pyinmana |
| Kinda | Hydro | 56 | Thazi |
| Nancho | Hydro | 40 | Pyinmana |
| Sedawgyi | Hydro | 25 | Belin |
| Kyaukse | Gas | 100 | Belin |
| Myingyan | Gas | 95 | Myingyan |

Source: JICA Study Team based on MOEPE data

In Myanmar, as well as, in Mandalay, hydropower plants are overwhelmingly dominating the other power plants. Kyaukse (APR) is the first gas-fired power plant operating as IPP in Mandalay and was commissioned in May 2014.

II) Existing Studies/Plan/Projects

Although the JICA Study Team could not find out any existing specific study or plan on power generation sector in Mandalay District or Mandalay Region, there are several IPP projects under construction. Table 1.5.90 shows the list of ongoing IPP projects around Mandalay City and Figure 1.5.110 shows the locations of these IPP projects.

Table 1.5.90: IPP Projects under Construction around Mandalay District

| Power Plant | Developer | Source | Capacity (MW) | Project Cost (USD in millions) |
|-----------------|-------------------------|--------|---------------|--------------------------------|
| Dee Doke Hydro | Andritz Hydro (Austria) | Hydro | 66 | - |
| Nabu Aing Solar | ACO Investment (USA) | Solar | 150 | 240 |
| Tharse Solar | ACO Investment (USA) | Solar | 150 | 240 |
| Minbu Solar | Green Earth Power | Solar | 220 | 350 |

Source: JICA Study Team

disturbance at the national grid in terms of frequency regulation services. Hence, the overall reliability and power quality would be a concern considering the industrial zone, hotel zone, and the urban area (Mandalay City). Controllable bulk power plants located very close to the load centers would have the advantage to compensate the frequency regulation as well as the reliability and power quality to some extent. The Myotha Industrial Park is already going to have such plant close to it. At least one Bulk power generator very close to or inside Mandalay District shall be able to compensate the reliability and power quality to Mandalay District itself as well as the nearby hotel zone in Tada-U.

Potential of Generation Development: As per the required infrastructure support to establish a gas-fired power station around the urban area of Mandalay District (including the industrial zone inside it), the following points could be considered as shown in Figure 1.5.111.

- The Myanmar-China Natural Gas Pipeline from Shwe Gas Station which goes through Mandalay.
- Taguntaing and Shwesaryan primary substation in Mandalay District.



Source: google.com

Figure 1.5.111: Myanmar-China Oil and Gas Pipeline

(II) Transmission and Primary Substations in Mandalay

I) Current Condition

In Mandalay, at the transmission level, the voltages are 230 kV and 132 kV. All the seven townships in Mandalay District is served by five primary substations that include two 230 kV and three 132 kV substations. The existing industrial zone is served by two substations including one 132 kV primary substation, namely: Industrial Zone-2 and one 33 kV distribution substation, namely: Industrial Zone-1. Table 1.5.91 shows the list of primary substations serving Mandalay District and their transformers specifications. The transformers that do not serve the Mandalay District are not included in the table. Figure 1.5.112 and Figure 1.5.113 show the locations and distributions of the primary substations and 33 kV substations serving Mandalay District, respectively.

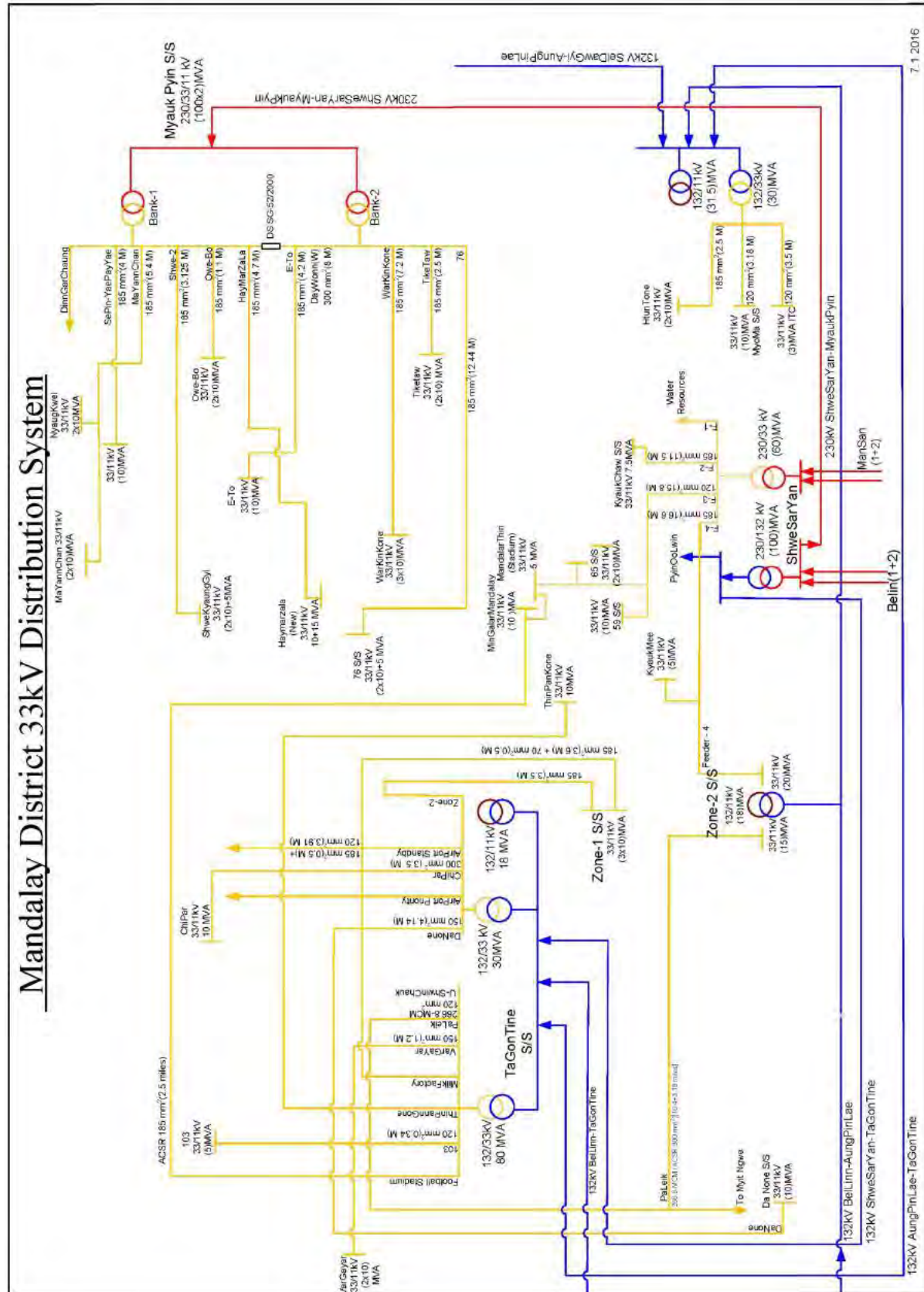
Table 1.5.91: Mandalay District Primary Substation

| No. | Substation | Voltage (kV) | Transformer (MVA) |
|-----|-------------------|--------------|-------------------|
| 1 | Shwesaryan | 230/33 | 60 |
| 2 | Myaukpyin | 230/33/11 | 100 x 2 |
| 3 | Aungpinlae | 132/11 | 31.5 |
| | | 132/33 | 30 |
| 4 | Tagundine | 132/33 | 80 |
| | | 132/33 | 30 |
| | | 132/11 | 18 |
| 5 | Industrial Zone-2 | 132/11 | 18 |

Source: JICA Study Team based on MOEPE & MESC data

II) Existing Studies/Plan/Projects

So far by now, no studies and/or projects have been conducted on transmission and primary substation sector in Mandalay District.

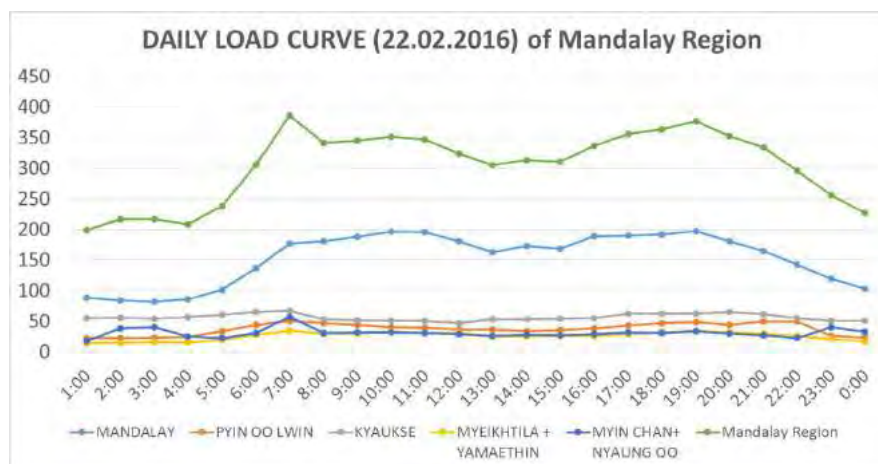


Source: MOEPE

Figure 1.5.113: Mandalay District 33 kV Distribution System

III) Fact Findings and Issues

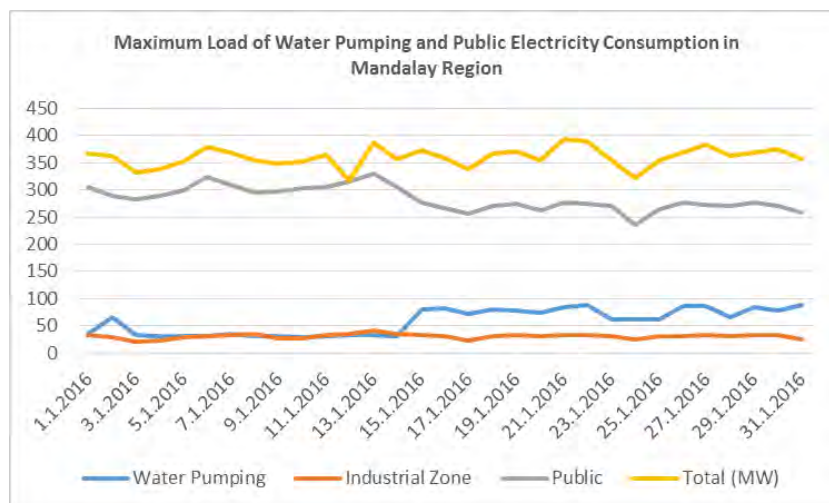
Load Curve Evaluation: Figure 1.5.114 shows the daily load curve of the Mandalay Region. The vertical axis indicates the power in MW and the horizontal axis indicates the time in 24-hour format. The electricity consumption in Mandalay District is more than half of the total in Mandalay Region, which is a common scenario all year round; and thus, the load curve in Mandalay Region follows the pattern of the load curve in Mandalay District.



Source: MESC

Figure 1.5.114: Daily Load Curve of Mandalay Region

Figure 1.5.115 shows the monthly consumption graph of Mandalay Region by major categories of load. Here, public consumers occupy most of the supply; and consumption of the industrial zones in Mandalay Region remains almost the same throughout the month.



Source: MESC

Figure 1.5.115: Monthly Load Curve of Mandalay Region

Primary Substation Capacity Assessment: By placing the transformer capacity, maximum % loading data of last year (May 2015), and demand forecast altogether, the reliability of the primary substations' capacity have been assessed and shown in Table 1.5.92. While the 2016 demand forecast has been considered as a 13% increase in load (according to MESC's demand forecast) and the next two years has been assumed as 15% increment of demand (according to Preparatory Survey on Distribution System Improvement Project in Main Cities, Final Report, JICA), the table shows that almost all the transformers in the primary substations will be overloaded by the year 2018.

More of it, the nearest substation from the planned hotel zone in Tada-U is Tagundine Primary Substation (132/33/11 kV), and the above forecast does not consider it yet.

Table 1.5.92: Capacity Assessment of Primary Transformers in Mandalay District

| NO | Substation | Primary Voltage kV | Transformer Rating MVA | Allowable Load (p.f=0.8) MW | 2015 May (maximum) | | | 2016 Demand Forecast (+13%) | | | 2017 Demand Forecast (+15%) | | | 2018 Demand Forecast (+15%) | | |
|-------|------------|--------------------|------------------------|-----------------------------|--------------------|---------------------|--|-----------------------------|---------------------|-------------------------|-----------------------------|---------------------|-------------------------|-----------------------------|---------------------|-------------------------|
| | | | | | MW | % Loading (p.f=0.8) | | MW | % Loading (p.f=0.8) | Remaining Capacity (MW) | MW | % Loading (p.f=0.8) | Remaining Capacity (MW) | MW | % Loading (p.f=0.8) | Remaining Capacity (MW) |
| 1 | Aungpinlae | 132 | 31.5 | 25.2 | 17.7 | 70 | | 20 | 79.4 | 5 | 23.0 | 91.3 | 2 | 26.5 | 105.0 | -1 |
| | | | 30 | 24 | 18.6 | 77 | | 21 | 87.5 | 3 | 24.2 | 100.7 | 0 | 27.8 | 115.8 | -4 |
| 2 | Tagundine | 132 | 18 | 14.4 | 10.6 | 73 | | 12 | 83.1 | 2 | 13.8 | 95.6 | 1 | 15.8 | 109.9 | -1 |
| | | | 30 | 24 | 15.2 | 63 | | 17.2 | 71.5 | 7 | 19.7 | 82.3 | 4 | 22.7 | 94.6 | 1 |
| | | | 80 | 64 | 59.4 | 92 | | 67.1 | 104.9 | -3 | 77.2 | 120.6 | -13 | 88.8 | 138.7 | -25 |
| 3 | Shwesayan | 230 | 60 | 48 | 30 | 62 | | 33.9 | 70.6 | 14 | 39.0 | 81.2 | 9 | 44.8 | 93.4 | 3 |
| 4 | Myaukpyin | 230 | 100 | 80 | 65.8 | 82 | | 74.4 | 92.9 | 6 | 85.5 | 106.9 | -6 | 98.3 | 122.9 | -18 |
| | | | 100 | 80 | 65.7 | 82 | | 74.2 | 92.8 | 6 | 85.4 | 106.7 | -5 | 98.2 | 122.7 | -18 |
| 5 | Zone 2 | 132 | 18 | 14.4 | 9 | 62 | | 10.2 | 70.6 | 4 | 11.7 | 81.2 | 3 | 13.4 | 93.4 | 1 |
| Total | | | | 374 | 292 | | | 329.93 | | | 379.4 | | | 436.33 | | |

Source: JICA Study Team based on the survey data

With the load sharing between transformers, some temporary solutions may be realized for the year 2016, but the capacity of primary transformers to serve/stand the peak demand of the year 2017 and so on is not enough.

(III) Distribution in Mandalay

I) Current Condition

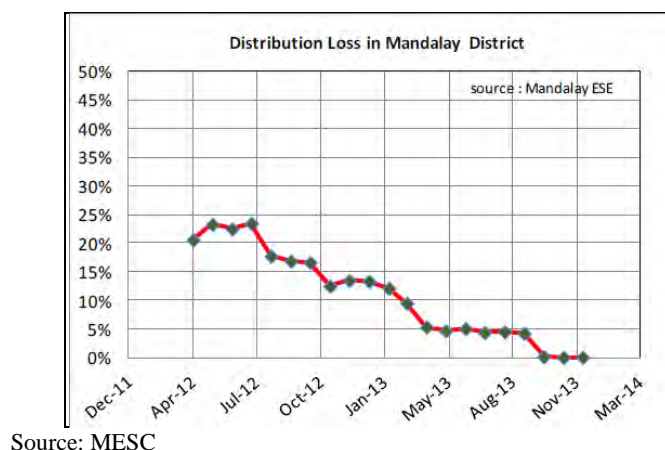
In Mandalay District, at the distribution level, the voltage is less than or equal to 33 kV. The 33 kV substations and distribution lines are under the direct authority of MESC; and 11 kV or less voltage level distribution lines and substations are handled by the three private companies, namely: Myanmar United Power, Pacific Electric, and Triple Circle. Figure 1.5.116 shows the business area of these companies in Mandalay District.



Source: JICA Study Team

Figure 1.5.116: Coverage Area of Distribution of Business by Private Companies

The distribution loss in Mandalay District is considered to be zero as shown in Figure 1.5.117.



Source: MESC

Figure 1.5.117: Mandalay District's Distribution Loss

II) Existing Studies/Plan/Projects

ADB's assistance to the Myanmar's power distribution sector includes Mandalay. The total amount of loan agreement between Myanmar and ADB is USD 60 million. The outline of the project is shown in Table 1.5.93.

Table 1.5.93: ADB Assisted Projects for Distribution System Improvement

| | |
|-----------------------|---|
| Project Name | Power Distribution Improvement Project |
| Project Period | 2014 to 2017 |
| Project Area (Region) | Mandalay, Sagain, Magway, Yangon |
| Project Scope | <ul style="list-style-type: none"> • Upgrade 33 kV and 66 kV substations, • Construct 33 kV and 11 kV distribution lines and install 11/0.4 kV transformers, • Replacement of aged poles with concrete poles, • Replacement of 400 V line, and • Replacement of analog meter with digital meter. |

Source: Final Report for TA-8251 Capacity Building Support for Project Identification (ADB, August 2013)

The JICA study project named the "Preparatory Survey on Distribution System Improvement Project in Main Cities" has been conducted and the final report has been submitted in July 2015. In this study, 11 out of the 32 cities has been selected and studied on high priority base. Mandalay is included in the study. Outline of the candidate projects proposed in this study for Mandalay City is shown in Table 1.5.94.

Table 1.5.94: Outline of Candidate Projects for Japanese ODA Loan (Five Years in Total in Mandalay City)

| Category | Outline |
|--|--|
| 33 kV substation | Construction: 7 projects Extension: 21 projects |
| 33 kV distribution line | Construction and Replacement |
| 11 kV distribution line | Nil |
| 400 V distribution line | Nil |
| Replacement with digital meters | Nil |
| 11 kV distribution line facilities to improve reliability and introduction of utility vehicles | <ul style="list-style-type: none"> • 11 kV distribution line equipment/material for improvement of reliability: 1 set • Truck mount aerial work platform: 1 • Pole erection machine: 1 • Mini excavator: 1 |

Source: Final Report, Preparatory Survey on Distribution System Improvement Project in Main Cities, JICA

III) Fact Findings and Issues

Necessity of Off-grid IPP: The private companies that maintain the distribution business of 11~0.4 kV level, purchase electricity from MESC ranging from MMK 37~83/kWh and sells electricity to the consumers at a price ranging from MMK 35~150 /kWh, with an intention to make profit on their own. There could be a scenario, where the raise in electricity tariff by MESC leads to impose an increased electricity tariff by private companies on consumers; and thus, either consumers prefer to switch to their back-up generators or private companies lose the motivation to maintain the distribution equipment as required by standard. Either of these cases inspired the introduction of off-grid IPPs. For bulk power consumers such as industrial and commercial users, the reliability and quality of electric power are important. Introduction of off-grid IPP in urban area dedicated to ensure the supply reliability and power quality to such consumers could be a key player for market competition and thus secure a consumer friendly electricity distribution market.

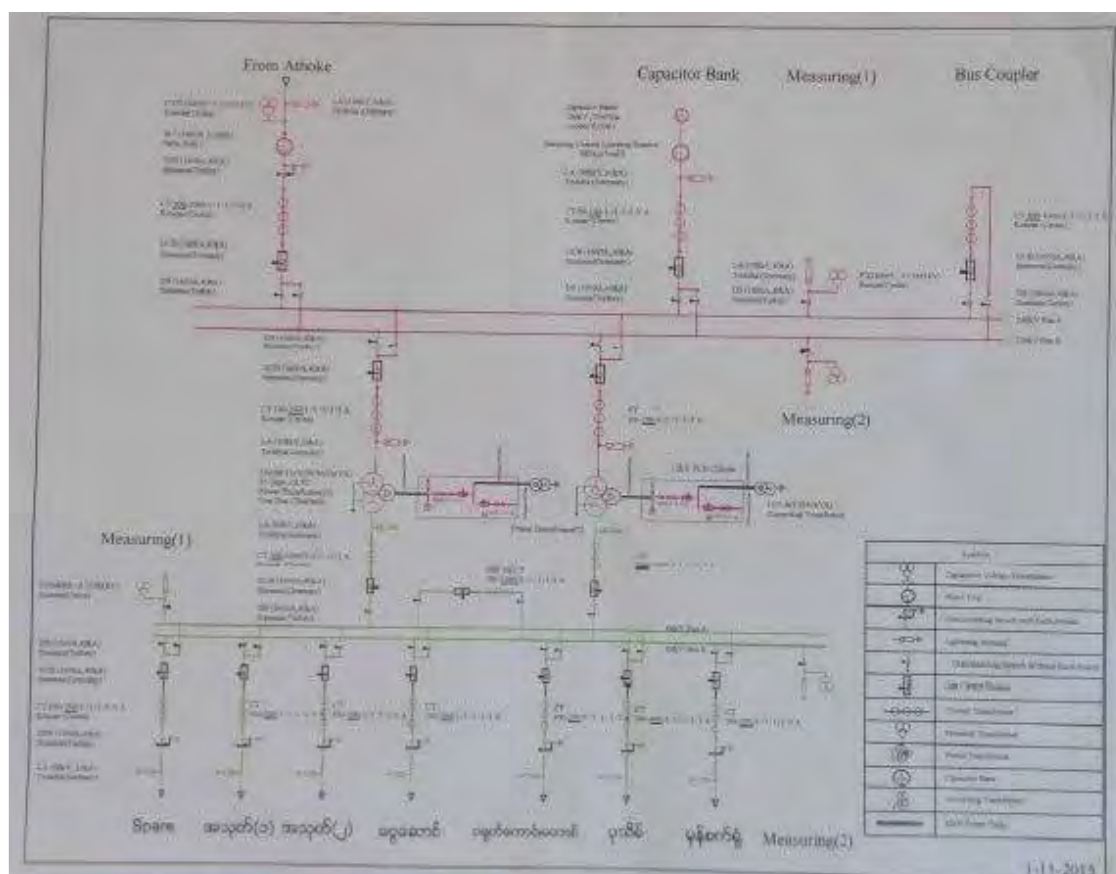
3) Pathein

(I) Generation, Transmission, Substation, and Distribution in Pathein

I) Current Condition

In Pathein, at the transmission level, the voltages are 230 kV and 66 kV. The input of the newly established and only primary substation in Pathein (230/66/11 kV, 50 MVA x 2) comes from Athoke Power Substation with a 230 kV transmission line. Figure 1.5.118 shows the single line diagram of Pathein Primary Substation. There are outgoing six active feeders and one spare feeder on the secondary (66 kV) side of the substation. The downtown of Pathein Township is served by one power transformer (66/11 kV, 20 MVA). The distribution loss rate in Pathein City was calculated at 29.5% in May 2014.

Distribution sector in Pathein is under the authority of ESE.



Source: MOEPE

Figure 1.5.118: Single Line Diagram of 230 kV Patheingyi Primary Substation

II) Existing Studies/Plan/Projects

The JICA's "Preparatory Survey on Distribution System Improvement Project in Main Cities" has covered the Patheingyi City. Outline of the candidate projects in Patheingyi is shown in Table 1.5.95.

Table 1.5.95: Outline of the Candidate Projects for Japanese ODA Loan (Five Years in Total in Patheingyi)

| Category | Outline |
|--|---|
| 66 or 33 kV substation | Nil |
| 66 or 33 kV distribution line | Nil |
| 11 kV distribution line | Construction and Replacement |
| 400 V distribution line | Construction and Replacement |
| Replacement with digital meters | Replacement |
| 11 kV distribution line facilities to improve reliability and introduction of utility vehicles | <ul style="list-style-type: none"> • 11 kV distribution line equipment/ material for improvement of reliability: 1 set • Truck mount aerial work platform: 1 • Pole erection machine: 1 • Mini excavator: 1 |

Source: Final Report, Preparatory Survey on Distribution System Improvement Project in Main Cities, JICA

III) Fact Findings and Issues

The peak load and the demand forecast of downtown transformer (66/11 kV, 20 MVA) are shown in Table 1.5.96.

Table 1.5.96: Peak Load and Demand Forecast of Downtown Transformer (66/11 kV, 20 MVA)

| Year | Peak Load and Demand Forecast (MW) |
|------|------------------------------------|
| 2015 | 11.3 |
| 2016 | 13.0 |
| 2017 | 14.9 |
| 2018 | 14.6 |
| 2019 | 16.8 |
| 2020 | 11.4 |

Source: JICA Study Team, Preparatory Survey on Distribution System Improvement Project in Main Cities

The capacity of the newly built primary substation can facilitate the existing demand. The JICA Study Team is still doing the survey, and shall provide more statistical analysis in the next report based on the additional information to be collected.

4) Mawlamyine

(I) Generation in Mawlamyine

I) Current Condition

The Mawlamyine combined-cycle power plant was developed by Myanmar Lighting under the government's independent power producer (IPP) system. The plant has a generation capacity of 230 MW from the four gas-fired turbines and two steam turbines. The output of each steam turbine is 33 MW and output of each gas turbine is 45 MW. The project was developed in three phases and began generating power in 2014, according to MOEPE. The gas supply source is the Yadana-Zawtika Natural Gas Pipeline under the authority of MOGE. Table 1.5.97 summarizes the IPP in Mawlamyine.

Table 1.5.97: IPP in Mawlamyine

| Power Plant | Source | Capacity | Connected Substation |
|--------------------------------|--------|----------|---|
| Mawlamyine Combined Cycle (ML) | Gas | 230 MW | Mawlamyine Electric Power Substation (230 kV) |

Source: JICA Study Team

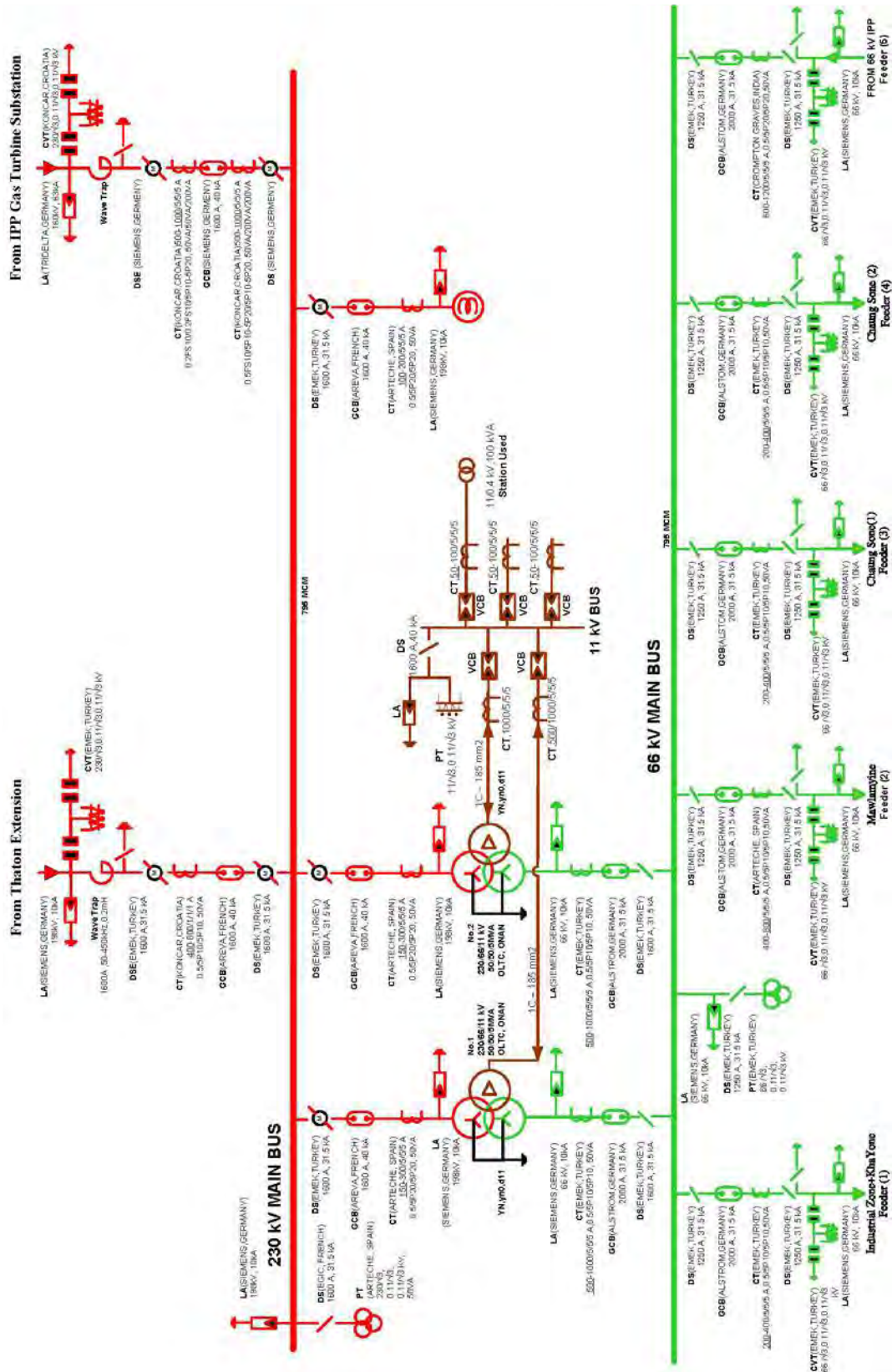
II) Existing Studies/Plan/Projects

The study entitled the "Study on the New Power Plant Project in Mawlamyine, Myanmar" proposing a coal-fired power plant near Mawlamyine has been conducted and the final report was prepared for the Ministry of Economy, Trade and Industry, Ernst & Young Shin Nihon LLC, and Japan External Trade Organization, by Mitsui & Co., Ltd. And Chubu Electric Power Co., Inc., and submitted in February 2015.

III) Fact Findings and Issues

Generation Potential: The required infrastructure support to establish a gas-fired power station in Mawlamyine District is as follows and shown in Figure 1.5.119.

- The gas pipeline under the authority of MOGE is sourcing from the Yadana-Zawtika Natural Gas Pipeline.
- 230 kV Mawlamyine Electric Power Substation along with 230 kV transmission line connecting Thaton Power Station (230 kV).



Source: MOEPE

Figure 1.5.120: Single Line Diagram of 230 kV Mawlamyine Primary Substation

II) Existing Studies/Plan/Projects

The JICA's "Preparatory Survey on Distribution System Improvement Project in Main Cities" has covered Mawlamyine City. Outline of the candidate projects in Mawlamyine is shown in Table 1.5.98.

Table 1.5.98: Outline of the Candidate Projects for Japanese ODA Loan (Five Years in Total in Mawlamyine)

| Category | Outline |
|--|---|
| 66 or 33 kV substation | Nil |
| 66 or 33 kV distribution line | Nil |
| 11 kV distribution line | Construction and Replacement |
| 400 V distribution line | Construction and Replacement |
| Replacement with digital meters | Replacement |
| 11 kV distribution line facilities to improve reliability and introduction of utility vehicles | <ul style="list-style-type: none"> • 11 kV distribution line equipment/ material for improvement of reliability: 1 set • Truck mount aerial work platform: 1 • Pole erection machine: 1 • Mini excavator: 1 |

Source: Final Report, Preparatory Survey on Distribution System Improvement Project in Main Cities, JICA

III) Fact Findings and Issues

The peak load and demand growth in Mawlamyine City is shown in Table 1.5.99.

Table 1.5.99: Demand Growth Trend in Mawlamyine

| Year | Peak Load (MW) | Demand Growth |
|------|----------------|---------------|
| 2010 | 12.88 | — |
| 2011 | 14.28 | 10.9% |
| 2012 | 17.74 | 24.2% |
| 2013 | 21.07 | 18.8 % |
| 2014 | 26.12 | 24.0 % |

Source: JICA Study Team, Preparatory Survey on Distribution System Improvement Project in Main Cities

The capacity of the newly built primary substation can facilitate the present existing demand. The JICA Study Team is still conducting the survey, and shall provide more statistical analysis in the next report based on the additional information to be collected.

(4) Solid Waste Management

1) Mandalay

(I) Current Condition

Solid waste in Mandalay City is collected by the Pollution Control and Cleansing Department (PCCD) belonging to Mawlamyine CDC. It is then transported to the final disposal site operated in an open dumping manner. There are two final disposal sites (Thaung Inn Myount Inn and Kyar Ni Kan) currently operating in Mandalay City, the contents are shown below.

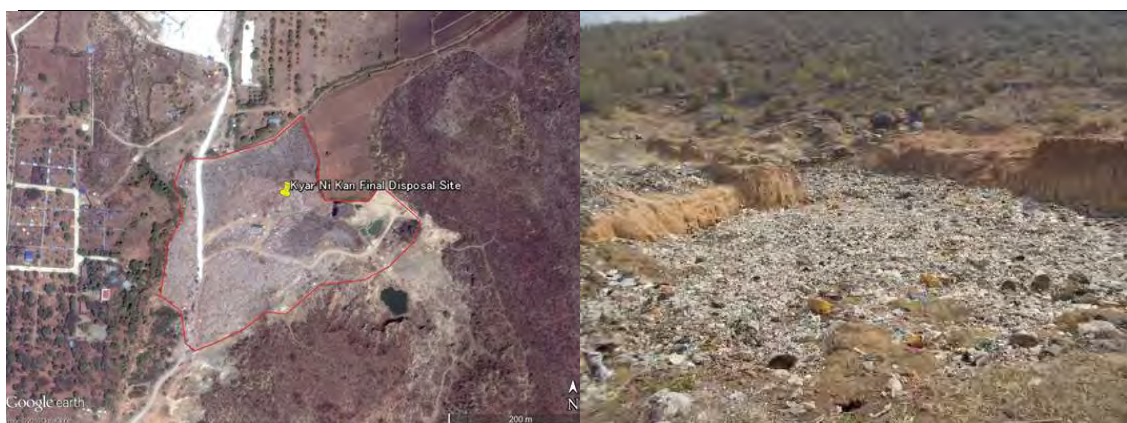
Thaung Inn Myount Inn final disposal site, shown in Figure 1.5.121, is in the south of Mandalay City with a capacity of 350 ton/day for the three southern townships. The operation of final disposal site is an open dumping manner without suitable soil covering.



Source: JICA Study Team

Figure 1.5.121: Thaung Inn Myount Inn Final Disposal Site in Mandalay

Kyar Ni Kan final disposal site, shown in Figure 1.5.122, is in the north of Mandalay City with a capacity of 450 ton/day for the three northern townships. In addition, there are five closed final disposal sites located within the urban area.



Source: JICA Study Team

Figure 1.5.122: Kyar Ni Kan Final Disposal Site in Mandalay

According to PCCD, the total waste collection per day has increased from 259 tons in 2005 to 779 tons in 2014. The waste separation and collection of recyclable materials is managed by the informal sector, and about 40 private recyclers are operating in the Aung Myae Tha San Township area to handle primary operations before exporting it overseas. However, organic waste that comprises 55% of the total waste generation still end up at the landfill site without proper

management. As a result, Mawlamyine CDC is in negotiation with Thai Capital Company to establish an integrated waste treatment facility in the landfill including bio-gas, incineration, and recycling activities.

The present staff and equipment of PCCD are as follows: 1942 staffs; 350 push-carts; 153 tri-bikes; 160 tipper trucks (7.5 m³); 20 hook-lift trucks (for containers); 138 roll on/off containers (7 m³); and 3 dumper trucks (15 m³).

(II) Existing Studies/Plan/Projects

Solid waste management plan in Mandalay City is as follows:

I) Mandalay Urban Services Improvement Project (ADB Loan Project)

According to the final report of Mandalay Urban Services Improvement Project (Vol. 1: Main Report by ADB and Vol.3: Waste Management by FASEP Studies);

- Detailed investigations have been undertaken by the FASEP Team and MCDC to plan a solid waste management for the new sanitary landfill as described below.
- Project summary: Development of new sanitary landfill.
- Capacity: 3,000,000 ton solid waste density of 750 kg/m³ and surface area of 25ha
- Disposal setup: Sorting, composting, anaerobic digestion, gasification, and energy recovery.
- Schedule of cell creation: Step1=35%(2015-2020), Step2=35%(2020-2025), Step3=30%(2025-2030)
- Status: In preparation of land acquisition

II) Proposal of Sustainable Cities (2014, Kitakyushu Urban Centre)

The Institute for Global Environmental Strategies (IGES) and Kitakyushu City hosted a panel discussion on "Mandalay - Kitakyushu City to City Cooperation Towards an Eco Model City of ASEAN" in collaboration with Mawlamyine CDC.

The experience in Kitakyushu City, one of the leading eco model cities in Japan, demonstrates that economic growth can be accomplished with environmental achievement by introducing local policies, including industrial promotion and environmental protection measures. Based on the current partnership between Mandalay City, Kitakyushu City will try to improve the municipal solid waste management (MSWM) in Mandalay.

(III) Fact Findings and Issues

The issues of solid waste managing works in Mandalay City are as follows:

- < Improper Landfill > The final disposal sites are simple dumping sites without any pollution control facility (no landfill liner and no drainage of leachate). Waste is dumped on the landfill by the trucks; and waste pickers sort recyclable waste (cans, bottles, and metals) before the bulldozer pushes the waste and compact it. Rubber is sorted and burnt in an open oven. According to PCCD, another issue is the practice of backfilling of low ground level plots of land (flood prone areas) using solid waste, a cheaper way than using earth and sand. About these improper landfill works, it will pose high risk on health and high impact on the environment.
- < Shortage of Capacity on the Final Disposal Sites > The total waste collection per day has increased from 259 tons in 2005 to 779 tons in 2014. Due to this rapid growth of waste to be landfilled, the handling capacity of the final disposal sites can last only for two years.

2) Pathein

(I) Current Condition

Solid waste in Pathein City is collected and managed by Pathein CDC. The solid waste is collected by the truck and dumped to the Nan Thar Kone final disposal site with about 5 acres wide as shown in Figure 1.5.123. The existing final dumping site will be almost in full capacity.



Source: JICA Study Team

Figure 1.5.123: Nan Thar Kone Final Disposal Site in Pathein

(II) Existing Studies/Plan/Projects

The reports of the study and plan for the solid waste management system in Pathein City were not collected in the first survey. According to Pathein CDC, they have a plan for development of new final disposal site. The new final dumping site of about 22 acres wide will be developed near Shwe Myin Tin Village, 8 km far from the town. But this area could not be used now because the road and other functions are not ready yet.

Now some companies come and proposed to invest on recycle project in the final dumping site. They want to recycle garbage, but there is no implementation because the profit is not much.

(III) Fact Findings and Issues

The issues of solid waste managing works in Pathein City are shown as follows:

- < Improper Landfill > The final disposal sites are simple dumping sites without any pollution control facility (no landfill liner and no drainage of leachate).
- < Decrepit Facilities > Some vehicle and facilities for collecting and filling have been severely decrepit.
- < Shortage of Capacity on the Final Disposal Sites > Solid waste collection is rapidly increasing now in Pathein City. The handling capacity of the final disposal site can only accommodate a little. And Pathein CDC wants to start environmental efforts like implementation of 3Rs (recycle, reuse, and reduce).

3) Mawlamyine

(I) Current Condition

Solid waste in Mawlamyine City is collected and managed by Mawlamyine CDC. The solid waste is collected by the truck and dumped to the existing final disposal site as shown in Figure 1.5.124. The sludge from the septic tank also is disposed at the same site.



Source: JICA Study Team

Figure 1.5.124: Existing Final Disposal Site in Mawlamyine

(II) Existing Studies/Plan/Projects

The reports of the study and plan for the solid waste management system in Mawlamyine City were not collected in the first survey. According to Mawlamyine CDC, they have plans for the expansion on the existing final disposal site and development of new final disposal site. The new site is ensured in the proposed town extension zone of the conceptual plan of the Urban Improvement Project.

(III) Fact Findings and Issues

The issues of solid waste managing works in Mawlamyine City are as follows:

- < Improper Landfill > The final disposal sites are simple dumping sites without any pollution control facility (no landfill liner and no drainage of leachate). Burning is observed in the final disposal site resulting to the release of dense smoke. Some garbage collector operates at the site, including women and children, without any safety protection (no mask and no gloves).
- < Shortage of Capacity on the Final Disposal Sites > Solid waste collection is rapidly increasing from now in Mawlamyine City. The handling capacity of the final disposal site can only accommodate a little.

1.6 Strategic Environmental Assessment (SEA)

1.6.1 General

(1) Strategic Environmental Assessment (SEA)

SEA is an assessment for environmental impact on potential activities causing from Policy, Plan and Program. SEA is featured as a structured, participative, open and transparent environmental impact assessment process, either rigorous Environmental Impact Assessment (EIA) based or flexible non EIA based. Effective SEA works within a structured and tiered decision framework, aiming to support more effective and efficient decision-making for sustainable development and improved governance by providing for a substantive focus regarding questions, issues and alternatives to be considered in policy, plan and program making.

(2) Policy of JICA

In accordance with JICA's Guidelines for Environmental and Social Considerations (April 2010) ("JICA Guideline"), when implementing an ODA project, the project proponents are required to provide an appropriate environmental considerations. For a case of a preparation for a master plan study, JICA Guideline requires implementation of Strategic Environmental Assessment ("SEA") to integrate appropriate environmental and social considerations into planning and monitoring of proposed project from early stage of the projects.

In this study, SEA was carried out for the development vision and basic policies for future development for each target city. The result of SEA is ideally reviewed and considered to be incorporated in the development master plan for each target city.

Due to the lack of presence of SEA procedure as a Myanmar's national rule and guidelines, in this study, SEA is conducted to follow the JICA Guideline for building future vision and basic policies for further consideration on urban development plan in each city.

1.6.2 General

SEA for the study was carried out for the process of establishing the future visions and basic policies for each city, as well as identify the negative impacts from alternative development options to conclude mitigation measures and monitoring plans. In this section, the SEA method and process of developing future visions basic policies are described below. The concluded results from SEA are to refer to the Part II of the report.

(1) Methodology

Three alternatives of the structure plans for each target city, which reflected the review of the existing development plans and conceptual plans prepared by MOC, were developed through preliminary meeting in March and further developed and discussed at the stakeholder meeting in May.

(2) Schedule

JICA Study Team held six stakeholder meetings as shown in the following schedule.

Table 1.6.1: Schedule of Stakeholder Meeting

| | Participants | Mandalay | Patheingyi | Mawlamyine |
|--|------------------------------------|----------------|----------------|----------------|
| Preliminary Meeting (2nd Workshop) | government officers | March 18, 2016 | March 25, 2016 | March 22, 2016 |
| Stakeholder Meeting (Seminar) | Academia, private sector, and NGOs | May 9, 2016 | May 13, 2016 | May 18, 2016 |

Source: JICA Study Team

1.6.3 Scoping

This study aims to discuss alternatives for urban structure and planning issues, rather than anticipated actions for actual proposed alternative development plans. Due to this nature of the study, the scoping work was carried in an irregular manner without listing up actual actions which would cause impacts on each item. The environmental impacts are selected from the below environmental checklist.

Table 1.6.2: Environmental Checklist

| | | |
|--------------------------------|--------------|---------------------------------------|
| Social Issues | Social Needs | Living standard |
| | | Clean water access |
| | | Sanitation |
| | | Other social service |
| | | Cultural heritage |
| | | Involuntary resettlement |
| | | Misdistribution of benefit and damage |
| | | Education |
| | | Safety & Accidents |
| Spatial & Physical Issues | Economy | Economic boost |
| | | New employment opportunity |
| | | Contribution to local economy |
| | | Utilization of local resource |
| | | Tourism |
| | | Poverty reduction |
| | Industry | New industry |
| | | Efficiency improvement |
| | | Connectivity to the existing industry |
| | Urban infra | Stress on Existing Infra |
| | | Relocation of existing infra |
| | | New Infra |
| | Civil Work | Natural disaster |
| | | Topography and geographical features |
| | Spatial use | Conflict on land use |
| | | Density |
| | | Urban sprawl/encroachment |
| | CBD | Expansion of existing CBD |
| | | Create new CBD |
| | Proximity | Connectivity to the city |
| | | To the outside |
| | | Congestion on road |
| | | Comprehensive development |
| | | Traffic increase |
| | | Trip length |
| Natural & Environmental Issues | Nature | Flora, Fauna and Biodiversity |
| | | Landscape |
| | | Recreation space |
| | | Green belt creation |
| | | Stress on water supply |
| | | Groundwater |
| | | Global warming |
| | Pollution | Air (quality) |
| | | Water (quality) |
| | | Soil contamination |
| | | Noise & order |
| | | Waste |

Source: JICA Study Team

1.6.4 Summary of Environmental Evaluation for Alternative Urban Structures

The Environmental Evaluation summary was presented and discussed at the Stakeholder Meeting to

Anticipated environmental impacts that would be caused by three alternatives of the urban structure (details to be discussed in section 4.1 in the final report part II) were evaluated in a matrix system from the point of natural and environmental impact, social impact, and economical impact. The impact categories were evaluated into positive and negative aspects. The magnitude of impact is considered following the three levels, namely, ⊙, ○ and △ for the positive and the negative. All three levels are showing “overall” tendency of the impacts in each category. ⊙ shows the most positive impact, × shows the most negative impact.

The evaluation for positive impacts were undertaken focusing on the total of 19 parameters, consisting of six impacts in nature and environment and social and seven impacts in economic categories. These 19 parameters were selected from the parameters in the environmental scoping checklist and rearranged in the following manner.

- Nature and Environmental Impact; (i) conservation of nature, (ii) landscape, (iii) air, (iv) water, (v) noise and order, and (vi) waste treatment.
- Social impact; (i) involuntary settlement, (ii) water supply, (iii) waste water, (iv) other social service, (v) living standard, (vi) cultural heritage.
- Economic Impact; (i) investment cost, (ii) GRDP or revenue increase, (iii) utilizing local resources, (iv) employment opportunity, (v) road congestion, (vi) connectivity, (vii) efficiency.

Tables 1.6.3-1.6.5 shows the result summary of Environmental Evaluation of each city.

Table 1.6.3: Environmental Impact Matrix for Mandalay

| Items | Option 1 “Concentration Core” | Option 2 “Suburb Core” | Option 3 “Satellite Core” |
|-------------------|---|---|---|
| Evaluation | - | - | BEST |
| Nature | △ <ul style="list-style-type: none"> ▪ Showing a positive potential to conserve nature, especially farmland in the north and east, where MCDC is keen to conserve as farm products supply area. ▪ Some concerns arise in overall pollution and waste treatment. | ○ <ul style="list-style-type: none"> ▪ potentially holds the risk of degradation of nature, farmland and landscape, especially from uncontrolled urban sprawl. ▪ Potential risks in pollution control, in general. Special risks in air pollution from the increased traffic between city centers. | ○ <ul style="list-style-type: none"> ▪ Showing a positive potential to conserve nature, especially farmland in the north and east, where MCDC is keen to conserve as farm products supply area. ▪ Some concerns arise in water supply and waste treatment due to the spreading city core in the larger area of the city. |
| Social | ○ <ul style="list-style-type: none"> ▪ No need for involuntary resettlement from this option. ▪ Due to the increase in population density, potential of less negative impact on social service is foreseen. ▪ Special care on protection of the cultural heritage | △ <ul style="list-style-type: none"> ▪ No need for involuntary resettlement from this option. ▪ Due to good density increase, potential of some negative impact on social service is foreseen. ▪ Special care on protection of the cultural heritage | ○ <ul style="list-style-type: none"> ▪ No need for involuntary resettlement from this option. ▪ Relatively positive in social service and space use due to the less dense city area. ▪ Special care on protection of the cultural heritage |
| Economic | ○ <ul style="list-style-type: none"> ▪ Due to the topologic feature of new urban areas | ○ <ul style="list-style-type: none"> ▪ Due to the topologic feature of new urban areas | ○ <ul style="list-style-type: none"> ▪ By avoiding topologically weak area as a new |

| | | | |
|--|--|--|--|
| | <p>heavy civil work is anticipated as anti-flooding measure, which could have big negative economic impact.</p> <ul style="list-style-type: none"> ▪ However, due to the good concentration of the new urban core, the positive impact on economic efficiency is anticipated. | <p>heavy civil work is anticipated as anti-flooding measure, which could have big negative economic impact.</p> <ul style="list-style-type: none"> ▪ However, due to the good concentration of the new urban core, the positive impact on economic efficiency is anticipated. | <p>development, less civil preparation work is anticipated, and showing economically most positive among the three.</p> <ul style="list-style-type: none"> ▪ However, since the scattering feature of new urban cores, some negative impact on efficiency is anticipated. |
|--|--|--|--|

Source: JICA Study Team

Table 1.6.4: Environmental Impact Matrix for Patheingyi

| Items | Option 1 “Concentration Core” | Option 2 “Suburb Core” | Option 3 “Satellite Core” |
|-------------------|---|--|--|
| Evaluation | - | - | BEST |
| Nature | △ | ○ | ◎ |
| | <ul style="list-style-type: none"> ▪ Showing potential negative impact on air pollution by anticipated increase in traffic going through the city to reach to the new city development on the west side of the city. | <ul style="list-style-type: none"> ▪ The new city center would be compact development pocket, thus some negative concern over pollution and noise in the core are. | <ul style="list-style-type: none"> ▪ Due to the creation of multiple cores, rather than one large new core, relatively positive impact on environment is anticipated. ▪ The creation of increase use and function of the lake area by connecting new tourism hub, positive impact of nature conservation is anticipated. |
| Social | ○ | △ | ○ |
| | <ul style="list-style-type: none"> ▪ No risk of involuntary resettlement for new development ▪ Anticipated some positive impact on living standard by new development | <ul style="list-style-type: none"> ▪ Due to the high density in the new development area by the new train station, negative impact on urban infrastructure, urban social services are anticipated. ▪ Potential risks in involuntary resettlement of the residence around the new development with a relocation of the train station. | <ul style="list-style-type: none"> ▪ No risk of involuntary resettlement for new development ▪ Anticipated some positive impact on living standard by new development |
| Economic | ○ | ◎ | ○ |
| | <ul style="list-style-type: none"> ▪ Some positive impact by stimulation of new transport infrastructure connecting between the new development and the existing city center is anticipated. | <ul style="list-style-type: none"> ▪ Showing positive impact on economic activity by having better connectivity with Yangon. ▪ Showing positive impact on increase in efficiency as a city center. | <ul style="list-style-type: none"> ▪ Some positive impact by stimulation of tourism from the new development in the north west of the city connecting the upgraded river front is anticipated. |

Source: JICA Study Team

Table 1.6.5: Environmental Impact Matrix for Mawlamyine

| Items | Option 1 “Western Axis” | Option 2 “Eastern Axis” | Option 3 “Two Axis development” |
|-------------------|---|---|---|
| Evaluation | - | - | BEST |
| Nature | △ | ○ | ◎ |
| | <ul style="list-style-type: none"> ▪ Some negative impact anticipated from increased | <ul style="list-style-type: none"> ▪ By avoiding new city development from already | <ul style="list-style-type: none"> ▪ Development core as a small pockets would |

| | | | |
|-----------------|---|--|---|
| | density in existing city center on pollution. | dense existing city area, less negative impact from pollution. | cause less impact on nature, and less risks of pollution from new city development. |
| Social | △ <ul style="list-style-type: none"> No need for involuntary resettlement from this option. Highly dense city core would cause negative risks in social service and living standard. Due to the increase in population density in the existing core, higher risk of negative impact on cultural and historical heritages. | ◎ <ul style="list-style-type: none"> No need for involuntary resettlement from this option. Special care on protection of the cultural and historical heritage | ◎ <ul style="list-style-type: none"> No need for involuntary resettlement from this option. Special care on protection of the cultural and historical heritage and landscape |
| Economic | ◎ <ul style="list-style-type: none"> Showing critical constraints as a development center caused by high density, which cause negative impact. Overall less civil preparation works are required, which has positive impact in economic. | ○ <ul style="list-style-type: none"> Showing critical constraints as a development center from topologic point, which cause negative impact. Some extra civil work for flooding hazard measure might be required for its upper east side of new development, which would cause some negative impact economically. | ○ <ul style="list-style-type: none"> Some extra civil work for flooding hazard measure might be required for its upper east side of new development, which would cause some negative impact economically. |

Source: JICA Study Team

In summary, the SEA was carried out in this Study as an examination of the development vision and basic policies for development of each target city in the future. Also, the environmental evaluation has been conducted to identify the future mitigation requirements and associated monitoring plan. The results of the detailed findings and identified mitigations such as development vision, development policies to refer to the Part II of the final Report.

1.7 Development of Topographical Map Data

The following works in the formulation of topographical map data were conducted to create the basic map data for the urban development planning of the target three cities, which are the Mandalay, Mawlamyine and Patheingyi.

- Ground survey
- Purchase of satellite image and digital information model (DEM)
- Field verification
- Digitizing and geographic information system (GIS) data formulation

The topographical map data for the GIS is generated on a scale of 1:10,000 based on a high resolution satellite images and existing 1:50,000 scale topographic maps.

The works was executed between January-April 2016 by a Myanmar company which was awarded as a contractor through a competitive bidding following JICA's guidelines.

1.7.1 Preparation Work

(1) Ground Survey

In the ground survey, the ground control points were surveyed for the geometric correction of the satellite images and the GPS spot heights were surveyed for the accuracy checking of DEM. Table 1.7.1 shows the quantity of points surveyed in the ground survey and Figure 1.7.1 shows the GCP ground control point (GCP) survey location.

Table 1.7.1: Quantity of Points Surveyed in the Ground Survey

| | | Mandalay | Mawlamyine | Patheingyi |
|---|-----------------------------|------------|------------|------------|
| 1 | Ground control point survey | 14 GCPs | 10 GCPs | 8 GCPs |
| 2 | GPS spot height survey | 120 points | 100 points | 80 points |

Source: Formulation of Topographical Map Data by the JICA Study Team

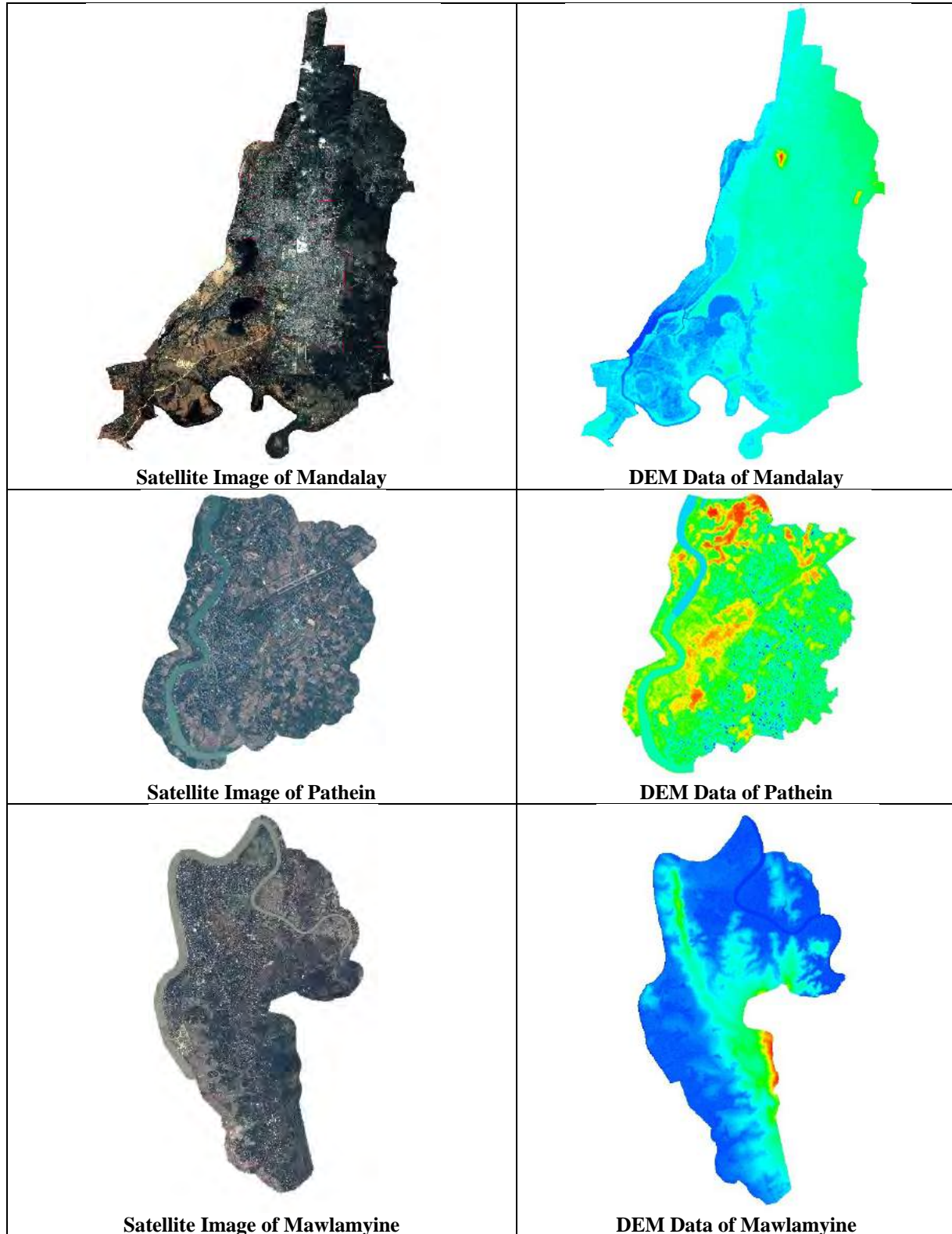


Source: Formulation of Topographical Map Data by the JICA Study Team

Figure 1.7.1: Ground Control Point Location

(2) Purchase of Satellite Image and DEM

The JICA Study Team purchased high-resolution of Pleiades satellite images and the advanced land observation satellite (ALOS) DEM data covered 600 km² (Mandalay: 330 km², Mawlamyine:170 km², Pathein:100 km²) shown in Figure 1.7.2.



Source: Formulation of Topographical Map Data by the JICA Study Team

Figure 1.7.2: Satellite Image and DEM

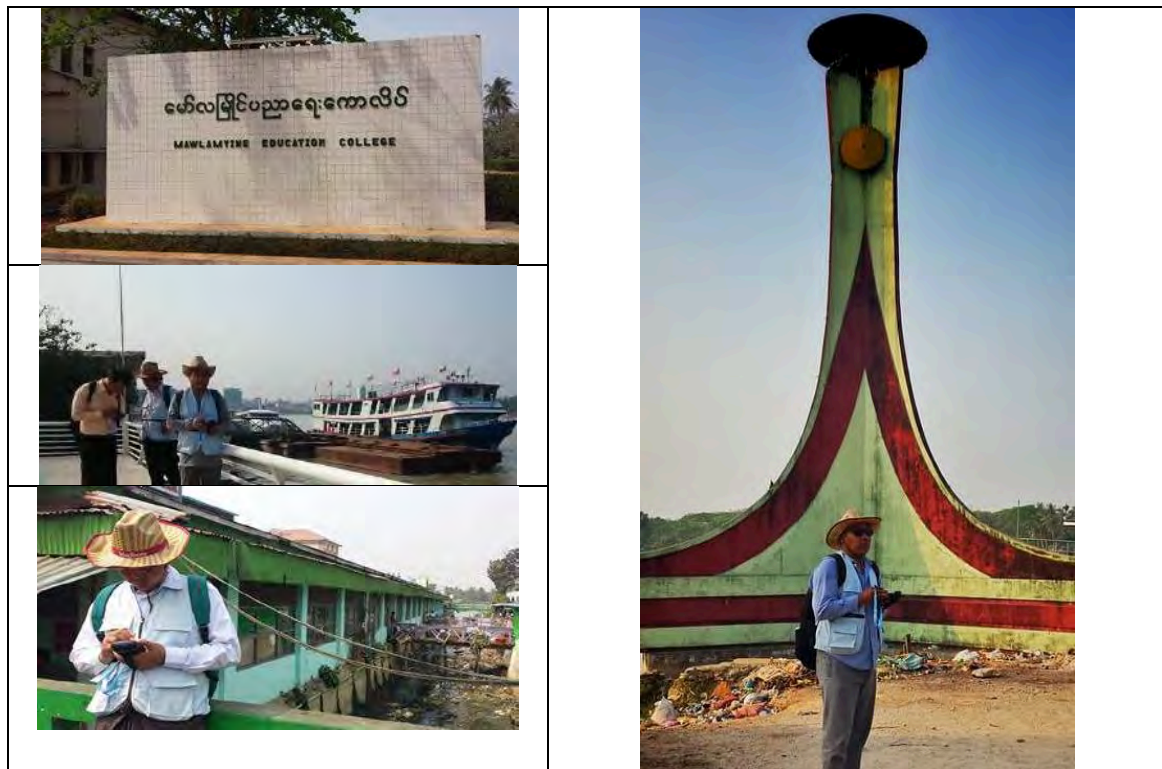
(3) Field Verification

The names of places and features, which are the well-known or landmarks of the city were collected/verified using GIS enabled data collector with the global positioning system (GPS). Table 1.7.2 shows the name/type of places/features to collect/verify in a field and how to present the results of them as GIS data.

Table 1.7.2: Feature Types to Collect and How to Present the Results as GIS Data

| | Features Type | Attribute | Data Type | Notes |
|---|-------------------|---------------------|-----------|--|
| 1 | Road (centerline) | Road name | Polyline | Input major road name as attribute |
| 2 | Place | Place name | Point | Draw point around the place and input name of major place as attributes |
| 3 | Facility | Facility name | Point | Draw point on the facility such as public, transit, major commerce, major industry, temple, and input name as attributes |
| 4 | River and lake | River and lake name | Point | Draw point on the water surface and input name of major features as attribute |

Source: Formulation of Topographical Map Data by the JICA Study Team



Source: Formulation of Topographical Map Data by the JICA Study Team

Figure 1.7.3: Photo of Field Verification

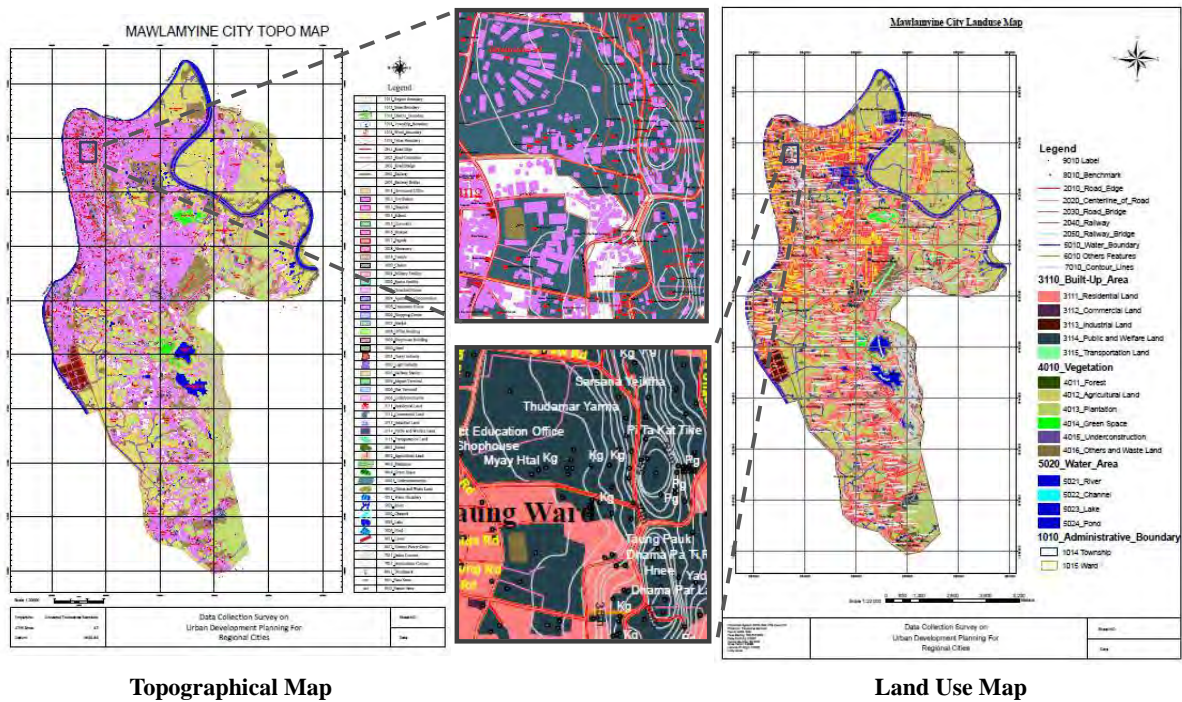
(4) Digitizing Based on Satellite Image and GIS Data Formulation

The topographic map data/GIS data was created by digitizing based on satellite image, collecting features/information from the existing topographic map of scale 1:50,000 and drawing contours from DEM. Feature digitizing/collection were conducted based on the definition in Table 1.7.3.

Table 1.7.3: Definition of 10,000 Scale Map Features and GIS Data Structure

| code | Main Feature Name | Sub code | Sub Feature Name | Data type | Annotation1 | Annotation 2 | Annotation 3 | Annotation 4 | Annotation 5 | Descriptions |
|------|-------------------------|----------|-------------------------|-----------|-------------|--------------|--------------|--------------------------|--------------|---|
| 1010 | Administrative Boundary | 1011 | Region | Polygon | Code | Sub code | name | | | to extract from existing topographical map with a scale of 1 to 50,000 |
| | | 1012 | State | | | | | | | |
| | | 1013 | District | | | | | | | |
| | | 1014 | Township | | | | | | | |
| | | 1015 | Ward | | | | | | | |
| | | 1016 | Other | | | | | | | |
| 2010 | Road edge | 2011 | Road edge | Polyline | Code | Sub code | | | | to draw right-of-way limit of all roads more than 3m from satellite imagery |
| 2020 | Centerline of Road | 2021 | Centerline | Polyline | Code | Sub code | name | width code | | to draw center line of all road from satellite imagery. Center line should have the network topology. To add the Width code 1: less than 3m 2: more than 3m, less than 10m 3: more than 10m, less than 20m 4: more than 20m |
| 2030 | Road bridge | 2031 | road bridge | polyline | Code | Sub code | | | | |
| 2040 | Railway | 2041 | Railway | Polyline | Code | Sub code | | | | to draw centerline of all track from satellite imagery |
| 2050 | Railway bridge | 2051 | Railway bridge | Polyline | Code | Sub code | | | | |
| 3010 | Building | 3011 | Government Office | Polygon | Code | Sub code | name | | | to draw all visible or assumable shape of the building roof more to input name of major feature |
| | | 3012 | Fire Station | | | | | | | |
| | | 3013 | Hospital | | | | | | | |
| | | 3014 | School | | | | | | | |
| | | 3015 | University | | | | | | | |
| | | 3016 | Mosque | | | | | | | |
| | | 3017 | Pagoda | | | | | | | |
| | | 3018 | Monastery | | | | | | | |
| | | 3019 | Temple | | | | | | | |
| | | 3020 | Church | | | | | | | |
| | | 3021 | Military facility | | | | | | | |
| | | 3022 | Sports facility | | | | | | | |
| | | 3023 | detached house | | | | | | | |
| | | 3024 | Apartment/condominium | | | | | | | |
| | | 3025 | temporary house | | | | | | | |
| | | 3026 | Shopping centre | | | | | | | |
| | | 3027 | Market | | | | | | | |
| | | 3028 | Office building | | | | | | | |
| | | 3029 | Shophouse building | | | | | | | |
| | | 3030 | Hotel | | | | | | | |
| | | 3031 | Heavy industry | | | | | | | |
| | | 3032 | Light industry | | | | | | | |
| | | 3033 | Railway station | | | | | | | |
| | | 3034 | Airport terminal | | | | | | | |
| | | 3035 | Bus terminal | | | | | | | |
| | | 3036 | Underconstruction | | | | | | | |
| 3110 | Built-up Area | 3111 | Residential land | Polygon | Code | Sub code | | | | to draw feature's boundary from satellite imagery base on field verification |
| | | 3112 | Commercial land | | | | | | | |
| | | 3113 | Industrial land | | | | | | | |
| | | 3114 | Public and welfare land | | | | | | | |
| | | 3115 | Transportation land | | | | | | | |
| 4010 | Vegetation | 4011 | Forest | Polygon | Code | Sub code | | | | to draw feature's boundary from satellite imagery base on field verification |
| | | 4012 | Agricultural land | | | | | | | |
| | | 4013 | Plantation | | | | | | | |
| | | 4014 | Green space | | | | | | | |
| | | 4015 | Underconstruction | | | | | | | |
| | | 4016 | Others and waste land | | | | | | | |
| 5010 | Water boundary | 5011 | Water boundary | polyline | Code | Sub code | | | | to draw water surface limit from satellite imagery |
| 5020 | Water area | 5021 | River | polygon | Code | Sub code | name | | | to draw water area limit from satellite imagery, and Name should be extracted from existing topographical map with a scale of 1 to 50,000 and field verification |
| | | 5022 | Channel | | | | | | | |
| | | 5023 | Lake | | | | | | | |
| | | 5024 | Pond | | | | | | | |
| 6010 | Other features | 6011 | levee | polyline | Code | Sub code | | | | high voltage only |
| | | 6012 | electric power cable | polyline | | | | | | |
| | | | | | | | | | | |
| 7010 | Contour lines | 7011 | Index contour | polyline | Code | Sub code | Height | | | 5m interval Contour lines should be generated using the purchased ALOS DTM data, and adjusted the generated contour lines based on ground survey results. |
| | | 7012 | Intermediate contour | | | | | | | |
| 8010 | Benchmark | 8011 | Benchmark | point | Code | Sub code | name | CoordinateE | CoordinateN | to extract from existing topographical map with a scale of 1 to 50,000 |
| 9010 | Label | 9011 | Place name | point | Code | Sub code | name | Sub code Feature Name | | to extract from existing topographical map with a scale of 1 to 50,000 and Field verification |
| | | 9012 | Feature name | | | | | | | to extract from existing topographical map with a scale of 1 to 50,000 and Field verification |

Source: Formulation of Topographical Map Data by the JICA Study Team



Source: JICA Study Team

Figure 1.7.6: Topographical Map and Land Use Map of Mawlamyine